

[54] MATERIAL CONTAINER SORTING APPARATUS AND METHOD

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[51] Int. Cl. **G06k 7/10, B07c 5/34**

[58] Field of Search **235/61.115, 61.11, 61.8, 61.7, 235/91.14 UX, 61.6 J, 61.6 L, 151.2; 340/146.3; 186/1; 104/88; 209/111.5; 214/11**

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[57] ABSTRACT

A method and apparatus for sorting, routing and otherwise categorizing material containers, such as luggage, freight, cargo and the like, comprising conveyor means upon which to place the material containers, labels adapted to be secured to the material containers and having alphanumeric code information thereon, electro-optical conversion means positioned adjacent the conveyor means, photoelectric means positioned adjacent the conveyor means and the electro-optical conversion means for conditioning a programmed logic system for operation. The electro-optical conversion means is adapted to read the alphanumeric code to produce an output signal to be fed to the programmed logic system which is in turn connected to and adapted to activate electromechanical equipment means to sort, route, weigh, tabulate, or otherwise categorize the individual material containers placed on the conveyor means.

15 Claims, 7 Drawing Figures

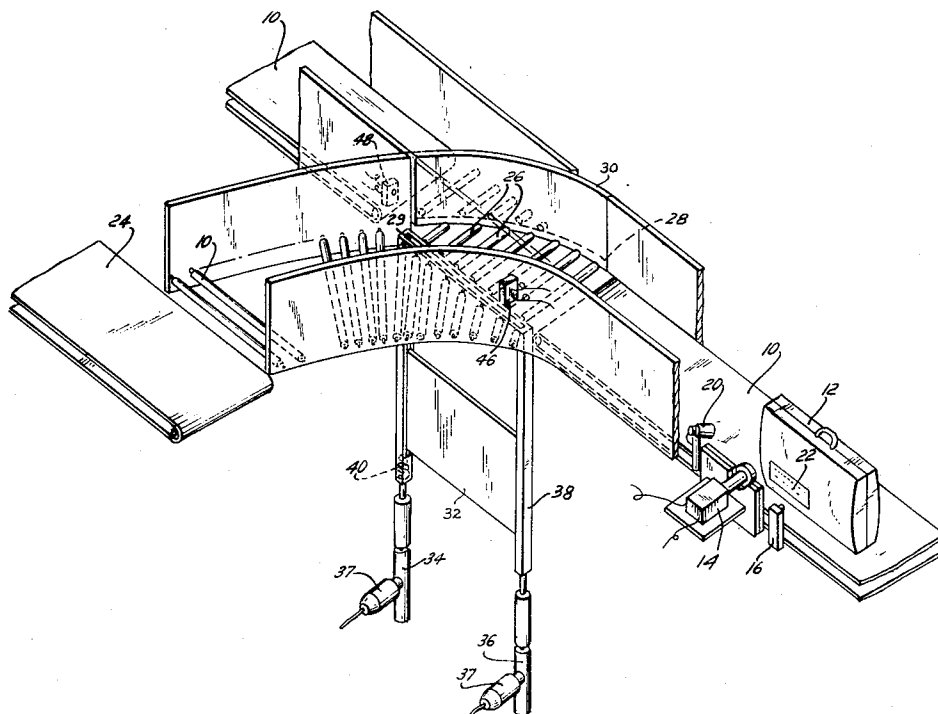
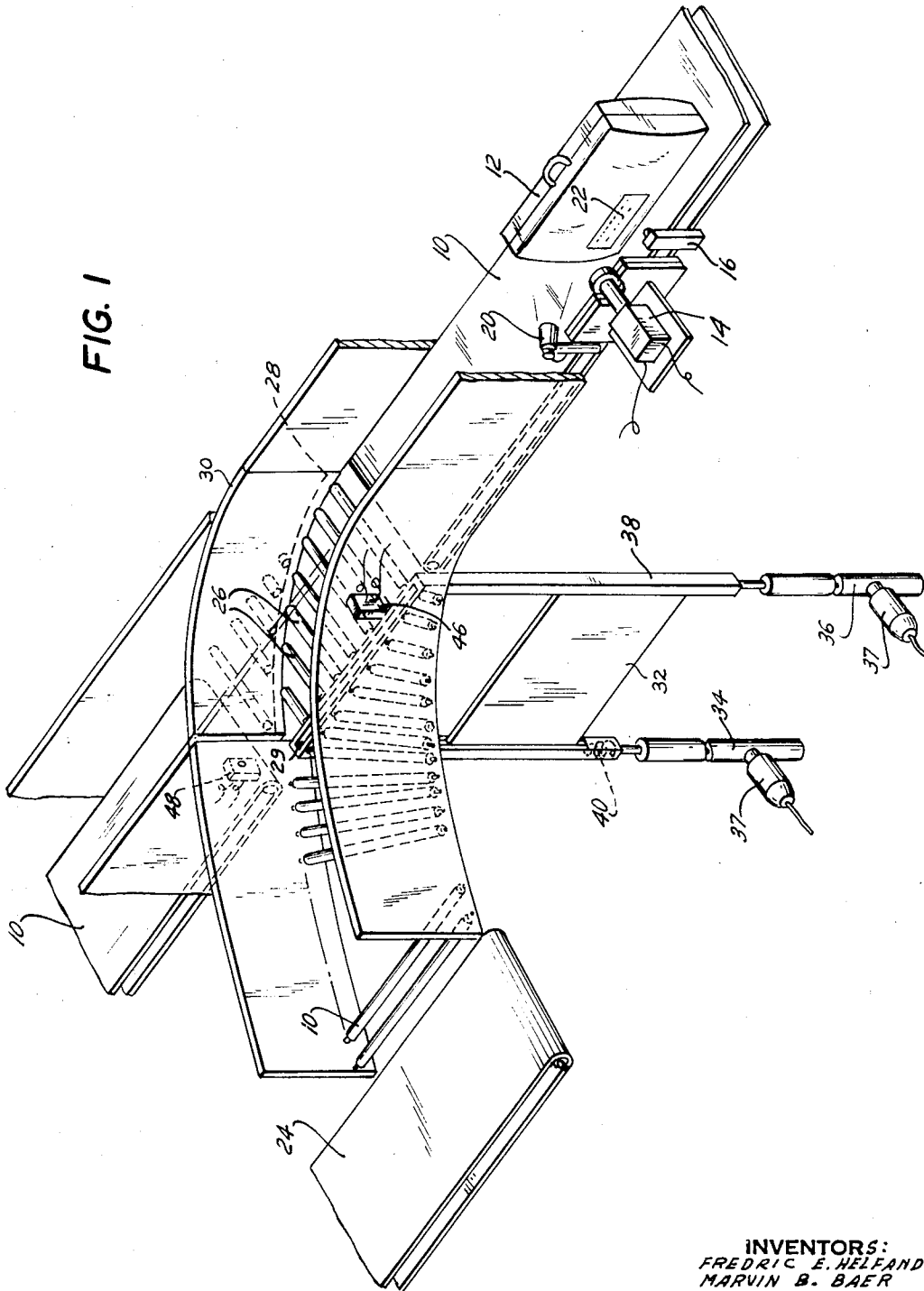


