



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

**SECURITY APPARATUS FOR THE DETECTION
OF APPROACHING OBJECTS**

Related Application

This application claims priority of United States Provisional Patent Application Serial No. 60/405,280 filed August 22, 2002, which is incorporated herein by reference.

Field of the Invention

5 The present invention relates to security systems for protecting objects or buildings and, more particularly, to a security system and method for detecting objects using capacitive sensing.

Background

10 Security systems using motion detectors and infrared light beams are known in the art. Typically, these conventional systems are operative to send a signal to a security monitoring station, or set off an alarm mechanism, when an intruder breaks the infrared light beam or sensed by the motion detector. Other conventional security systems are known to utilize an electromagnetic field produced by an oscillator in communication with a sensing element or antenna.

15 The sensing element acts as one plate of a capacitor with there being a dielectric, typically air, and a second sensing element as the opposing plate. In the case of a person being an approaching conductive object moving into the capacitive field between the first and second sensing elements, a frequency and/or phase shift of the oscillator signal occurs which can be monitored and

20 utilized to develop a warning signal that an object is present within the capacitor sensing field.

 An example of such a system is disclosed in U.S. Patent No. 4,169,260. The '260 patent discloses a system which includes a housing containing object detection circuitry disposed inside an item or object to be protected such as a

25 file cabinet. A sensing element is provided for generating an approach sensitive field around each object desired to be protected. In cases of metal

objects such as doorframes, file cabinets, or art sculptures, the object being protected may be implemented as the sensing element.

However, many conventional systems suffer from a number of problems including delivering false warnings due to high noise environments and/or an inability to be used with a wide range of applications, such as on doors, windows, art works, etc. Accordingly, there is a need for a security system that has utility in many security applications and is substantially immune to false alarms due to noisy environments. The present invention provides a system which may be used in securing a variety of objects such as file cabinets, art works and the like as well as having utility in detecting intrusion into buildings.

Summary of the Invention

The present invention provides a security apparatus and method for detection of approaching objects comprising at least one control unit operative to monitor a reference signal indicative of a secure environment surrounding at least a portion of an object being protected. The control unit is provided in electrical communication with at least one alarm mechanism for triggering an alarm or for alerting security personnel others when the secured environment has been breached.

At least one variable oscillator is provided in communication with the control unit whereby the oscillator is operative to continuously generate at least one sensing field signal. The sensing field signal generated is equivalent to the reference signal being monitored by the control unit.

At least one field-generating sensing element is provided and disposed on or near the object to be protected and is in electrical communication with the oscillator. The field-generating sensing element is operative to receive the sensing field signal from the oscillator and to generate an object-sensing field.

In operation, the security system allows for the sensing field signal to change in response to a disturbance being detected by the object-sensing field. Thereafter, the control unit monitoring the reference signal and the sensing field signal generates an object-detection signal in response to detecting a

difference between the sensing field signal and the reference signal. The object-detection signal generated by the control unit is operative to activate the at least one alarm mechanism. In this manner, the present invention provides a security system that has utility for a plurality of applications including individual object protection as well as for detecting intrusion into buildings.

Brief Description of the Drawings

A better understanding of the present invention will be had upon reference to the following detailed description when read in conjunction with the accompanying drawings in which like parts are given like reference numerals and wherein:

Figure 1 illustrates the security system of the present invention being utilized to protect various objects as well as to protect against intrusion;

Figure 2 illustrates the security system of the present invention being utilized to secure an object disposed in a picture frame;

Figure 3 illustrates the security system of the present invention being utilized to protect a non-metallic object; and

Figure 4 illustrates a variable oscillator circuit as according to the invention.

Detailed Description of the Invention

With reference to Figure 1, the security system 10 for use in protecting objects and buildings against intrusion is generally illustrated. The security system 10 preferably includes at least one control unit housing 12 having at least one control unit 14 disposed therein. Each control unit 14 is operative to transmit and receive signals to and from the various components that make up the security system 10 to be described in detail hereinafter. It is appreciated that the control unit 14 contains at least one signal processing circuit including application software for facilitating the method of securing objects and/or buildings against intrusion utilizing capacitive-sensing techniques.

