United States Patent [19] [11] **3,832,530**
Reitboeck et al. [45] **Aug. 27, 1974**

[54] **OBJECT IDENTIFYING APPARATUS**

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

[22] Filed: **July 19, 1973**

[21] Appl. No.: **380,928**

Related U.S. Application Data

[63] Continuation of Ser. No. 215,333, Jan. 4, 1972, abandoned.

[52] **U.S. Cl..... 235/61.11 H,** 235/61.12 R, 343/6.5, 340/280, 340/224

[51] **Int. Cl... G06k 7/10,** G06k 19/06, G08b 13/14, G01s 9/56

[58] **Field of Search** .... 343/6.5; 340/280, 258, 340/224 R; 235/61.11 H, , 61.6 J, 61.7 B, 61.11 A

[56] **References Cited**

UNITED STATES PATENTS

2,774,060	12/1956	Thompson	340/258
3,299,424	1/1967	Vinding	343/6.5
3,752,960	8/1973	Walton	235/61.11

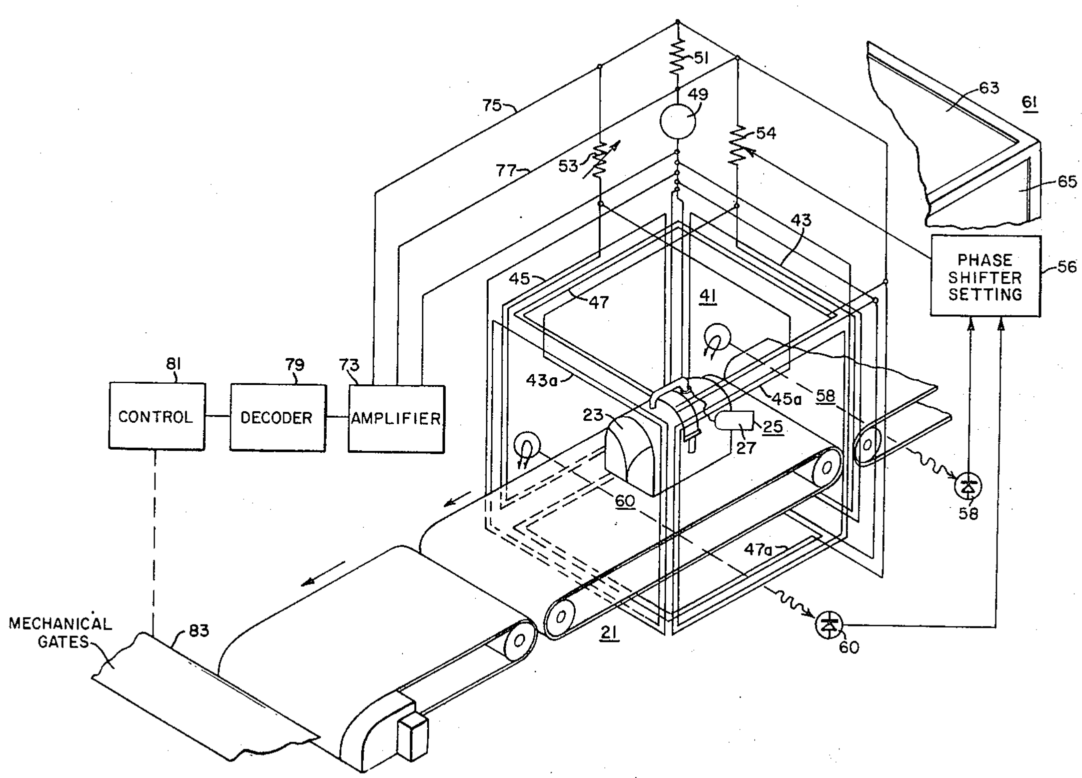
Primary Examiner—Daryl W. Cook
Assistant Examiner—Robert M. Kilgore
Attorney, Agent, or Firm—D. Schron

[57] **ABSTRACT**

There is disclosed object identifying apparatus for an object carrying an identifying label having an identifying electrical circuit and moving or being moved through a region where the identifying circuit is read. Typically, the object is a mail sack or baggage which is to be directed along a predetermined path. When the object moves through the region, the label is randomly positioned in the region. A substantially homogeneous electromagnetic field is produced in the region and as the object moves through the region, the circuit on the label is powered by, and reacts with, the field, absorbing energy from the field. The circuit on the label includes counter elements such, as a chain of multivibrators which are flopped from OFF to ON in predetermined succession. A circuit is connected to the field which differentiates the energy absorbed by the flopping of the multivibrators responding to the changes in the conduction of the multivibrators. A succession of pulses are thus produced which serve as a code to identify the object.

There is also disclosed a label having a throwaway flexible substrate on which the circuit is printed. The circuit includes an antenna connected to the counting elements, for example, interrupted-ring counters or shift registers. The circuit may be set for different codes.

