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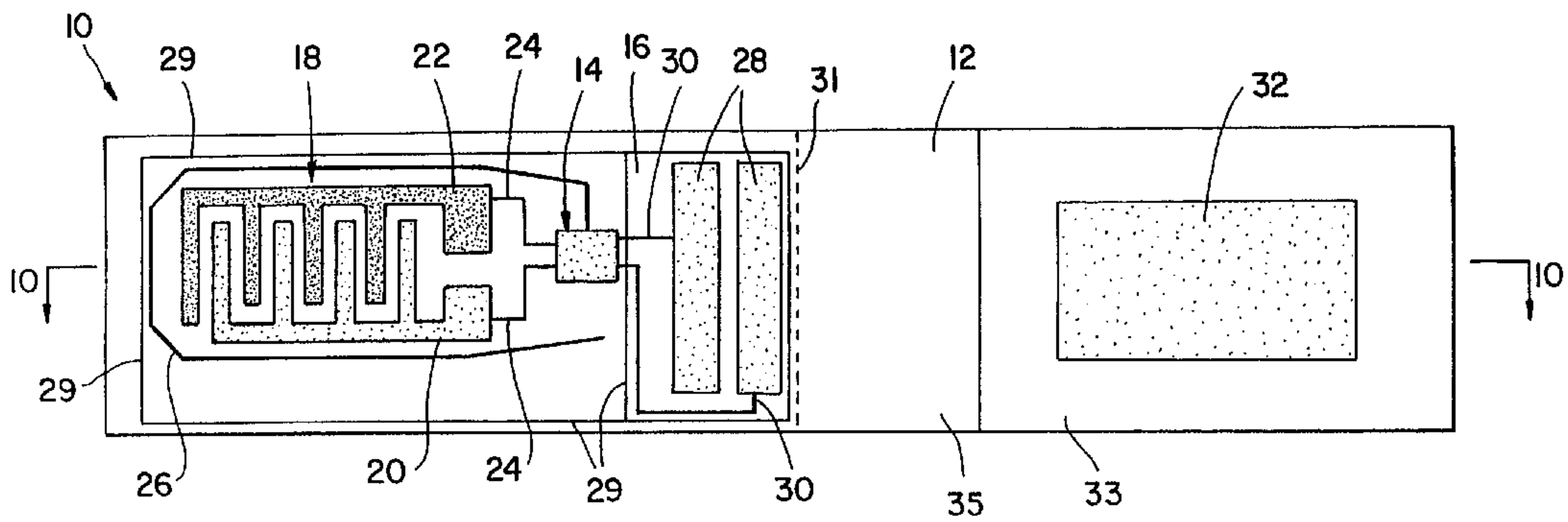
(54) **ETIQUETTE D'IDENTIFICATION A FREQUENCE RADIO**

(54) **RADIO FREQUENCY IDENTIFICATION LABEL**



(57) Une étiquette d'identification à fréquence radio comporte un accumulateur, activable de manière sélective, ainsi qu'un circuit de commande et de génération de fréquence radio qui est couplé à l'accumulateur. Cet accumulateur comporte deux composants séparés qui sont mis en contact opérationnel pour activer l'accumulateur et assurer ainsi l'énergie nécessaire au circuit de commande et de génération de fréquence radio. La réalisation préférée de ce circuit de commande et de génération de fréquence radio comporte une puce programmable à circuits intégrés pourvue de contacts qui permettent à un utilisateur de définir le signal d'identification qui est produit.

(57) An RF identification label includes a selectively activatable battery and control and RF generating circuitry which is coupled to the battery. The battery comprises two separate components which are brought together in operative contact to activate the battery and thereby provide power to the control and RF generating circuitry. The preferred embodiment of the control and RF generating circuitry comprises a programmable integrated circuit chip with contacts which permit programming by a user to define the identification signal which is generated.

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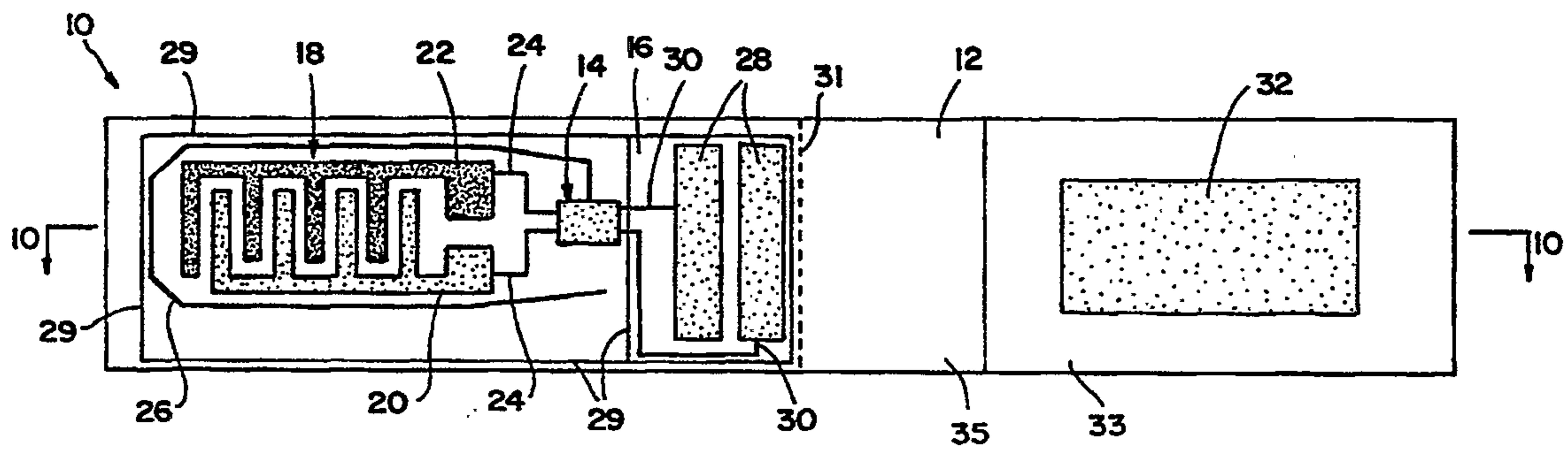
(54) Title: RADIO FREQUENCY IDENTIFICATION LABEL



(57) Abstract

An RF identification label includes a selectively activatable battery and control and RF generating circuitry which is coupled to the battery. The battery comprises two separate components which are brought together in operative contact to activate the battery and thereby provide power to the control and RF generating circuitry. The preferred embodiment of the control and RF generating circuitry comprises a programmable integrated circuit chip with contacts which permit programming by a user to define the identification signal which is generated.

RADIO FREQUENCY IDENTIFICATION LABEL

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to identification labels. More particularly, the invention relates to an active radio frequency identification label which includes an activatable battery for remotely detecting, identifying and tracking goods, packages, baggage or similar items.

