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(54) APPARATUS FOR COUNTING AND PRICING PHOTOGRAPHIC PRINTS

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to photographic apparatus, and more particularly to apparatus for counting and pricing customer print orders.

It is customary in the photofinishing industry to splice individual customer order negative film strips together before continuously processing the negative filmstrip. The spliced processed film strips are spooled and placed in a photographic printer for automatic or semi-automatic printing of each negative frame on a continuous roll of photographic print material. The sensitized photographic print material is developed and dried in a continuous process. Each print in the roll is inspected to determine if it is a commercially acceptable print. Over-exposed, under-exposed or subject failure prints are marked by the inspector as being unacceptable and requiring, when possible, reprinting.

After a print roll is inspected, it is fed through a print cutter which, as its name suggests, properly severs the individual prints from the print roll. It is also necessary to cut the negative film strip, which may contain 12 or 20 negative frames in each customer order, into lengths that are convenient for packaging with the prints. The cut print and negative filmstrips of each customer's order must thereafter be connected together, packaged and priced. The price, of course, depends upon the number of commercially acceptable prints produced from each customer's order.

The operations of cutting the negative filmstrips into appropriate lengths, cutting the prints, counting the prints, calculating the price therefrom, marking the envelope with the price and filling it with the proper prints and negatives are time consuming and subject to human error. It is also necessary that the operator set aside the customer's orders that contain commercially unacceptable prints for reprinting. Before reprinting these unacceptable prints, someone has to locate the corresponding negative frame from among the several negative filmstrips in the customer order.

In a large scale photofinishing plant, a number of photographic printers and processors are continuously operating and continuously producing negative filmstrip rolls and print rolls that must be cut and packaged in the manner described above. Naturally, it is highly desirable that the number of manual and mental steps associated with the cutting, pricing, and packaging of the customer's order be reduced in order to increase the speed of the entire photofinishing operation.

In accordance with the present invention there is provided apparatus for counting and displaying the number of prints in a print order cut from a roll of prints, wherein the last print of each print order is designated by a first mark, said apparatus comprising: a print cutter for severing prints from a roll of prints advanced through the cutter; means responsive to the severance of each print for producing a first signal; a counter for counting the first signals; means for detecting the said first mark for the last print in each print order and for producing a second signal in response thereto; means responsive to the second signal and to the severance of the said last print for halting the operation of the print cutter; restart means for restarting the operation of the print cutter; and means responsive to the operation of the restart means and to the count number of the first signal in the said counter means for displaying the count number indicating the total number of prints cut from the print order.

In the detailed description of the preferred embodiment of the invention presented below

by way of example, reference is made to the accompanying drawings in which:—

Fig. 1 is a prespective view of a finishing operations apparatus including counting apparatus according to the present invention;

Fig. 2 is a diagram, partly in perspective, showing a portion of the path of travel of the strip of photographic prints through the print cutter;

Fig. 3 is a schematic illustration of a logic diagram of the operative elements of the apparatus;

Fig. 4 is a series of waveform diagrams illustrative of the signals developed at particular points in the logic diagram of Fig. 3;

Fig. 5 is a schematic illustration of a print and memory counters referred to in the logic diagram of Fig. 3;

Fig. 6 is a schematic illustration of an electrical circuit for automatically correlating unacceptable prints with the negative filmstrip containing the corresponding negative referred to in the logic diagram of Fig. 3; and

Fig. 7 is a perspective view showing the detail of the price display unit on the apparatus of Fig. 1 and a price card for use therewith.

Referring now to the drawings, and first to Fig. 1, there is shown in part perspective a view of the finishing operations workcentre The finishing operations workcentre consists of a console 10 whereat an operator sits and faces an automatic print cutter and sorter 12, an automatic filmstrip cutter and stacker 14, a "marked" print and negative filmstrip correlator 16, an automatic print counter and price display unit 18 and an envelope dispenser 20. Briefly stated, the automatic print cutter and sorter 12 advances a strip 22 of prints from a print roll 24 through a print cutting blade 26 that severs each print. As the severed prints 28 fall from the print cutter 26, they are stacked on slanted plane 36. A marked print is automatically detected by apparatus to be described hereinafter, and a reject print solenoid flipper 34 is actuated to divert the severed, marked print down the slanted surface 30 and upon the tracks 32. Three marked prints 28 are illustrated along tracks 32. Therefore, after each customer's order of prints has been cut, the unacceptable prints have been separated from the acceptable prints.

Arranged adjacent to the automatic print cutter and sorter 12 is the automatic negative cutter and stacker 14 that is described in detail, in copending Patent Application No. 17633/72 (Serial No.). For the present application it is sufficient to state that the automatic negative cutter and stacker 14 advances the spliced negative filmstrips 38 from a roll 40 and through a negative frame counter (not shown) that actuates a film cutter and stacker (not shown) when the counter achieves a certain count, such as four negative frames. At the end of each customer's order, a splice detector halts the operation of the automatic film cutter and stacker 14. The cut negative filmstrips 41 of each customer's order are each retained at one end by the negative stacker (not shown).

