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[54] INVENTORY CONTROL SYSTEM

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[52] **U.S. Cl.** **340/172.5**

[51] **Int. Cl.** **G01d 5/12,** G01d 5/39

[58] **Field of Search** ..... 340/172.5, 147, 153; 235/92, 235/61.7 R, 61.6 H, 61.6 J, 61.6 L, 61.11 E, 61.11 F, 61.11 G, 61.6, 61.7; 283/18

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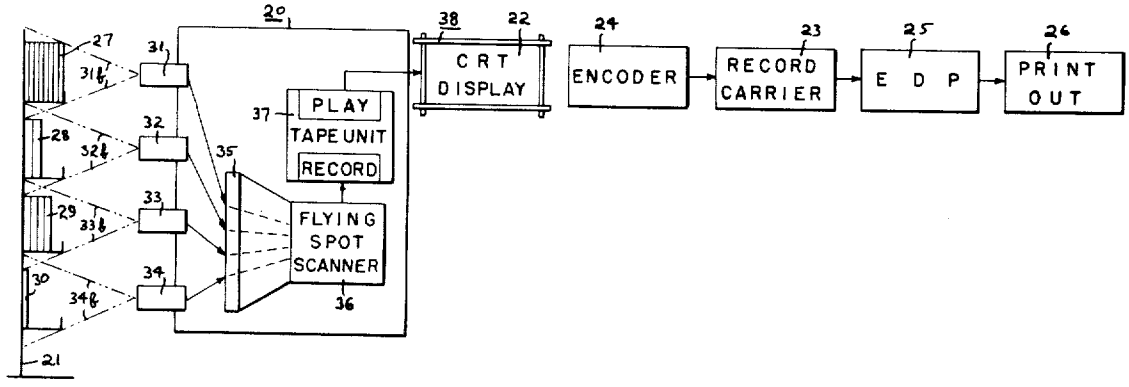
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[57] **ABSTRACT**

An inventory control system for rapidly taking an inventory of items in an array including an optical scanning system which provides an image of variable size of each item in accordance with the number of units of the item in the inventory, a larger image denoting more units, a signal generator which converts the image to a train of electrical signals, a storage device for storing the signals for later use, retrieval apparatus for regenerating the stored signals at a subsequent time, and a display system for displaying and size quantizing the original image. The item identified by its quantized image is checked against a data bank to determine for that item how many units correspond to the particular image size displayed. The checking may be automatic or manual, and an automatic print-out may be provided if desired.

20 Claims, 14 Drawing Figures



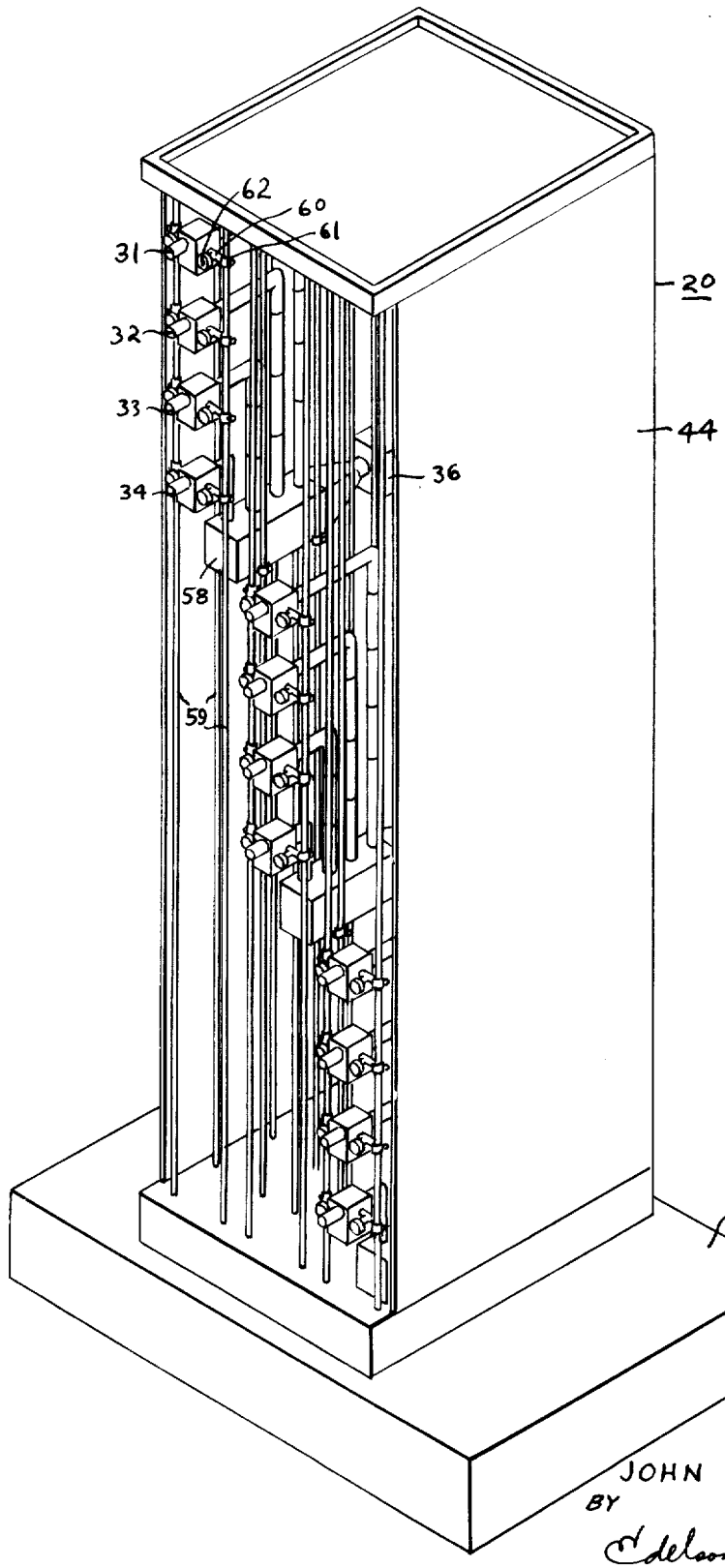


Fig. 1.