FIG. 1



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FIG. 2

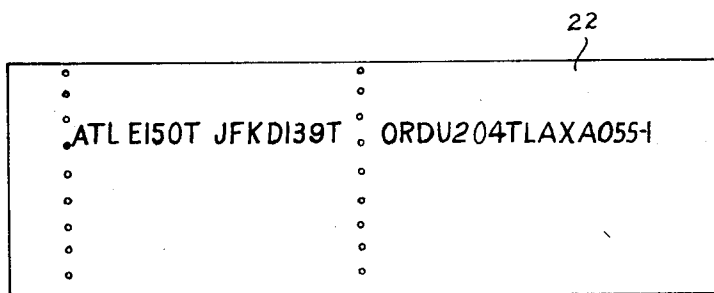
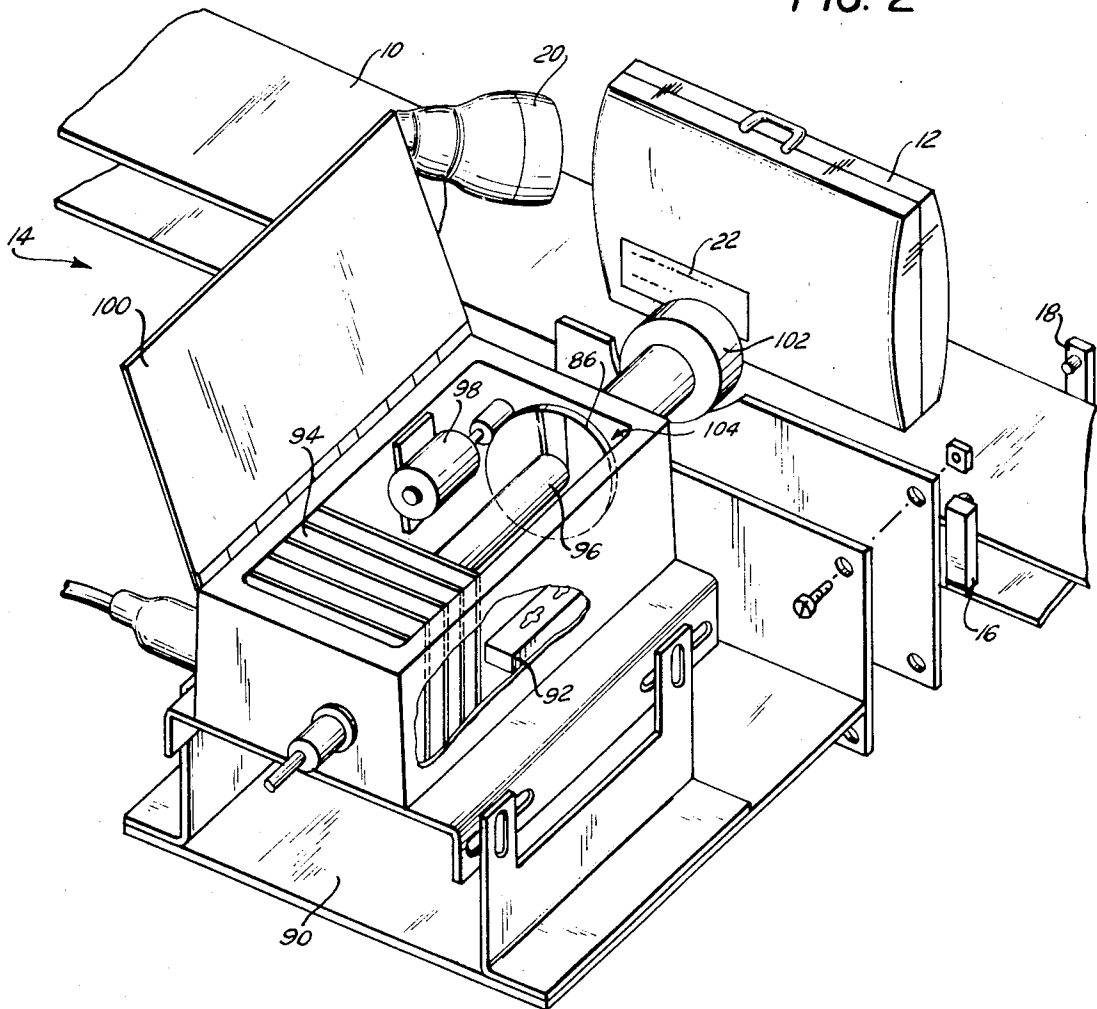
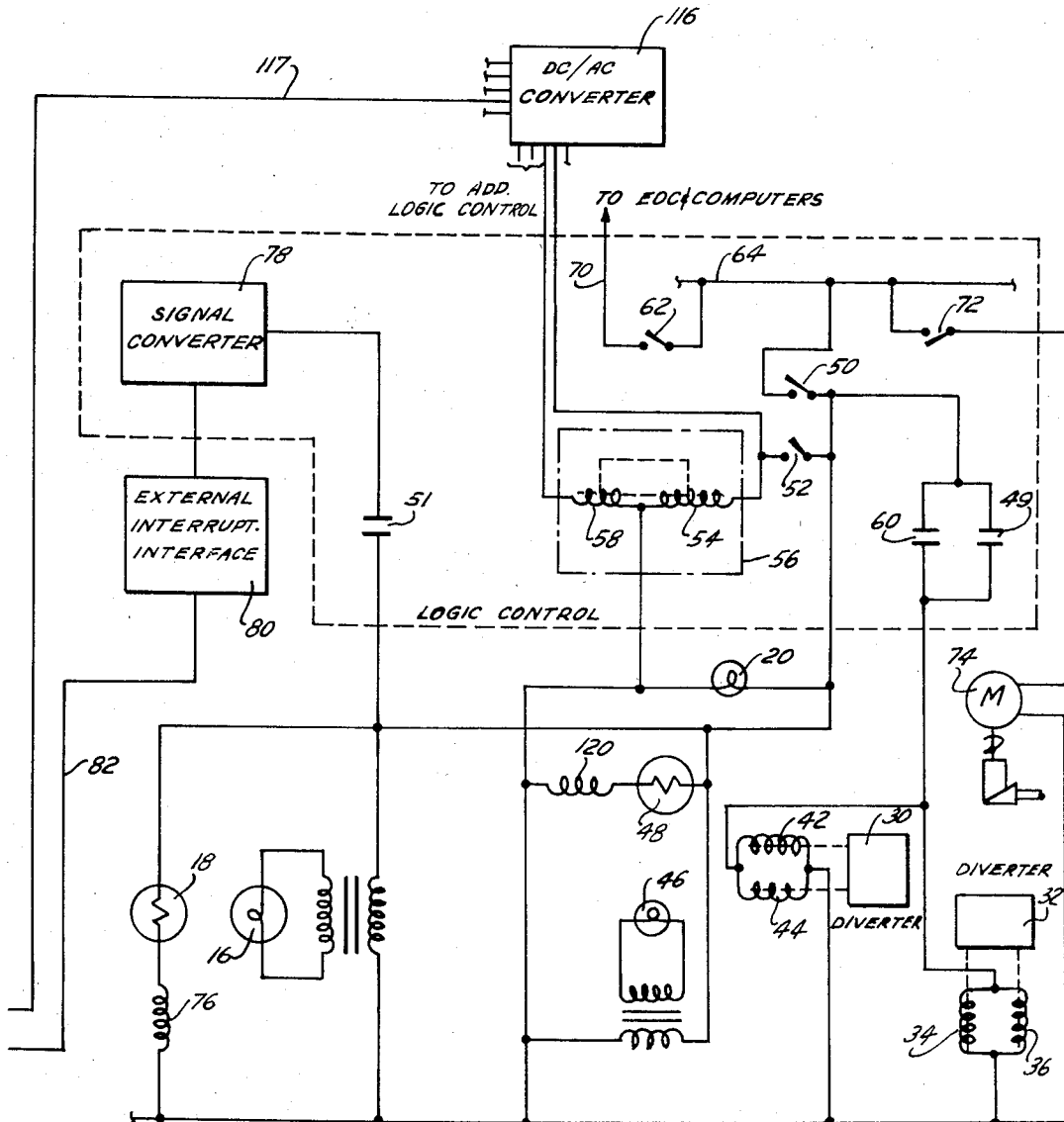