12 Claims, 10 Drawing Figures



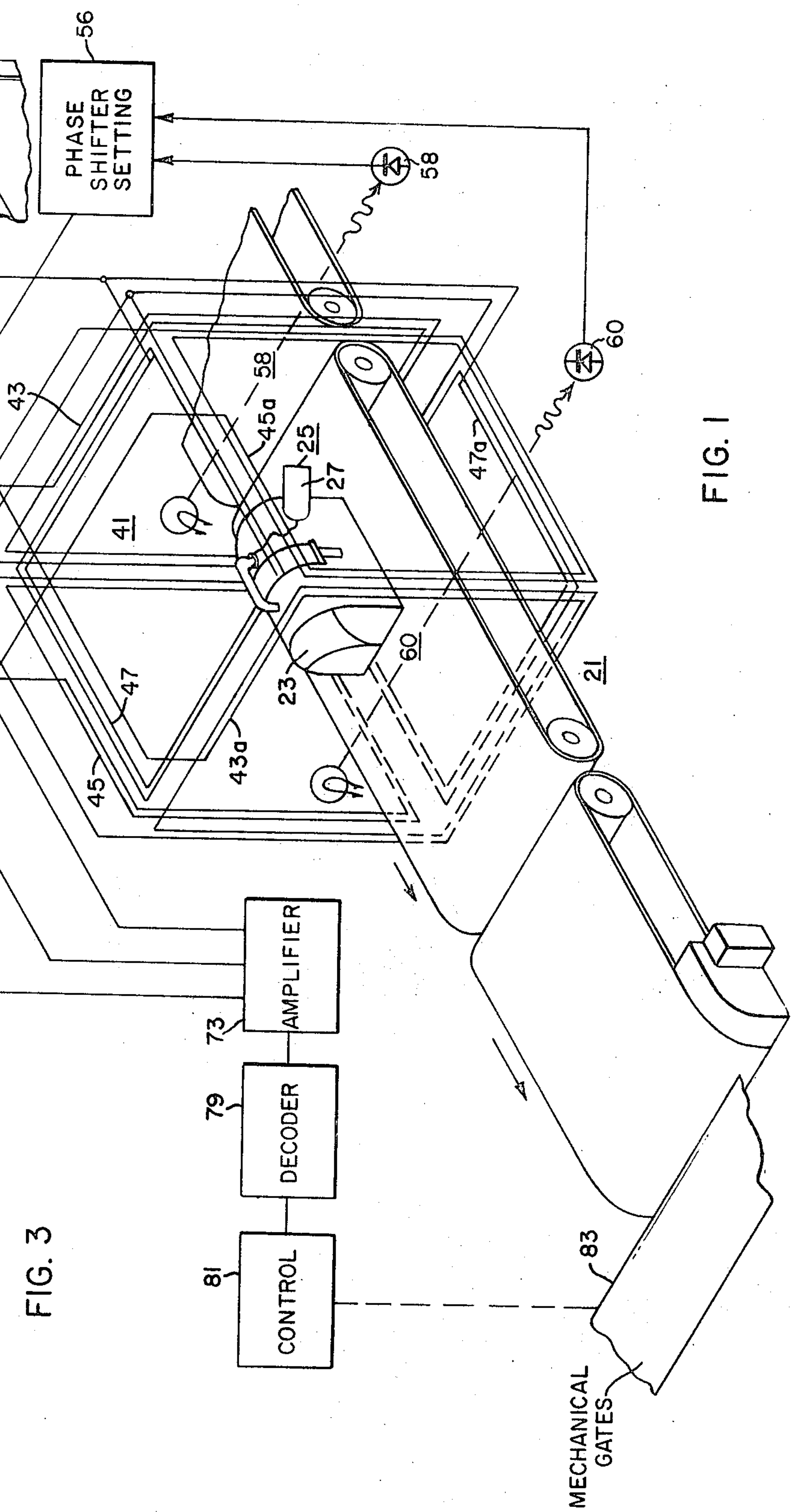

PHASE SHIFTER SETTING
AMPLIFIER
DECODER
CONTROL
MECHANICAL GATES

FIG. 1

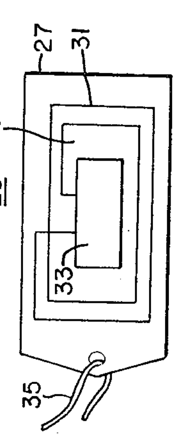


FIG. 3

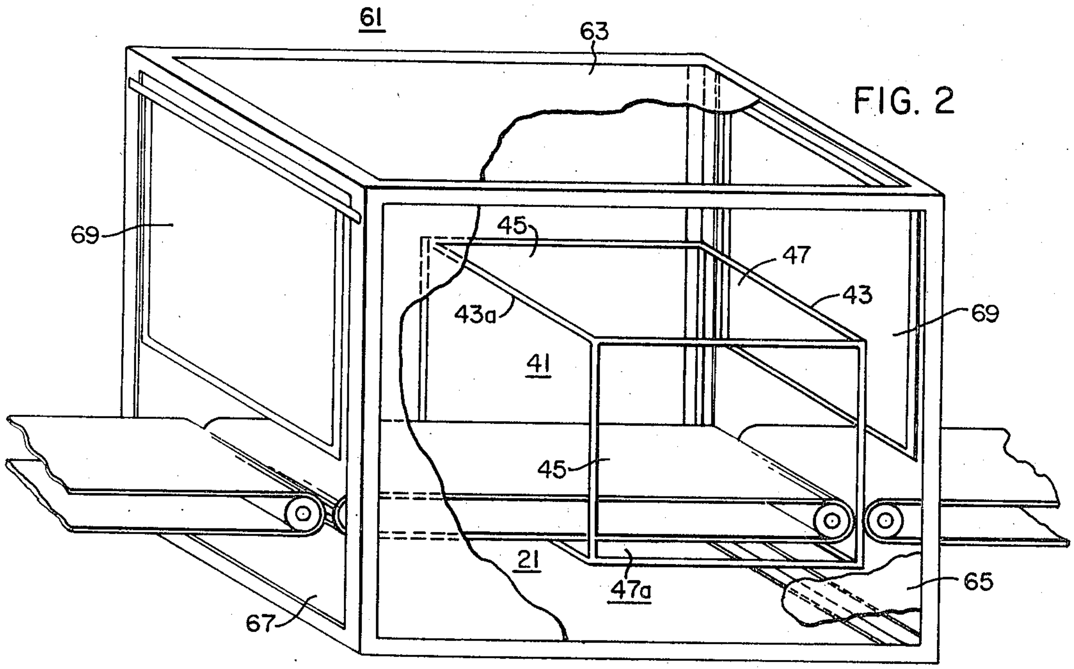


FIG. 2

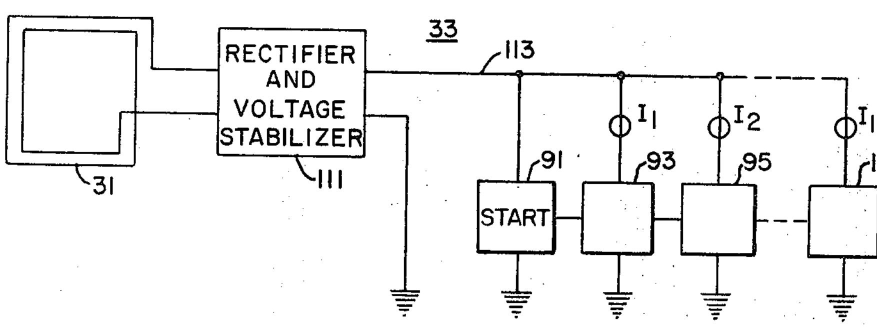


FIG. 4

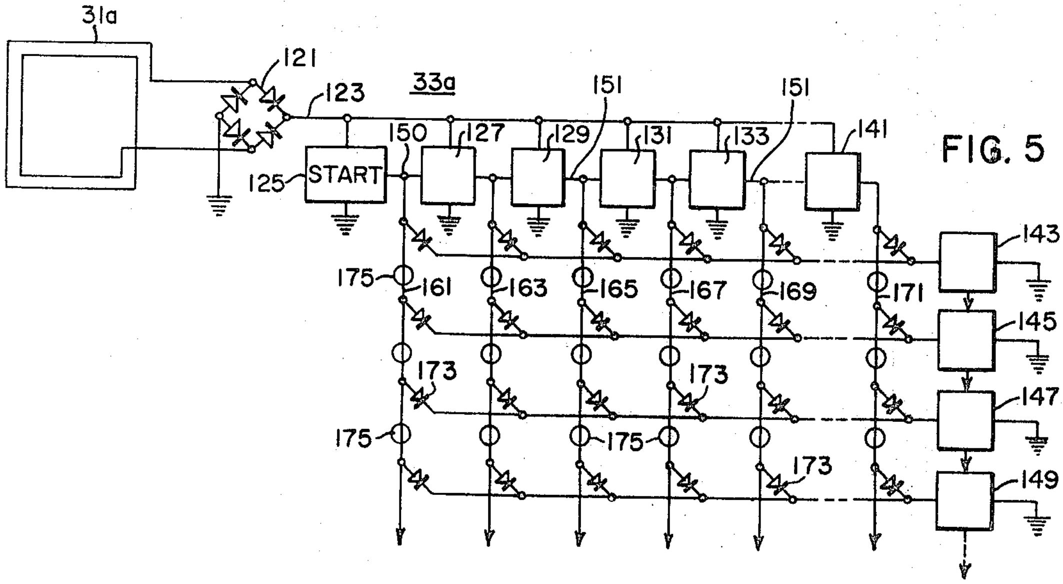


FIG. 5

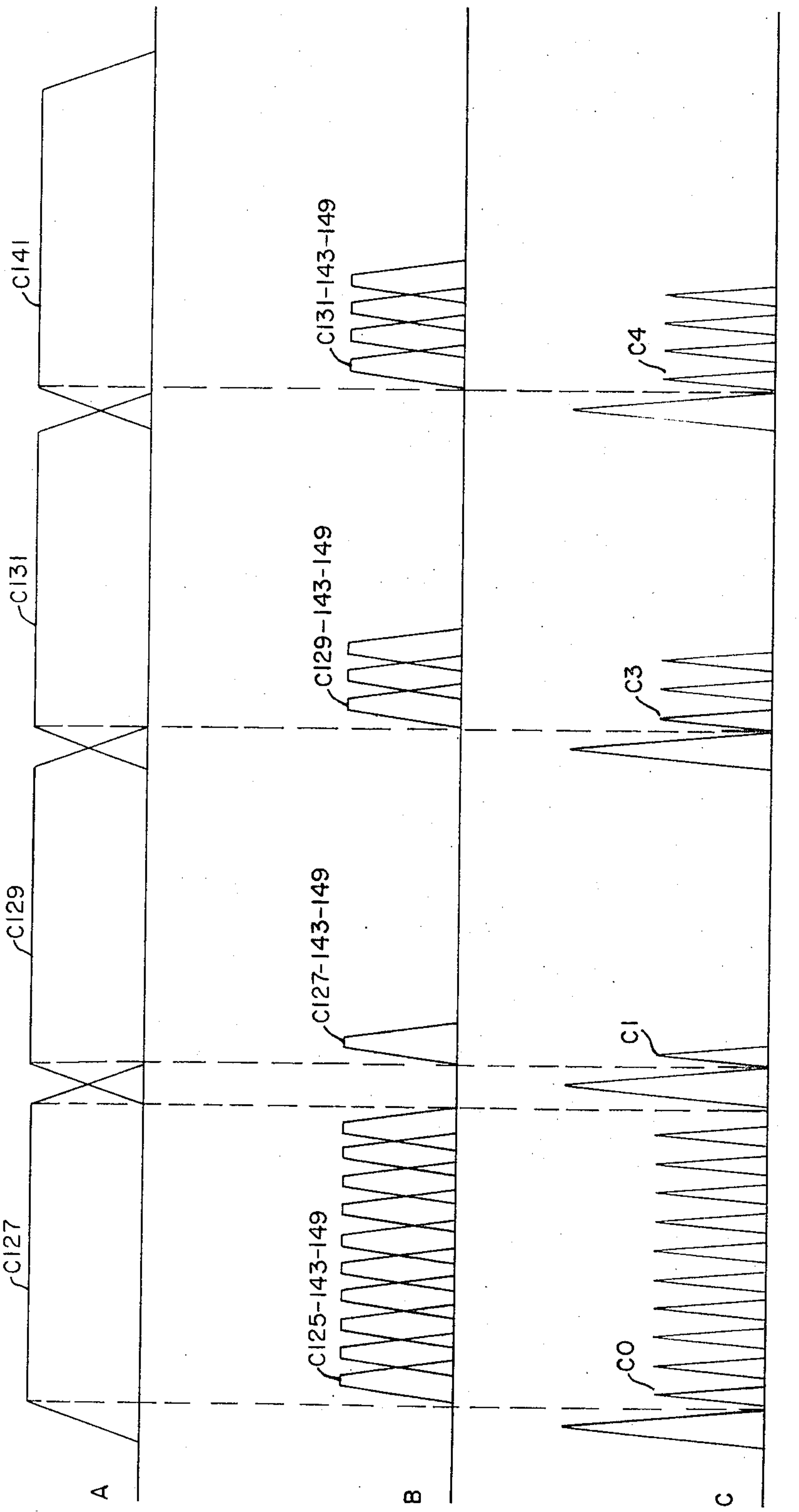

A
B
C
C127
C129
C131
C141
C125-143-149
C127-143-149
C129-143-149
C131-143-149
C0
C1
C3
C4

FIG. 6

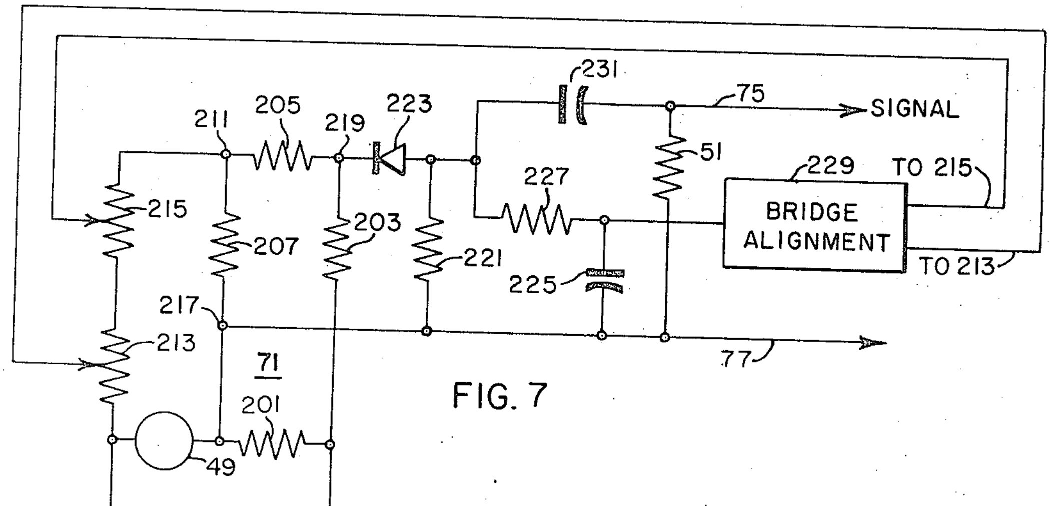


FIG. 7

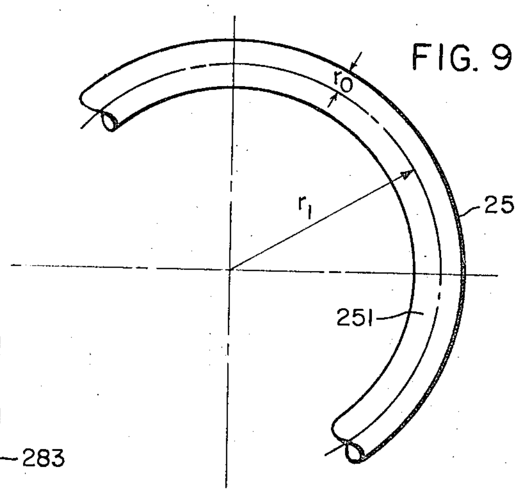


FIG. 9

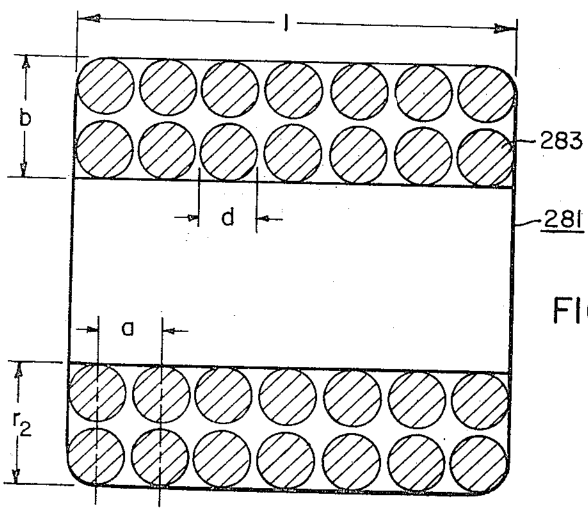
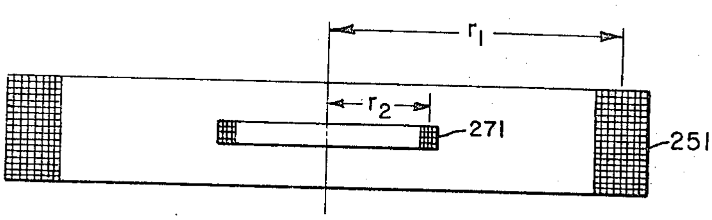


FIG. 10

FIG. 8



OBJECT IDENTIFYING APPARATUS

This is a continuation, of application Ser. No. 215,333 filed Jan. 4, 1972, now abandoned.

CROSS-REFERENCE TO RELATED DOCUMENTS

The following documents are incorporated in this application by reference as of special significance to this invention unlike the significance of the prior art as a whole:

Reference I — *Flexible Thin-Film Transistors Stretch Performance, Shrink Cost* — Peter Brody and Derrick Page — Electronics — Aug. 19, 1968.