The control unit 14 may be adapted to communicate through wire connections or wirelessly, to facilitate system communication. Preferably, the

control unit housing 12 includes at least one electrical connection point, such as a jack or plug, for connecting a communication cable, such as a coaxial cable to each control unit 14 housed therein to support wired communication. One or more of the security system 10 components may be powered via conventional power sources such as AC outlets, batteries, solar cells, and/or other power generating devices.

The control unit 14 may include a wireless transceiver operative to transmit and receive at least one RF signal to other components of the system 10. However, in this fashion, the control unit can communicate with a standard transmitter to other parts of the system. It is appreciated, however, that the system may be designed to operate efficiently at distances greater than 20 without exceeding the scope of the invention.

At least one alarm mechanism 15 is provided in communication with the control unit 14. Although illustrated as an audible device, the alarm mechanism 15 may be any device operative to trigger an alarm or alert security personnel that a breach has occurred within the security system 10. Such devices or mechanisms may illustratively include audible or visual alarms, tactile alarms, silent alarms such dialing a telephone to alert security personnel, and/or alarm signals that cause the trigger or actuation of a supplemental security measure such as automatically closing security gates, windows or doors. The alarm mechanism 15 may be provided in wired or wireless communication with the control unit 14 as desired for various security applications.

At least one variable oscillator circuit 32 is provided in communication with the control unit 14. The variable oscillator circuit 32 is operative to generate at least one sensing field signal equivalent to the reference signal being monitored by the control unit 14. The variable oscillator circuit 32 provides the sensing field signal to a sensing element 28, to be described in detail hereinafter, that is responsible for generating an object-sensing field. Preferably, the variable oscillator circuit 32 includes an inductor/capacitor (LC) tank circuit comprised of a dual inline pin (DIP) switch 38 that interconnects

with a plurality of inductors 36 and capacitors 34 in parallel and/or series fashion such that values of the inductors 36 and capacitors 34 are selectable by proper selection of the individual switches of the DIP switch 38.

5 An integrated circuit (IC) oscillator 33 is provided in communication with the LC tank circuit and the sensing element 24. The (IC) oscillator 33 operates to echo the sensing field signal produced by the tank circuit to the sensing element. Further, the (IC) oscillator 33 operates to provide feedback the tank circuit to counter damping effects that cause attenuation to the sensing field signal.

10 Other types of oscillator circuits 32 may be used for this purpose and illustratively include crystal oscillators, resistor capacitor oscillators, integrated circuit oscillators or other types of continuous-frequency or steady-state signal generators.

15 As best illustrated at Figures 2 and 3, at least one field-generated sensing element 28 is disposed on or near the object to be protected or the entry to be protected against intrusion. Figure 1 illustrates how the security system 10 can be implemented to guard against intrusion when disposed on an entry door 24 or window 18.

20 Figures 2 and 3 illustrate how a field-generating sensing element 28 of the security system 10 is implemented to protect individual objects 20 and 22 against other damage. The at least one field-generating sensing element 28 may be provided in the form of a conductive metallic material such as a metal plate, resiliently durable metallic tape or a metal foil. Various metals that may be used to form the field-generating sensing element 28 illustratively include
25 copper, aluminum, silver, brass or other highly conductive metal. Preferably, when disposed on an object such as a picture frame 20 or perimeter of a window 18, the field-generating sensing element 28 is provided in the form of a metallic tape having physical characteristics similar to Mylar® tape, particularly resiliency and durability. If the object to be protected is metallic
30 then the oscillator circuit 32 may be coupled capacitively or directly to the object such that the object itself operates as the sensing element. Capacitive

coupling would require that a layer of dielectric material be disposed between the oscillator circuit and the metal object.