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Fig. 2.

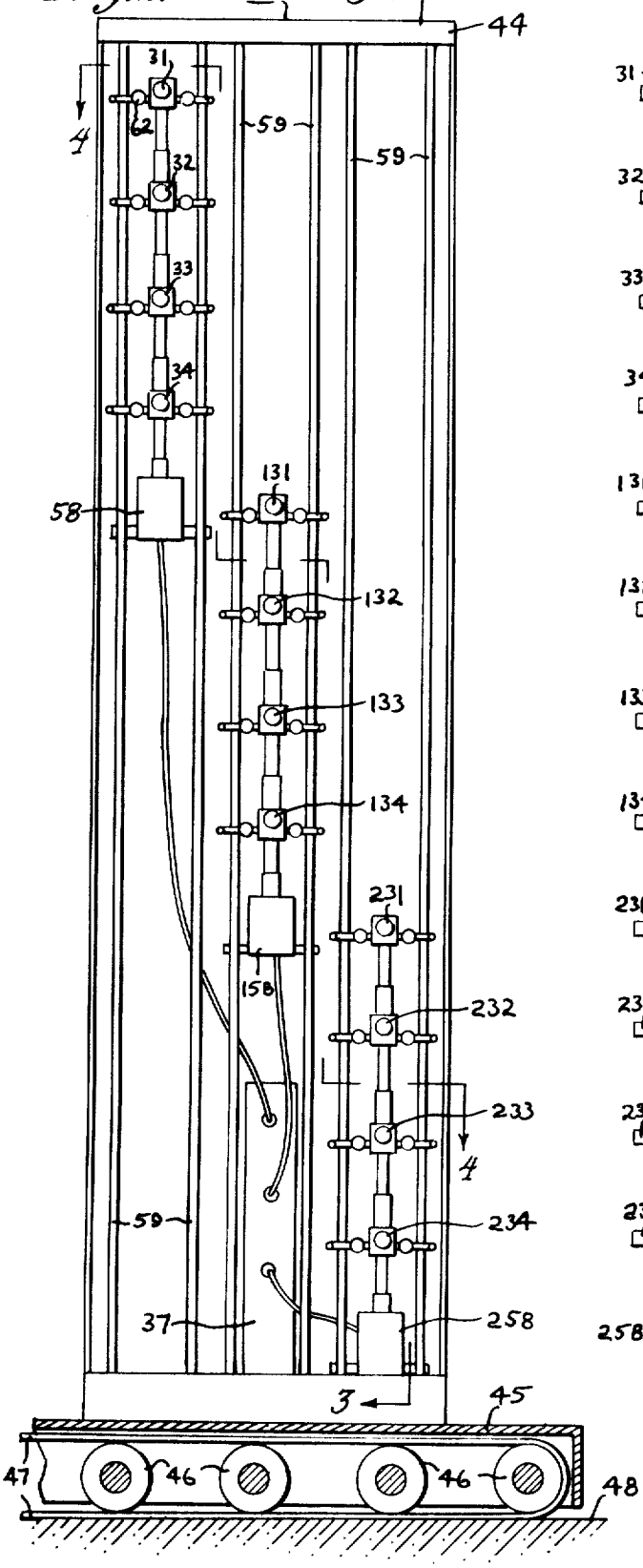
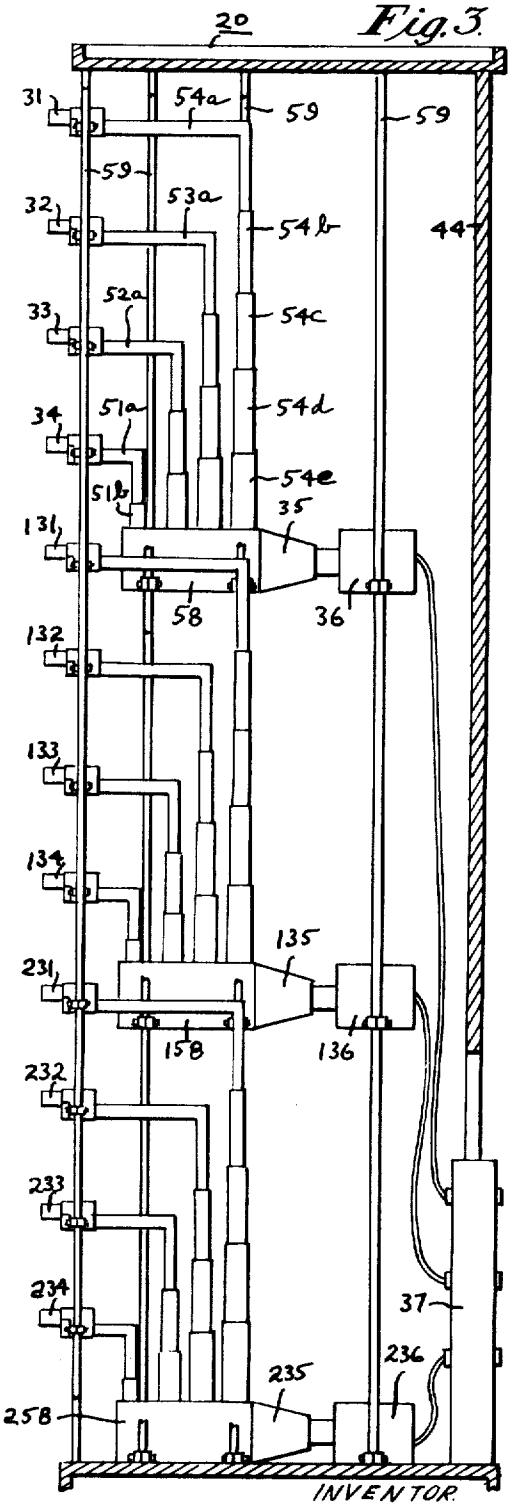


Fig. 3.