Reference II — *Flexible Transistors, Large-Scale Ingegration and Displays* — T. P. Brody and D. J. Page — Digest of Techanical Papers — 1969 Government Microcircuits Applications Conference, Washington, D.C. September, 1969.

Reference III — *Digital Integrated Circuit D.A.T.A. Book* — 12th Edition.

BACKGROUND OF THE INVENTION

This invention relates to automatic object identification and automatic object classification and sorting and has particular relationship to such identification and sorting where the identifying intelligence is randomly positioned. In the interest of concreteness, this invention is described in this application as used in the sorting of such objects as mail sacks in an automatic Post-Office facility or of baggage in an airport. Such objects are moved usually by a conveyor in being sorted. However, this invention may also be applied to identification and classification of objects moving under their own power, for example, vehicles or persons passing into a military compound or other secure area. It is an object of this invention to achieve high reliability in such an automatic identification, classification and sorting.

As typical of the prior art in the area of this invention are the U.S. Pat. Nos., Vinding 3,299,424 and Cambornac, 3,438,489. Vinding is not applicable to a situation where the object to be identified carries the identifying intelligence and is not addressed to random disposition of such intelligence. Cambornac discloses the sorting of mail sacks having tickets which carry the sorting intelligence (20 FIG. 1*a*) However, Cambornac does not have the reliability that is indispensable for such a sorting operation.

It is an object of this invention to overcome the disadvantages of the prior art and to provide highly reliable identification, classification and sorting apparatus for objects which have the identifying intelligence attached to them and assume a random position or orientation during the identification.

SUMMARY OF THE INVENTION

This invention arises from the realization that reliability of the prior-art apparatus as typified by Cambornac is wanting because in such apparatus the identifying intelligence is actively transmitted back from the label in the mailbag to the sorting receiver. The magnitude of the received signal then depends on the signal transmitted from the label and may be larger or smaller or lost in the noise of the sorting detector depending on the position of the label with respect to the transmitting and receiving antennas of the sorting apparatus.