Description Of Related Art

The automated package identification industry is currently dominated by optical scanning technologies and labels, such as bar code scanning and optical character recognition. Optical labels are suitable for use in many applications, however, they have two basic limitations: a relatively short reading range and poor readability under harsh environmental conditions. Correct positioning of a label on a package for accurate reading by a scanner is very time-consuming. When many packages are grouped together and labels are otherwise obscured, marred or unreadable, such as on a conveyor, it may be difficult or impossible to provide a line of sight between the scanner and the bar code label. Accordingly, the scanner will be unable to read the label.

The use of radio frequency (RF) identification labels overcomes many of these limitations and provides additional advantages over optical labels. RF identification labels use a transceiver or a transponder which is placed on the item being tracked. The label transmits encoded data on a selected frequency and the RF signal is received by an antenna. The RF signals generated by these labels can be read at a distance from the receiving antenna. Additionally, since there is no requirement to have a direct line of sight between the RF label and the receiving antenna, an obscured RF labeled item can still be easily read.

RF identification labels are generally categorized as either passive or active, based upon the power source used to power the label. Passive RF labels do not contain an independent power source. They rely solely on the power from an externally supplied RF carrier to supply all of the label's power requirements. This provides a virtually unlimited shelf life and low cost since the problems of charging and maintaining a battery are eliminated. However, passive RF labels tend to have a limited transmission range.

A typical passive RF label is disclosed in U.S. Patent No. 5,153,583 (Murdoch) which discloses a portable, passive transponder having a single inductive coil for simultaneous reception of signals from, and transmission of signals to, an interrogating unit. The transponder receives its power from an inductive powering field created by the interrogating unit and capacitively stores the received energy.

In contrast, conventional active RF labels include a self-contained power source, or battery. These labels have more power available than a passive label which greatly increases the data transmission rate and transmission range of the label. These devices are typically activated by a switch when operation of the device is desired. Since no strong external RF interrogating field is required to power the label, communication interference and worker safety concerns are reduced.

A conventional active RF identification label is disclosed in U.S. Patent No. 3,772,688 (Smith). Smith discloses a freight security system comprising a base station and a plurality of active transponders. Each transponder includes a battery and a switch, which is manually switched to the "on" position when the transponder is placed on an item to be tracked. The base station includes a transceiver which detects when a transponder leaves a designated area.

Another conventional active RF identification label is disclosed in WO 95/12901 (Ghaem). This system comprises an active RF tag including a low profile battery power source and an RF transmitter for transmitting a predetermined identification code. However, this type of system is limited in that it does not permit selective transmission of information based upon the priority of information stored within memory.

Since active RF labels include a battery, their shelf life is limited to the life of the battery. Although a shelf life of up to ten years can be achieved by utilizing lithium batteries, such batteries greatly add to the expense of conventional active RF identification labels and pose environmental problems at the time of disposal. Additionally, conventional active RF labels are impractical for high-volume, low-cost applications wherein the label is discarded after a single use.

It would be desirable to provide a low-cost RF identification label which has a shelf life comparable to a passive RF label, yet provides the operational advantages associated with a conventional active RF label.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a relatively low-cost active RF identification label, which has an extended shelf life prior to usage.

According to the invention, there is provided an active RF identification label that comprises a memory for storing data; RF generating means for generating an RF identification signal based upon the stored data; and an activatable battery, connected to the RF generating means, for providing power to the RF generating means. The battery comprises at least a first component and a separate second component such that the battery is activated when the first component comes in operative contact with the second component. The second component includes means for maintaining the first and second battery components in operative contact with each other after activation of the battery, whereby the RF identification signal is producible on demand by activation of the battery. Additionally, a control unit is coupled to the battery, the RF generating means and the memory, for controlling the generation of the RF identification signal to selectively output data from the memory into the RF identification signal for transmission, the control unit being programmable to output data having a higher priority more frequently than data having a lower priority.

The first battery component preferably comprises an anode and a cathode supported on a dielectric base and the second battery component preferably comprises an electrolyte.

More preferably, the electrolyte comprises an adhesive applied to a supporting substrate such that the substrate is adhered to the anode and cathode to activate the battery, whereby the adhesive comprises the means for maintaining the first battery component and the second battery component in operational contact with each other.

The preferred embodiment of the control and RF generating circuitry comprises a programmable integrated circuit chip with contacts, which permit programming by a user to define the identification signal, which is generated.

Other objects and advantages of the invention will be apparent to those skilled in the art from the description of a presently preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an elevated view of an active RF identification label according to the teachings of the present invention;

Figure 2 is a block diagram of the control circuit used with the RF identification label shown in **Figure 1**;

Figure 3 is a side elevation of the RF identification label of Figure 1 showing an initial stage in the activation of the label;

Figure 4 is a side elevation of the RF identification label of **Figure 1** showing an intermediate stage in the activation of the label;

Figure 5 shows a side elevation of the identification label of **Figure 1** in its activated position;

Figure 6 is an elevated view of an alternate embodiment of an RF identification label according to the teachings of the present invention;

Figure 7 is side view of a second alternate embodiment of an RF identification label according to the teachings of the present invention;

Figure 8 is an elevated view of a third alternate embodiment of an RF identification label according to the teachings of the present invention;

Figure 9 is a perspective view of the data input means;

Figure 10 is a section view along line 10-10 in **Figure 1**; and

Figure 11 is a block diagram of the memory within the data module.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to **Figure 1** there is shown an active radio frequency (RF) identification label **10**. The label **10** preferably comprises a thin rectangular strip **12** of flexible material of the type conventionally used for baggage labels and may be plastic, paper, cardboard, a synthetic, natural, woven or non-woven material. A substrate **16** is mounted in a conventional manner, such as via an adhesive, to the strip **12**. The substrate **16** supports a control circuit **14**, a first battery portion 18, an antenna **26**, and programming contacts

28. The substrate **16** also includes a small lip **29** which surrounds the components located on the substrate **16**.

The first battery portion **18** comprises an anode **20** and a cathode **22**. The anode **20** and cathode **22** are connected to power the control circuit **14** via conductors **24**. The conductors **24** are made of conventional materials such as conductive ink, thin film, or metallic foil. Programming contacts **28**, which are coupled to the control circuit **14** via conductors **30**, enable a user to program the label **10** with the desired identification signal as will be described in detail hereafter.

A second battery portion **32** is provided on the end of the strip **12** opposite the end on which the substrate **16** is mounted. The second battery portion **32** serves as a substrate for an electrolytic material. In the preferred embodiment, the battery comprises zinc-manganese dioxide; wherein the anode **20** is magnesium dioxide, the cathode **22** is zinc and the electrolyte is an aqueous gel of ammonium chloride and zinc chloride. One skilled in the art would appreciate that there are many other materials that may be substituted for the materials used in the preferred embodiment without departing from the spirit and scope of the present invention.