FIG. 7

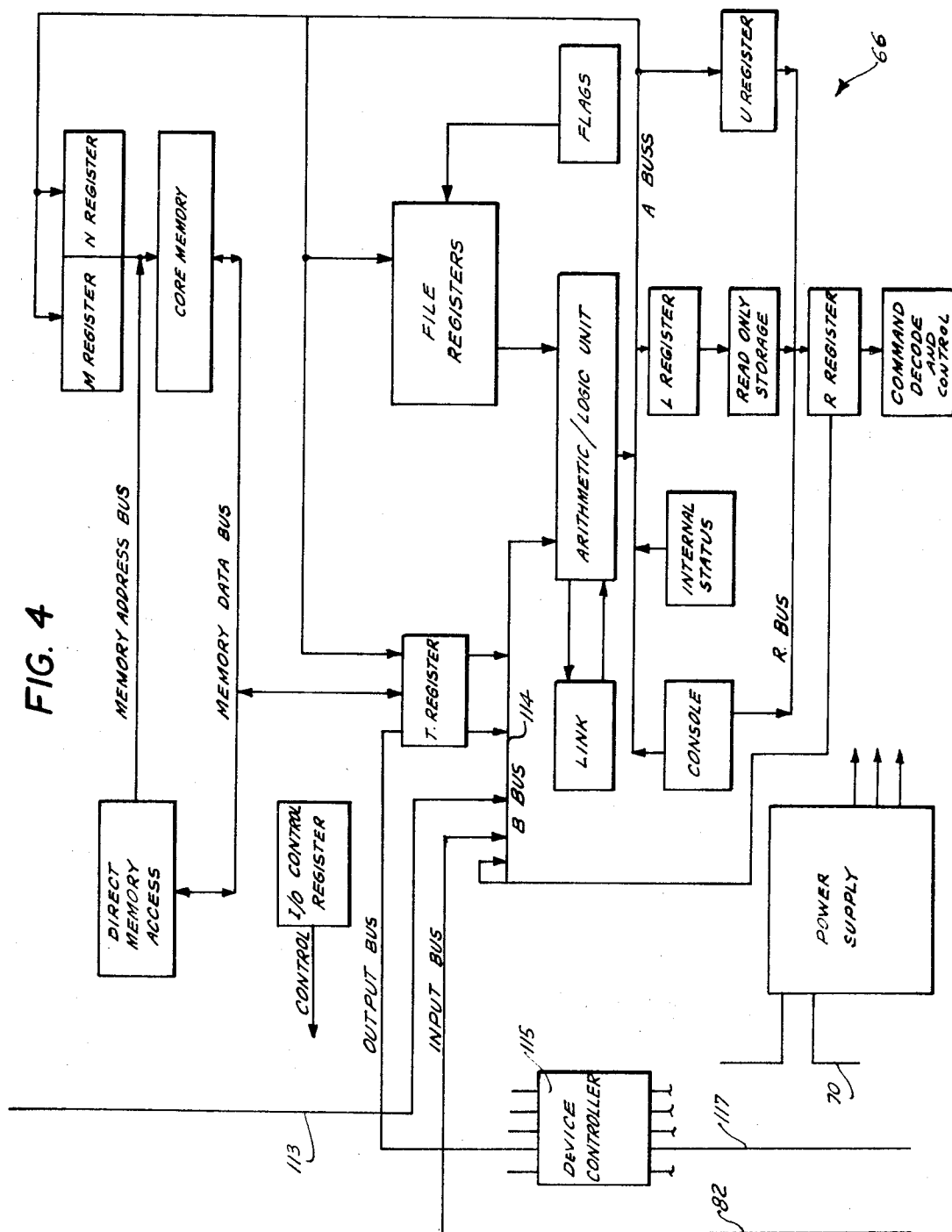
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FIG. 3



