

Dec. 21, 1965

E. K. HYPOLAINEN

3,225,175

CASE SELECTOR

Filed July 18, 1960

6 Sheets-Sheet 1

FIG. 2.

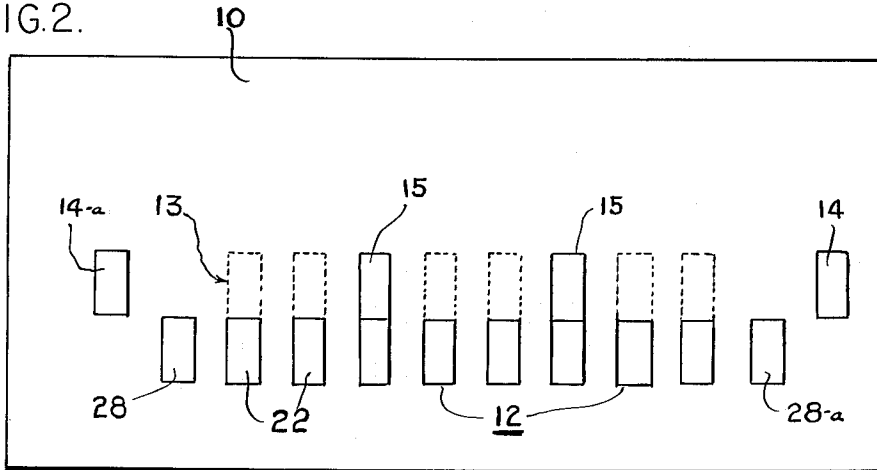
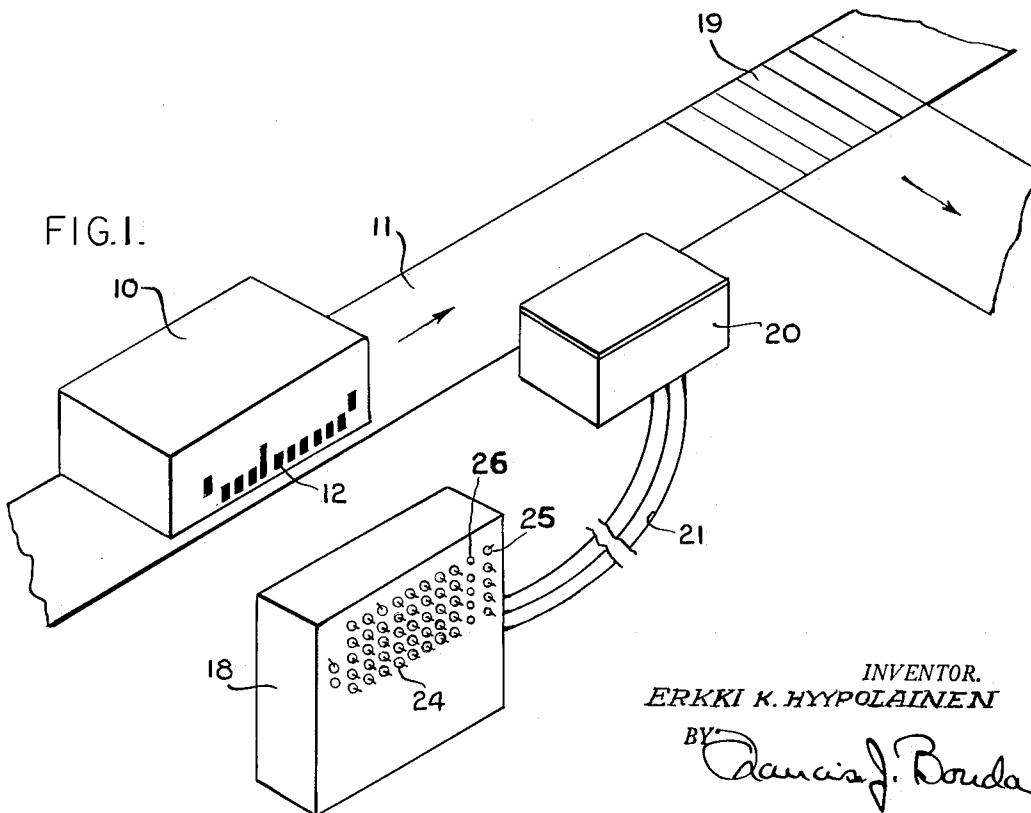


FIG. 1.



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FIG.3.

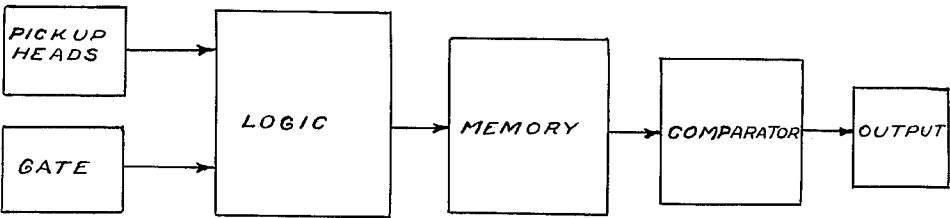


FIG.4.

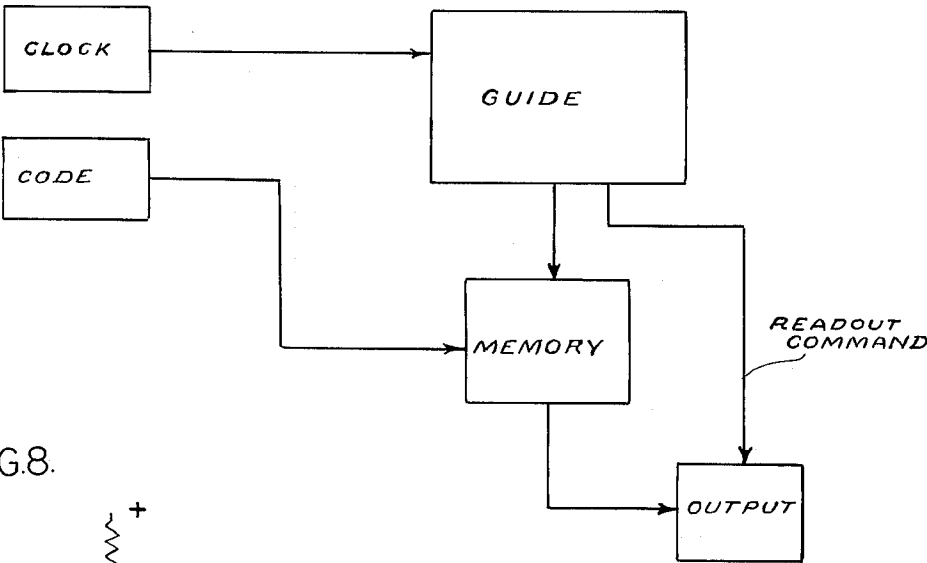


FIG.8.

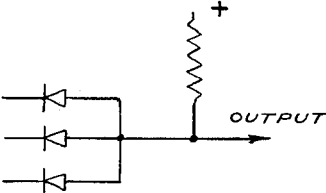
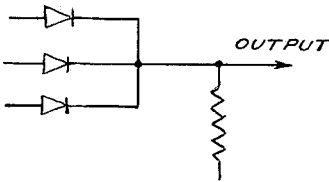


FIG.9.