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Fig. 4.

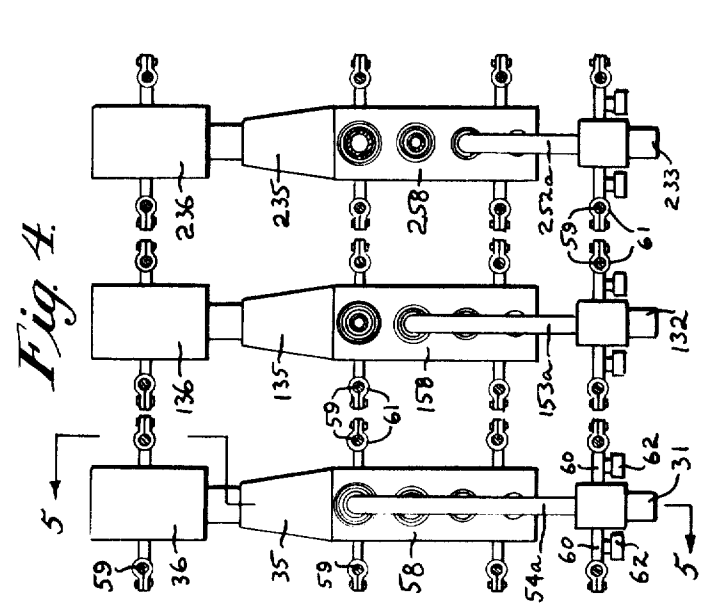
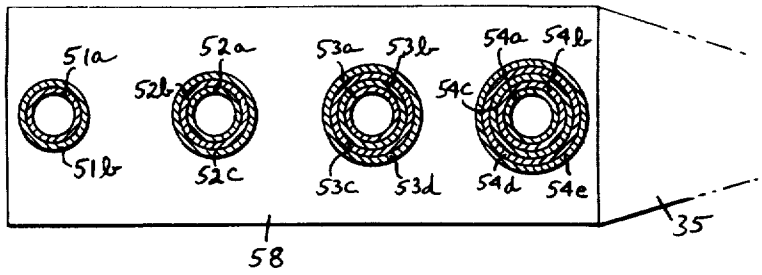


Fig. 5.

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Fig. 7.



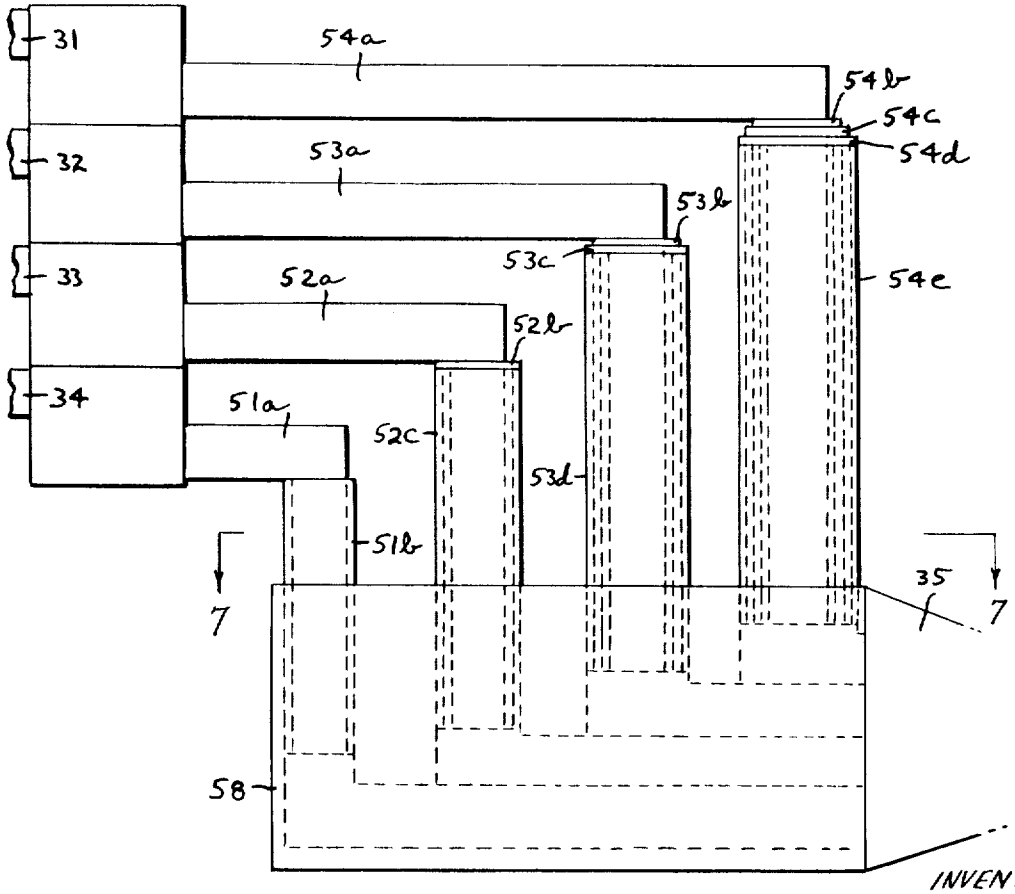


Fig. 6.