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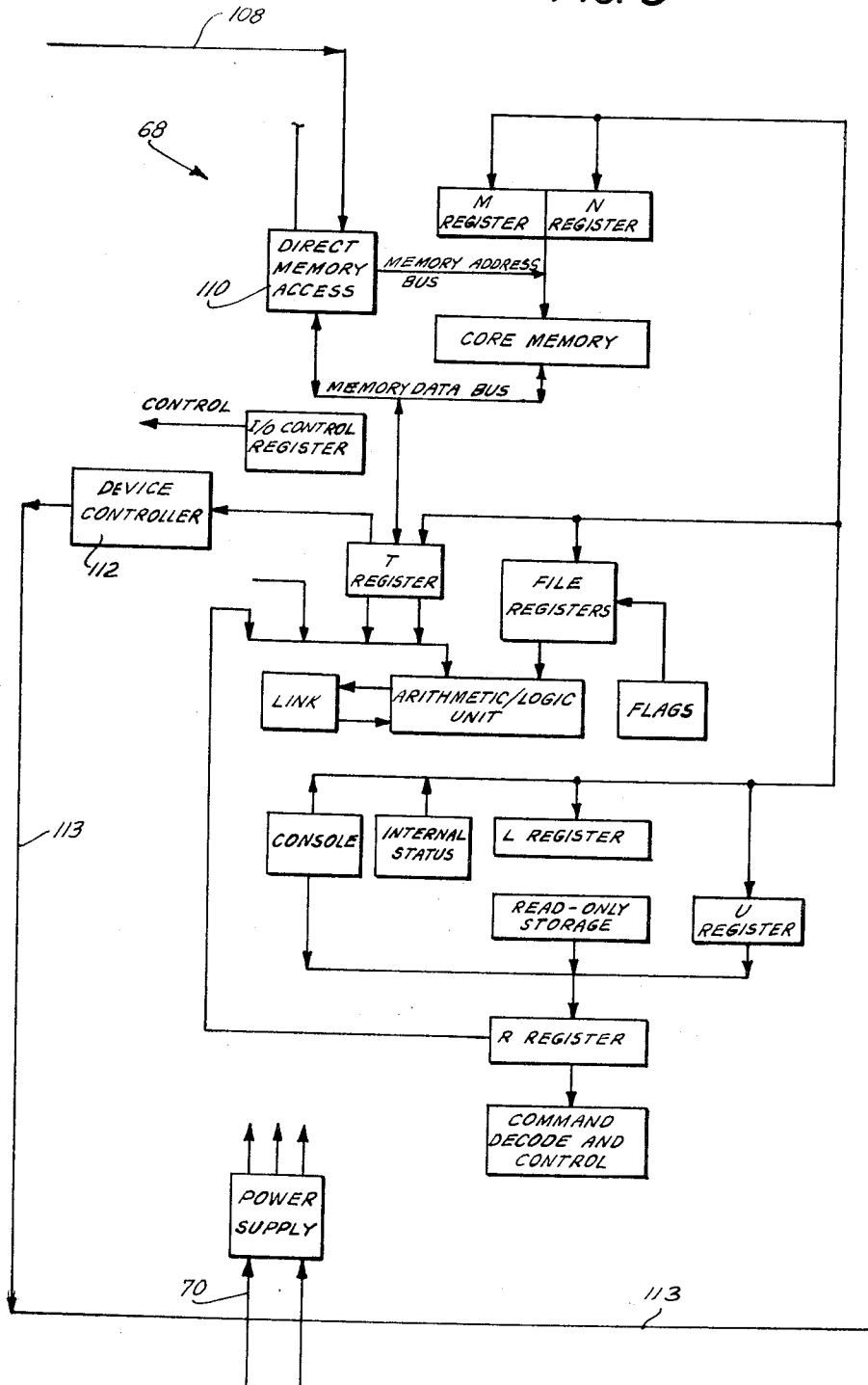
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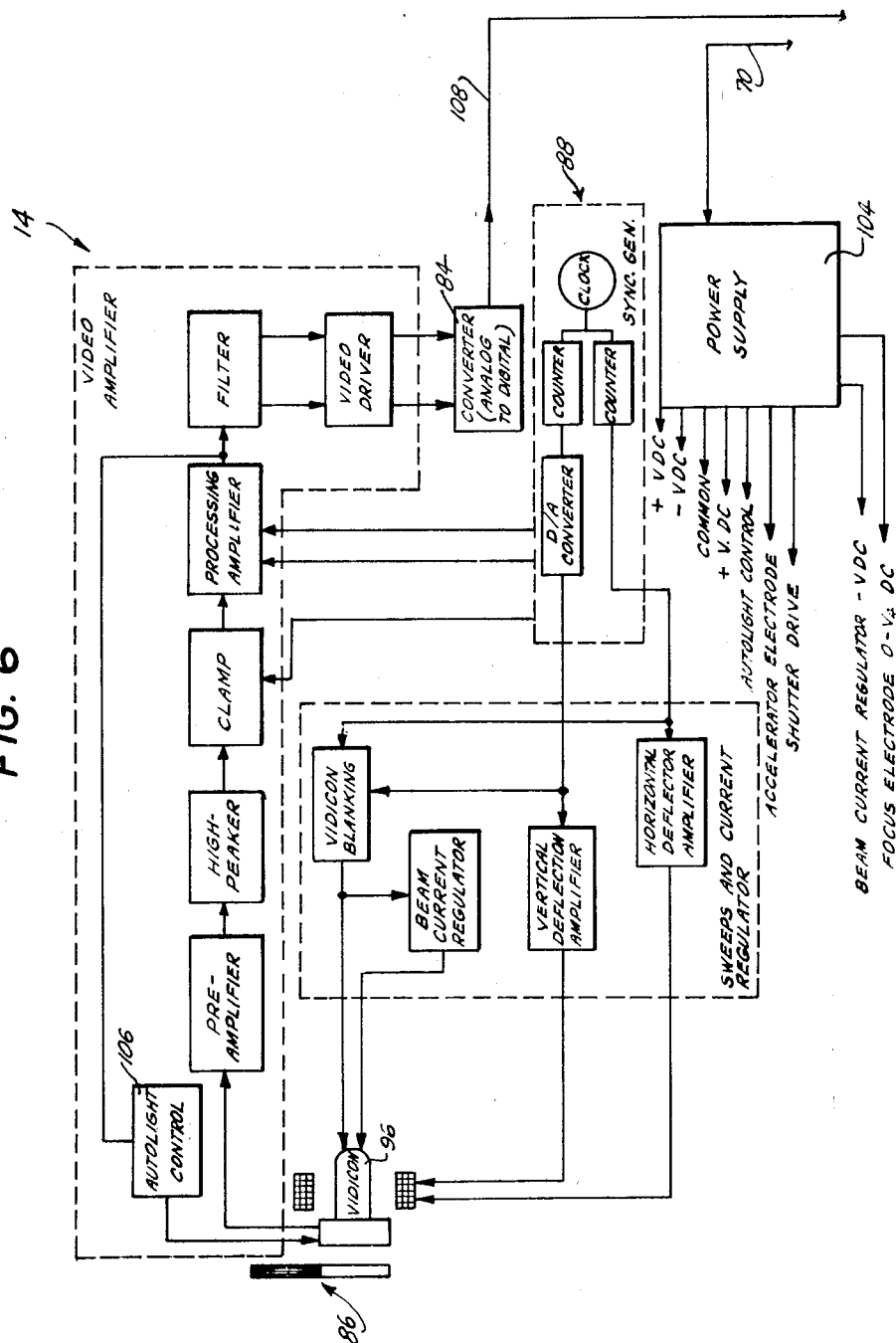
FIG. 5



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FIG. 6



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MATERIAL CONTAINER SORTING APPARATUS AND METHOD

With the advent of larger storage, warehouse, and transportation facilities, it has become necessary to provide improved merchandise and material container routing, sorting, tabulating and similar categorizing operations which can be accomplished quickly and relatively easily by employing new techniques and imagination while utilizing the advanced present-day technology, especially computer apparatus. One extremely important area of commerce which requires modernization and facilitation of baggage, luggage, freight cargo and similar material container handling is the transportation industry, particularly airports and similar terminals.

Accordingly, it is the primary object of the present invention to provide a method and apparatus for categorizing material containers.

It is another and more particular object of the present invention to provide the method and apparatus above described which is capable of routing and sorting material containers in dependence upon alphanumeric coded information applied to them.

It is a further object of the present invention to provide the alphanumeric coding by means of adhesive backed labels adapted to be applied to the material containers.

It is still another object of the present invention as described hereinabove to provide electro-optical conversion means for reading the alphanumeric code and for translating the same into a digital signal.

It is still another object of the present invention to provide a logic system to receive the digital output signal from the electro-optical conversion means and to provide a command output signal therefrom.