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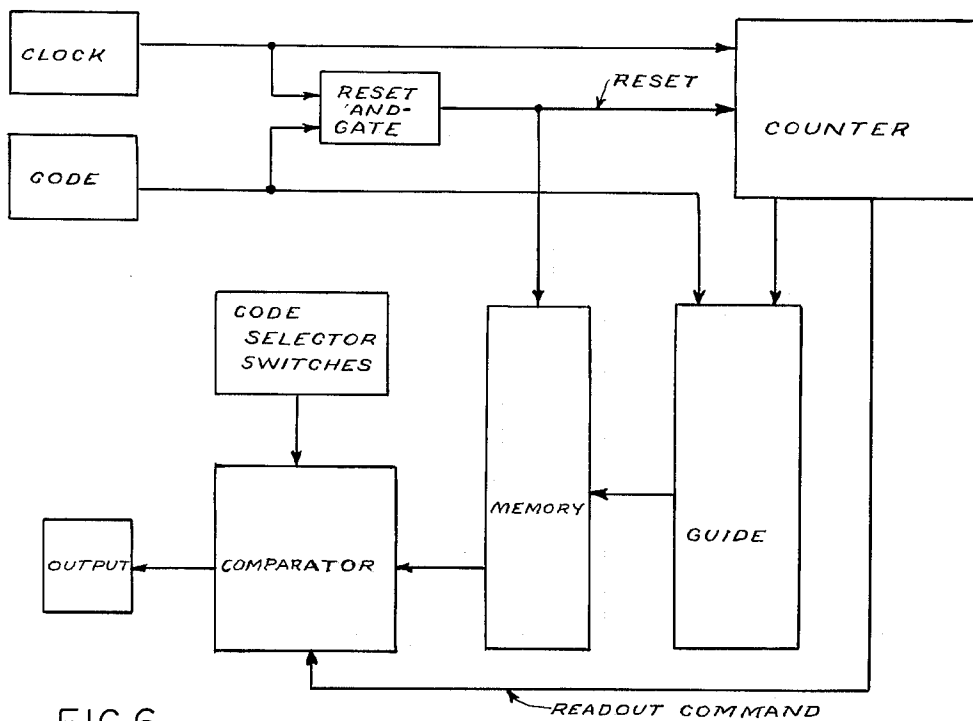
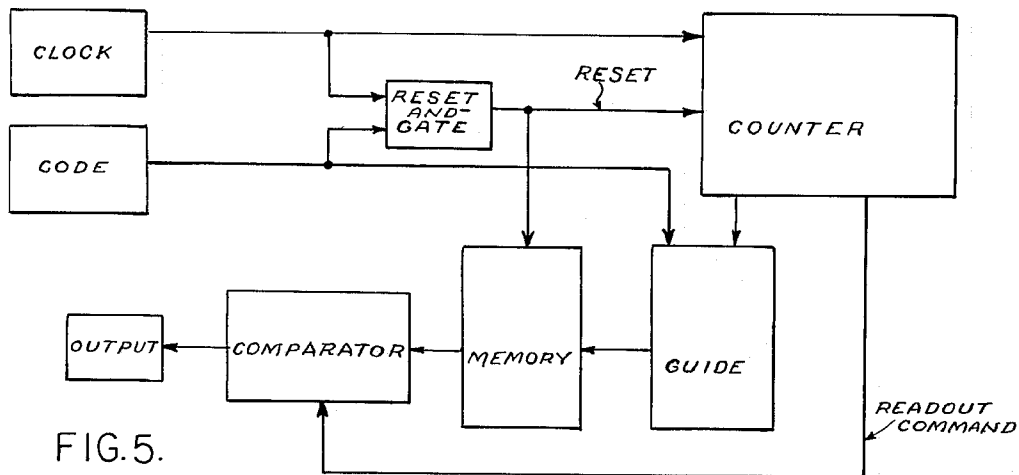
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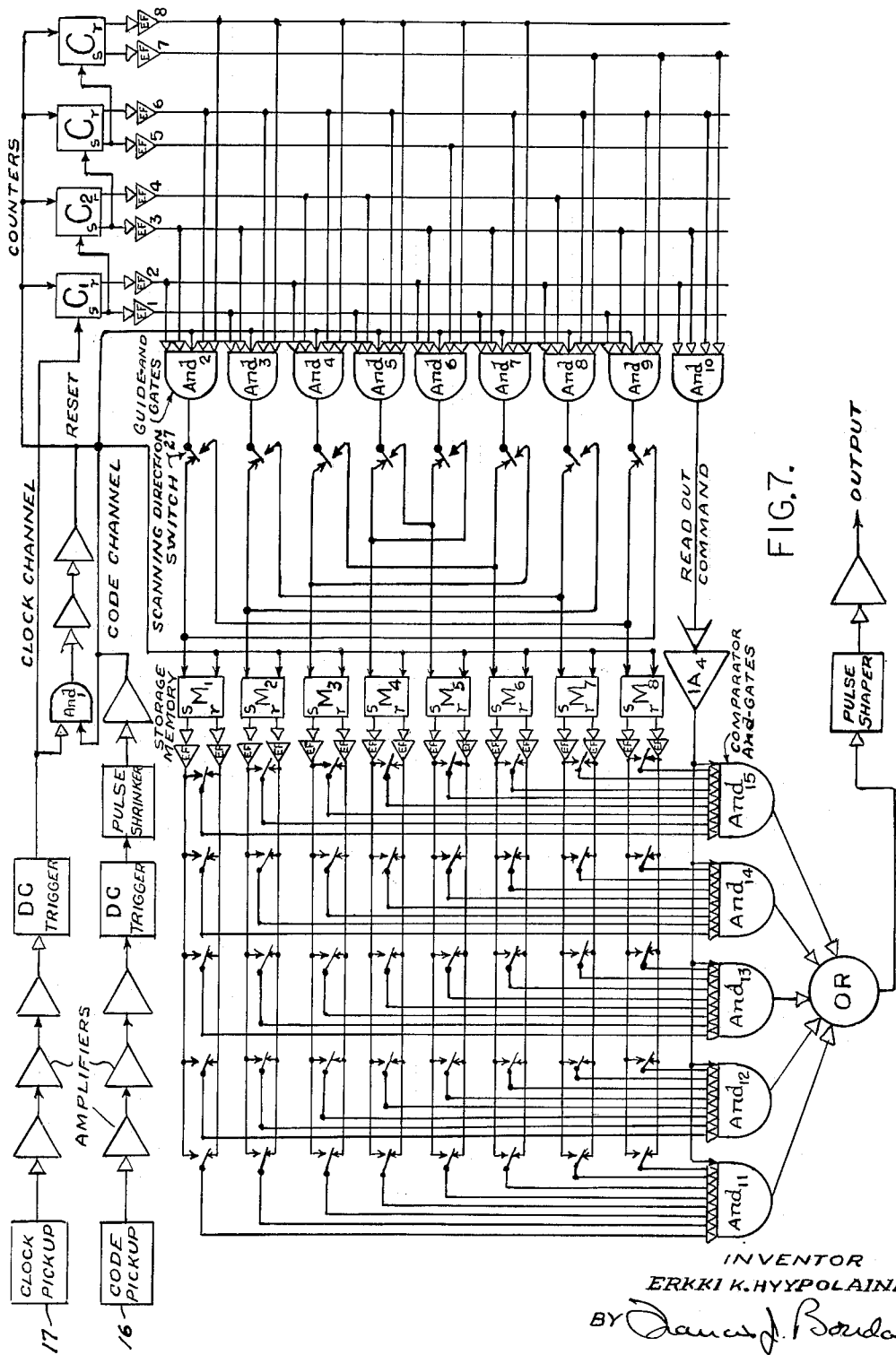


FIG. 7.