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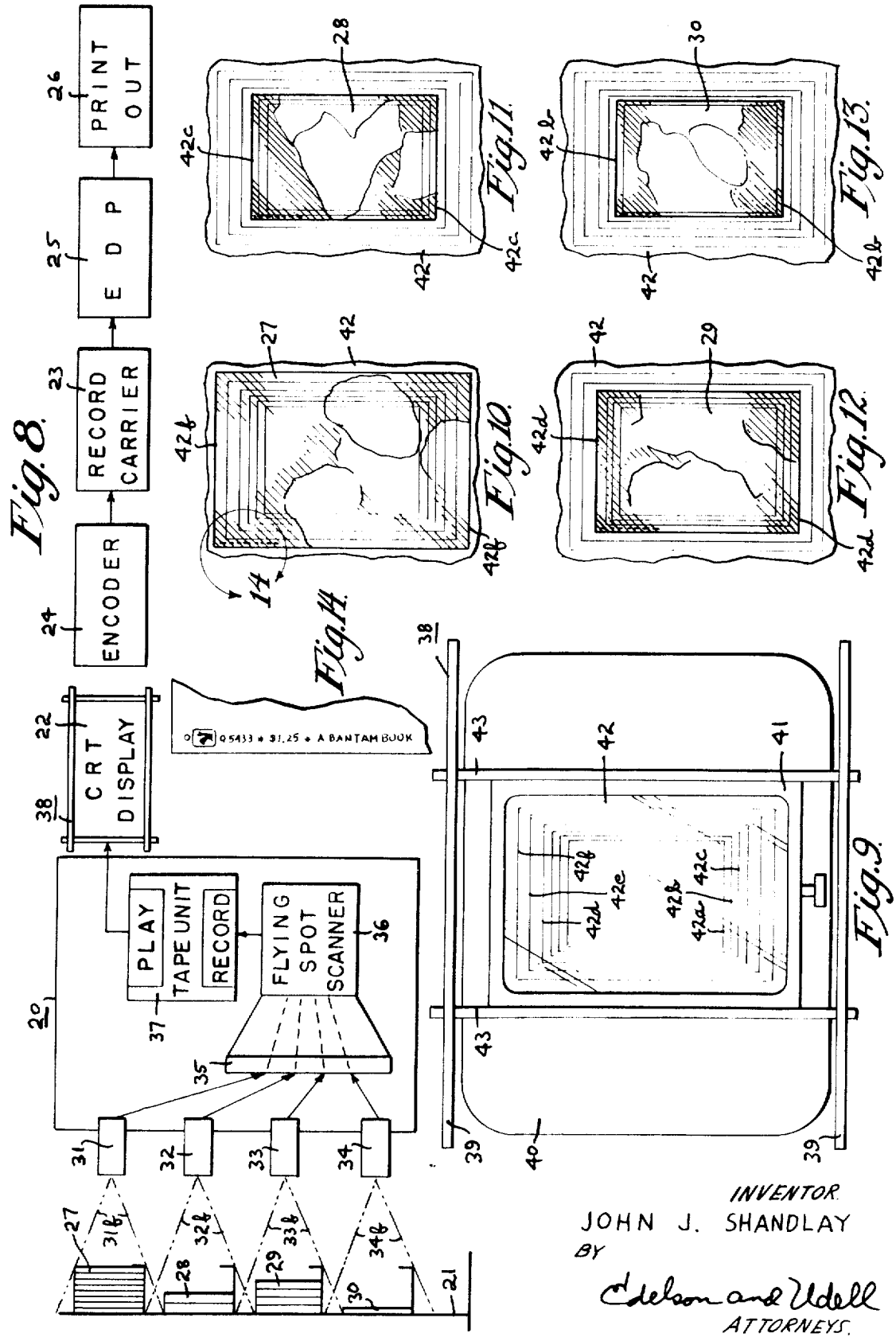


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

INVENTORY CONTROL SYSTEM

This invention relates generally to inventory control systems and more particularly relates to a system which automatically inspects and records data corresponding to the quantity of particular items which are stored at particular locations, and then makes the recorded data available for tabulation and interpretation.

The system generally consists of an optical scanning system arranged in a mobile apparatus which traverses and optically examines the area within which is stored the items to be inventoried. The scanning is done at a relatively high rate of speed with the data of the scanned items being converted into electronic signals which are read into a storage unit for later examination. The high scanning speed of the system enables a complete inventory to be taken in a very short time without disrupting the normal sales operation of a store which is for example being inventoried. The information read into the storage unit, which may typically be a tape recording device, is subsequently examined and processed to provide an itemized printing inventory list for the particular establishment which has been inventoried.

The system according to the invention has wide applicability and will be illustrated hereinafter in connection with the taking of an inventory of a store which sells paperback books. It is apparent that paperback book stores carry a large number of titles, and the present method of hand inventory is extremely time consuming and consequently relatively expensive. A similar situation exists for example in supermarket food stores. The system according to the invention is utilizable for the taking of inventory in conjunction with any items in which the number of items of a particular kind in the inventory is determinable by a correlation of the size of the viewed image of the item, as observed by the scanning apparatus, with information stored in a data bank which relates the size of the image to the quantity of the item.