In accordance with this invention, the identifying intelligence which is embodied in a circuit on the label produces energy absorption from an electromagnetic field through which the object with the label attached to it passes. The energy absorption is converted into impulses in groups or trains, each group or set of groups constituting an identifying code which serves to produce an identifying or classifying signal.

More concretely, the label carries a solid-state circuit on a flexible substrate, as disclosed in References I and II above, which may be called an "electronic post stamp." Typically, the circuit includes an antenna or coil for deriving energy from the field and counter means energized from the antenna or coil. The counter means is typically a plurality of interrupted ring counters or shift registers which are pre-set to produce the groups of energy-absorbing pulses constituting the identifying code for each object. Such counter means is shown in Reference III, for example, EO3-18 shown on page 238. However, typically the counter means may be made up of sets of monostable multivibrators preferably formed of field effect transistors, each set being connected to flop from OFF to ON in sequence and the sets being interrelated to produce an adequate number of digits for the code (for example, five digits for a ZIP code). As the conduction of the transistors forming the multivibrators changes in sequence, the energy absorption from the field changes. The changes are abrupt, particularly if field-effect transistors are used, and can be differentiated electrically to produce sharp pulses.

The field through which the object passes is substantially homogeneous; that is, of sufficient magnitude throughout the identifying region to reflect accurately and reliably identifiable the changes in the absorption of energy from the labels. Typically, the field is produced by three pairs of orthogonal Helmholtz coils bounding the identifying region. These coils are energized from an adequate radio-frequency source. Typically, the source may have a frequency of about 1 megacycle (1 Mc). A differentiating circuit is coupled to the field and produces pulses dependent on the changes in the absorbed energy.

To avoid distortions of the readout due to stray fields from electric power devices and/or inteference from radio transmitters, the sensing system should be enclosed in a magnetically shielded box. The shielding must be of a material of low loss and of high magnetic permeability. This shielding also increases the coupling between the antenna on the label and coils producing the field.

The identification achieved with this apparatus is highly reliable because the code is composed of the seqential order of ON-OFF pulses and does not depend on the magnitude of these pulses. The apparatus lends itself readily to use of the "electronic post stamp" on the label since it operates in a simple manner with induced or received power.

BRIEF DESCRIPTION OF THE DRAWING

For a better understanding of this invention, both as to its organization and as to its method of operation, together with additional objects and advantages thereof, reference is made to the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a view partly in perspective with parts broken away and partly diagrammatic showing an embodiment of this invention;

FIG. 2 is a view in perspective showing particularly the electromagnetic field producing coils and the shield for the field of the apparatus shown in FIG. 1;

FIG. 3 is a plan view of the object-identifying label of apparatus in accordance with this invention;

FIG. 4 is a schematic of counting means of relatively simple structure which is impressed on a flexible substrate for a label in the practice of this invention;

FIG. 5 is a like schematic of counting means for producing a coded absorption impulse train having a plurality of digits;

FIGS. 6A, B, C are graphs showing the operation of the counting means of FIG. 5;

FIG. 7 is a schematic of a circuit for reliable detecting and differentiating the energy absorption in the practice of this invention; and

FIGS. 8, 9 and 10 are diagrams used in computations of the electrical parameters which are involved in the practice of this invention.

DETAILED DESCRIPTION OF EMBODIMENTS

The apparatus shown in the drawings includes a conveyor system **21** along which objects **23** to be classified or sorted are advanced. Each object **23** carries a label **25.** The label **25** (FIG. 3) typically comprises a rectangular plate **27** of cardboard or the like to which is secured a flexible substrate **29** having impressed thereon an object-identifying circuit. This circuit includes a coil or antenna **31** to which is connected a network **33.** When electrical energy is induced by an electromagnetic field in the antenna, the circuit absorbs energy from the field. The network **33** is structured so that the absorbed energy varies in such a way as to produce an object-identifying code. The plate **27** has wire or strings **35,** or may be provided with a pressure-sensitive adhesive on its back face (not shown) for attachment to the object **23.**

The conveyor **21** carries the object **23** through a substantially homogeneous electromagnetic field. This field is produced by an assembly **41** of three pairs **43,** **43***a*, **45,** **45***a*, **47,** **47***a* of Helmholtz coils mutually at right angles to each other. The pairs of coils are energized from a radio-frequency source **49** which may typically have a frequency of the order of 1 Mega-Hertz through a resistor **51** (or other type of impedance) across which is produced a voltage drop corresponding to the time-differential of the energy absorption reflected by the antenna **31** (see FIG. 7). The connection to two of three pairs of coils includes variable impedances **53** and **54** for setting the phase of the current flowing through the two pairs of coils. The assembly **41** produces a substantially homogeneous electromagnetic field; the coupling between the field and the antenna **31** may be improved in reliability by automatic setting of the impedance **54** to two opposite values by phase-shift setter **56** while the object **23** is moving through the field. The setter **56** may be shifted between the two settings responsive to switches **58** and **60** (photo-electric typically) which set the phase shift in one position when the object **23** enters the field and in a second opposite position after it passes part way through the field. Thus, any difficulty with obtaining a reliable signal by reason of parallelism between the antenna **31** and the field is avoided.

The assembly **41** is enclosed in a magnetically shielded box **61.** This box is generally in the form of a rectangular parallelepiped whose faces typically consist of a foil of plastic that contains magnetic particles in an insulating suspension. As an additional protection against the influence of external electric fields, a second shield such as copper wire mesh, or laminar metal foils (not shown) can be added on the outside. At the opposite faces **65** and **67** through which the object **23** is carried by the conveyor in and out of the box **61,** the box is provided either with hinged flaps **69** or photo cell controlled doors, made of the abovementioned shielding material (FIG. 2).

The resistor **51** is connected to derive signal current pulses from a bridge network **71** shown in FIG. 7. The voltage pulses which appear across resistor **51** are impressed on the input of an amplifier **73** through conductors **75** and **77.** The output of the amplifier impresses pulses on a decoder **79** which supplies the signals resulting from the decoding to a control **81** (a logic network) that actuates mechanical gates **83** to sort the objects **23** in accordance with the codes.