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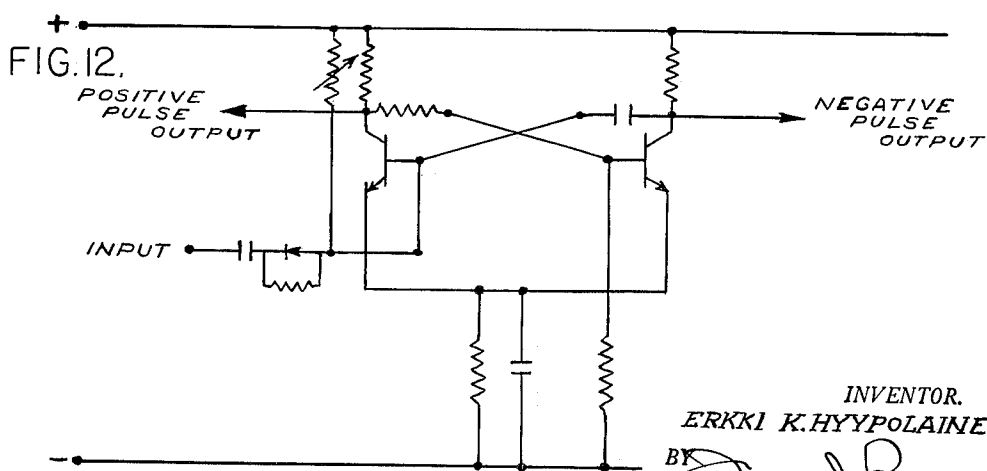
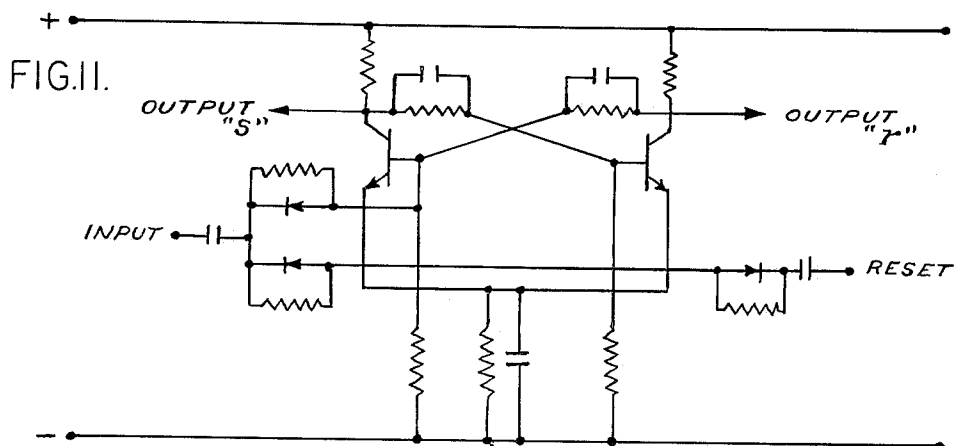
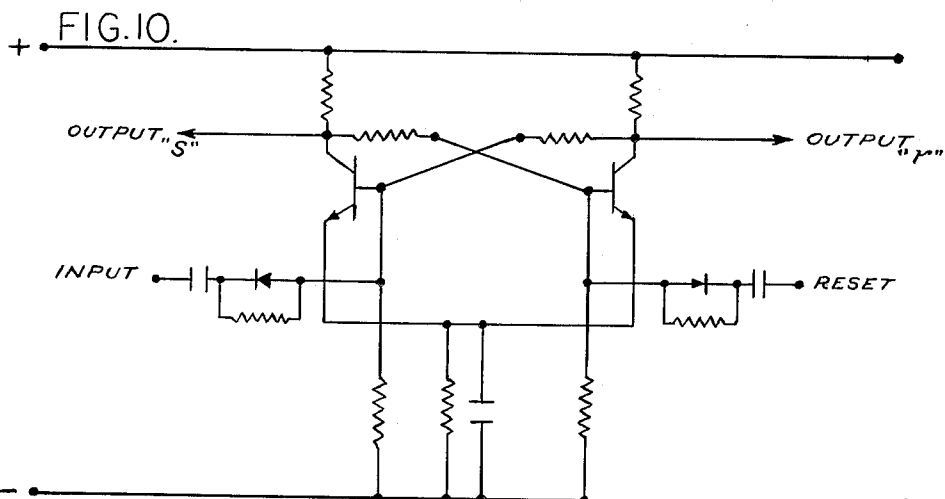
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CASE SELECTOR

Filed July 18, 1960

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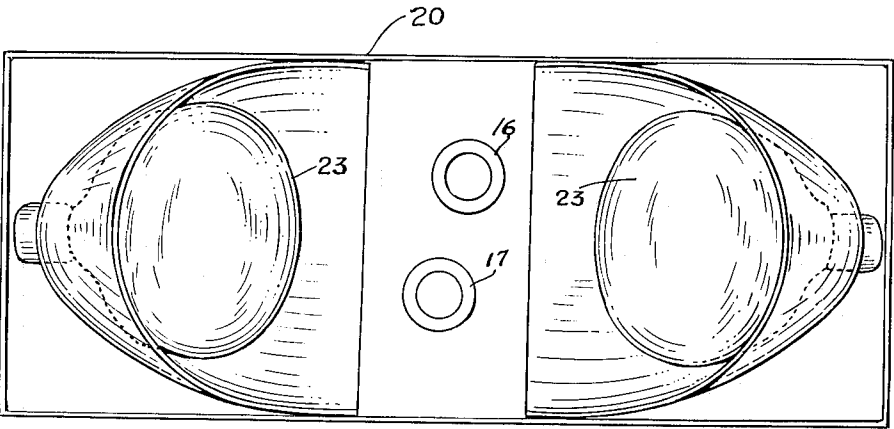


FIG. 13.