Located in clear view of the operator is an automatic marked print and negative filmstrip correlator 16 which includes an individually illuminable counter display 42 marked *1* through *5* that correspond to the five possible negative filmstrips in a customer order of 20 negative frames (wherein each negative filmstrip contains four negative frames). Further counters may be provided to display the total number of marked prints in the customer's order. Counters may also be provided to indicate the total number of prints cut and the total number of marked prints detected during a predetermined period of operation of the finishing operations workcentre. Located alongside counter display 42 is an illuminated panel 44 against which the operator may place the cut negative filmstrips to inspect the negative frames indicated as unacceptable by the correlator 16.

The total number, up to and including twenty, of prints cut from an individual customer's order is displayed on the automatic pricing unit 18. As described later with reference to Figs. 5 and 7, the automatic pricing unit 18 of the preferred embodiment of this invention may consist of a 20 stage serial counter and corresponding 20 stage memory circuit, each stage of the latter containing an illuminable numeral corresponding to the count achieved on the counter and stored in the memory. The illuminable numerals are arranged in a 4×5 matrix on the display panel 46 of the automatic pricing unit 18. A transparent price card 48, corresponding in size and shape to the display panel 46, carries the price corresponding to the illuminable numerals of the display panel 46. Also, although each customer's negative filmstrip may contain either 12 or 20 negative frames, the automatic circuits provided by, or the operator of, the photographic printer may have determined that certain of the negative frames were unprintable and, therefore, a number less than 12 or 20 prints may be on the print roll 22. Therefore, the automatic price display may exhibit a price for a number less than 12 or 20 prints.

The finishing operations workcentre console 10 also contains an envelope dispensing unit 20 that conveniently dispenses envelopes to the operator. Further envelopes may be contained in the tray 50 which contains compartments for the varied requirements of a particular photofinisher.

After loading the negative and print rolls on the finishing operations workcentre the operator sits before the console 10 and de-

presses a Start button (not shown). The automatic print cutter and sorter 12 cuts and sorts the prints until the order sort mark on the last print in the customer's order is sensed, whereupon the print cutter ceases operation. Simultaneously and independently, the automatic film cutter and stacker 14 cuts and stacks the negative filmstrips 41 until the splice, between successive customer orders, is sensed, whereupon it ceases operation. During the cutting of the respective prints and negative filmstrips, the automatic "marked" print and negative film strip correlator 16 illuminates the number, in the order in which the film strips are cut and stacked, of the stacked filmstrips 41 that contain a negative frame that requires reprinting.

After the prints and negative filmstrips have been cut the operator gathers the prints 28 and inserts them in the envelope 52. Thereafter the operator pulls the stacked negative filmstrips 41 out of the negative stacker 14, and inserts them into the envelope. The finishing operations workcentre automatically restarts upon the removal of the stacked negative filmstrips 41, and the print counters are reset. The memory stages of the automatic pricing unit 18 are reset upon the removal of the stacked negative filmstrips 41 and, after a short time delay, the print count in the serial counter (of the prints in the envelope 52) is shifted into the corresponding memory stages which illuminate their respective numerals of the display panel 46. Thereafter the operator of the machine records the price on the envelope 52 or elsewhere and stacks the completed order into photofinisher boxes (not shown) provided for that purpose, as the next customer order is processed by the finishing operations workcentre.

Referring now to Fig. 2 there is shown in part perspective, a section of the strip of prints 22 that are being advanced in the direction of the arrow 54 to the print cutter (not shown) that severs the individual prints along the dotted line 56. The prints are indicated by order numbers *1*, *2* and *3* and corresponding print numbers. It will be noted that order number *2* contains only one print which would indicate that all of the negative frames of customer order number *2* were considered to be unprintable at the photographic printer. A single print was made in order to keep customer numbers in sequence with the customer order negatives.

Referring now to print number *20* of order number *1* of Fig. 2, there are shown three photosensitive devices 58, 60 and 62. Each of the photosensitive devices contain a light source 64, for example, that directs light, either visible or invisible, upon a predetermined area in the path of travel of the strip of photographic prints 22. The light is reflected by the glossy surface of the photographic print material and upon a photocell 66 that is rendered conductive in direct proportion to the amount of light reflected by the surface of the print. Each of the photosensitive devices 58, 60 and 62 will develop a signal at its respective output terminal 68, 70 and 72 that has an amplitude dependent upon the amount of light striking its respective photocell 66. The amplitude of the output signal will vary when the light from source 64 strikes a dull or light absorbing mark on the surface of the photographic print.

"Marked" prints, such as cut print *19* of order number *1* and print *1* of order number *2*, contain dull, light absorbing marks 74 and and 76 placed upon these prints by the print inspector. As the strip of photographic prints 22 is advanced in the direction of the arrow 54, these marks intercept the light from the lamp 64 of the photosensitive device 60, and a significant difference is noted in the amplitude of the output signal at terminal 70 of the photosensitive device 60. Thus a "marked" print signal may be generated in this manner.

On the first edge portion 78 of the strip of photographic prints 22 are print cut marks 80 which also reduce the amount of light reflected to the photocell 66 of the photosensitive device 58. The photosensitive device 58 produces a variation in its output signal at terminal 68 in response to each print cut mark.

A photosensitive device 62 is responsive to "order sort" marks 82 placed upon the other edge portion 84 of the strip of photographic prints 22 to produce a signal whenever an order sort mark is detected. The print cut mark 80 and the order sort mark 82 are recorded on the respective edges of the photographic print material at the time the corresponding print is made. It will be noted that the single print of order number 2 also contains an order sort mark 82.