Illustratively, if the picture frame 20 or window 18 for which the security system 10 is attached to is metal, then the metallic tape may be constructed as a laminate having an adhesive layer, a thin dielectric layer, a conductive metal layer and an insulated layer, preferably Mylar®, as covering for the field-generating sensing element 28. In this fashion, a field-generating sensing element 24 may be disposed around the perimeter of the object or entry to be protected by simply attaching the sensing element 28 at its adhesive side about the object or area to be protected. In cases where the metal object is of small size, the oscillator may be directly coupled thereto without the need for dielectric material. It is appreciated that a field-generating sensing element 28 provided in the form of a metal tape material is made to be resiliently flexible and durable to facilitate protecting objects of various shapes and sizes accordingly.

A field-generating sensing element 28 may be attached to a metal door 24 via capacitive coupling whereby the door or other metal object may be used as an extension of field-generating sensing element 28. To accomplish this, a field-generating sensing element 24 is capacitively coupled to the metal door 24 via a layer of dielectric material. In such a case, the field-generating sensing element 28 may be provided in the form of a metal plate laminated with the dielectric material and disposed on the metal door via an adhesive layer applied to the dielectric as best shown in Figure 1. The plate or sensing element 28 has a relatively small area with regard to the size of the door, preferably six square inches for a standard-sized door. Also, the distance between the control unit 14 and the oscillator circuit 32 should preferably not exceed 20 feet using wired communication because of signal attenuation caused by the communication cable 30.

As illustrated in Figure 3, the plate form of the field-generating sensing element 28 can also be utilized for protecting a non-metallic object 22 whereby the field-generating sensing element 28 is disposed adjacent the non-metallic

object such that the sensing field surrounds or covers a portion of the non-metallic device 22.

5 A field-generating sensing element 28 is provided in electrical communication with the variable oscillator circuit 32 such that the field-generating sensing element 28 is operative to receive the sensing field signal and generate an object-sensing field. In this manner, if the object-sensing field is disturbed by an approaching conductive object then the sensing field signal changes which causes the control unit 14 to generate an object-detection signal. The object-detection signal is generated in response to the control unit 14
10 detecting a difference between the sensing field signal and the reference signal being monitored by the control unit 14. Thereafter, the object-detection signal generated by the control unit 14 causes the at least one alarm mechanism 15 to be activated.

As described, the security system 10 may be comprised of a plurality of
15 field-generating sensing elements 28 whereby at least one of the field-generating sensing elements 28 can be disposed on at least one of a plurality of objects or entryways to be protected. In such case, the security system 10 may also be comprised of a plurality of variable oscillator circuits 32 whereby each of the variable oscillator circuits 32 is in electrical
20 communication with at least one field-generating sensing element 28. In this manner, the different oscillator circuits 32 may be tuned to different frequencies so that each will work independent of the other without causing interference or disruption to system operation. Preferably, a control unit 14 is placed in communication with each of the variable oscillator circuits 33 such
25 that each object being protected has a dedicated security system. However, a single oscillator circuit 32 may be connected in parallel to two or more objects without sacrificing system performance.

As described above, the control unit 14 may be placed in communication with the oscillator circuit 32 of the security system 10 in
30 wireless or wired communication. As best illustrated in Figure 1, the oscillator circuit 32 may be disposed in a remote sensor box 12 having at least one

remote monitor card that is operative to perform the function of the control unit as described above (not shown). The remote monitor card (RMI) preferably includes the oscillator circuit 32 as well as at least one transmitter for communicating with the alarm mechanism 15 wirelessly.

5 The control unit 14 or (RMI) preferably includes an object-detection circuit that is operative to activate the alarm mechanism 15 after distinguishing between a true disturbance and electrical noise caused by electro-magnetic interference (EMI). The object-detection circuit may be adapted to activate the alarm mechanism 15 after detecting a disturbance for a pre-determined period
10 of time or after a pre-determined number of sequential disturbances have been detected.

 A method for securing an object or a building using the security system
10 comprises providing at least one control unit 14 operative to monitor a reference signal. The control unit 14 is placed in communication with at least
15 one alarm mechanism 15 for sounding an alarm upon detecting an approaching object or intrusion. Next, at least one variable oscillator circuit 32 is provided in communication with the control unit 14 and is operative to generate at least one sensing field signal equivalent to the at least one reference signal. Thereafter, at least one field-generating sensing element 28 is disposed on or
20 near the object or building to be protected such that the field-generating sensing element 28 is in electrical communication with the oscillator circuit 32.