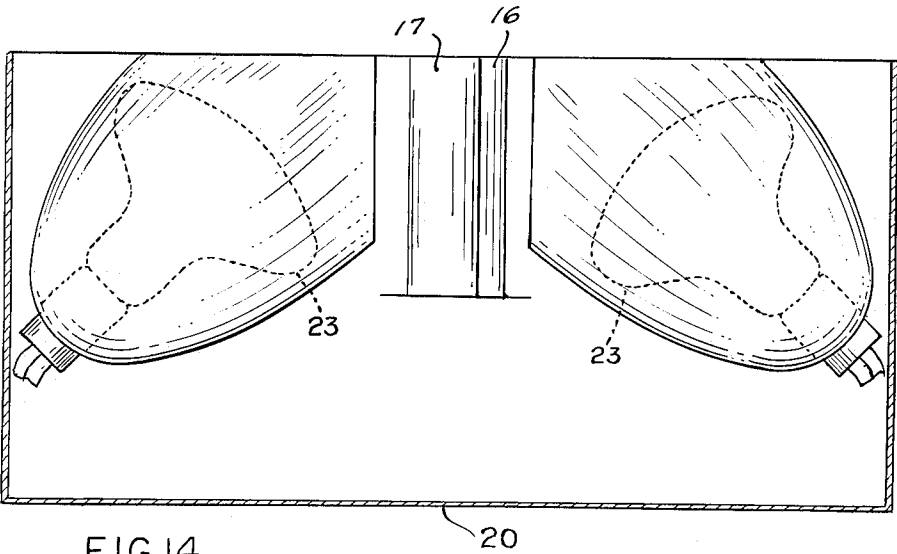


FIG. 14.

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3,225,175

CASE SELECTOR

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Filed July 18, 1960, Ser. No. 43,567

8 Claims. (Cl. 235—61.7)

The present invention relates to selector or sorting apparatus generally used in connection with conveyor systems. Thus the present invention has particular application in the field of warehousing where a great number of generally similar but specifically different items, such as cartons, cases or boxes, pass along a conveyor. The case selector of the present invention is utilized to actuate sorting devices operating in conjunction with the conveyor for moving the items, selectively, from the conveyor to destination points such as box cars, trucks or selected storage places.

More specifically, the case selector of the present invention utilizes or detects a group of marks printed on the sides of each case or carton and, if the carton carries marks printed in an appropriate array, through an electronic selector generates a pulse which actuates a trip or similar ejection device for removing that carton from the conveyor. Thus the device of the present invention is referred to as a "case selector."

Broadly speaking, the case selector includes two elements, a photoelectric pickup and a case selector logic cabinet. The pickup is fastened at the side of the conveyor that carries the cartons at a usual speed of at least about 100 ft./min. The case selector logic cabinet can be located as far away as several thousand feet from the photoelectric pickup.

The pickup contains only two photo cells or "eyes" which are arranged close together. Therefore, the area of even illumination which is required is very small, being only a few inches square. The light source is a simple 30 watt spotlight, operating at lower than normal voltage with a life expectancy of several thousand hours and the light source is resiliently mounted so as to damp out conveyor vibrations. A spare light source is provided which automatically takes over if the first lamp burns out. The pickup box is dusttight and has a flat glass window which is easy to clean and will not very easily collect dust.

The two photoelectric pickup heads, one above another, slightly staggered, control four different operations:

- (1) Receive the code signals, caused by the changing intensity of light reflected from a moving printed pattern,
- (2) Direct the code signals to proper storage or memory units,
- (3) Initiate the readout and
- (4) Reset or clear the complete system.

In the past, photoelectric pickup heads have been utilized in case selectors, but generally speaking there have been more than two photo cells or "eyes" required for each selector. Because of the construction of such prior devices, which may be best described as parallel input, D.C. coupled (or A.C. coupled) units, various unsatisfactory results are attained. Some of the principal dis-

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advantages of such prior devices, are the sensitivity to (a) changes in light intensity, (b) the condition of the surface of the object being scanned and (c) similar problems involving the optics of the system. In addition, such selectors have required so many components, particularly the photo electric cells, that any variation in the construction or condition of the device tended to multiply the errors (being particularly true with regard to illumination and optical effects) so that it has been difficult to provide 100% efficiency in the operation of the device.

Of particular concern has been the requirement that a large number of photo electric cells be used. For example, if the number of cartons or cases to be detected is 2^8 or 256, a parallel input selector system requires at least $8+2$ or 10 separate photoelectric pickup heads and input channels.

The selector of the present invention is a serial input photoelectric system and reduces the number of pickup heads required, eliminates practically all optical problems and enables (because of the few connections between scanning device and selector system) extremely wide separation between the scanning device on the conveyor line and the centrally maintained or self-contained cabinet where the electronic circuitry is disposed.

Furthermore, in the device of the present invention, the photoelectric pickup heads and the case selector logic cabinets may be interchanged. That is, a single logic cabinet may be provided which operates effectively with a plurality of pickup heads. The relatively inexpensive photoelectric pickup heads may be disposed in many places along the conveyor system and any one of them may be connected selectively to the logic cabinet for operating an effective device for removing the carton from the conveyor line. Hence, at many places along the conveyor line an inexpensive detector can be placed without the necessity of providing the relatively more expensive logic cabinet for each one of the pickup units.

With the foregoing in mind, one object of the present invention is to provide a case selector having no more than two photoelectric scanning devices and which can, nevertheless, select a specific item from among any number of items passing the selector.

Another object of the present invention is to provide a case selector which may select one or more items from any number of different items moving past the selector, said selector utilizing no more than two photoelectric cells.

Another object of the present invention is to provide a case selector which will operate at 100% efficiency, regardless of reasonable variations in conveyor speed, electrical supply, conditions of lighting and the relative condition of the objects to be selected which pass the detecting portion of the case selector.

Another object of the present invention is to provide a case selector having only two photo electric cells which operate with objects printed with only $x+2$ number of marks when the number of cases or cartons from which the selection is to be made is equal to 2 to the x power (2^x).

Further objects will be apparent by reference to the appended specification, claims and drawings.

For the purpose of illustrating the invention, there is shown in the accompanying drawings forms thereof which are at present preferred, although it is to be understood

that the various instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangements and organization of the instrumentalities as herein shown and described.

In the drawings wherein like reference characters indicate like parts:

FIGURE 1 is a schematic, perspective view of the selector of the present invention shown in conjunction with a carton disposed on a conveyor belt.

FIGURE 2 is a side elevational view of a carton with the pattern of detector marks displayed thereon.

FIGURE 3 is an elementary block diagram of the serial input case selector of the present invention.

FIGURE 4 is a slightly more detailed elementary block diagram similar to that of FIGURE 3.

FIGURE 5 is a basic block diagram of the selector of the present invention.

FIGURE 6 is a more detailed basic block diagram of the selector.

FIGURE 7 is a detailed schematic diagram of the case selector of the present invention.

FIGURE 8 is a diagram of a simplified and-circuit.

FIGURE 9 is a diagram of a simplified or-circuit.

FIGURE 10 is a diagram of a storage flip-flop circuit.

FIGURE 11 is a diagram of a counting flip-flop circuit.

FIGURE 12 is a diagram of a one-shot multi-vibrator (pulse stretcher).

FIGURE 13 is a front elevational view of the photoelectric pickup unit or scanner.

FIGURE 14 is a top plan view of the photoelectric pickup unit.