The location with respect to each other of the photosensitive devices 58, 60 and 62 should be noted. As described in greater detail hereinafter, the output signal developed by the photosensitive device 58 is employed to halt the movement of the strip of photographic prints 22 in the direction of arrow 54 and to energize the print cutter to sever the prints along the dotted line 56. After the print is cut, the strip of photographic prints 22 again starts to advance until the next print mark 80 is detected.

As the strip 22 advances, the order sort mark 82 on the last print (or on the first print of the next order, depending upon the operation of the photographic printer) of the particular customer order is detected by the photosensitive device 62 which generates an order sort signal at terminal 72. Upon the cessation of movement of the strip 22, the last

print of the order is severed by the print cutter. The order sort signal inhibits the continued advancement of the strip 22 until the print cutter and sorter 12 is restarted in a manner to be described hereinafter.

Furthermore, during the advancement of the strip 22, the third photosensitive device 60 responds to the marks such as 74 or 76 on unacceptable prints to generate a "marked" print signal at the output terminal 70. The "marked" print signal is applied to further apparatus to be described in detail hereinafter that responds to the "marked" print signal and to the action of the print cutter to separate the severed, "marked" print from the acceptable prints in the customer's order.

Referring now to Figs. 3 and 4 there are shown a block diagram of particular components of the finishing operations workcentre of Fig. 1 and a waveform diagram depicting signals developed at particular points in the block diagram of Fig. 3. The print cut mark detector 86 of Fig. 3 includes the first photosensitive device 58 of Fig. 2 and further amplifying circuits for producing, upon the detection of each print mark 80, detected print cut mark signal A depicted in Fig. 4A. The print cut mark signal A is simultaneously applied to the input terminals of the print cutter 26, which may be a knife blade that severs the print strip 22 at the dotted line 56 between the prints after a short time delay related to the time necessary to halt the advancement of the strip 22. The print cut mark signal A is also applied to the "stop" input terminal of the print advance unit 90 which immediately halts the advancement of the strip 22. As the knife blade of the print cutter 26 returns to its original position, the cut print signal B of Fig. 4B is applied to the first input terminal of AND gate 92. In the absence of an order sort signal C, depicted in Fig. 3C, a positive voltage gating signal G, depicted in Fig. 4G is applied to the second input terminal of the AND gate 92. Therefore, the AND gate 92 passes the cut print signal B to the first input terminal of OR gate 94. Or gate 94 passes the cut print signal B to the "start" input terminal of the print advance 90. Thus the print detector 86 continually advances the strip 22 until a print cut mark is detected, halts the advancement, cuts the print and advances the strip 22 until the next print cut mark is detected.

Referring back to Fig. 2 it will be noted that as the print mark 80 of print *20* is detected by the first photosensitive device 58, the print *19* is severed. For this reason the pulses of the print cut mark signal A are numbered in accordance with both the detected cut mark number and the cut print number.

Referring back to Fig. 3, an order sort mark detector 96 (which includes the third photosensitive device 62 of Fig. 2 and further amplifying circuits which are known in the prior art) generates an order sort signal C depicted at Fig. 4C as the last print of a customer order is advanced past the dotted line 56 of Fig. 2. As shown, with respect to Figs. 4A and 4B, the order sort signal C is generated as the print number *20* of the order number *1* of Fig. 2 advances past the cut line 56. The order sort signal C generated by the order sort mark detector 96 is applied to the "set" input terminal of bistable flip-flop 98 that responds thereto to switch, an output terminal Q, a positive voltage signal to the first input terminal of AND gate 100. The print cut mark signal A is applied to the second input terminal of the AND gate 100. At the moment when the print number *1* of order number *2* is detected by the print cut mark detector 86, the print cut mark signal A (shown in Fig. 4D) is passed by the AND gate 100 so that signal D is applied to the "set" input terminal of the bistable flip-flop 102.

The bistable flip-flop 102 has previously been "reset" at the beginning of customer order number *1*, and the bistable flip-flop 102 has previously provided the positive voltage gating signal G to the second input terminal of the AND gate 92 which responded thereto in the manner described hereinbefore. Upon the application of the signal D, corresponding to the cut print mark signal A of Fig. 4D, to the "set" input terminal of flip-flop 102, the flip-flop 102 switches the output signal level of the output terminal $\overline{Q}$ to ground potential as shown in Fig. 4F. When this occurs, the AND gate 92 is incapable of passing the cut print signal B to the "start" input terminal of the print advance 90. Thus, when an order short detector produces the order short signal C, the last print (in this case, print *20* of order number *1*) is advanced and severed, and the operation of the print cutter and sorter 12 is halted. The first print number of the next customer order has been detected by the print cut mark detector 86.

After a time delay, depicted in Fig. 4 by the vertical slash marks located in each waveform diagram, necessary for the operator to gather and package the cut prints of the customer order, the operator removes the stack of negative filmstrips 41 of Fig. 1 from the negative cutter and stacker 14 which may include a switch that responds to the removal of the negative filmstrip stack 41 to activate a shift signal generator 104. The shift signal generator 104 provides a shift signal E, depicted at Fig. 4E, that is applied to the reset/restart circuit 105 which produces, in response thereto, a reset/restart signal F after a time delay necessary to insure the oper-

ation of certain other circuits (to be described hereinafter) by the shift signal E. The reset/restart circuit 105 also responds to the start or reset switch of the finishing operations workcenter to produce the reset/restart signal F. The reset/restart signal F is applied to the reset input terminal of flip-flop 98 which switches, in response thereto, the positive voltage signal at the output terminal Q to ground potential, thus disabling the AND gate 100. Simultaneously, the reset/restart signal F is applied to the Clear C, terminal of the flip-flop 102 which switches the $\overline{Q}$ output terminal to the positive voltage state, thus enabling the AND gate 92. And, the reset/restart signal F is applied to the second input terminal of the OR gate 94 which passes the reset/restart signal F to the " start " input terminal of the print advance 90. The print advance 90 responds to the reset/restart signal F to advance the strip 22 in the manner hereinbefore described.