A circuit imprinted on a substrate **29** on a label **25,** with which a simple number code can be produced is shown in FIG. 4. This circuit includes a start network or electronic gate **91** and a succession of counter elements **93,** **95,** **101.** The network **33** is supplied with power from the antenna **31** through a rectifier and voltage stabilizer **111** which supplies potential between its hot terminal **113** and ground. The start network **91** is connected directly to terminal **113**; the elements **93** through **101** are each connected to the terminal **113** through perforable "knock-out" **I1,** **I2–I10,** any of which may be perforated to interrupt the connection of the element to the terminal **113.** The start network is connected to the start input of the first element **93**; the element **93** and each element thereafter is connected to the start input of a succeeding element **95** through **101.** When an element **93** through **101** receives power from terminal **113** and in addition receives a start signal, it is actuated or flops and a valve, for example, a field-effect transistor, is rendered conducting. Each element in its turn remains actuated for a predetermined interval and then becomes quiescent and transmits a starting signal to the next element. The number N of successive elements **93,** **95–101** which are actuated is determined by interrupting the conduction through the $n + 1$st element by perforating its associated "knock-out" $In + 1$. Thus, if "knock-out" **I2** is perforated, only element **93** is actuated; if "knock-out" **I10** is perforated, nine elements are actuated.

In the use of the network **33** shown in FIG. 4, terminal **113** and the start network **91** are actuated when the label **23** with circuit **33** is moved into the electromagnetic field. Element **93** is then actuated. A predetermined time interval after **93** is actuated, it impresses a starting signal on element **95** and the latter is actuated; a predetermined time interval later, **95** impresses a signal on the next element actuating it, and so on until the element preceding the one whose connection to terminal **113** is interrupted is actuated. On each actuating, a current flows through the element absorbing energy from the field.

The code in this case is produced by differentiating the absorbed energy and consists of a number of impulses. Apparatus in which the label includes a circuit as shown in FIG. 4 could serve to direct objects **23** along separate paths corresponding to the number of absorbed impulses. In this case, the control **81** responds to the number of impulses to set the gates **83** accordingly.

FIG. **5** shows a coding circuit **33***a* which is capable of producing a more complex code, for example, a ZIP code. The antenna **31***a* is connected to the coding network through a rectifier **121** having hot output terminal **123.** The terminal **123** supplies a start network **125** which in turn is connected to turn on in sequence a succession of counting elements **127, 129, 131, 133** and **141** and another sequence of counting elements **143, 145, 147, 149 - - - .** For producing a ZIP code, there may be four elements **127–141** and ten elements **143–149.**

The elements **127–141** are free running and once actuated by the start network **125** through terminal **150,** operate in the same sequence or cycle on each start. The timing components of these elements is such that they shift from each to the succeeding element at a relatively low rate, for example, 1 millisecond. When each element **127–141** times out, it sends a starting signal to the succeeding element through terminals **151.** For any element **127–141** to be actuated, it is necessary that it receive a start signal through terminal **150** or **151** and voltage through terminal **123.**

The counting elements **143–149** are connected respectively to terminals **150** and **151** through conductors **161, 163, 165, 167, 169, 171** and through diodes **173.** The conductors **161–171** includes "knock-outs" or interrupting positions **175** where the conductors **161** may be interrupted to set the numbers of elements **143** through **149** connected to each terminal **150** or **151.** For example, if the upper "knock-out" **175** in conductor **161** is perforated, only element **143** is actuated through terminal **150;** if the lower "knock-out" **175** in conductor **165** is perforated, only elements **143, 145, 147** are actuated through the terminal **150** through which conductor **165** is connected to element **129.** The elements connected to any conductor **161–171** flop at a frequency which is substantially higher than the frequency at which the elements **127–141** flop. Typically, the elements **143–149** may flop in succession in 0.05 millisecond after they are actuated.

The interruption of the conductors **161–171** at positions **175** of FIG. **5** and at I1 through I10 of FIG. **4** can be carried out in a number of different ways; for example by key punching or by etching. For etching, a sheet of plastic or paper that contains on one side microscopic bubbles with sealed-in acid would be opposite to the printed circuitry. When pressure is applied (e.g., by writing on the sheet) the bubbles break and the released acid locally interrupts the circuitry.

The operation of the circuit shown in FIG. **5** will be explained with reference to FIG. **6,** particularly FIGS. **6**A and **6**B. In FIGS. **6**A and **6**B current is plotted vertically and time horizontally. Points along the time axis on all graphs **6**A, **6**B, **6**C which are at the same distance from the ordinate axes represent the same time instant.

When the label carrying an appropriately set circuit as is shown in FIG. **5** moves into the field produced by assembly **41** (FIG. **1**) power is impressed on terminal **123** and the start network **125** is actual and then the counter elements **127** to **141** are actuated in succession, each element conducting for an interval of the order of 1 millisecond and then rendering the succeeding one conducting while it is rendered non-conducting by the reaction of the succeeding element. The generally trapezoidal curves of FIG. **6**A represent the conduction of each of the elements **127** to **141** in its turn and are labelled accordingly with a prefix C. The rising and falling ends of each of the curves C**127** to C**141** have a high slope, particularly as the elements **127–141** are formed of field-effect transistors.

The actuation of the start network also causes the counter elements **143** through **149** to be actuated up to the element preceding the open "knock-out" point **175** in line **161.** This actuation of elements **143** through **149** is represented by the narrow trapezoidal curves on the right of FIG. **6**B which are identified as **C125–143–149.** This set of curves corresponds to a condition in which there are 10 elements **143–149** and no "knock-out" **175** in line **161** is perforated. The first digit of the code is zero.

The actuation of element **127** causes elements **143** through **149** to be actuated up to the perforated "knock-out" in line **163** which is the first "knock-out". In this case, only element **143** is actuated. The curve is identified as C**127–143–149** in FIG. **6**B. This actuation produces the second digit **1.** In the same manner, the third digit, **3,** and the fourth digit, **4,** are produced as shown in FIG. **6**B. A fifth digit (not shown) is produced through element **141** and line **171.**

FIG. **7** shows the detector circuit which responds to the absorption of energy by the circuits of FIGS. **4** or **5** and converts the variations in this absorption into an object-identifying code. The current pulses produced in these circuits are of the order of a few microamperes compared to field-producing current which may be as high as 10 amperes. The circuit shown in FIG. **7** takes advantage of the fact that the current pulses caused by the power absorption have an approximate phase shift of 90°. To achieve this advantage, the detector circuit is phase sensitive.