On each carton 10 which passes along the conveyor 11, a plurality of marks 12 are placed, in predetermined position, in two separate horizontal lines, as shown in FIGURES 1 and 2. In one line 13 (the top one in FIGURE 2) a reset marker 14 is placed in line with a series of code marks 15 appropriately spaced horizontally from each other as predetermined for the particular product in the carton. The horizontal position of the code marks varies from product to product but each mark bears specified relation to each other and to the reset mark on each case of similar products.

One of the photo electric eyes or photo cells 16 in the pickup unit 20 is vertically aligned with the row of code marks and the second photo electric cell 17 is vertically aligned with a second horizontal line of marks known as clock channel marks. The photo electric eyes are horizontally off-set from each other, as shown in FIGURE 13, and when any carton passes the scanning device the first spot to activate a photo cell is the reset spot 14 so as completely to clear any information previously conveyed to the system. Thereafter, as the carton passes in front of the two photo electric eyes, each eye scans its aligned row of marks and conveys suitable electric pulses through appropriate circuitry to the logic cabinet 18 hereinafter described. The system then sends out a pulse or signal which trips an appropriate trigger device 19 for ejecting the carton from the conveyor if appropriate information has been conveyed through the circuitry because proper markings on the case identify it as one item to be removed from the conveyor.

It is to be noted at this particular time that the only apparatus which is necessary near the conveyor line for scanning the cartons as they pass is the relatively compact and uncomplicated pickup 20 shown in FIGURES 1, 13 and 14. From this pickup or scanning device appropriate cables 21 may convey the signal to a distant electronic selector unit or logic cabinet 18 where the receiving, storing, interpreting and transmission of the signals takes place. The output pulse emanating from the logic cabinet is amplified and sent to the trip or ejector 19 for removing the carton from the conveyor line.

The lower photo cell 17 (and its corresponding input amplifier) is called the clock channel. The main func-

tion of this clock channel is to direct the information received by the other input channel, the code channel, into proper locations in the case selector logic circuits shown in FIGURE 7.

Preferably there are two reset marks 14 printed on each carton (FIG. 2). These are in line with the code marks 15 and outside the region of the clock channel marks 22, one before and another after the set of clock marks. When a carton 10 passes the photoelectric pickup 20 a reset mark first activates the case selector electronic system to clear or cancel the previous information. This happens every time the code channel photo cell senses a signal from a mark at a time when the clock channel photo cell is not simultaneously sensing a similar signal from a clock mark. That is, the system is reset every time the code mark is not aligned with a clock mark. The photoelectric pickup heads are slightly off-set as shown in FIGURE 13, so that when both clock and code marks are simultaneously present, the clock mark is sensed somewhat before the code mark. The code signal is shortened to a small fraction of the original pulse to prevent a false reset which could be caused by normal irregularities of the printed marks.

The clock channel pickup head 17 scans the clock marks 22 and directs the code pulses into proper storage or memory locations. After sensing ten (or any pre-determined number) clock marks, the case selector causes a readout command to be sent to the comparator and-gates of the system to activate an output mechanism, but only if the information stored in the storage locations agrees with a pre-selected code pattern.

This readout is accomplished immediately after the clock channel pickup head senses the tenth clock mark. Irregular defects in the reflecting carton surface or in the printing within the code mark area may reset or clear the electronic system and thus prevent a readout command. Therefore, the probability of accepting or selecting wrong cartons is very much smaller than the probability of rejecting or missing correct cartons. A 100 percent performance may be expected if there are no faulty components in the case selector circuits and if the cartons and the printed marks are in reasonably good condition.

It is of particular interest that the marks affixed to the carton are placed thereon independently of the edges or corners of the cartons, that a simple scanning mechanism employing only two photo cells is used to detect and select from among an unlimited number of cartons passing along the conveyor, that the marks printed on the cartons may be simple rectangular spots and that the system will select from among many cartons with very few spots (the number of cartons and spots being determined by the formula $N=2^x$ where N is the number of cartons and the number of spots is $(x+2)$).

In FIGURE 2 the second reset mark is numbered 14a and the second readout mark 28a. These two marks are printed with the previously described marks so that the system will operate with the carton moving in either direction along the conveyor, merely by changing the scanning direction switch 27 (FIGURE 7).

In a preferred form the case selector selects any five types of cartons from a total of 256 different cartons. However, without changing the photoelectric pickup, every additional clock mark 22 on the carton (together with minor additions in the case selector electronic logic circuits) will always double the total number of different cartons that can be recognized by the unit. This is accomplished at conveyor speed operating between 60 ft./min. and 600 ft./min., but preferably at approximately 150 ft./min.

There are some specific features that make this case selector especially suitable for remote control applications. The pickup unit 20 can detect printed marks on the carton 10 approximately 2-3 inches away. There-

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fore, the probability of a faulty behavior and the need for preventing misaligned cartons is decreased.

Because the pickup unit 20 has only two photo cells, the inter-connections between the case selector logic cabinet and the pickup are very simple. Also, case selectors and pickup units are interchangeable and can be located as far as several thousand feet from each other. There is no sensitivity adjustment to set. If one lamp 23 in the pickup box burns out, the spare takes over without any interruption in the operation of the case selector.

Furthermore, because the pickup units are inexpensive and need very little maintenance, they can be located in seldom used areas and connected for use only when necessary.

If so desired, it will be relatively easy to place all case selector logic cabinets in a central control room, to build a graphic panel or a model of the warehouse with plug-in jacks to the stationary pickups, and to connect any case selector anywhere it is needed.

It is also possible to use separate, pre-set counters to determine beforehand the exact number of each type of cartons required. These pre-set counters would suffice as long as only a few case selectors would be used but to automate an entire warehouse the use of an electronic digital computer may be desirable so that brands, amounts, locations and loading times could all be punched on tape or on cards and fed in the computer. The computer also could keep records of incoming and outgoing cases and of the total inventory to provide a perpetual inventory control.

The case selector also can easily be modified to eject or count every passing carton and it can be expanded to separately count every brand produced.

It is quite possible that local retail organizations which have several stores and use delivery trucks will often want their purchases loaded in predetermined assortments which can be unloaded at the local stores without additional handling. Such arrangement requires a storage area either on the conveyor loop or on the warehouse floor. In this case the use of present counters or a digital computer becomes very profitable.

It can be seen and appreciated from the foregoing that it is necessary to feed some information into the selector unit in advance of the operation of the device.

A group of toggle switches 24 are used to select the desired brands (five rows, eight in each row, one row for each brand). There is also a brand switch 25 and an output delay potentiometer 26 for each row of switches 24. Each brand switch determines if the corresponding brand will be selected. The output delay potentiometers are adjustable from approximately 0.3 second to 1 second delay before the case selector triggers the carton ejecting mechanism. A similar output duration potentiometer that controls the length of the output is located inside the cabinet 18.

Also included is a scanning direction switch 27. It is turned to the right if the photoelectric pickup is installed on the right side of the conveyor, when facing to the direction of conveyor movement. The scanning direction switch should be turned to the left if the pickup is installed on the left side of the conveyor.

Although the clock and code marks provide two separate rows of marks, one above another, for practical reasons the code marks may be printed as extensions of the clock marks.