Referring back to Fig. 2, it will be noted that a reject mark 74 has been applied to the surface of cut print *19* of order number 1. A further reject mark 76 has been applied to the single print of order number 2. The second reject mark 76 indicates that all of the negative filmstrips of order number *2* have been found to be unprintable. In Fig. 3, the reject mark detector 106, which includes the second photosensitive device 60 of Fig. 2 and further amplifying circuit, generates an output signal as a reject mark, such as 74 and 76, passes beneath the photosensitive device 60. This signal is applied to the positive input terminal of the comparator 108. A reference voltage +V, which may be adjusted in amplitude by the variable resistor 110, is applied to the negative input terminal of the comparator 108. When the voltage signal developed by the reject mark detector 106 exceeds the reference voltage level, the comparator 108 generates a reject mark signal H, depicted in Fig. 4H, at its output terminal. Referring to Fig. 4H it will be noted that a reject mark signal H has been generated as the detected print number *19* of order number *1* advanced past the dotted line 56.

The reject mark signal H is applied to the set input terminal of the bistable flip-flop 112 which switches its Q output terminal to a positive voltage level in response thereto. The positive voltage level of the Q output terminal of the flip-flop 12 is depicted in Fig. 4J and is applied to one input terminal of AND gate 114. The print cut mark signal A generated by the print cut mark detector 86 is applied to the second input terminal of the AND gate 114. Therefore, when the advancement of the strip 22 is halted by the detection of the print number *20* of order number *1*, the AND gate 114 passes the print cut mark signal A to the reject sorter 116.

Referring back to Fig. 1, the reject sorter 116 may include a print separator 35 consisting of a pair of converging sloped members 30 and 36 and a solenoid actuated flipper 34. Normally the flipper 34 is located with respect to the sloped member 30 so that the cut prints 28 are stacked on the sloped member 36. However, when a marked print, such as print *19* of order number *1*, is cut, the reject sorter 116 energizes the solenoid actuated flipper 34 which changes its position and diverts the marked print, as it is cut, down the sloped member 30 and onto the track 32. Thus, the marked prints are separated from the acceptable prints as they are cut by the print cutter 26. After the marked print has been sorted, the solenoid actuated flipper 34 returns to its original position. The operator may spread marked prints along the track 32 as shown in Fig. 1, for their immediate inspection.

Upon the return of the solenoid actuated flipper 34 to its original position, a reset signal L, depicted at Fig. 4L is applied to the reset input terminal of the bistable flip-flop 112, which responds thereto and switches the voltage level of the signal of Fig. 4J to ground potential. The AND gate 114 is rendered incapable of passing further detected print number signals to the reject sorter 116 unless a further reject mark signal is generated by the comparator 108.

When print number *1* of order number *2* advances past the cutter blade, a further reject mark signal H is generated in response to reject mark 76. Since this is the only print of order number 2, the reject sorter 116 is actuated and the print advance is halted in response to the order sort signal C.

Referring now to the remaining elements of Fig. 3, the cut print signal B is applied to the input terminals of *1—9* serial binary counter 118 and *10, 20* serial binary counter 120 through decimal shift 122 that are shown in greater detail in the electrical circuit of Fig. 5. The circuit of Fig. 5 also includes the *1—9* binary count memory 124 and the *10, 20* binary count memory 126 and elements of the shift circuit 104 and the reset/restart circuit 105 of Fig. 3. The binary counters 118 and 120 respond to the serial generation of each pulse of the cut print signal B to count in binary form the total number of cut prints in each customer's order. Upon the generation of the shift signal E, the print count is shifted into the count memories 124 and 126. The binary print count is decoded by the first binary to decimal decoder 128 and applied to the 20 stage print counter and display 130 which illuminates the price on the display panel 46. Shortly thereafter, the reset/restart signal F is applied in parallel to the reset input terminals of each serial binary counter to return the count to zero. The count stored in memories 124

and 126 remains until the next shift signal E.

Referring now to Fig. 5, there is shown in detail, the print cutter clock signal circuit of the print cutter 26, the binary counters 118 and 120, the binary memories 124 and 126, the decimal shift circuit 122 the shift circuit 104 and the reset/restart circuit 105. The print cutter clock signal circuit of print cutter 26 produces the cut print signal B when the normally-closed contacts 130 are opened by the energization of the cutter solenoid 132 and the transistor 134 is thereby rendered conductive. When the transistor 134 turns "on", the voltage source +V is removed from the input terminal of the single shot multivibrator 136 which responds thereto to generate the uniform pulses of the cut print signal B.