The second battery portion **32** is located such that when the strip **12** is folded back upon itself, the second battery portion **32** contacts and overlays the first battery portion **18**. An adhesive **33** coats the portion of the strip **12** surrounding the second battery portion **32**. This ensures that positive contact between the two battery portions **18**, **32** will be maintained after the strip **12** is folded back upon itself. The adhesive **33** also seals the electrolytic material within the lip **29** to prevent leakage. A second area **35** of the strip is kept free from adhesive. Backing material **37**, as shown in **Figure 9**, overlays the adhesive **33** and the second battery portion **32** to ensure that unwanted materials do not adhere to the strip **12**. The backing material **37** is removed by the user when operation of the label **10** is desired. A perforation **31** is also provided about the center of the strip **12**.

Referring to **Figure 2** the control circuit **14** comprises a control and timing module **40**, a data encoding and storage module **42**, an RF modulator **44** and a power amplifier **46**. In the preferred embodiment, the control module **40** and the data module **42** are software-implemented modules. To program the label **10** with the desired message or data to be transmitted, data is input from a data input source **100** (shown in **Figure 9**) into the label **10** via the programming contacts **28**. The data enters the data encoding and storage module **42** in binary form. This data typically pertains to a package upon which the label **10** is adhesively mounted. This data may include the contents of the package, the destination of the package, the source of the package, the weight of the package or any other data known about the package at the time the label **10** is programmed.

The data encoding and storage module **42** includes a non-volatile random access memory (NVRAM) for storing and retrieving data. The binary data is encoded and compressed by the data module **42** as it is stored in memory.

Additionally, error-detection and error-correction information are added by the data module **42** to guarantee that the data decoded by the receiver is error-free. Compression and encoding of the data may be performed prior to inputting the data into the data module **42**. This reduces the complexity of both the control circuit **14** and the data module **42** and permits data to be encrypted by the data input source **100** to provide security, if desired.

The radio-frequency (RF) modulator **44** uses frequency-shift keying (FSK) to modulate the carrier signal. Alternatively, phase-shift keying (PSK) or any other known modulation method may be used. The binary data signal output from the data module **42** is mixed with a selected RF carrier for transmission. In the preferred embodiment, the selected RF carrier is 908 MHZ. The power amplifier **46** increases the power of the signal provided by the modulator **44** and output to the antenna **26**.

The control and timing module **40** oversees all operations of the control circuit **14**. The control module **40** includes a processor which directs the encoding and storage of data by the data module **42**. Once the label **10** has been assembled and the power source is available, the control module **40** activates the data module **42**, the RF modulator **44** and the power amplifier **46**. Once activated, the label **10** transmits the stored data over the selected RF carrier for reception by an external receiver. Preferably, the data is transmitted at irregular intervals, with several transmissions occurring each second. By staggering the transmission intervals, a receiver has the opportunity to receive a complete transmission from each of several labels **10** that may be in its reception area.

In the preferred embodiment, portions of the encoded data which is considered to be of a higher priority are transmitted more frequently than non-priority encoded data. For example, routing and unique identification information are transmitted in every transmission, whereas the entire contents stored in the data module **42**, which may include additional information such as the contents, weight, date and place of origin of the package, are transmitted in every third transmission.

Data is selectively configured and stored in memory **43**, as shown in **Figure 11**, to enable separation of priority data from non-priority data. In an application such as the routing of a package for mailing, the zip code, city, street, address number and name of the receiver of the package are required to ensure proper delivery of the package. The highest priority data **102**, such as the zip code, is transmitted in every transmission. The lower priority data **104**, **106** and the non-priority data **108** are transmitted at less frequent intervals.

The memory **43** may also be programmed to transmit a message after a predetermined duration has elapsed upon activating the label **10**. For example, if the label **10** is still on a package after one week, the label **10** will transmit a message indicating that the package is lost. This will enable easier identification and tracking of packages which may be misplaced. The data module **42** may be specifically programmed for each application. Accordingly, data may be transmitted in any desired format or interval.

In an alternative embodiment, the label **10** receives an RF signal from an external source, such as an RF transmitter. This signal may include control instructions to control operation of the control module **40** or additional data for storage in the data module **42**. In this embodiment, the modulator **44** is a modulator/demodulator (modem) and the preferred receive RF carrier is 2.45 GHz. The received RF signal is demodulated by the modem **44** and processed by the control module **40**. The control module **40** implements the control instructions and stores received data in the data module **42**. The received data may erase data currently stored in the data module **42** or may be added to the data. In this manner, the contents of the data module **42** may be updated as the package progresses along its predetermined route. Additionally, the desired destination of the package may also be changed to from its original destination to a new destination as the package is en route.

The received control instructions enable or disable specific operating modes of the of the label **10**. For example, if the label **10** is used for routing airline luggage, it would be desirable to instruct the labels **10** to cease all RF transmissions (i.e. "no RF transmission" mode) prior to loading the luggage into the cargo hold of an airplane. Thus, communication interference concerns are eliminated during flight. An "RF transmission" mode may be enabled when unloading the luggage from the cargo hold.

Referring again to **Figure 9**, the data input means **100** is shown. Unprogrammed labels **10** are fed from a supply roll **110** to a programming mechanism **112**. Although a supply roll **110** is shown, a fan fold box may also be utilized. The programming mechanism **112** includes programming probes **114**, **116** and a print head **118** which contact opposite sides of the label **10**. The programming probes **114**, **116** contact corresponding programming contacts **28** on the label **10** as the label **10** is fed past the programming probes **114**, **116**. Simultaneously, the print head **118** prints the information on the reverse side of the label **10**. Direct thermal, thermal transfer, ink jet or other well known printing techniques may be used to print human- or machine-readable information on one side of the label **10**.

The data input means **100** receives the data to be programmed from an external source (not shown) such as a personal computer. The data input means **100** programs the desired data into the label **10** and prints the visible information on the surface of the label **10**. The programming probes **114**, **116** also provide a temporary source of power to the control circuit **14** during programming of the label **10**. The contact between the programming probes **114**, **116** and the programming contacts **128** and the contact between the print head **118** and the label **10** is shown in more detail in **Figure 10**.

Referring again to **Figure 9**, once the label **10** is dispensed, the label **10** is separated from adjoining labels **10** by tearing along a perforation **120** between labels **10.** The label **10** is then affixed to the item to be tracked and is activated by pressing the second battery portion **32** against the first battery portion **18.**

To activate the label **10,** the flexible strip **12** is folded back upon itself as illustrated in **Figures 3, 4** and **5.** The electrolyte **32** operatively contacts the anode **20** and cathode **22** of the first battery component **18**, thereby completing the battery and powering the control circuit **14.** At that point, the data which has been preprogrammed into the label **10** is transmitted by the label **10** via the selected RF carrier for reception by a receiving means. The active RF identification label **10** is particularly suited for use as an airline baggage label where the strip **12** is folded around the handle of a piece of luggage and the adhesive-free portion **35** of the strip **12** contacts the handle. The perforation **31** facilitates easier removal of the label **10** after use.