 As described above, the field-generating sensing element 28 is operative to receive the sensing field signal from the oscillator circuit 32 and to generate an object-sensing field. When a disturbance is detected by the
25 object-sensing field the sensing field signal changes. Thereafter, the control unit 14 generates an object-detection signal in response to detecting a difference between a sensing field signal and the reference signal whereby that the object-detection signal is operative to activate the at least one alarm mechanism 15 when the objects are in close proximity.

30 From the foregoing, a security system that has utility in a wide range of security applications is provided. The system may be successfully used for

securing individual objects such as file cabinets, art works and the like as well as for use in detecting intrusion into buildings. Having described the invention, however, many modifications thereto may become apparent to those skilled in the art to which it pertains without deviation from the spirit of the invention as

5 defined by the scope of the appended claims.

We claim:

CLAIMS

- 1 1. A security system for securing a stationary object comprising:
2 at least one control unit operative to monitor at least one reference
3 signal;
4 at least one alarm mechanism in communication with said control unit;
5 at least one variable oscillator circuit in communication with said
6 control unit and operative to generate at least one sensing field signal
7 equivalent to the at least one reference signal; and
8 at least one field-generating sensing element disposed on or near the
9 stationary object and in electrical communication with said oscillator circuit,
10 said at least one field-generating sensing element being operative to receive
11 said sensing field signal and to generate an object-sensing field whereby the
12 sensing field signal changes in response to a disturbance being detected by said
13 object-sensing field, and said control unit being operative to generate an
14 object-detection signal in response to detecting a difference between said
15 sensing field signal and said reference signal, said object-detection signal
16 operative to activate the at least one alarm mechanism.
- 1 2. The system of claim 1 comprising a plurality of field-generating
2 sensing elements whereby at least one of said field-generating sensing elements
3 is disposed on at least one of a plurality of stationary objects.
- 1 3. The system of claim 2 comprising a plurality of variable
2 oscillator circuits whereby each of said variable oscillator circuits is in
3 electrical communication with one of said plurality of field-generating sensing
4 elements and a control unit.
- 1 4. The system of claim 1 wherein the control unit is in wireless
2 communication with said alarm mechanism.

1 5. The system if claim 4 wherein the oscillator circuit is disposed
2 in a remote sensor control box including at least one remote monitor card.

1 6. The system of claim 1 wherein the control unit is further
2 operative to generate a fail safe signal in response to detecting an open or short
3 circuit at the field-generating sensing element, said fail safe signal operative to
4 activate a fail safe alarm.

1 7. The system of claim 1 wherein said control unit further
2 comprises an object-detection circuit being operative to activate said alarm
3 mechanism after detecting the disturbance for a predetermined period of time.

1 8. The system of claim 1 wherein said control unit further
2 comprises an object-detection circuit being operative to activate said alarm
3 mechanism after detecting a predetermined number of sequential disturbances.

1 9. The system of claim 1 wherein the field-generating sensing
2 element is formed of a laminate comprising an adhesive layer and electrically
3 insulating cover layer.

1 10. A method of securing an object or building comprising:
2 providing at least one control unit operative to monitor at least one
3 reference signal;
4 providing at least one alarm mechanism in communication with said
5 control unit;
6 providing at least one variable oscillator circuit in communication with
7 said control unit and operative to generate at least one sensing field signal
8 equivalent to the at least one reference signal; and
9 disposing at least one field-generating sensing element on or near the
10 object or building whereby said field-generating sensing element is in electrical
11 communication with said oscillator circuit, said at least one field-generating

12 sensing element being operative to receive said sensing field signal and to
13 generate an object-sensing field whereby the sensing field signal changes in
14 response to a disturbance being detected by said object-sensing field, and said
15 control unit being operative to generate an object-detection signal in response
16 to detecting a difference between said sensing field signal and said reference
17 signal, said object-detection signal operative to activate the at least one alarm
18 mechanism.