The cut print signal B is applied to the trigger T input of the bistable flip-flop 138-1 of the binary counter 118 and to the first input terminal of the AND gate 140 of the decimal shift circuit 122. The binary counter 118 includes the flip-flops 138-1, 138-2 ,138-4 and 138-8 that each have a Q and a $\overline{Q}$ output terminal and a trigger terminal T, that is connected to the Q terminal of the preceding flip-flop. A reset conductor 141 is connected in parallel to the Preclear, P, terminal of each flip-flop. The Set, S, and Clear, C, input terminals may be connected together and are not employed in the operation of the counter.

Initially the flip-flops of the counter 118 have a Low or "0" output voltage level at terminal Q and a High or "1" output voltage levely at terminal $\overline{Q}$ that is established by depressing momentary contact Start button 142 of reset/restart circuit 105 which causes single shot 144 to generate a reset/restart signal F that is passed by OR gate 146 to the reset conductor 141. Thereafter, as the pulses of the cut print signal B are generated, the flip-flops of the counter 118 produce a binary count at their respective Q and $\overline{Q}$ terminals in the manner shown in the truth table I set forth below:

TABLE I

	138-1		138-2		138-4		138-8	
Count	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$
0	0	1	0	1	0	1	0	1
1	1	0	0	1	0	1	0	1
2	0	1	1	0	0	1	0	1
3	1	0	1	0	0	1	0	1
4	0	1	0	1	1	0	0	1
5	1	0	0	1	1	0	0	1
6	0	1	1	0	1	0	0	1
7	1	0	1	0	1	0	0	1
8	0	1	0	1	0	1	1	0
9	1	0	0	1	0	1	1	0

It will be noted that the flip-flops are connected to toggle on the negative going transitions of each pulse of the cut print signal B.

Referring back to Fig. 5, the Q output terminals of flip-flops 138-1 and 138-8 are connected to the second and third input terminals of the AND gate 140. Upon the achievment of a count of 9 in the counter, these Q terminals are High as shown in Table I. Thereafter, the tenth pulse of the cut print signal B is applied to the flip-flop 138-1 and to the first input terminal of the AND gate 140 which passes the tenth pulse to the input terminal of single shot 148. Single shot 148 generates an output pulse which is applied to one input terminal of OR gate 146 and to the trigger, T, of the flip-flop 150-10 of the binary counter 120. The negative going transition of the output pulse of the single shot 148 applied through OR gate 146 resets the flip-flops 138-1, 138-2, 138-4 and 138-8 to "0" and toggles the flip-flop 150-10. Therefore, the binary count of counter 118 is reduced to zero, and the Q terminal of flip-flop 150-10 switches to High.

The flip-flop 150-10 thus stores the tenth count of the cut print signal B. The eleventh through nineteeth counts are achieved on the flip-flops of binary counters 118 and 120 in accordance with the following truth table II:

TABLE II

Count	138-1		138-2		138-4		138-8		150-10		150-20	
	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$	Q	$\overline{Q}$
10	0	1	0	1	0	1	0	1	1	0	0	1
11	1	0	0	1	0	1	0	1	1	0	0	1
12	0	1	1	0	0	1	0	1	1	0	0	1
13	1	0	1	0	0	1	0	1	1	0	0	1
14	0	1	0	1	1	0	0	1	1	0	0	1
15	1	0	0	1	1	0	0	1	1	0	0	1
16	0	1	1	0	1	0	0	1	1	0	0	1
17	1	0	1	0	1	0	0	1	1	0	0	1
18	0	1	0	1	0	1	1	0	1	0	0	1
19	1	0	0	1	0	1	1	0	1	0	0	1
20	0	1	0	1	0	1	0	1	0	1	1	0

After the achievement of the count of *19*, and at the twentieth pulse of cut print signal B, AND gate 140 is again energized to produce a reset/restart signal F that resets the count of binary counter 118 to zero. Simultaneously, the twentieth count toggles flip-flops 150-10 and 150-20 to provide the count of *20*.

The binary counter flip-flops 150-10 and 150-20 are also reset by application of a negative going transition of a reset/restart signal applied by conductor 152 to their respective Preclear, P, input terminals. Such a reset/restart signal is generated by the single shot 144 in the manner described hereinbefore and passed by OR gate 154 to the conductor 152.

A further reset/restart signal is generated by the reset/restart circuit 105 upon the removal of the stack 41 of negative filmstrips and is applied to further input terminals of OR gates 146 and 154 and thereafter to the P input terminals of each flip-flop.

Before the binary counters 118 and 120 are reset by the removal of the stacks 41 of negative filmstrips, it is necessary to shift the count to the binary count memories 124 and 126 in order that the price display 130 may be activated. The binary count memories 124 and 126 include memory flip-flops 156-1, 156-2, 156-4, and 156-8, and memory flip-flops 158-10 and 158-20, respectively. Each memory flip-flop is connected by its S and C input terminals to the Q and $\overline{Q}$ output terminals of the corresponding counter flip-flop. The trigger T inputs of each memory flip-flop are connected in parallel to a shift conductor 160. The memory flip-flops switch to the High or Low state presented to their S and C input terminals upon a negative going transition of the shift signal E applied to their T input terminals.. Thus the count of the counter flip-flops is transferred into the memory flip-flops only upon the occurrence of a shift signal E, and the memorized count is retained until the next occurrence of a shift signal E.

The shift signal E is generated by the single shot 162 of the shift circuit 104 in response to the closure of a switch 164. Switch 164 is mechanically closed upon the removal of the stack 41 of negative filmstrips from the negative film-strip cutter stacker 14.