Since the size of an image viewed through a lens is determined by the distance between the lens and the object, the apparatus according to the invention utilizes lens systems which are established at a pre-determined reference distance from the reference plane of the objects being inventoried, and this standard reference distance is taken into account in the information stored in the data bank. Accordingly, it is a primary object of the invention to provide a novel inventory control system utilizing an optical scanning device for examining items of inventory at a pre-determined reference distance from the object, recording the observed object on a record storage medium, comparing the size of the examined object with information in a data storage device which correlates the object size with the number of objects in inventory, and providing a permanent record of the inventoried object.

Another object of the invention is to provide a novel inventory control system as aforesaid utilizing mobile optical scanning devices which move past the items to be inventoried and scan the positional location thereof, the scanned images being relayed to a viewing mechanism and recorded in a data storage system.

A further object of the invention as aforesaid is to provide novel apparatus for reading out the stored inventory information and translating the stored data into coded information which identifies the inventory item and provides a measure of the quantity of the item in the inventory.

The foregoing and other objects of the invention will become clear from a reading of the following specification in conjunction with an examination of the appended drawings wherein:

FIG. 1 is a front perspective from above of a portion of the mobile apparatus which includes the scanning mechanisms and houses some of the electronic recording devices;

FIG. 2 is a front elevation of the apparatus shown in FIG. 1 with the lower portion vertically sectioned to disclose the mobile crawler for moving the scanning apparatus;

FIG. 3 is a vertical sectional view as would be seen when viewed along the line 3—3 of FIG. 2;

FIG. 4 is a horizontal jump section through the apparatus of FIG. 1 as would be seen when viewed along the line 4—4 of FIG. 2, and is on an enlarged scale;

FIG. 5 is a vertical jump section through one of the scanning units as would be seen when viewed along the line 5—5 of FIG. 4;

FIG. 6 is a side elevation of the same portion of the apparatus shown in vertical section in FIG. 5 with the telescopic light tubes in collapsed or compacted position;

FIG. 7 is a horizontal section through the telescopically engaged light tubes as would be seen when viewed along the line 7—7 of FIG. 6;

FIG. 8 is a schematic representation of the entire inventory control system illustrating the recording, play back, encoding and print-out phases of the system;

FIG. 9 is a front view of the apparatus associated with the CRT display of FIG. 8 for determining the information to be encoded on a record carrier;

FIG. 10 through 13 represent different views of data items displayed on the CRT of FIG. 8 through the device of FIG. 9; and

FIG. 11 is an enlarged fragment of the data shown within the circle 14 shown on FIG. 10.

In the several figures, like elements are denoted by like reference characters.

Referring first to the schematic representation of the Inventory Control System illustrated in FIG. 8 of the drawings, there is seen a data recording unit designated generally as 20 which includes equipment for examining and making a record of the inventory of books in different pockets of a bookrack designated generally as 21 so that this recorded information may be subsequently displayed by means of an optical display device 22 to thereby permit the displayed information to be recorded on a record carrier 23 by means of an encoding device 24. The record carrier 23 may then be suitably processed through compatible electronic data processing equipment 25 to produce a printed tabulated inventory report from the print-out mechanism 26. The record carrier 23 may be of any suitable form, such as punched cards or magnetic tape or punched paper tape, and the encoding device 24 is of course a manually operable suitable piece of equipment for encoding onto the record carrier, as for example a suitable key punch machine or paper tape puncher or keyboard operated magnetic encoder.

The information which is encoded onto the record carrier for processing by the electronic data processing equipment 25 is visually observed on the optical display device 22 by the operator of the encoder 24 and the information is then encoded onto the record carrier 23. The information which is observed by the encoder operator consists of two items, the first item being the size of the book image as observed through a calibrating grid to be subsequently described in connection with the showings of FIGS. 9 through 13, and the second item of information being the book code designation which appears in the upper left hand corner of all paperback books, as is shown in the fragmentary view of FIG. 14 which illustratively designates the book shown in FIG. 10 as being Bantam book Q5433.

With these two items of information encoded onto the record carrier 23, the electronic data processing equipment 25 can search its memory for the data relating to Bantam book Q5433, and having located such data can then compare the information on the record carrier 23 relating to the book image size with size-related data stored in the EDP memory and thereby determine the number of Q5433 books in the book rack pocket and cause this information to be printed out as one item of inventory. The relationship between the size of the book image as observed on the optical display device 22 and the number of books held in the particular pocket of the bookrack 21 shown at the left side of FIG. 8.

For purposes of illustration, bookrack 21 is shown having four book-holding pockets arranged vertically one beneath another and holding differing amounts of books 27, 28, 29 and

30, with these books being respectively viewed by lens systems 31, 32, 33 and 34 all having identical fields of view defined by the upper and lower bounding lines associated with each lens and designated as 31*f* through 34*f*. Since all of the lenses are of the same fixed focal length and are all spaced away from the front edges of the book-holding pockets by exactly the same distance, it is of course clear that the size of the image seen by each lens would be exactly the same if all of the pockets were full and the books were of the same dimensions.

Assuming for the moment that all books are of the same size, it will be understood then that the size of the book image seen by each lens will depend upon the distance of the lens from the front of the book, and that the more remote a book is from the lens, the smaller the image of the book will appear. For example, the image of book 27 which is observed by lens 31 fills substantially the entire optical field of the lens as is shown by the fact that the optical field limiting lines 31f are just tangent to the top and bottom of the book 27. It is observed however that the books 28, 29 and 30 do not fill their respective pockets and are therefore spaced backward from the pocket front edge by differing distances. Accordingly, the book image seen by lens 32 is smaller than that seen by lens 31 and smaller than that seen by lens 33 while being larger than the image seen by lens 34. The image seen by lens 33 while smaller than that seen by lens 31 is larger than the images seen by lenses 32 and 34. Finally, the image seen by lens 34 is the smallest of all since the front face of the single book in the pocket is more remote from lens 34 than the other books are from their associated viewing lenses.