1 11. A security system for securing a metal object comprising:
2 at least one control unit operative to monitor at least one reference
3 signal;
4 at least one alarm mechanism in communication with said control unit;
5 at least one variable oscillator circuit in communication with said
6 control unit and operative to generate at least one sensing field signal
7 equivalent to the at least one reference signal; and
8 at least one conductive plate capacitively coupled to the metal object and
9 in electrical communication with said oscillator circuit, said conductive plate
10 being operate to receive said sensing field signal and to couple the sensing field
11 signal to the metal object whereby the metal object is caused to generate an
12 object-sensing field, and whereby the sensing field signal changes in response
13 to a disturbance being detected by said object-sensing field, and the control unit
14 being operative to generate an object-detection signal in response to detecting a
15 difference between said sensing field signal and said reference signal, said
16 object-detection signal operative to activate the at least one alarm mechanism.

1 12. The system of claim 14 wherein the conductive plate is formed
2 of copper or brass.

1 13. The system of claim 14 further comprising a dielectric material
2 disposed between the conductive plate and metal object.

1 14. The system of claim 13 wherein the conductive plate is covered
2 with an electrically insulating layer.

1 15. The system of claim 14 wherein said control unit further
2 comprises an object-detection circuit being operative to activate said alarm
3 mechanism after detecting the disturbance for a predetermined period of time.

1 16. The system of claim 14 wherein said control unit further
2 comprises an object-detection circuit being operative to activate said alarm
3 mechanism after detecting a predetermined number of sequential disturbances.

1 17. The system of claim 14 wherein the at least one variable
2 oscillator circuit is in wireless communication with said control unit.

1 18. The system of claim 17 wherein the oscillator circuit is disposed
2 in a remote sensor control box having at least one remote monitor card.