The delay between the shift signal E and the reset/restart signal F is achieved by the single shot 166, the inverter 168 and the AND gate 170. The single shot 166 responds to the negative going transition of the shift signal E to generate a positive pulse that is applied to one input terminal of AND gate 170. Simultaneously, the inverter 168 responds to the negative going transition at its input terminal to produce a positive output signal that is applied to the other input signal of AND gate 170. Thus AND gate 170 passes the reset/restart signal F generated by single shot 166 through the OR gates 146 and 154 and to the P input terminals of the counter flip-flops. The inverter 168 and AND gate 170 ensure that the shift signal E and the reset/restart signal F do not overlap. Thus the count of the counter flip-flops is transferred to the memory flip-flops before the count is reset. Also, the count is reset before the next cut print signal B is generated by single shot 136.

Referring back to Fig. 2, it will be noted that the last print of a customer order is cut at the time the first print number of the next order is detected by the first photosensitive device 58. When the print cutter and sorter 12 is restarted by the reset/restart 105 of Fig. 3, the count of the binary counters 118 and 120 is reset to zero. Thereafter, the second print number of the next customer order is detected by the first photosensitive device 58, and the print detector 86 generates the first pulse of the cut print signal B that is applied to the input terminal of the binary counter 118. Simultaneously, as explained hereinbefore, the first print of the next customer order is cut. Thus the binary counters 118 and 120 count the actual number

of prints that are cut in each customer's order.

Referring back to Figs. 3 and 5, the terminals Q and $\overline{Q}$ of the memory flip-flops are connected to the input terminals of the first binary to decimal decoder 128 which may consist of a conventional electrical matrix that responds to the binary count input signals to provide a decimal count output signal of from *1*—*20* at twenty output terminals. The decimal count output signal is applied to twenty lamp illuminating circuits arranged in a matrix array on the illuminable display panel 46.

Referring now to Fig. 7 there is shown in partial perspective and in greater detail the price display unit 18 of Fig. 1 including the illuminable display panel 46 and the transparent price card 48. The illuminable display panel 46 consists of a matrix of twenty lamps located behind the light transmitting squares 172 numbered *1*—*20*. Each correspondingly numbered output terminal of binary to decimal decoder 128 develops a decimal count signal, when energized, that is applied to the respective lamp situated behind the light transmitting squares 172 of the panel 46. Thus, when the binary count of the binary counters 118 and 120 of Fig. 5 is shifted into the count memories 124 and 126, the binary count is decoded to a decimal count ranging from *1* through the total number of prints in each customer order, and the correspondingly numbered light transmitting square 172 of the display panel 46 is illuminated.

The transparent price card 48 may consist of plastic sheet material also having twenty squares 174 to correspond in size and location to the twenty light transmitting squares 172 of the display panel 46. The price, per counted print, may be permanently or semi-permanently printed upon the corresponding squares 174 of the price card 48.

The display panel 46 is mounted in the price display unit 18 at an angle, and a slot 176 is provided through the top surface 178 of the display unit. The price card 48 is inserted through the slot 176 to overlie the display panel 46. The printed price numbers on the squares 174 of the price card 48 are opaque. After the print count developed by the binary counters of Fig. 5 is shifted into the memory counters and the decimal square 172 of the display panel 46 is illuminated, the price displayed on the corresponding square 174 of the price card 48 is illuminated. The operator of the finishing operations workcentre may, with a glance at the price display unit 18, instantly determine which of the price figures is illuminated and transcribe that price upon the print package 52.

The price display card 48 illustrated in Fig. 7 displays a unit price of $0.23 per print. Other display cards bearing other unit prices applicable to the different retailers serviced by the photofinisher may be substituted for the illustrated price display card.

Returning again to Fig. 3 there is shown a reject print/negative filmstrip correlator and display that corresponds to the reject print/negative film strip correlator 16 and the numerical display 42 of Fig. 1. The correlator 180 responds to the reject print signal K of Fig. 4K and the output signal developed by a secondary binary to digital decoder 182 to correlate the marked print with the negative filmstrip containing the corresponding negative.

The second binary to digital decoder 182 is connected, as shown in Fig. 5, at its input terminal to the Q and $\overline{Q}$ terminals of the binary counter flip-flops 138-1, 138-2, 138-4, 138-8, 150-10 and 150-20. Decoder 182 has twenty output terminals and provided a decoded decimal count of the cut print signal B as it is counted by the binary counters 118 and 120. The twenty output terminals of the decoder 182 are applied to the input terminals of the reject print/negative filmstrip correlator and display 180.

The rejet print/negative filmstrip correlator and display 180 is shown in greater detail in Fig. 6. For the purpose of describing the preferred embodiment of the present invention, it has been assumed that the negative filmstrips 41 each contain four negative frames. For this reason the output terminals of the binary to digital decoder 182 have been connected to five groups of four input terminals numbered *1* to *4*, *5* to *8*, *9* to *12*, *13* to *16* and *17* to *20* of OR gates 184, 186, 188, 190 and 192, respectively. The output conductors of the OR range 184, 186, 188, 190 and 192 are respectively connected to one input terminal of AND gates 194, 196, 198, 200 and 202. The second input terminal of the AND gates 194, 196, 198, 200 and 202 are commonly connected to the output terminal of the AND gate 114 of Fig. 3. In operation, the OR gate 184, for example, passes each one of the decimal count signals, *1* to *4* developed by the binary to decimal decoder 182 as they are sequentially developed, as explained hereinbefore, as each print is cut. When the reject print signal K is developed, the AND gate to which the decimal count signal of the shift register is simultaneously applied passes the reject print signal K to its output terminal. For example, in the instance shown in Fig. 2, print *19* of order number *1* is about to be cut, and decimal count signal *19* is passed by OR gate 192 to the first input terminal of AND gate 202. Simultaneously the reject print signal K is developed, and AND gate 202 passes the reject print signal K to its output terminal.