We may consider the printed marks on a carton arranged in two rows, clock and code, even if the printing is not clearly separated. That row which has ten marks (marks 22 plus the two readout marks 28 and 28a) in a continuous regular sequence forms clock marks (this is for cases printed so as to accommodate travel in either direction). If both reset marks 14 and 14a and both readout marks 28 and 28a are eliminated, i.e., one mark from each end of each row of marks, or two marks from

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both ends of the whole mark pattern, the code area is defined. It covers the area from the second to ninth clock mark. This code area can be represented with an eight digit binary number calling for "0" when the clock mark is not extended to cover also the code row as a code mark, and calling for "1" every time the clock mark is extended to the code row or a code mark is present (as at 15). These eight digit binary numbers may be expressed also as decimal numbers as follows:

Binary number	Decimal number
0 0 0 0 0 0 0 0	= 0
0 0 0 0 0 0 0 1	= 1
0 0 0 0 0 0 1 0	= 2
0 0 0 0 0 0 1 1	= 3
0 0 0 0 0 1 0 0	= 4
0 0 0 0 0 1 0 1	= 5
1 1 1 1 1 1 1 1	= 255

When setting the code in each row of eight code selection switches 24 in the cabinet 18, the switch is down if there is no code mark at that particular location, i.e., the binary digit is "0." If there is a code mark (i.e., the binary digit is "1"), the switch is turned up.

Then the output delay potentiometer is adjusted for each brand (row of code selection switches) to a suitable value so that the case will be above the ejector 19 when the ejector is actuated. If the cases are ejected too early, the potentiometer is adjusted to increase the output delay. If the cases are ejected too late, the potentiometer is adjusted to decrease the output delay.

Without changing the construction or arrangement of the photoelectric detector systems, but merely by changing the electronic circuitry in the selector systems, a great number of additional items may be scanned and handled on the conveyor system, because, merely by adding an additional guide and-circuit, storage circuit and expanding the comparator and-circuit in the selector system and adding another spot to the case in the code area, the number of units which may be detected will be double the amount which previously had been handled by the system. Furthermore, the simple inverter switch 27 on the selector permits proper handling of the cases regardless of the direction of travel past the scanner.

As the case passes in front of the photoelectric eyes, the photoelectric eye in alignment with the clock channel markers scans each mark and emits a square pulse for each mark. If at the same time a code mark pulse is emitted, a signal is directed into a proper memory location in the selector unit. After the case has passed in front of the electric eyes sufficiently far so that all the code mark spots have been scanned, the readout spot 28 passes its photo cell and the case selector then sends out an output pulse (which trips the trigger mechanism for removing the case from the conveyor line) but only if the information received from the photo cells corresponds to the preset pattern (binary number) on the selector switches 24. Because of the integrating networks in both the input channels, the signals passing therethrough are smooth and thus the effect on the operation of irregularities on the carton surface and in the printing of the marks is substantially eliminated.

Any one selector system may be set so that a combination of cartons 10 may be removed from the system by the same ejector mechanism 19. A tabulating or counting mechanism may be interconnected with the selector system so that when a given number (for example 100) of one type of cartons have passed through and been ejected, then the case selector will automatically stop ejecting any more cartons bearing that combination of marks and eject only the cartons for which another row of switches 24 has been pre-set, until each of their quotas is filled, and so on, until the correct quantity of each of the selected cartons has been removed from the conveyor line. With such a device, it is therefore possible to fill a box-car or a trailer truck with the appropriate numbers of any given

units without attention by an operator other than removing the cases from the end of the ejector mechanism.

CIRCUIT DESCRIPTION

I. The input stages

The photocells 16 and 17 are connected from the positive side of the logic power supply, to the first input amplifier. The input amplifiers consist of three stages. The output of the first stage is transformer-coupled to the second stage. The coupling transformer also inverts the signal so that the second stage of the input amplifier can be normally cut off. Only the incoming signals cause this stage to conduct. At the base of the second stage there is a simple RC low-pass filter or integrating network, the function of which is to eliminate high frequency noise from the low frequency signal. This decreases the effects of an uneven reflecting paper surface and of the small irregularities in the printing of the scanned marks.

The third stage of the input amplifier is nearly a copy of the second stage but without the filtering network, to pass about 10 c.p.s. signal without too much attenuation.

The use of these low frequency, mainly A.C.-coupled, input amplifiers makes the system less vulnerable to low light level, voltage, temperature, and circuit parameter variations. It also allows wider distance variations between the photoelectric pickup and the reflecting carton surface.

II. D.C.-trigger

In order to trigger the logic switching circuits, the rise and fall times of the slow input pulses have to be decreased considerably. This is done with D.C.-triggers which are bistable multivibrators, or flip-flops, which the D.C.-coupled output of the input amplifier forces to swing between two stages when the amplified signal passes through a certain voltage level. The switching time is about the same as in other switching circuits or about from 0.5 to 5 microseconds.

III. Reset

This far, both input pulse trains have passed completely equal amplification and pulse forming stages in clock and code channels. However, the negative clock pulses must be able to completely cover and inhibit the shortened and inverted, originally negative code pulses at the reset and-gate. Thus, only the code channel pulses with no simultaneous inhibiting clock pulses are allowed to pass as reset pulses. Therefore, code pulses are shortened in a pulse squeezer.

In order to have an output from the reset and-gate, both inputs must exit. That is, both inputs must be at the more positive or less negative potential. Therefore, the originally negative, shortened and inverted code channel pulses and the negative clock pulses are fed to the and-circuit to get a negative reset pulse from the output of the reset and-gate every time a code channel pulse is present and the clock pulse is not present.

Within the normal scanned code-clock mark pattern, the system will always be reset in the beginning and at the end of the scanning cycle. Also, because of the 1/8" horizontal displacement between the staggered code and clock photoelectric pickup heads, any vertical line and the end of a carton also will reset the system. Thus the probability of accepting wrong cartons is diminished.

The reset pulses switch to zero state all bistable multivibrators, i.e., counting flip-flops and storage or memory flip-flops. Because of this rather heavy load, the reset pulse has to be amplified, but without phase inversion. This has been done using two inverting amplifier stages.

IV. Code guiding and storage

The serial input code pulses have to be stored in proper storage or memory locations for a future comparison. This guiding is accomplished with a binary

counter and a set of eight five-input guide and-gates. The binary counter is a combination of four counting flip-flops. Every flip-flop has two outputs at the opposite states. One is at the higher voltage level, level "1" (about -1 volt) and another at the lower voltage level, level "0" (about -6.4 volts). The voltage drop across a saturated transistor is about 0.1 volt and the supply voltage is about 8 volts.

Clock pulses from the D.C. trigger switch the first counter flip-flop back and forth. Ten square negative clock pulses are thus divided by two and reduced to 5 square positive pulses. These trigger the second counter flip-flop which divides the five pulses to $(2 + \frac{1}{2})$ pulses. Because of the reset pulse after the clock pulse train these $2\frac{1}{2}$ pulses appear as two normal pulses followed by a third pulse with half the width of the earlier ones. The third counter flip-flop will divide the two normal pulses again into one pulse, but, because only the negative trailing edge of the pulse triggers the flip-flop, the $\frac{1}{2}$ pulse is ignored. The trailing edge of this output pulse of the third counting flip-flop again triggers the last counting flip-flop, which is reset after about $\frac{3}{4}$ its normal pulse width. Therefore, the output from both third and fourth counting units is one square pulse. The length of the latter is $\frac{3}{4}$ the former.