It is yet a further object of the present invention to provide electromechanical equipment means responsive to the command output signal to accomplish the routing and sorting of the material containers or to otherwise affect the categorization of them.

It is still a further object of the present invention to provide a material container handling system which is rapid, efficient, and reliable and which provides a significant improvement in automatic control apparatus for use in conjunction with conveyance systems.

In one embodiment of the invention, the apparatus is employed for the purpose of facilitating the ease and rapid handling of baggage and freight units at transportation terminals and particularly at airports. Thus, a passenger purchasing a ticket in advance of departure is provided with alphanumeric pressure sensitive adhesive back labels which have printed identification numbers on them, and include a receipt portion for retention by the passenger. Additionally, the alphanumeric code is one which can easily be read and discerned by airport personnel.

At a passenger arrival area which may be a parking lot, curbside terminal, or inner terminal, the passenger places his baggage bearing the alphanumeric coded information upon a conveyor system and then continues unencumbered to the point of departure. The baggage is then conveyed past an optical character detector where the alphanumeric coded label is read, the coded routing is logically read, the identification number is read and stored. This produces a command signal which is transmitted to an electromechanical diverter means which diverts the baggage on the conveyor system to cause the same to be conveyed to the proper loading gate.

Upon arrival at the destination terminal, the baggage is placed upon a delivery conveyor system and sorted and routed for delivery to a predetermined pickup area. If the terminal is a transfer point, the baggage is then rerouted to the proper loading gate. Should the baggage be marked incorrectly or unmarked, the baggage is diverted to a reject sorting area where airport personnel may visually inspect the same to ascertain any problems for the purpose of manual correction.

The preceding and other objects, features and advantages of the present invention will become more apparent from the detailed description hereinafter considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective view depicting a material sorting apparatus constructed in accordance with the present invention;

FIG. 2 is an enlarged perspective view of the electro-optical converter and a portion of the conveyor means of the material sorting apparatus depicted in FIG. 1;

FIG. 3 is a block diagram and partial schematic illustration of the logic control and system sequence network of the material sorting apparatus of the present invention;

FIG. 4 is a block diagram of the sorting code and command generator computer employed in the material sorting apparatus of the present invention, this computer being interfaced with the logic control and system network illustrated in FIG. 3;

FIG. 5 is a block diagram of a character discrimination and recognition computer employed in the present invention and which is interfaced with the command generator computer illustrated in FIG. 4;

FIG. 6 is an electrical block diagram of the electro-optical converter depicted in FIG. 2, this converter being interfaced with the character discrimination and recognition computer illustrated in FIG. 5; and

FIG. 7 is a face view of a label of the type which may be applied to units being handled by the apparatus, the alphanumeric information on the label being scanned by the electro-optical converter.

Referring now to the drawings and more particularly to FIGS. 1 and 2 thereof, there is shown a material sorting apparatus chosen to illustrate the invention. The apparatus is primarily intended for use at airports in conduction with the routing and sorting of material containers, such as luggage, so as to facilitate the deposit of the luggage and its loading on the proper designated aircraft. The sorting apparatus includes power driven conveyor means, generally designated by the reference numeral 10. A luggage unit 12 is placed upon the conveyor means and is propelled leftwardly, as viewed in FIGS. 1 and 2, toward the loading gates. Disposed within the airline terminal, at one side of the conveyor, is an electro-optical converter, generally designated 14. Positioned on one side of the conveyor means 10 adjacent the electro-optical converter 14 and up-path thereof is a light source 16. A photoelectric relay device 18 is positioned on the other side of the conveyor means directly opposite the light source 16.

The unit 12 travels on the conveyor 10, and it is to be noted that the unit 12 has applied to it an alphanumeric coded label 22 which contains the unit identification number, the point of embarkation, the destination, the airline and the flight number. This information, although coded, is readily discernible by airport personnel for the purpose of enabling manual handling of the units 12 should this be necessary. The label 22 is simply and easily affixed to the unit by means of a pressure sensitive adhesive on its back surface. An illuminating means 20 directs sufficient light at the label 22 to enable the latter to be read by the converter 14. Label 22 may also bear an identification number which may be read and stored by the apparatus.

Upon activation of the electro-optical converter 14, the code on label 22 is read to cause proper routing of the unit 12. Assuming that the unit 12 is to be routed from the main conveyor means 10 to branch conveyor 24, then it will be necessary to divert the unit from its straight movement along the main conveyor means. This is accomplished at an intermediate position along the main conveyor means which is provided with a plurality of rollers 26, some of which may be power driven and some of which are free rolling, in a manner well known to those skilled in the art. At this intermediate position, the main conveyor means 10 is provided with two horizontally disposed slots 28 and 29 through which are adapted to pass diverter members 30 and 32, respectively. The slots are produced by providing spaces in at least some of the rollers 26, along their lengths, and suitably supporting the ends of the roller portions. In the normal mode of operation, the diverter member 32 is in a raised position and diverter member 30 is in a lowered position, whereby the travel path of the unit is straight along main conveyor means 10. In the present example, the alphanumeric

code information on the label 22 demands that the unit 12 be conveyed to the branch conveyor 24. Thus, a command signal is applied to drive solenoids 34 and 36 via input connectors 37 to cause the diverter 32 to assume its lowered position by sliding downwardly along guide rails 38. The guide rails are provided with damper means 40 to absorb the shock upon downward movement of the diverter member. Simultaneously with the diverter member 32 being moved to its lowered position, power is supplied to energize similar drive solenoids 42 and 44 shown only in FIG. 3 to cause the same to move the diverter member 30 into its raised position, as shown in FIG. 1, whereby the unit 12 is transferred from the main conveyor means 10 to the branch conveyor 24. Diverter 30 is guided by rails similar to rails 38, but not shown.