With reference to **Figure 6** there is shown an alternate embodiment of the RF identification label **50.** The RF identification label **50** is constructed in the same manner and with the same components identified with respect to the label **10** depicted in **Figures 1-5,** with the exception that two separate pieces of material **52, 54** are provided instead of a unitary strip **12.** The label **50** is activated by adhering the two pieces **52, 54** together such that the first battery portion **18** becomes operatively associated via the second battery portion adhesive **32**. To facilitate adherence of the identification label **50** to boxes or other items, an adhesive is provided on the outer side **52** of portion **52** or outer side **58** of portion **54**.

In a second alternative embodiment, shown in **Figure 7**, the electrolyte **32** comprises two inert components **60, 62** which are separately encapsulated. Both components are maintained in a sealed enclosure **64**. The battery is activated by fracturing the encapsulating material **66** between the components, **60, 62**. The sealed enclosure **64** maintains the activated electrolyte **32** in contact with the anode **20** and cathode **22**.

A third alternative embodiment is shown in **Figure 8**. In this embodiment, the label 80 comprises a unitary housing 82 which encloses the control circuit 14 and the battery. In this embodiment, the battery is a zinc-air battery comprising zinc and an aqueous solution of potassium hydroxide. As is well understood by those skilled in the art, exposure of the solution to air (oxygen) will activate the battery **81**. In its inert form the solution is isolated from air with an isolating strip 84. To activate the label 80, the isolating strip 84 is removed from the housing 82, thereby exposing the solution to air. Programming contacts 28 are provided on one face of the housing 82 for access to the control circuit 14 by the data input means **100**. An adhesive 86 is applied to the second face of the label 80 to affix the label 80 onto a package.

Additionally, a bar code label 88 may be provided for optical identification of the label 80.

Although the invention has been described in part by making detailed reference to the preferred embodiment, such detail is intended to be instructive rather than restrictive. It will be appreciated by those skilled in the art that many variations may be made in the structure and mode of operation without departing from the spirit and scope of the invention as disclosed in the teachings herein.

* * * *

Claims:

1. An active RF identification label, comprising: a memory for storing data; RF generating means for generating an RF identification signal based upon said stored data; an activatable battery, connected to said RF generating means, for providing power to said RF generating means; said battery comprising at least a first component and a separate second component such that said battery is activated when said first component comes in operative contact with said second component; said second component including means for maintaining said first and second battery components in operative contact with each other after activation of the battery; whereby said RF identification signal is producible on demand by activation of said battery; and wherein a control unit is coupled to said battery, said RF generating means and said memory, for controlling the generation of said RF identification signal to selectively output data from said memory into said RF identification signal for transmission, said control unit being programmable to output data having a higher priority more frequently than data having a lower priority.

2. The active RF identification label of claim 1, wherein said first battery component comprises an anode and a cathode supported on a dielectric base and said second battery component comprises an electrolyte.

3. The active RF identification label of claim 2, wherein the electrolyte comprises an adhesive applied to a supporting substrate such that the substrate is adhered to the anode and cathode to activate the battery; whereby the adhesive comprises said means for maintaining said first battery component and said second battery component in operational contact with each other.

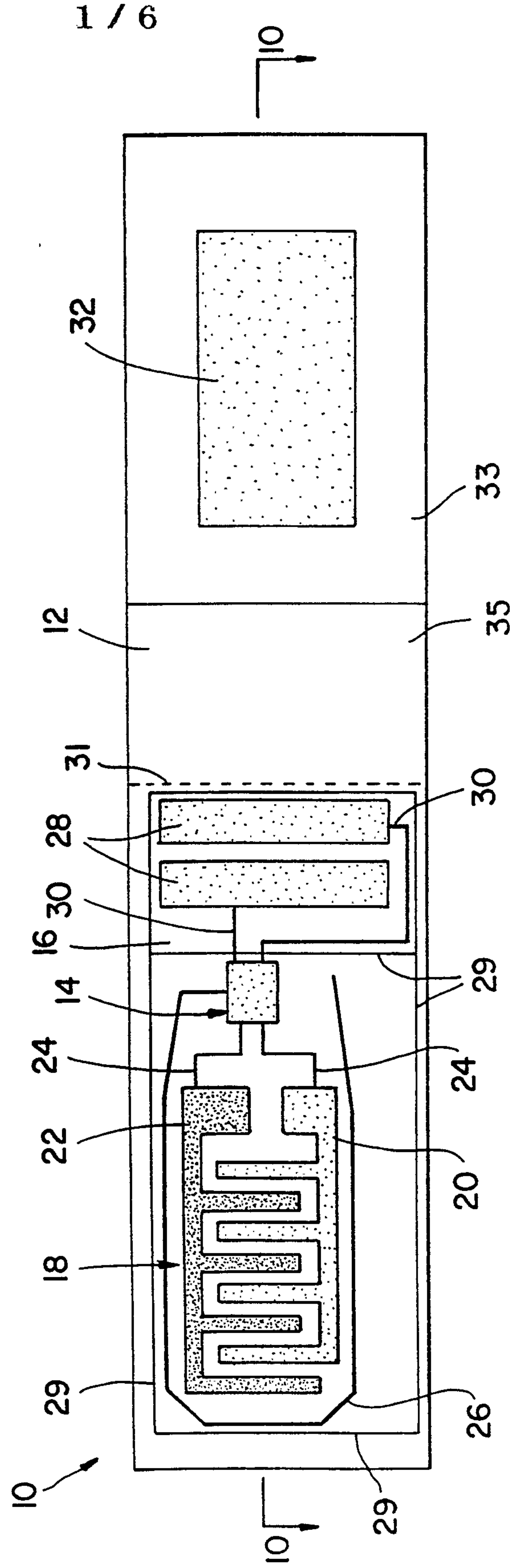
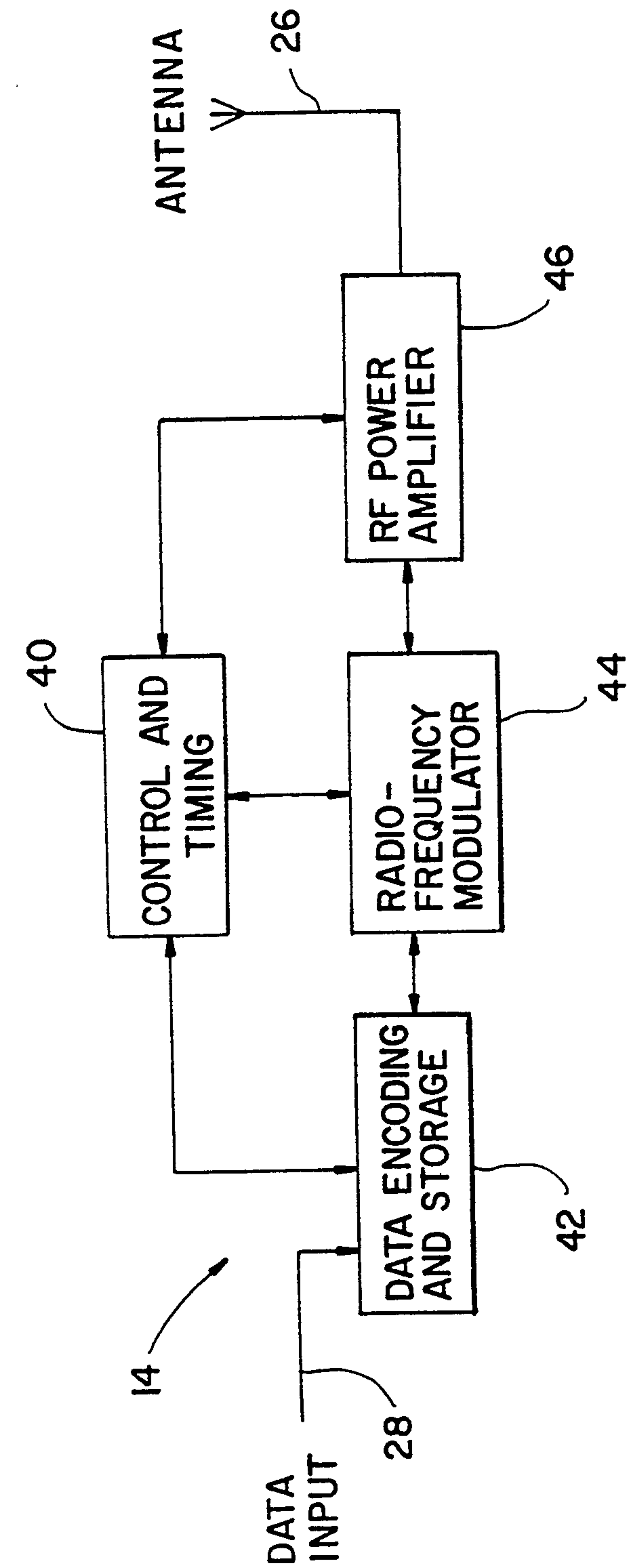