The detector circuit includes the bridge network **71.** The network **71** includes the power supply **49,** a sensing resistor or impedance **201** and balancing impedances **203, 205, 207.** The impedance **201** may be a standard resistor of 1 ohm, for example, and the other impedances may be appropriately dimensioned. The source **49** and the assembly **41** are connected across the sensing impedance **201.** The source **49** is also connected to the junction **211** of the bridge through variable attenuation impedance **213** and phase-shifter **215.** The output terminals of the bridge **71** are at the junctions **217** of the source **49** and the impedance **201** and the junction **219** of resistors **203** and **205.** Between terminals **217** and **219** a voltage U_s is derived which varies with the power absorbed by the object identifying circuit (FIGS. **4, 5**).

The potential U_s is impressed across an impedance **221** through a diode **223** which operates as a rectifier. The rectified voltage U_s has a low frequency (slow) component, caused by the movement of the object **23** and label **25** and the varying absorption of the object **23** as it moves, and a high frequency (fast), pulsed component, produced by the circuit in the label. The slow component is impressed across a capacitor **225** through a resistor **227** which operate as an integrating network. The voltage of capacitor **225** supplies a bridge alignment network **229** which is connected to attenuator **213** and phase shifter **215** to maintain the bridge **71** in alignment. The pulsed component is passed through a differentiating network including capacitor **231** and resistor **51** and it delivers the code signals to amplifier **73** (FIG. **1**).

The operation of the detector circuit is illustrated in FIG. **6C** in which time-rate-of-change of the currents represented in FIGS. **6A** and **6B** is plotted vertically and time horizontally. The sharply peaked curves identified by **C0, C1, C3, C4** are the pulses transmitted to amplifier **73.** These pulses depend on the rate at which the counter elements **127** to **149** pass from non-conducting state to fully conducting state and are positively and reliably identifiable.

COMPUTATION ON TYPICAL APPARATUS

The following computation of the voltage induction in the coil or antenna **31** of the circuit on the label is made with reference to the simplified structure shown in FIG. **8.**

It is assumed that the assembly **41** and antenna **31** are coplanar and are represented by coils **251** and **271** having parameters as indicated. It should be noted, however, that in the actual design, a Helmholtz arrangement of the antennas should be used, since coplanarity of the antennas **41** and **31** is generally not fulfilled in practice.

The mutual inductivity between two coils (FIG. **1**) is:

$$M^{[nH]} \doteq 2\pi^2(r_2^2/r_1)\ W_1\ W_2 \qquad (1)$$

where W_1 and W_2 are the respective number of turns in coils **251** and **271.** The voltage induced in coil **2** (antenna **31**) is given by

$$U_2 = M(di_1/dt) \qquad (2)$$

where i_1 is the instantaneous value of the current in the coil **251.** With $i_1 = J_1 \cos(2\pi ft)$ we obtain for the peak value of the voltage in the coin **271**:

$$U_2^{[V]} = M\cdot 2\pi f J_1^{[A]} = 4\pi^3\cdot 10^{-9}\cdot(r_2^2/r_1)\ W_1 W_2\cdot\ f\cdot J_1^{[A]} \qquad (3)$$

For r_1=50 cm, r_2=2 cm, W_1=1, W_2=100, we obtain from Eq. 3:

$$U_2^{[V]} \doteq 10^{-6}\cdot f J_1^{[A]} \qquad (4)$$

Eq. 4 applies to unshielded coil **251** and a coil **271** without ferrite.

The power requirement for the field produced by assembly **41** will be computed with reference to FIG. **9.** An antenna **251** (loop antenna) of one turn has been chosen above for the following reasons:

From Eq. 3 it follows that the voltage, U_2, which is induced in the antenna **31** on the label, is proportional to the number of windings W_1 of the antenna **251,** at a given current, J_1, for coil **251.**

The inductivity, L, of a loop antenna, however, increases approximately with W_1^2, so that the voltage required to drive a current J_1 through the coil **251** ($U_1 = J_1\cdot 2\pi f\cdot L_1$) becomes very high for large W_1. It is therefore, desirable to keep the turns W_1 of the antenna **251,** W_1, low. This can be also understood from the basic transformer equation:

$$U_2/U_1 \propto W_2/W_1 \qquad (5)$$

The inductivity of a circular loop antenna of one winding (FIG. **9**) is in a good approximation

$$L \approx \mu_o r_1 \ln(r_1/r_o) \qquad (6)$$

For r_1=50 cm and r_o=1 cm, we obtain

$$L = \pi\cdot 10^{-9}\cdot 50\cdot \ln 50 = 2.46\mu H$$

From equation 4 it follows that for a voltage of 10V in the antenna or coil **271,** a current of ~10A is required in the antenna or coil **251** at a frequency of 1 MHz.

The voltage required to drive a current of 10A through the antenna **251** is then

$$U_1 = 2\pi f\, L\cdot J_1 \doteq 155\text{V}$$

which yields a required power to produce the field of:

$$P = 1/\mathbf{2}U\cdot J \doteq 780\ \text{VA}$$

The following computation of the voltage induced in the antenna **31** on the label **25** is made with reference to FIG. **10** in which the antenna **31** is shown as a coil **281** in cross section with turns **283.** These are W_2 turns.

The inductivity of the receiver coil is approximately

$$L_2^{[nH]} \doteq (100\cdot\pi W_2^2\cdot r_2^2)/6\ r_2 + 9l + 10b \qquad (7)$$

(See FIG. **10**)

With $a \cong d$=0.4 cm and l=b=0.4 cm we obtain

$$L_2^{[nH]} = (100\pi\cdot 10^4\cdot 2^2)/6.2+9\cdot 0.4+10\cdot 0.4 = 4\pi\cdot 10^6/12+3.6+4$$

$$L_2 = 630\mu H$$

$$R_2 = [8\pi(r_2+1/\mathbf{2})\cdot W]/k\cdot d^2\cdot \pi = 8\cdot 2.2\cdot 100/(57\cdot 16) = 1760/\mathbf{912} \doteq 1.93\Omega$$

$$R_2 = 1.93\Omega$$

$$J_2 = U_2/\sqrt{R_2^2+\omega^2 L_2^2 \omega L_2} = 2\pi\cdot 10^6\cdot 630\cdot 10^{-6} = 3950\Omega$$

$$J_2 \doteq 8.96/\mathbf{3950} \approx 2.3\text{mA}$$

The power absorption with a matched external load (ohmic) of R_2'=4000Ω is

$$P_2 = 1/\mathbf{2}\ (J_2/2)^2\cdot R_2' \doteq 2.6\ \text{mW}$$

The relative change in the transmitter current is

$$\Delta J/J = (1/2)\ \Delta P/P = (1/2)\ 2.6\cdot 10^{-3}/780$$

and

$\Delta J = 16.6 \mu A$ ($J = 10A$)

While embodiments of this invention have been disclosed herein, many modifications of the embodiments and of their uses are feasible. This invention then is not to be restricted except insofar as is necessitated by the spirit of the prior art.