As the diverted unit 12 is being shunted to the branch conveyor 24, it interrupts the light beam between a light source 46 and a photoelectric relay device 48 which is positioned immediately down-path of the vertical plane defined by the diverter member 32, which results in the apparatus being returned to its normal mode of operation, where it awaits the next down-path travel of another unit 12, in response to a computer signal.

In the event that the unit 12 is to be conveyed further along main conveyor means 10, the conveyor is maintained in its normal mode of operation with diverter member 30 down and diverter member 32 up, by spring loading.

The actual operation of the electrical portions of the apparatus will now be discussed with particular reference to FIGS. 3 through 6 of the drawings. When switch 50 (FIG. 3) is closed, such as by an attendant, the light source 16, photoelectric relay device 18, illumination means 20, light source 46 and photoelectric relay device 48 are energized, causing contacts 49 and 51 to open. Thereafter switch 52 which is a momentary contact switch is activated and then returns to its open position. The momentary closure energizes a coil 54 of a dual coil magnetic latching relay 56 whose other coil 58 is mechanically linked to coil 54. This action maintains contact 60 in an open position.

The above logical sequence action places the sorting apparatus in its normal nondiverting condition, in which the apparatus is prepared to accept sorting command signals, as will become apparent hereinafter.

Thereafter switch 62 is closed, e.g., also by an attendant, supplying prime power from an AC bus line 64 to the sorting code and command generator computer, generally designated by the reference numeral 66 (FIG. 4), the character discrimination and recognition computer, generally designated by the reference numeral 68 (FIG. 5), and to the electro-optical converter 14 (FIG. 6), via the connecting lead line 70 and parallel connections therefrom. Then switch 72 is activated to energize the conveyor drive motor 74 which initiates the conveying operation of the main conveyor means 10 and the branch conveyors, such as branch conveyor 24.

It should be noted that the switches 50, 52, 62 and 72 are all mounted within a conveniently located logic control rack whose physical configuration is not shown in the drawings.

After the sorting apparatus has been placed in the operating condition just described, a luggage unit 12 having an alphanumeric label 22 applied thereon is placed on the main conveyor means 10. As described previously, when the unit passes in front of light source 16 it interrupts the light beam received by the photoelectric relay device 18 which causes energization of the coil 76 to thereby close the relay contact 51. This results in the transmission of a signal via the signal converter 78 and the external interrupt interface 80 to the input of the sorting code and command generator computer 66 through the lead line 82. This initiates the commencement of the program within computer 66, to provide the eventual diverter actuation discussed hereinabove in conjunction with FIG. 1. The unit 12 thereafter passes within the viewing field of the converter 14, the label 22 being illuminated by the energized illumination means 20.

With particular reference now to FIGS. 2 and 6, the electro-optical converter is modified commercial vidicon camera which incorporates an analog to digital converter 84, a stop action shutter, generally designated 86, and a digital counter mechanism and its associated required modifications, generally denoted by the reference numeral 88. The converter 14 includes a frame 90, a chassis 92, a plurality of printed circuit cards 94, a vidicon tube 96, a shutter drive mechanism 98, the stop action shutter 86, a hinged access cover 100, an adjustable lens 102, a power supply 104, and supporting electronic equipment (as best seen in FIG. 6).

As the coded unit 12 passes in front of the electro-optical converter 14 the image of the alphanumeric code on the label 22 is raster scanned to result in a video waveform. This is accomplished by utilizing the conventional vidicon pickup tube 96 in a pulsed exposure mode to thereby achieve a stop action photographic effect. The stop action is achieved by placing the stop action shutter wheel 86 in front of the face of the vidicon tube 96, thereby providing a controlled short duration exposure of the photo cathode. The recorded image is then immediately read out by utilizing the modified television raster scan. The resulting video waveform is then amplified and quantized, by means of the analog to digital converter 84, resulting in a digital pulse train which is representative of the exposed image. The entire process may be repeated from between 20 to 40 times a second, thereby resulting in an exposure time of less than 1 millisecond and providing an output which is relatively independent of the motion of the conveyed unit 12. It is to be noted that the provision of an autolight control circuit 106 (FIG. 6) enables scanner operation over a wide range of image illumination and contrast levels.

The digital pulse output train representative of the exposed image produced as the output of the analog to digital converter 84, is transmitted via a communication link 108 to the direct memory access 110 of the character discrimination and recognition computer 68 (FIG. 5). The computer 68 is a modified micro-800 series computer manufactured and sold by Micro Systems Inc., of Santa Anna, Calif. This type of computer is generally referred to as a "mini-computer."

The digital information is transmitted to the computer processing section where it is discriminated, recognized, and retransmitted in digital form via the device controller 112 and lead line 113 to the bus line 114 of the sorting code and command generator computer 66 (FIG. 4) which is also a modified Micro-800 series computer manufactured by Micro Systems, Inc. The digital signal transmitted to computer 66 is stored and processed and is decoded into a sorting code and compared with a preprogrammed repertoire. Recognition of the stored code results in the generation of a time-framed command signal which is transmitted by means of a device controller 115 and lead line 117 to a DC to AC converter 116 (FIG. 3).