FIG. 1

FIG. 2


ANTENNA
26
RF POWER AMPLIFIER
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CONTROL AND TIMING
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RADIO-FREQUENCY MODULATOR
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DATA ENCODING AND STORAGE
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14
28
DATA INPUT

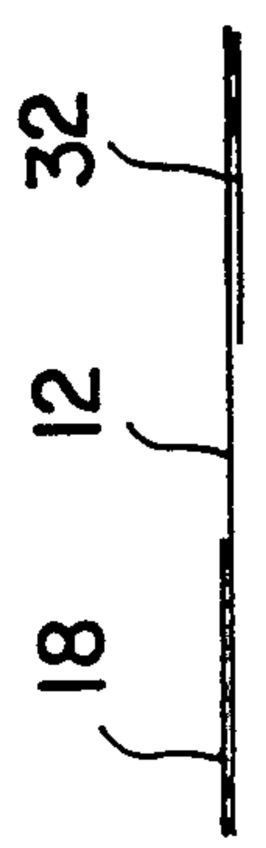

FIG. 3

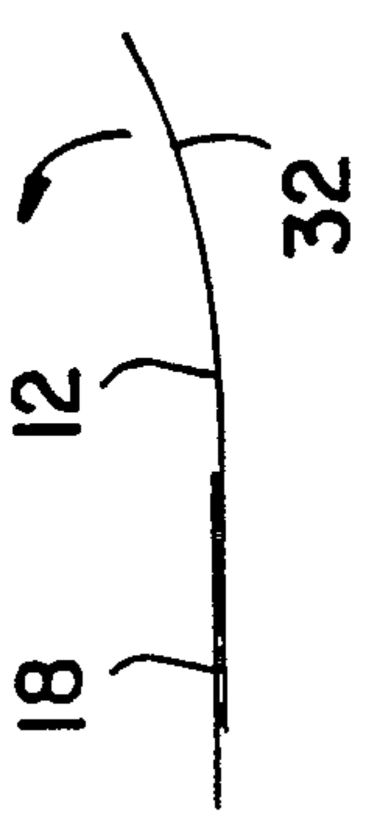

FIG. 4

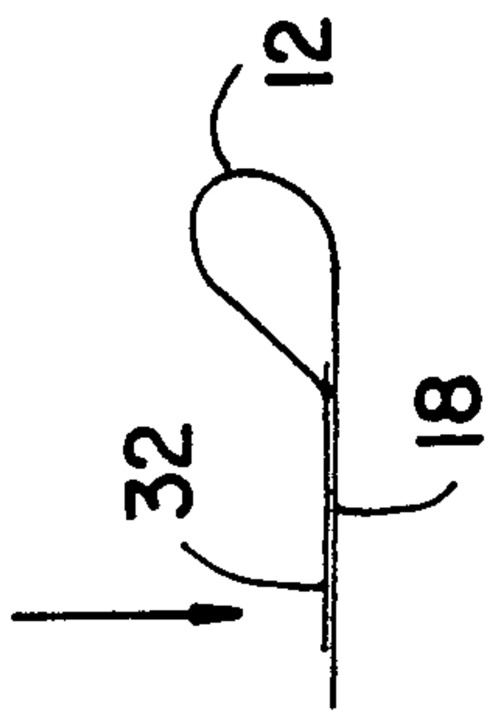

FIG. 5

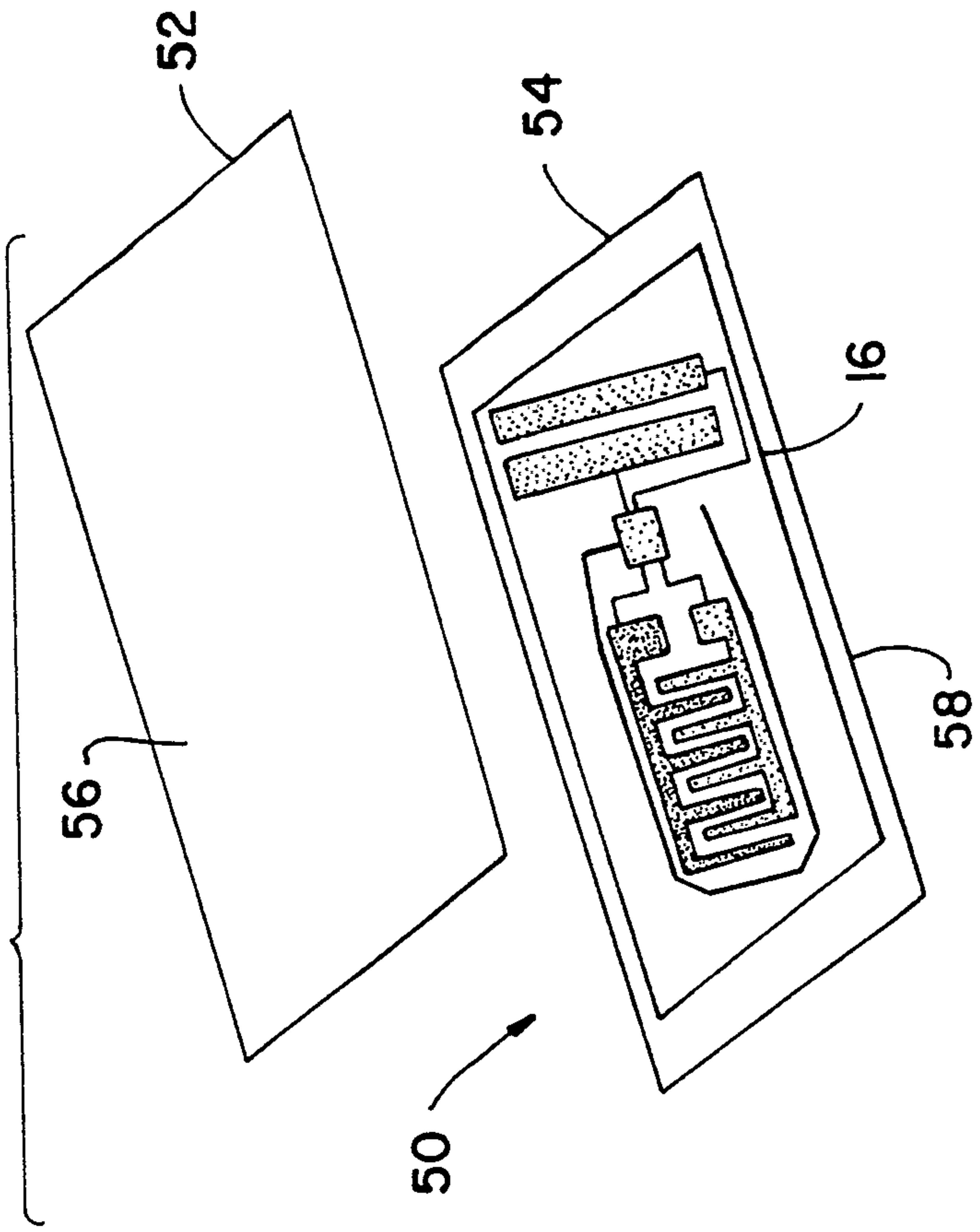

FIG. 6

FIG.7

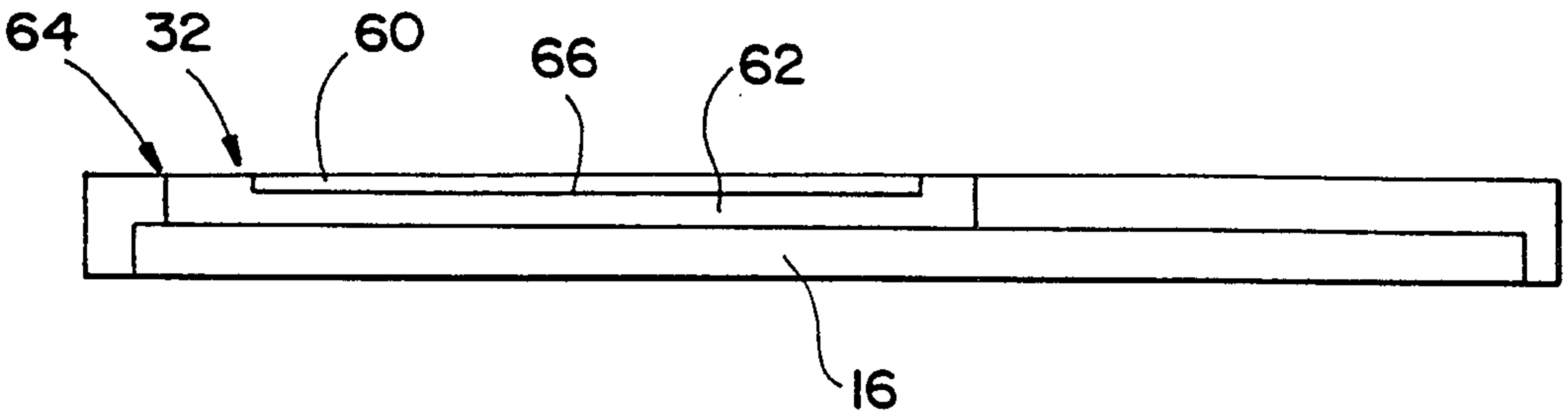