Connected to the output terminals of AND gates 194, 196, 198, 200 and 202 are hold-

ing circuits 204, 206, 208, 210 and 212 for the illuminable lamps 214, 216, 218, 220 and 222, respectively, for the numerical display 42. When an input signal is applied at the respective input terminals of the driving circuits, the output terminal of the driving circuit is grounded to allow current to flow from the commonly connected voltage source +V through the associated display numeral and to ground potential until the reset/restart signal F is applied to the "reset" terminal R of the voltage supply circuit.

Since each of the holding circuits are identical in design and operation, only the holding circuit 204 will be described in detail. The holding circuit 204 consists of a phototransistor 224 having its emitted connected to ground potential and its collector connected through a lamp 226 to the voltage source +V. The base electrode of the phototransistor 224 is connected by diode 228, resistor 230 and resistor 232 to the voltage source +V. The input terminal of the holding circuit 204 is the junction of resistors 230 and 232 and is connected to the output terminal of AND gate 194. Normally the output terminal of AND gate 194 is at ground potential.

When the output conductor of AND gate 194 is at ground potential, the phototransistor 224 is rendered nonconductive and the lamp 226 is dark. However, when the AND gate 194 simultaneously receives a decimal count signal from the binary to decimal decoder 182 and a reject print signal K, the reject print signal K, having a positive voltage, is passed to the input terminal of the holding circuit 204 and, by resistor 230 and diode 228 the base electrode of phototransistor 224 which is rendered conductive thereby. When phototransistor 224 is rendered conductive, lamp 226 is illuminated. Light from the lamp 226 strikes the base electrode region of the phototransistor 224 which responds thereto by remaining highly conductive after the input terminal of the holding circuit 204 is again grounded.

When the phototransistor 224 conducts, its collector electrode is at ground potential and the voltage drop across the display lamp 214 causes the numeral *1* of the display panel 42 to be illuminated. The numeral *1* when when illuminated indicates that a negative in the first filmstrip of the stack 41 requires reprinting. Similarly, the numerals *2, 3, 4* and *5* may be illuminated to indicate the location of a negative in each respective filmstrip that requires reprinting.

When the reset/restart signal F is developed by the reset/restart 105, it is applied to a relay coil 234 that opens normally-closed relay contacts 234a. The reset/restart signal F thus extinguishes the lamps 226 and 214—222. With the lamp 226 extinguished and the input terminal at ground potential, the phototransistor 224 is rendered nonconductive and the display lamp 214 is extinguished.

Thus apparatus has been shown for correlating marked prints with the negative filmstrip containing the corresponding negative that must be reprinted to complete the customer's order. The incorporation of this correlating apparatus with the marked print sorter and the automatic price display on a single console with a negative cutter and stacker provides a highly efficient finishing operations workcentre that shortens the time and lessens the chance of error in packaging and pricing customer orders. Although specific circuits and apparatus have been described that will efficiently accomplish the functions of the particular elements of the finishing operations work-centre, it will be apparent that many modifications may be made in accordance with the invention. For example, the location of the photosensitive devices that sense the print sort mark, and the order sort marks and the reject mark may be changed with corresponding modifications made to the described circuits that respond to these photosensitive devices. Furthermore, it will be apparent to those having ordinary skill in the art that the print counter, the price display unit, and the marked print/negative filmstrip correlator circuit may be modified to accommodate a greater number than 20 prints in any customer order. It will also be apparent that the disclosed counters may take any form including that of a digital counter or shift register without binary to decimal conversion.

WHAT WE CLAIM IS:—

1. Apparatus for counting and displaying the number of prints in a print order cut from a roll of prints, wherein the last print of each print order is designated by a first mark, said apparatus comprising: a print cutter for severing prints from a roll of prints advanced through the cutter; means responsive to the severance of each print for producing a first signal; a counter for counting the first signals; means for detecting the said first mark for the last print in each print order and for producing a second signal in response thereto; means responsive to the second signal and to the severence of the said last print for halting the operation of the print cutter; restart means for restarting the operation of the print cutter; and means responsive to the operation of the restart means and to the count number of the first signals in the said counter means for displaying the count number indicating the total number of prints cut from the print order.

2. Apparatus as claimed in Claim 1, wherein the means responsive to the operation of the restart means and to the counter comprises storage means for storing the number of first signals counted by the counter means, and price display means responsive to the

ing circuits 204, 206, 208, 210 and 212 for the illuminable lamps 214, 216, 218, 220 and 222, respectively, for the numerical display 42. When an input signal is applied at the respective input terminals of the driving circuits, the output terminal of the driving circuit is grounded to allow current to flow from the commonly connected voltage source +V through the associated display numeral and to ground potential until the reset/restart signal F is applied to the "reset" terminal R of the voltage supply circuit.