The AC output signal from converter 116 energizes coil 58 of the magnetic latching relay 56 resulting in the closure of the relay contact 60. The magnetic latching action maintains contact 60 closed subsequent to the removal of the AC signal from the coil 58. This command signal will be in the form of a pulsed input having a time duration of approximately 25 milliseconds. With contact 60 closed, power is applied to the drive solenoids 42 and 44 of the diverter member 30 causing it to move from its normally lowered position to a raised position, as was discussed previously hereinabove. Simultaneously with the actuation of diverter member 30, power is applied to the drive solenoids 34 and 36 of the diverter member 32 causing it to move from its normally raised position to a lowered position, as was described previously in conjunction with the discussion of FIG. 1.

As the unit 12 is shunted from the main conveyor means 10 to the branch conveyor means 24, it interrupts the light beam passing from the light source 46 to the photoelectric relay device 48 and in so doing deenergizes the relay coil 120 of device 48 which causes the relay contact 49 to close. Thereafter, another time framed pulse command input signal

of approximately 25-millisecond duration from computer 66 is transmitted and applied to the coil 54 of the magnetic latching relay 56 and this causes the relay contact 60 to open. At this time power transmitted from bus 64 through contact 49 maintains the drive solenoids 34, 36, 42, and 44 in their energized transfer-sorting position.

After the unit 12 has completely passed through the light beam of source 46, the beam once again energizes the coil 120 of the photoelectric relay device 48 to cause the contact 49 to return to an open position which removes the power supplied to the drive solenoids of the diverter members 30 and 32, whereupon they return to their normal position. The device 48 thereby prevents movement of the diverters, which could injure the unit 12, until after the unit has cleared the light beam from source 46, i.e., until after the unit has passed diverter 32. However, even before unit 12 passes diverter 32, another unit may move past electro-optical converter 14 to initiate another sequence of operation as just described.

While the command signal in the described embodiment is programmed to cause the proper routing and sorting of the units 12 only, it is to be noted that the programming can be modified so that the output means upon which the command signal is operable, may also weigh the units, store the information thereon for providing a bill of lading or for storing the identification numbers of the units, and/or automatically printing out the stored information. Moreover, the preceding may be employed in conjunction with, or separate and apart from, the diversion sorting operation of the preferred embodiment. Thus, the apparatus is capable of categorizing a plurality of material-handling units, such as baggage units 12, either in a single or a multiplicity of various ways.

While there has been shown and described but a single preferred embodiment of the present invention, it will be apparent to those skilled in the art that there are many modifications, variations, changes and improvements which may be made therein without departing from the spirit and scope thereof.

What is claimed is:

1. Apparatus for sorting material containers into various categories comprising
 - conveyor means for transporting said material containers, alphanumeric code means,
 - electro-optical converter means,
 - means connected to the output of said electro-optical converter means and responsive thereto to produce a command signal,
 - output means connected to said responsive means, and
 - means for applying said alphanumeric code means to said material containers,
 - said electro-optical converter means being operative to read said alphanumeric code means as the material containers are transported by said conveyor means, and
 - said output means being operative upon the application of said command signal thereto to effect the sorting of said material containers into various categories.
2. Apparatus in accordance with claim 1, wherein the sorting of the material containers into various categories is predeterminedly defined by said response means.
3. Apparatus in accordance with claim 1, wherein said alphanumeric code means comprises a label applicable to the containers.
4. Apparatus in accordance with claim 1 wherein said responsive means includes a computer means, said computer means being operative to produce said command signal.
5. Apparatus in accordance with claim 4, wherein said computer means is programmed to predetermine said various

categories, and said alphanumeric code is definite of at least one of said categories.

6. Apparatus in accordance with claim 1 wherein said response means comprises first computer means, and second computer means, said first computer means being operative to receive said electro-optical converter output, and said second computer means being connected to the output of said first computer means and being operative to produce said directive command signal in response to an output signal from said first computer means.

7. Apparatus in accordance with claim 6 wherein said output means include diverter means, said diverter means being operative in response to said command signal to selectively divert said material containers from said conveyor means.

8. Apparatus in accordance with claim 7, including at least one branch conveyor means, said diverter means being selectively operable in dependence upon said directive command signal to divert selective ones of said material containers from said conveyor means to said branch conveyor means.

9. Apparatus in accordance with claim 1 wherein said electro-optical converter means comprises a modified vidicon camera, and an analog to digital converter, said vidicon camera output being connected to said analog to digital converter, thereby resulting in a digital output from said electro-optical converter.

10. Apparatus in accordance with claim 1 wherein said electro-optical converter means comprises a vidicon camera, and a stop action shutter in front of said camera.

11. Apparatus in accordance with claim 10 wherein said electro-optical means comprises a vidicon camera, and an autolight control circuit for permitting operation of said camera over a wide range of illumination and contrast levels.

12. Apparatus in accordance with claim 9 wherein said response means comprises first computer means, and second computer means, and means for transmitting said digital electro-optical converter means output to said first computer means, said second computer means being connected to the output of said first computer means and being operative to produce said command signal in response to an output signal from said first computer means.

13. Apparatus in accordance with claim 12, wherein said first computer means is of the character recognition and discrimination type, and said second computer means is of the sorting code and directive command signal generation type and being programmed to direct the sorting into said various categories.

14. A method of sorting material containers into various categories comprising the steps of transporting said material containers along a conveyor means, applying a label carrying an alphanumeric code to said material containers, said code corresponding to at least one of said various categories, conveying said coded material containers before an electro-optical converter to read said coded information and transform the same into an electrical signal representative thereof, transmitting said electrical signal to a signal responsive means to produce a command signal in response thereto, and transmitting said command signal to output means which are effective upon reception of said command signal to effect the sorting of said material containers into said various categories.

15. A method of sorting material containers in accordance with claim 14 including the step of programming a computer means to correlate said code on said material container with that of its corresponding category and to produce a command signal to said output means to effect the sorting of said material container into said corresponding category.

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