The images seen by each of the lens 31 through 34 are projected onto a viewing screen 35 where they are scanned by a television type electronic image scanner 36 which converts the optical images into alternating current electrical signals. These electrical signals are transmitted to a video recording and play-back apparatus 37 where they are recorded on a suitable recording medium such as magnetic tape for future play-back Suitable apparatus for providing the functions of the image scanner 36 and video tape apparatus 37 is the Javelin Radio Tape Recorder model VTR–1000SH made by Javelin Electronics of Los Angeles, California. This unit in addition to properly recording the data of interest, provides a play-back feature of great importance in that the image of each book is displayable on the cathode ray tube display device 22 as a "still" picture for any desired length of time so that the operator of the encoding device 24 may hold a picture on display for a sufficient length of time to read off the necessary information. The cathode ray tube display device 22 is fitted with the usual controls for moving the visual display to a desired position on the screen which in most cases will be substantially a central location.

Used in conjunction with the optical display device 22 is a shiftable grid device designated generally as 38. The grid structure 38, as best seen in FIG. 9, consists of a pair of horizontal tracks 39 fixed in position with respect to the cathode ray tube face 40, and a grid frame 41 carrying a transparent grid 42, the grid frame 41 being shiftable horizontally by means of side frames 43 slidably coupled to the horizontal tracks 39, and being shiftable vertically by its slidable coupling to the side frame 41 permits the transparent grid 42 to be positioned as desired with respect to the display face of the cathode ray tube 40.

The transparent grid 42 is provided with a set of concentric rectangular size indicia designated as 42*a* through 42*f* with the smallest central indicia designated as 42*a* and the largest outer indicia designated as 42*f*. The use of the grid 42 is illustrated in the showings of FIGS. 10 through 13 to which attention should now be directed. The showing of FIG. 10 corresponds to a showing of the image as seen by lens 31 through the grid 42 from which it is observed that the largest grid indicia 42*f* coincides with the outline of the books 27. The illustration of FIG. 11 corresponds to the image size as seen by the lens 32, and it is observed that as viewed through the grid 42 the size of the image corresponds to the grid indicia 42*c*. Similarly, FIG. 12 shows the somewhat larger image seen by lens 33 as noted by the indicia frame 42*d*, while FIG. 13 illustrates the smallest image of all for the book 30 as seen by lens 34 and designated by the sizing indicia 42*b*.

The operator of the encoding device 24 when playing back the recorded data, causes the image of each book to be displayed on the cathode ray tube face 40, notes the image size by means of the shiftable transparent grid 42 and encodes this information onto an appropriate record carrier with the data which identifies the particular book for which the data is being recorded, the identifying data being that previously mentioned as appearing in the upper left hand corner of the book and as shown in FIG. 14. An image magnifier of any desired type may be used if desirable to enlarge the size of the book identifying information in the upper left hand corner. The magnification may be effected electronically by control of the optical display device 22 in any of the well known manners or could optionally be a simple optical magnifier such as a magnifying lens positionable over the upper left-hand corner region of the book image as displayed to enlarge the book identifying indicator.

When the information has been encoded onto the record carrier 23, the record carrier, and all of the similar carriers containing the information for all of the books to be inventoried, may be processed into the electronic data processing unit 25 for comparison of the data on the record carriers with the data stored in the processing unit in order to provide an inventory print out. The book-identifying information in the upper left-hand corner of the book, not only identifies the book by title, but also provides other information which is necessary in order to insure a correct inventory result. For example, it should be appreciated that two different books in different pockets of a bookrack may produce identically the same image size on the display unit but may nevertheless represent different numbers of books in two different pockets.

It must be recalled that the size of the image merely determines how far from the lens the front face of the book being examined is located. Reference to FIG. 8 shows that each of the books 28 is substantially twice as thick as each of the books 27 so that the front face of the two books 28 from the lens 32 is substantially the same distance as the front face of the front one of the rearmost four books 27 from the lens 31. Therefore, if there were only four books 27 in the upper pocket, they would produce the same sized image on the display tube as the two books 28 in the second pocket. From this, it will be understood that the size of the image alone is not sufficient to determine the number of books in the pocket, but that the thickness of the book must also be known in order to be correlated with a particular image size in order to determine the number of books in the pocket. This correlation information is of course known for each book and is part of the information stored in the electronic data processing unit 25.

It will be appreciated that a certain length of time is required by the person operating the encoder 24 to read the necessary information from the display 22 and to encode it onto the record carrier 23. The advantage of the present system is that the time consumed in carrying out this process is not consumed at the store where the inventory is being taken, but is on the contrary carried out at a convenient processing location where the data taped by the recording unit 37 may be examined at a convenient time without disrupting the business operations of the store in which the inventory was in fact taken.

The actual taking of the inventory proceeds very rapidly by employing as the scanning and recording unit 20 a mobile apparatus which is placed in front of a wall or array of bookracks and moved rapidly parallel to the array from one end to the other with the viewing lenses held at a fixed pre-determined distance from the bookracks as the unit 20 moves past. The functioning speed of the optical and electronic system of the data recording unit 20 is obviously so fast compared to any possible speed of physical movement of the data recording unit 20 that the only limitation in the rate at which the con-

tents of a store may be inventoried is determined by how rapidly the data recording unit **20** can be moved into the store, properly aligned and indexed with respect to the articles to be inventoried, and then moved past those articles while the data is recorded.