FIG.8

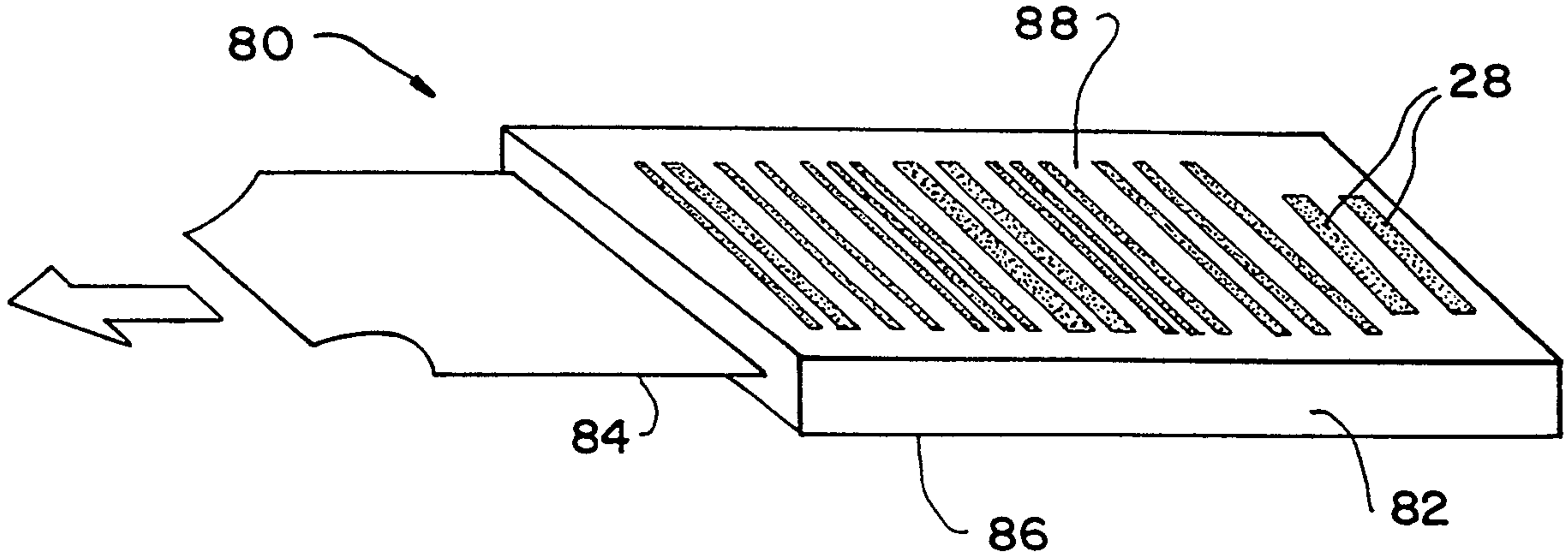

FIG.9

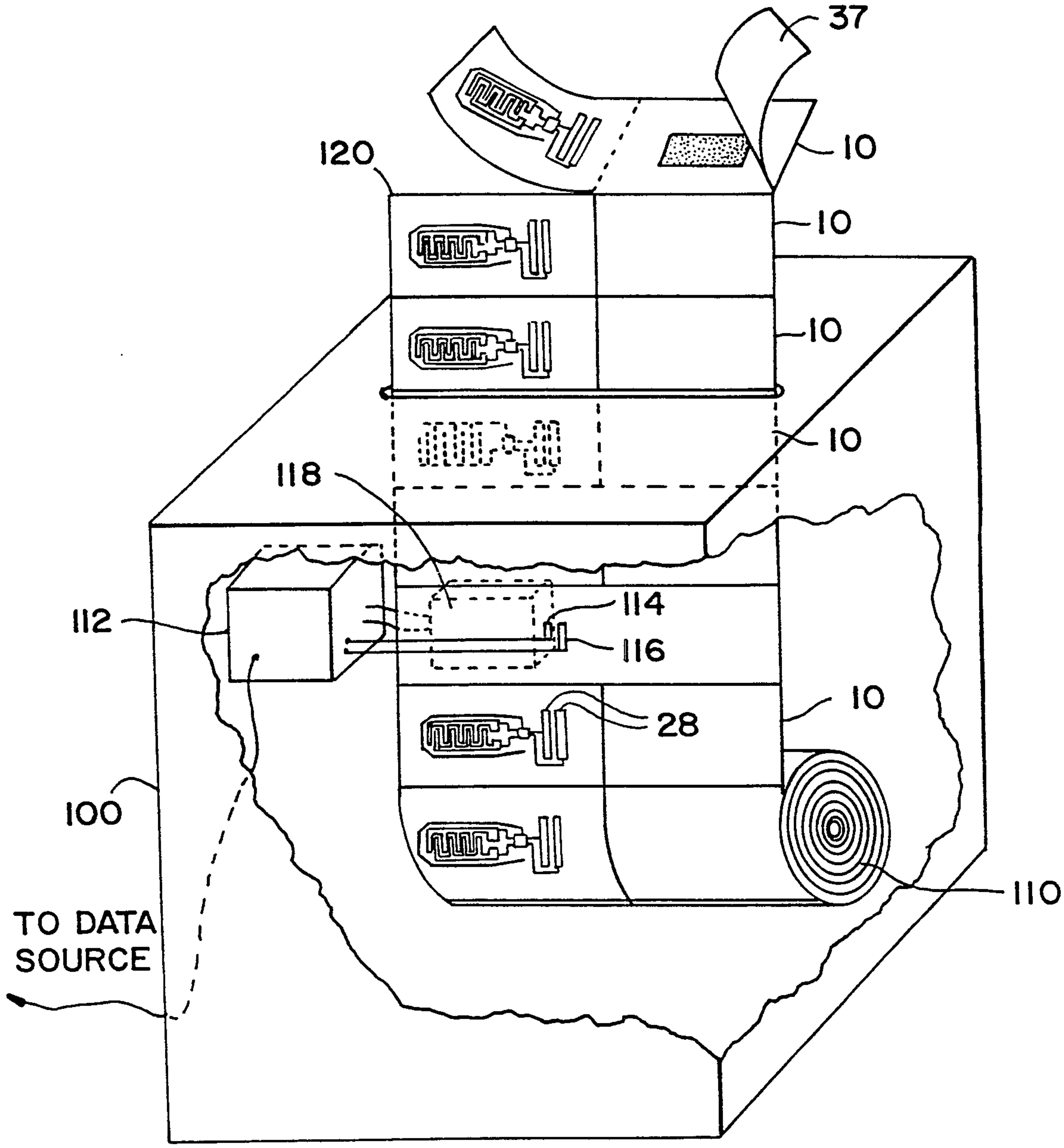

FIG. 10

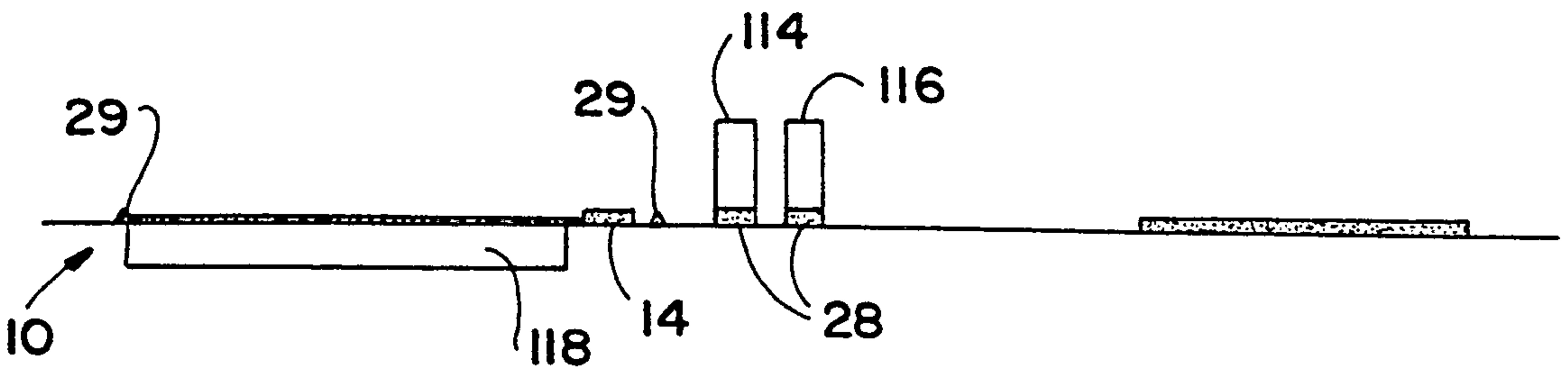
114
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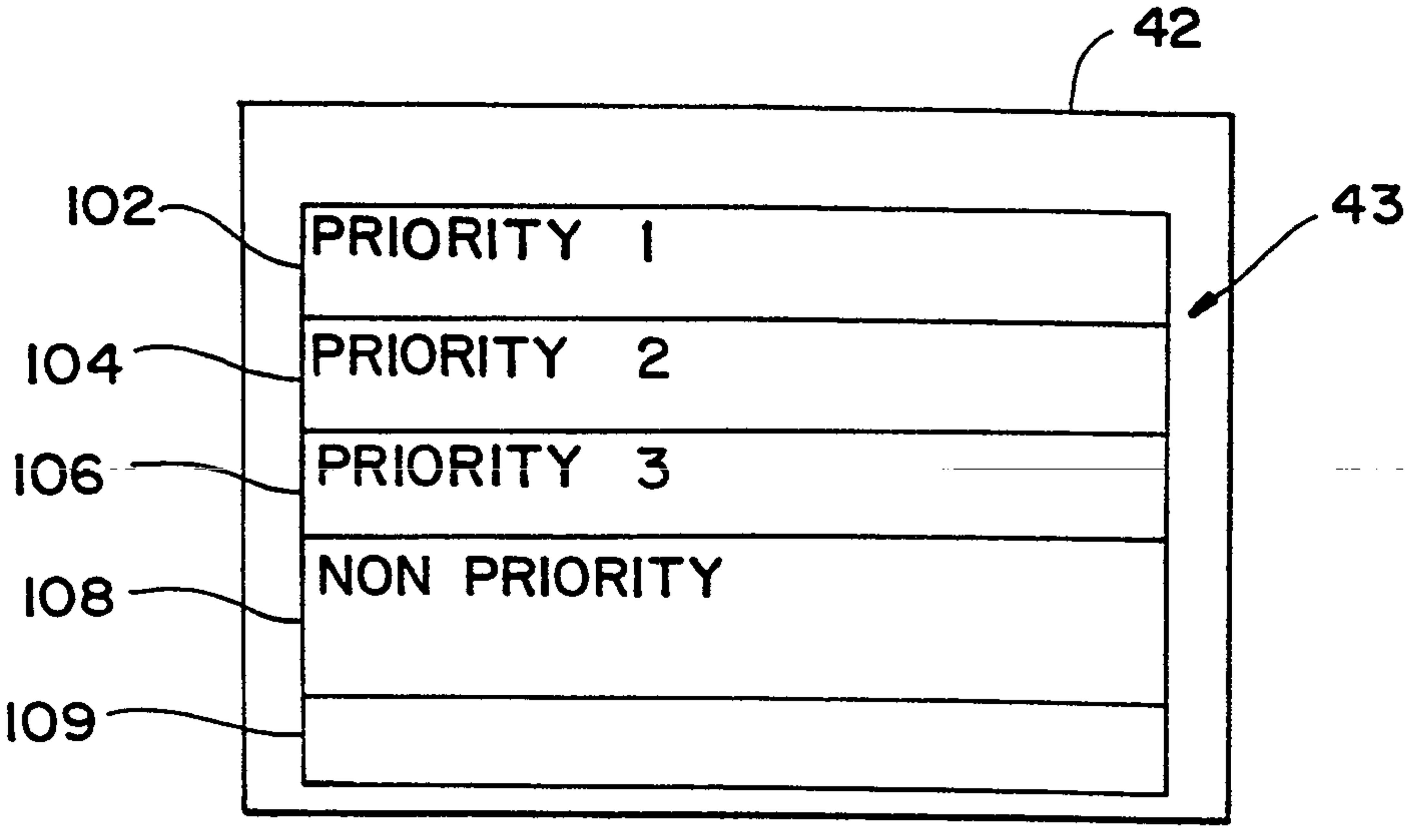
FIG. 11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PRIORITY 2