In the block diagram, the output sides of the counter flip-flops, C_1-C_4 , and storage or memory flip-flops, M_1-M_8 , are marked "r" and "s." Output side "r" is at higher voltage level after reset and output side "s" is at higher voltage level after one negative input pulse or, in storage units, after one bit of information, i.e., after a code pulse has been stored in the unit. Each guide-and-circuit is connected to one output side of each counting flip-flop via an isolating emitter follower. Thus, each code pulse, that is simultaneously applied at one of the inputs of every guide-and-circuit gating each storage unit, can pass only through the proper guide-and-gate to the corresponding storage location.

Scanning direction switch 27 allows the installation of the photoelectric pickup on either side of the conveyor by simply inverting the order of the storage units.

Thus, finally in the storage units, M_1-M_8 , is a perfect copy of the code marks. This can be understood as an eight digit binary number from 00000000=0 to 11111111=255, and gives the option of selecting any one of $2^8=256$ different binary coded cartons.

V. The comparator

To select a specified carton, the operator sets a row of eight code selection switches, connected to the inputs of a nine-input comparator and-gate, to couple, via isolating emitter followers, those output sides of the storage flip-flops that will be at the higher voltage level when the photoelectrically scanned binary code number has been stored in the proper storage locations. In short, this means that the row of eight switches corresponds to an eight digit binary number representing the binary code on the carton side. If the case selector now finds a case that has these code marks, all the eight comparator and-gate inputs from the storage units will be at the higher voltage level.

The ninth input to this comparator and-gate is the positive readout command pulse that will be generated at the last guide-and-gate every time the binary counter reaches the count ten. Because the readout command pulse has to be positive, the originally negative output from a guide and-gate is passed through a basically A.C. coupled inverting amplifier. If the proper code combination is now in the storage units, the comparator and-gate will pass the readout command pulse which will now be the output of the logic system. This is a negative pulse.

VI. The output stages

The comparator and-gate negative output pulse is the output of the case selector basic logic circuit. How-

ever, this pulse must be modified to drive an output mechanism.

First this negative pulse is passed to a pulse stretcher which acts as an output delay. This can be adjusted from 0.3 to 1 second. The output of this pulse stretcher is connected to a two stage emitter follower power amplifier (which may also control an indicator light to show if a certain brand is selected.)

The trailing negative edge of the output delay pulse triggers the last pulse stretcher which now controls the duration of the output from the case selector. The output of this pulse stretcher is again connected to a two-stage emitter follower power amplifier. This drives the output relay or output switching reactor that finally controls the carton ejecting mechanism of the case selector.

By way of illustration, it was desired to preset the case selector to select any five brands from the total of 256 brands and hence five rows of code selection switches and five corresponding comparator and-gates are used in parallel, as shown. Their outputs after output delay pulse stretchers and power amplifiers are combined in an or-circuit to trigger the common output pulse stretcher. This arrangement provides only one final output.

Of course it is possible to keep all five outputs also separated. If the indicator lamps are replaced by mercury wetted contact relays, undelayed outputs from each five channels and a single delayed common output is provided. If five individual delayed outputs are required, five additional output pulse stretcher-power amplifier combinations have to be added, one after each output delay pulse-stretcher or corresponding power amplifier. By changing the location of the or-circuit one pulse stretcher may be eliminated. If a common delayed output is not necessary, the or-circuit and the following power amplifier also can be eliminated.

If, an output for every code-marked carton is desired, it can be accomplished simply by first disconnecting the output of any comparator-and-gate from the input of the following output delay pulse stretcher. Then the original negative readout command pulse before the inverting amplifier is connected, via a diode passing only negative pulses, to the input of the above output delay pulse stretcher. If no output delay for this operation is necessary, the common output pulse stretcher also can be used.

It might also be desired to use preset counters to determine how many cartons of each brand are wanted. This is done by connecting the output of every output delay power amplifier through a set of normally closed contacts of a preset counter output relay. Thus, when the desired number of cartons has been ejected, this preset counter output relay opens its contacts and prevents all further actuations of the final output stages of the case selector from this brand selection channel.

Thus, all five brand selection channels operate individually. If the contacts of the preset counter output relay are between the emitter of an output delay power amplifier power transistor and the corresponding brand switch the preset counter input is condenser-coupled to the emitter of the power transistor. The preset counter must be set to operate only from negative pulses. The case selector and the preset counter have a common ground connection.

Reference has been made to three specific portions of the circuitry which will be more fully described.

(1) BISTABLE MULTIVIBRATORS (FLIP-FLOPS)

Following the D.C. trigger, the clock pulses are counted in a binary counter, built of bistable multivibrators or flip-flops.

A flip-flop can be considered to be combined of two inverting amplifiers in common emitter configuration with D.C. coupling and feedback between both amplifier stages. When no triggering pulses are applied, one side, i.e. one

amplifier transistor is always conducting, often completely saturated, and another side is cut off. Consider the conducting side. Because of the flowing current, there is a very large voltage drop across the collector resistor and a very small, usually about 0.1 volt, voltage drop across the transistor between collector and emitter. This conduction state is caused by a heavy forward bias current to the base of the transistor provided through a forward bias cross-coupling resistor from the collector of the other non-conducting transistor. Because very little current is flowing, the collector of the non-conducting transistor is nearly at the power supply potential, i.e. very near the positive voltage. The bias current to the base of the non-conducting transistor is also provided through a forward bias cross-coupling resistor from the collector of the conducting transistor. As mentioned earlier, the collector of the conducting transistor is very nearly at the emitter potential. However, to insure safe operation and a clear cut off state even at higher temperatures when the gain and leakage of the transistors increase, the bases of both flip-flop transistors are also, via reverse bias resistors, connected to the negative power supply terminal (with NPN transistors, or to the positive terminal if PNP transistors are used).

In the storage or memory units, the basic flip-flops are triggered to 0 or 1 states with negative pulses at the base of either transistor. However, the counter units must be able to alternate their states from the same input pulses. This is afforded by connecting the input coupling condenser via diodes simultaneously to the bases of both flip-flop transistors. The negative triggering pulses try to cut off both transistors. Nothing happens to that transistor which is not conducting but the conducting transistor will be cut off. It will change its state, and hence switches both sides of the flip-flop to the opposite states of conduction and cut off. The output of a counting flip-flop directly operates the next counting flip-flop, and all are reset to zero state by a reset pulse. The size of the reset coupling condensers has to be relatively large because the reset pulse has to last long enough to counteract the mutual switching effects of the counter flip-flops.

(2) ONE-SHOT MULTIVIBRATOR (PULSE SQUEEZER AND PULSE STRETCHER)

The reason for calling one one-shot multivibrator a pulse stretcher and another one-shot multivibrator a pulse squeeze is that the output pulse of the former is usually longer and the output pulse of the latter is shorter than the input pulse.