Immediately upon completion of the inventory scanning, the entire data recording unit **20** may be removed from the store or warehouse and transported to the nest location to be inventoried. The data recorded in the tape units is of course removed therefrom and a new tape recording medium supplied in preparation for taking the subsequent inventory. The data tape may be then taken to the data processing center where the aforedescribed display, encoding and processing of the data may be carried out. One form of apparatus suitable for carrying out the functions of the data recording unit **20** is illustrated in FIGS. **1** to **7** to which attention should be now directed.

The data recording unit **20** has an upper housing **44** within which is contained all of the optical scanning and electronic recording apparatus, and a lower housing **45** within which is contained a crawler device for moving the entire unit at a prescribed rate of speed. As best seen in FIG. **2**, the lower housing **45** contains a plurality of drive and idler wheels **46** about which are trained a caterpillar type belt tred **47** which engages and moves along the underlying floor **48**. The crawler system may either be self powered, as for example by an electrically energized motor, or may be unpowered and may be moved manually be merely pushing the housing at a desired rate of speed.

As best seen from FIGS. **1**, **2** and **3**, the scanning and recording apparatus contained within the upper housing **44** is illustrated as consisting of three identical optical scanning assemblies each including four scanning lenses, and the outputs of which are commonly fed into the video tape apparatus **37**. The upper left hand assembly is observed to include the lenses **31** through **34**, the viewing screen system **35** and the electronic image scanner **36** all as previously described in the representational showing of FIG. **8**. The other two systems are identical and include comparable sets of four lenses **131** through **134** and **231** through **234**, identical viewing screen systems **135** and **235**, and electronic image scanners **136** and **236**. As illustrated, since all three image scanners are functioning simultaneously, their output signals are fed simulaneously to the recording apparatus **37**, and these signals may either be recorded on three separate tracks or three separate recording devices may be utilized.

As best seen in FIG. **5**, each of the lenses, as for example lens **34**, is mounted in an image box **49** which contains a planar reflecting mirror **50** positioned at the proper distance behind the lens to cause the images of the scanned items to be in focus in the plane of the mirror. The image focused at the mirror **50** is reflected downward through the periscopic telescopically engaged light tubes **51***a* and **51***b* by the planar mirrors **50***a* and **50***b* to the mirror **50***c* which directs the image onto the ground glass viewing screen **35**. Similarly, the lenses **33**, **32** and **31** are connected to the periscopic telescopically engaged light tubes **52***a* through **52***c*, **53***a* through **53***d*, and **54***a* through **54***e*, these light tube systems respectively projecting the images of the lenses **33**, **32** and **31** to the ground glass screen **35** by reflection from the bottom planar mirrors **55**, **56** and **57** respectively. The four vertically spaced images on the ground glass screen **35** are scanned by the electronic image scanner **36** which converts these images to electronic signals and transmits them to the video tape apparatus **37** as previously described.

As just described, and as more clearly seen from the showings of FIGS. **6** and **7** the periscope systems associated with the lenses **31** through **34** include different numbers of telescopically engaged light tubes since the lenses require vertically spaced separation different distances above the periscopic common mounting box **58**, more sections being required for the lens **31** than for the lens **34** because of the considerably extended vertical spacing of the former with respect to the latter, and similarly for the intermediate lenses **32** and **33**. The periscope systems associated with the mounting boxes **158** and **258** are of course arranged in the same manner.

The telescopic arrangement permitting vertical adjustability of all of the lenses of the system provides a ready means for precisely positioning each viewing lens at the proper elevation with respect to the associated items to be examined by that particular lens. The support structure for maintaining the lenses at the desired elevations is best seen from the showings of FIGS. **2**, **3** and **4**, from which it is observed that each system is flanked on opposite sides by a set of four vertically extending support tubes **59** fixedly secured at their opposite ends to the floor and top of the upper housing **44**. Extending laterally from each of the lens-carrying image boxes is a crossbar **60** which terminates in a pair of adjustable friction clamps **61** each disposed about one of the vertical tubes **59** and frictionally adjustable so that the image box and lens may be vertically adjusted to any desired position and held in that position by the frictional engagement between the friction clamps **61** and the vertical support tubes **59**. Similar crossbars and adjustable clamps are seen to extend from each of the mounting boxes **58** and electronic image scanner devices **36** so that the entire scanning system associated with each group of four lenses may be shifted as a unit vertically as necessary or desirable.

Finally, as best seen in FIGS. **1**, **2** and **4** a pair of lights **62** are mounted to each crossbar **60** on opposite sides of the lens for the purpose of illuminating the object being viewed by the particular lens.

Having now described my invention in connection with a particularly illustrated embodiment thereof, it will be appreciated that variations and modifications of the invention may now occur from time to time to those persons normally skilled in the art without departing from the essential scope or spirit thereof, and accordingly it is intended to claim the same broadly as well as specifically as indicated by the appended claims.

What is claimed to be new and useful is:

1. A method of taking an inventory of items in an array, consisting of the steps of,

a. establishing a viewing reference line with respect to the array,

b. scanning the items to be inventoried and recording for each item a first indicia which uniquely identifies such item and recording one of a series of second indicia which precisely delineates the apparent size of such item as viewed from the said viewing reference line,

c. preparing an information data bank which contains the identifying said first indicia for each item of inventory and correlates for each such item of inventory the apparent sizes corresponding to the said series of second indicia with the number of units of the item in the inventory, and

d. comparing the said recorded first and second indicia of each inventoried item for identity with the information in the data bank to obtain the inventory count for each item.