Since each of the holding circuits are identical in design and operation, only the holding circuit 204 will be described in detail. The holding circuit 204 consists of a phototransistor 224 having its emitted connected to ground potential and its collector connected through a lamp 226 to the voltage source +V. The base electrode of the phototransistor 224 is connected by diode 228, resistor 230 and resistor 232 to the voltage source +V. The input terminal of the holding circuit 204 is the junction of resistors 230 and 232 and is connected to the output terminal of AND gate 194. Normally the output terminal of AND gate 194 is at ground potential.

When the output conductor of AND gate 194 is at ground potential, the phototransistor 224 is rendered nonconductive and the lamp 226 is dark. However, when the AND gate 194 simultaneously receives a decimal count signal from the binary to decimal decoder 182 and a reject print signal K, the reject print signal K, having a positive voltage, is passed to the input terminal of the holding circuit 204 and, by resistor 230 and diode 228 the base electrode of phototransistor 224 which is rendered conductive thereby. When phototransistor 224 is rendered conductive, lamp 226 is illuminated. Light from the lamp 226 strikes the base electrode region of the phototransistor 224 which responds thereto by remaining highly conductive after the input terminal of the holding circuit 204 is again grounded.

When the phototransistor 224 conducts, its collector electrode is at ground potential and the voltage drop across the display lamp 214 causes the numeral *1* of the display panel 42 to be illuminated. The numeral *1* when when illuminated indicates that a negative in the first filmstrip of the stack 41 requires reprinting. Similarly, the numerals *2, 3, 4* and *5* may be illuminated to indicate the location of a negative in each respective filmstrip that requires reprinting.

When the reset/restart signal F is developed by the reset/restart 105, it is applied to a relay coil 234 that opens normally-closed relay contacts 234a. The reset/restart signal F thus extinguishes the lamps 226 and 214—222. With the lamp 226 extinguished and the input terminal at ground potential, the phototransistor 224 is rendered nonconductive and the display lamp 214 is extinguished.

Thus apparatus has been shown for correlating marked prints with the negative filmstrip containing the corresponding negative that must be reprinted to complete the customer's order. The incorporation of this correlating apparatus with the marked print sorter and the automatic price display on a single console with a negative cutter and stacker provides a highly efficient finishing operations workcentre that shortens the time and lessens the chance of error in packaging and pricing customer orders. Although specific circuits and apparatus have been described that will efficiently accomplish the functions of the particular elements of the finishing operations work-centre, it will be apparent that many modifications may be made in accordance with the invention. For example, the location of the photosensitive devices that sense the print sort mark, and the order sort marks and the reject mark may be changed with corresponding modifications made to the described circuits that respond to these photosensitive devices. Furthermore, it will be apparent to those having ordinary skill in the art that the print counter, the price display unit, and the marked print/negative filmstrip correlator circuit may be modified to accommodate a greater number than 20 prints in any customer order. It will also be apparent that the disclosed counters may take any form including that of a digital counter or shift register without binary to decimal conversion.

WHAT WE CLAIM IS:—

1. Apparatus for counting and displaying the number of prints in a print order cut from a roll of prints, wherein the last print of each print order is designated by a first mark, said apparatus comprising: a print cutter for severing prints from a roll of prints advanced through the cutter; means responsive to the severance of each print for producing a first signal; a counter for counting the first signals; means for detecting the said first mark for the last print in each print order and for producing a second signal in response thereto; means responsive to the second signal and to the severence of the said last print for halting the operation of the print cutter; restart means for restarting the operation of the print cutter; and means responsive to the operation of the restart means and to the count number of the first signals in the said counter means for displaying the count number indicating the total number of prints cut from the print order.

2. Apparatus as claimed in Claim 1, wherein the means responsive to the operation of the restart means and to the counter comprises storage means for storing the number of first signals counted by the counter means, and price display means responsive to the

stored number of first signals for displaying this number and arranged to display the price to be charged for the prints.

3. Apparatus as claimed in Claim 2, wherein the price display means is arranged to display the counted number and corresponding price to be charged for the prints for the period of time between each operation of the restart means.

4. Apparatus as claimed in Claim 2, wherein the counter further comprises means responsive to the operation of the restart means and the storage means for resetting the counter after the storage means has stored the count.

5. Apparatus as claimed in Claim 2, wherein the price display means further comprises: a display panel divided into a predetermined plurality of areas, each area having numerals indicative of a count and a corresponding price thereon; means for illuminating each panel in response to the corresponding stored print number; and means responsive to the storage means for providing a third signal representative of the stored count and for directing the third signal to the illuminating means corresponding to the stored count in order to illuminate the respective numerals indicative of the count and the corresponding price to be charged for the prints.

6. Apparatus as claimed in Claim 2, comprising: a price display panel comprising a plurality of translucent first areas; a corresponding plurality of lamps each located with respect to a particular first area of the price display panel for individually illuminating the said first area upon the energization of the lamp; a price card comprising a plurality of second areas corresponding to the plurality of first areas of the price display panel, the price card being substantially transparent and having substantially opaque price numerals inscribed in each second area thereof; means for maintaining the second areas of the price card in parallel alignment with the first areas of the price display panel; and means for energizing the lamp of the price display panel corresponding to the total number of prints counted whereby the price to be charged for the print is distinguished by the illumination of the lamp through the respective first and second areas of the price display panel and the price card.

7. Apparatus substantially as herein described with reference to the accompanying drawings.

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