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PRIORITY 3
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NON PRIORITY
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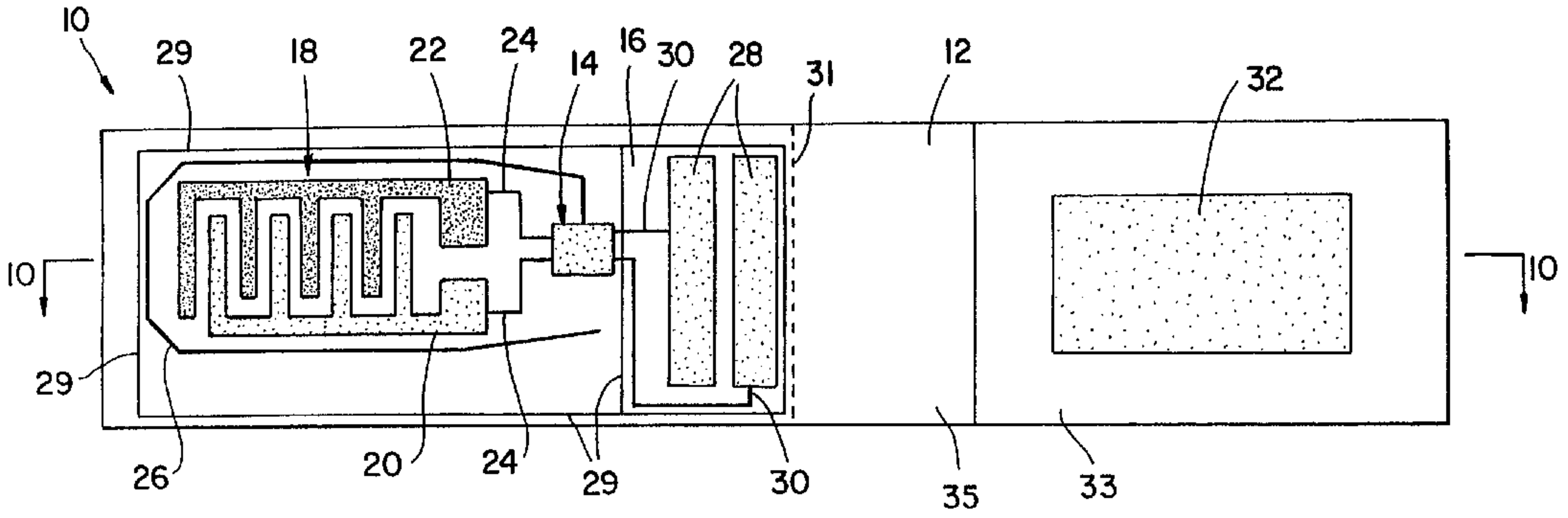

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