One-shot multivibrators can be considered as modified bistable multivibrators and are used to form on standardize pulses, especially to change the duration of the pulses. Preferably the base of the first transistor on the input side of the one-shot multivibrator is forward biased. This saturates the first transistor. A forward bias cross-coupling resistor connects the collector of the first transistor to the base of the second transistor, exactly as in the bistable multivibrator. This forces the second transistor to switch together with the first transistor, but in the opposite phase. However, the other forward bias cross-coupling resistor is omitted and only a timer condenser is connected between the collector of the second transistor and the base of the first transistor.

When a negative triggering pulse at the base of the first transistor cuts it off, the second transistor switches into the conducting state. This suddenly swings the potential of the timer condenser down. The base of the first transistor stays reverse biased until the charge of this timer condenser has reached a new equilibrium. Then the normal constant forward bias of the first transistor takes over and switches again the first transistor into the conducting state and the second transistor into the cut off state.

The input to this one-shot multivibrator is coupled via a condenser and a series diode. This diode passes only negative pulses which may be caused also by negative

going voltage steps. Thus the input pulse will normally only trigger the one-shot multivibrator. The duration of the square pulse is determined by the electrical charge stored in the timer condenser and by the total resistance of all parallel leakage paths, or its time constant, RC. The pulse length can be controlled by changing either the capacitance of the timer condenser or, less expensively, the resistance of a leakage path.

The only basic difference between a pulse stretcher and a pulse squeezer is the difference in the value of the time constant, RC, determined as the product of the timer condenser capacitance, C, and the total parallel leakage resistance, R.

(3) LOGIC CIRCUITS (AND-CIRCUITS AND OR-CIRCUITS)

"And-Circuit" or "And-Gate" is a shorthand notation for a bistable circuit with states "0" and "1," which will have an output, usually designated as "1" state, when, and only when, all input signals exist simultaneously. If even one input does not exist, that is, its level is "0," there will be no output.

The Or-Circuit or Or-Gate will have an output "1" every time when one or more inputs exist, that is, have the level "1."

FIGURE 8 shows a simple And-Circuit. There the output level is determined by the lowest input level. FIGURE 9 shows an Or-Circuit. In this case, the highest input level determines the output level. Both these circuits assume that a more positive signal level is called "1" state. If the polarities of the inputs and output are interchanged, the functions of the circuits are interchanged.

In the present invention there has been added an inverting amplifier stage to the And-Circuit.

This type of And-Circuit does not require that all inputs are connected. Some diodes may be just floating. Therefore, if the number of input diodes provided is large enough only one type of And-Circuit would be necessary.

The use of two slightly different And-Circuits in the case selector is caused by the difference of the triggering input pulse. The in-input, comparator-and-gates include a series diode and parallel condenser combination to limit the positive overshoot at the output of the inverting amplifier.

Maintenance of the case selector is relatively simple because etched circuit plug-in boards are used which enable the operator to locate and separate parts of the circuit. Also, the reliability of the system is better than the reliability of normal vacuum tube circuits because there are no vacuum tubes in the case selector. Instead, germanium transistors and silicon diodes are used as active circuit elements.

It is to be understood however that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes hereof, and it is therefore desired that the present embodiments be considered in all respects as illustrative and therefore not restricted, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having described my invention what I claim as new and desire to protect by Letters Patent are the following:

1. An object identification system comprising a series of code markings and a related series of clock markings on the object to be identified, a first detector device for serially sensing said clock markings, a second detector device for serially sensing said code markings, a logic system coupled to said detector devices and including means for storing in binary number form the series of simultaneous occurrences and non-occurrences of clock and code markings sensed by said first and second detector devices, and a presettable read-out system responding to the binary number condition of said storage means.

2. An object identification system as set forth in claim

1 including means triggering said read-out system responsive to said first detector device sensing a predetermined number of clock markings.

3. An object identification system as defined in claim 1 including means for resetting the logic system in response to said second detector device sensing a code marking when said first detector device is not sensing a clock marking.

4. In apparatus for distinguishing between differing marking sets each comprising a plurality of clock markings and a plurality of code markings, the combination of first detector means for serially scanning said clock markings and producing a series of electrical pulses corresponding to said clock markings, second detector means for serially scanning said clock markings and producing a series of electrical pulses corresponding to said clock markings, a counting circuit triggered by said clock pulses for sequentially directing clock pulses and simultaneously occurring code pulses to a logic system adapted to record in binary number form the pattern of simultaneous occurrence and non-occurrence of individual clock and code pulses and a presettable read-out circuit adapted to read the binary number condition of said logic system and produce a usable output signal in response to reading a binary number condition for which it has been set.

5. Apparatus for selectively identifying an object from among a plurality of objects, said objects bearing indicia in the form of a series of code markings and a related series of clock markings, said apparatus comprising detector means for scanning the indicia on said objects and providing a series of code signals corresponding to code markings observed and providing a series of clock signals corresponding to the clock markings observed, counter means and a plurality of guide units, said counter means receiving a series of clock signals from said detector means and selectively and serially conditioning individual guide units, means for applying code signals from said detector means to said guide units, a series of storage units, there being a different storage unit connected to each of said guide units, each of said guide units being adapted to permit a code signal applied thereto to pass to its storage unit when conditioned by said counter means and to block the passage of a code signal when not conditioned by said counter means, each storage unit being capable of assuming a set condition from a reset condition upon receiving a code signal from its guide unit, whereby the series of storage units is capable of storing in binary number form the series of simultaneous occurrences and non-occurrences of code signals and clock signals provided by said detector means, a read out circuit adapted to be set to respond to a particular binary number condition of said series of storage units, and a read out command circuit connecting said counter means with said read out circuit for triggering said read out circuit in response to said counter means receiving a predetermined number of clock signals.

6. The apparatus as set forth in claim 5 including means for resetting said storage units in response to a code signal produced in the absence of a clock signal by said detector means.

7. Apparatus for selectively identifying a plurality of different objects from among a larger plurality of objects, said objects bearing indicia in the form of a series of code markings and a related series of clock markings, said apparatus comprising detector means for scanning the indicia on said objects and providing a series of code signals corresponding to code markings observed and providing a series of clock signals corresponding to the clock markings observed, counter means and a plurality of guide units, said counter means receiving a series of clock signals from said detector means and selectively and serially conditioning individual guide units, means for applying code signals from said detector means to said guide units, a series of storage units, there being a different storage unit connected to each of said guide units, each of said

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guide units being adapted to permit a code signal applied thereto to pass to its storage unit when conditioned by said counter means and to block the passage of a code signal when not conditioned by said counter means, each storage unit being capable of assuming a set condition from a reset condition upon receiving a code signal from its guide unit, whereby the series of storage units is capable of storing in binary number form the series of simultaneous occurrences and nonoccurrences of code signals and clock signals provided by said detector means, a plurality of read out circuits each being adapted to be set to respond to a different binary number condition of said series of storage units, and a read out command circuit connecting said counter means with said read out circuits for triggering said read out circuits in response to said counter means receiving a predetermined number of clock signals.

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8. The apparatus set forth in claim 7 including means for resetting said storage units in response to a code signal produced in the absence of a clock signal by said detector means.

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