What is claimed is:

1. Apparatus for identifying objects in a region including means for producing an electromagnetic field in said region, object-identifying means carried by each said object, electromagnetically coupled to said field, to absorb energy of variable magnitude from said field while said object is in said region, said object-identifying means including circuit means powered only by said field, for converting said absorbed energy into sequential pulses defining a code for identifying said last-named object, the said object-identifying means also including means for selecting different sequences of pulses to define different codes for different objects, said object-identifying means while in said region being randomly positioned in said field but the flux of said field permeating said region so that the energy absorbed from said field by electromagnetic linkage of said circuit means with said field defines reliably distinguishable pulses regardless of the random positioning of said object-identifying means, and means responsive to said pulses for producing an identification of said last-named object.

2. The apparatus of claim 1 wherein the identification-producing means includes differentiating means to convert the pulses derived from the energy absorbed from the field into impulses constituting the identifying code.

3. The apparatus of claim 1 wherein the object-identifying means for each object includes a plurality of ring counters connected in an electrical circuit to convert the energy absorbed from the field into a predetermined number of sets of digital counts defining the code corresponding to said object.

4. The apparatus of claim 1 wherein the object-identifying means while in said field defines, for different objects, a plurality of corresponding codes substantially greater than two and the circuit means is an electrical circuit printed on a flexible substrate attached to the object.

5. Apparatus for selectively advancing objects such as mail sacks, baggage or the like along a plurality of predetermined paths, certain selected of said objects to be advanced along certain ones of said paths and others of said objects to be advanced respectively along certain others of said paths; the said apparatus including conveyor means by which said objects are carried in succession to said paths, said conveyor means passing through a region of extended volume in which the said path through which each said object in its turn is to pass is to be selected, means producing, in said region, an electromagnetic field, path-defining means connected to, and carried by, each said object, coupled to said field for absorbing energy of variable magnitude from said field, while said last-named object is carried through said region, said path defining means including circuit means, powered only by said field, for converting said absorbed energy into sequential pulses defining a code in accordance with the path to be followed by said last-named object, the said object-identifying means including means for selecting different sequences of pulses to define different codes for different objects, said path-defining means being randomly positioned in said field, but said circuit means being electromagnetically linked with said field so that the energy absorbed from said field by said path-defining means in said region produces readily distinguishable pulses regardless of the random positioning of said path-defining means, and means responsive to said pulses derived from absorption of energy by each path-defining means in said field for selecting and presetting in accordance with the define code, the path to be followed by said last-named object.

6. The apparatus of claim 5 including field-producing means having means for maintaining the field in effective energy transfer relationship with the path defining means, such as to produce reliably distinguishable code-defining pulses derived from absorption of energy in said field regardless of the random orientation in said field of the path-defining means which random orientation might in the absence of said maintaining means produce low absorption of energy from said resultant field.

7. Apparatus for identifying objects in a region including means for producing an electromagnetic field in said region, said field-producing means including a plurality of pairs of Helmholtz coils bounding said region and also including means for energizing said Helmholtz coils to produce said field, object-identifying means carried by each said object, electromagnetically coupled to said field, to absorb energy of variable magnitude from said field while said object is in said region, said object-identifying means including circuit means for converting said absorbed energy into variations defining a code for identifying said last-named object, said object-identifying means while in said region being randomly positioned in said field but being electromagnetically linked to said field so that the variations derived from the energy absorbed from said field by said object-identifying means defines a reliably distinguishable code regardless of the random positioning of said object-identifying means, and means responsive to said energy absorbed from said field for producing an identification of said last-named object.

8. Apparatus for identifying objects in a region including means for producing an electromagnetic field in said region, object-identifying means carried by each said object, electromagnetically coupled to said field, to absorb energy of variable magnitude from said field while said object is in said region, said object-identifying means including circuit means for converting said absorbed energy into pulses distinguishing a code for identifying said last-named object, said object-identifying means while in said region being randomly positioned in said field but said field permeating said region so that the energy absorbed therefrom by said object-identifying means in said field defines reliably distinguishable pulses regardless of the random positioning of said object-identifying means, and means responsive to the pulses derived from said energy absorbed from said field for producing an identification of said last-named object, said responsive means including a balanced network unbalanced by each said pulse as it is absorbed and said network including means, responsive to the movement of the object

through the region, for maintaining the network in balance in the absence of pulses.

9. Apparatus for identifying objects in a region including means for producing an electromagnetic field in said region, object-identifying means carried by each said object, electromagnetically coupled to said field, to absorb energy of variable magnitude from said field while said object is in said region, said object-identifying means having circuit means for converting said absorbed energy into variations defining a code for identifying said last-named object, said object-identifying means while in said region being randomly positioned in said field but said field permeating said region so that the energy absorbed therefrom by said object-identifying means in said field defines reliably distinguishable variations regardless of the random positioning of said object-identifying means, means responsive to said object, for changing the orientation of said field relative to said object-identifying means while said object is in said region, and means, responsive to said variations, for producing an identification of said last-named object.

10. The apparatus of claim 1 wherein the object-identifying means includes a plurality of digital counters and also includes means powered only by the energy absorbed from the field for selectively actuating said counters to count in a predetermined succession, said counters being interconnected so that on actuation of said actuating means each succeeding counter is actuated to count responsive to the actuation of a preceding counter.

11. The apparatus of claim 7 wherein the region is bounded by mutually orthogonal pairs of Helmholtz coils.

12. The apparatus of claim 9 wherein the changing means includes means responsive to the object for setting the field in a first orientation when the object enters the region and means responsive to the object for thereafter setting the field in at least one second orientation after said object has passed a predetermined distance through the region.

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