2. A method of taking an inventory as described in claim **1** further including the step of arranging the units of each item of inventory one behind another and extending forward toward said viewing reference line from a second reference line spaced a predetermined distance from said viewing reference line.

3. A method of taking an inventory as described in claim **1** further including the step of arranging the units of each item of inventory one behind another and extending forward toward said viewing reference line from a second reference line spaced a predetermined distance from and parallel to said viewing reference line.

4. A method of taking an inventory as described in claim **1** wherein the said step of scanning for recording said second indicia is taken along a line substantially orthogonal to said viewing reference line.

5. A method of taking an inventory as described in claim **1** wherein said recording step consists of, the step of recording

said first and second indicia on a first medium in a first form different from the form of information in said data bank, and a subsequent step of translating said first and second indicia in said first form from said first medium to a second medium in a second form which is the same as the form of information in said data bank.

6. A method of taking an inventory as described in claim 5 further including the step of arranging the units of each item of inventory one behind another and extending forward toward said viewing reference line from a second reference line spaced a predetermined distance from and parallel to said viewing reference line.

7. A system for taking an inventory of items in an array with the units of each item spaced closely behind one another, said system being usable with an information data bank containing identifying first indicia for each item of inventory, and correlation data for each item of inventory which correlates a series of second indicia with the number of units of the item in the inventory, and comprising in combination,

a. scanning and generating means for scanning from a predetermined reference line the items to be inventoried and generating a data output including a first indicia which uniquely identifies each item, and one of a series of second indicia which precisely delineates the apparent size of such item as viewed from the said reference line,

b. storage means coupled to and responsive to said scanning means for storing said data output,

c. retrieval means operative to regenerate the said stored data output,

d. display means couplable to said retrieval means effective responsive to the regenerated data output from the latter to display said first indicia and said one of said series of second indicia for each item of inventory,

whereby, said first and second indicia displayed by said display means may be compared with the information in the data bank to thereby establish the number of units of each item in the inventory.

8. A system as described in claim 7 wherein the scanning portion of said scanning and generating means comprises at least one short focal length optical lens which produces an optical image of the item of inventory viewed which is larger or smaller dependent on whether the item is closer or more remote from the lens.

9. A system as described in claim 7 wherein the scanning portion of said scanning and generating means comprises,

a. at least one short focal length optical lens which produces an optical image of the item of inventory viewed which is larger or smaller dependent on whether the item is closer or more remote from the lens,

b. an optical display screen upon which the image from said lens is projected, and

c. an optical transmission device effective to transmit the optical image from said lens to said display screen.

10. A system as described in claim 7 wherein the scanning portion of said scanning and generating means comprises at least one short focal length optical lens which produces an optical image of the item of inventory viewed which is larger or smaller dependent on whether the item is closer or more remote from the lens, and wherein the generating portion of said scanning and generating means comprises an electronic scanner which scans the optical image produced by said lens and generates a train of electrical signals corresponding to the picture information content of the optical image.

11. A system as described in claim 7 wherein the scanning portion of said scanning and generating means comprises,

a. at least one short focal length optical lens which produces an optical image of the item of inventory viewed which is larger or smaller dependent on whether the item is closer or more remote from the lens,

b. an optical display screen upon which the image from said lens is projected, and

c. an optical transmission device effective to transmit the optical image from said lens to said display screen,

and wherein the generating portion of said scanning and generating means comprises an electronic scanner which scans the optical image produced by said lens on said display screen and generates a train of electrical signals corresponding to the picture information content of the optical image.

12. A system as described in claim 7 wherein said storage means comprises a magnetic tape video recording device.

13. A system as described in claim 7 wherein said retrieval means comprises a video magnetic tape playback device.

14. A system as described in claim 7 wherein said display means comprises a closed circuit television receiver.

15. A system as described in claim 7 wherein said display means comprises a closed circuit television receiver including a cathode ray tube having a display face, and a transparent sizing grid closely overlying said cathode ray tube face for superposition on the displayed data to measure said second indicia.

16. A system as described in claim 9 wherein said optical transmission device includes means permitting movement of said lens with respect to said optical display screen without changing the image projected on the latter.

17. A system as described in claim 9 wherein said optical transmission device is a periscope system of variable length permitting movement of said lens with respect to said optical display screen without changing the image projected on the latter.

18. A system as described in claim 9 wherein at least said scanning and generating means is housed in a mobile apparatus adapted for movement in front of the array of items to be inventoried along a line parallel to said reference line.

19. A system as described in claim 15 wherein said sizing grid is shiftable in directions parallel to the face of said cathode ray tube to thereby permit positioning of said grid at any point over the tube face.

20. A method for taking an inventory of items in an array with the units of each item spaced closely behind one another, consisting of the steps of,

a. scanning from a predetermined reference line the items to be inventoried and generating a data output including a first indicia which uniquely identifies each item and one of a series of second indicia which precisely delineates the apparent size of such item as viewed from the said reference line,

b. recording said data output on a data carrying medium,

c. preparing an information data bank containing the identifying said first indicia for each item of inventory and correlation data for each item of inventory which correlates the apparent sizes corresponding to the said series of second indicia with the number of units of the item in the inventory,

d. reading the data output recorded on the said data carrying medium,

e. comparing the data output first and second indicia recorded on said data carrying medium for each item of inventory for identity with the first and second indicia in said data bank, and when a match is obtained, operating terminal equipment for indicating the count for each item for which such a match was obtained.

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