FIG - 1

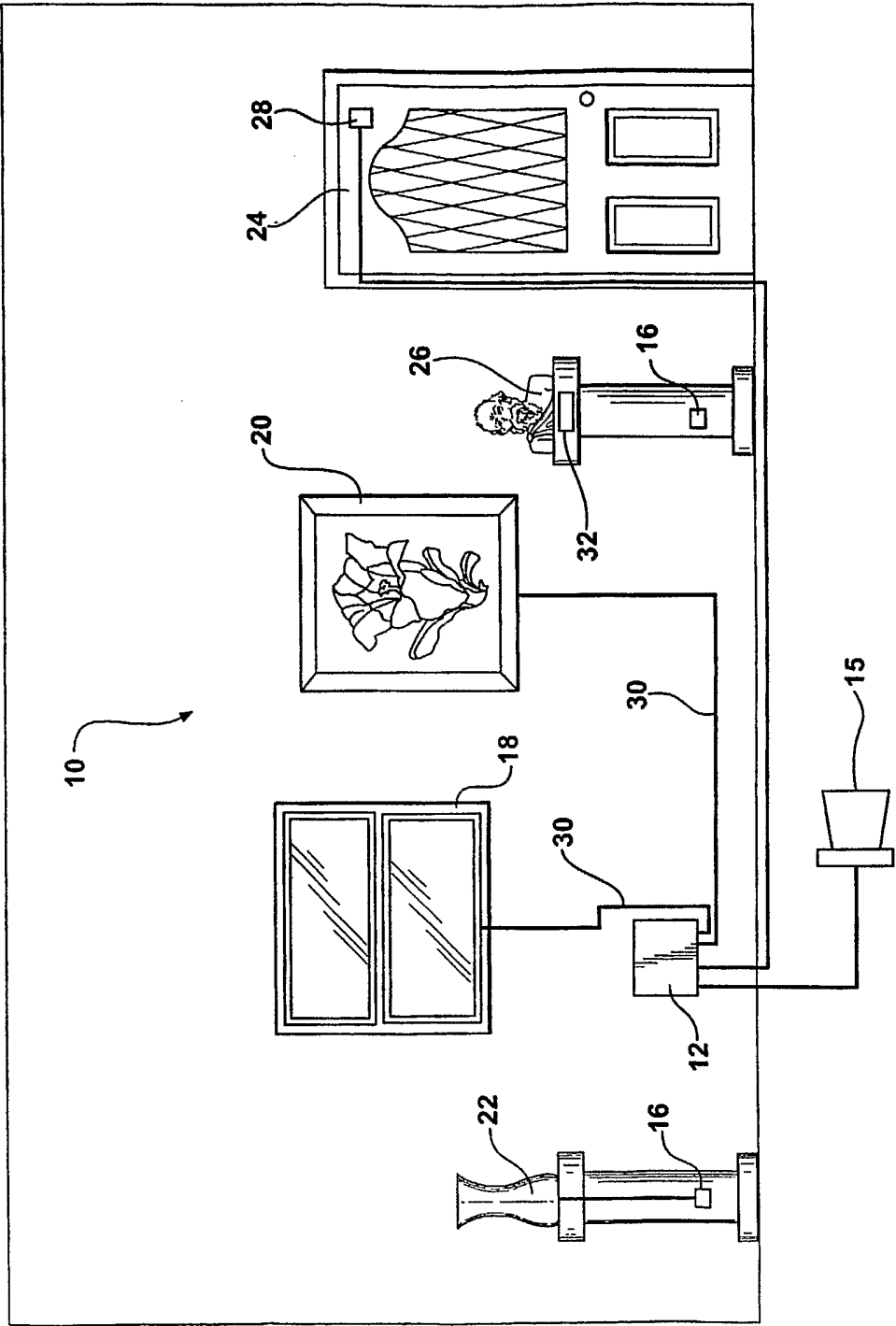
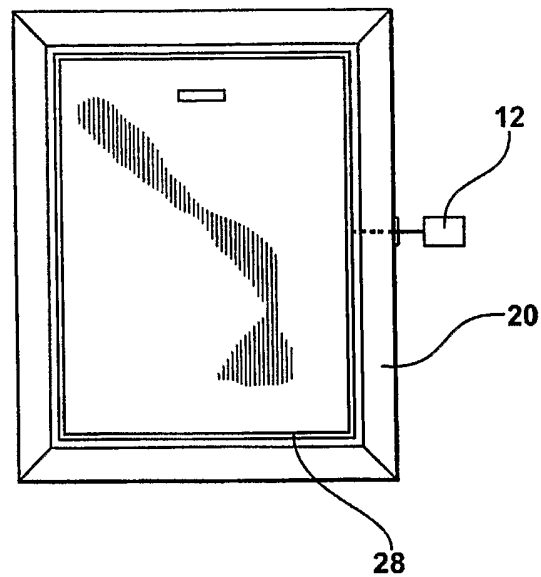
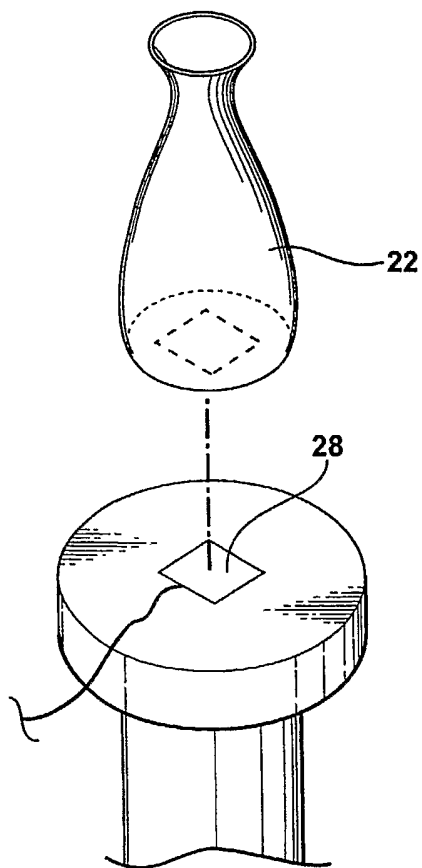


FIG - 2**FIG - 3**

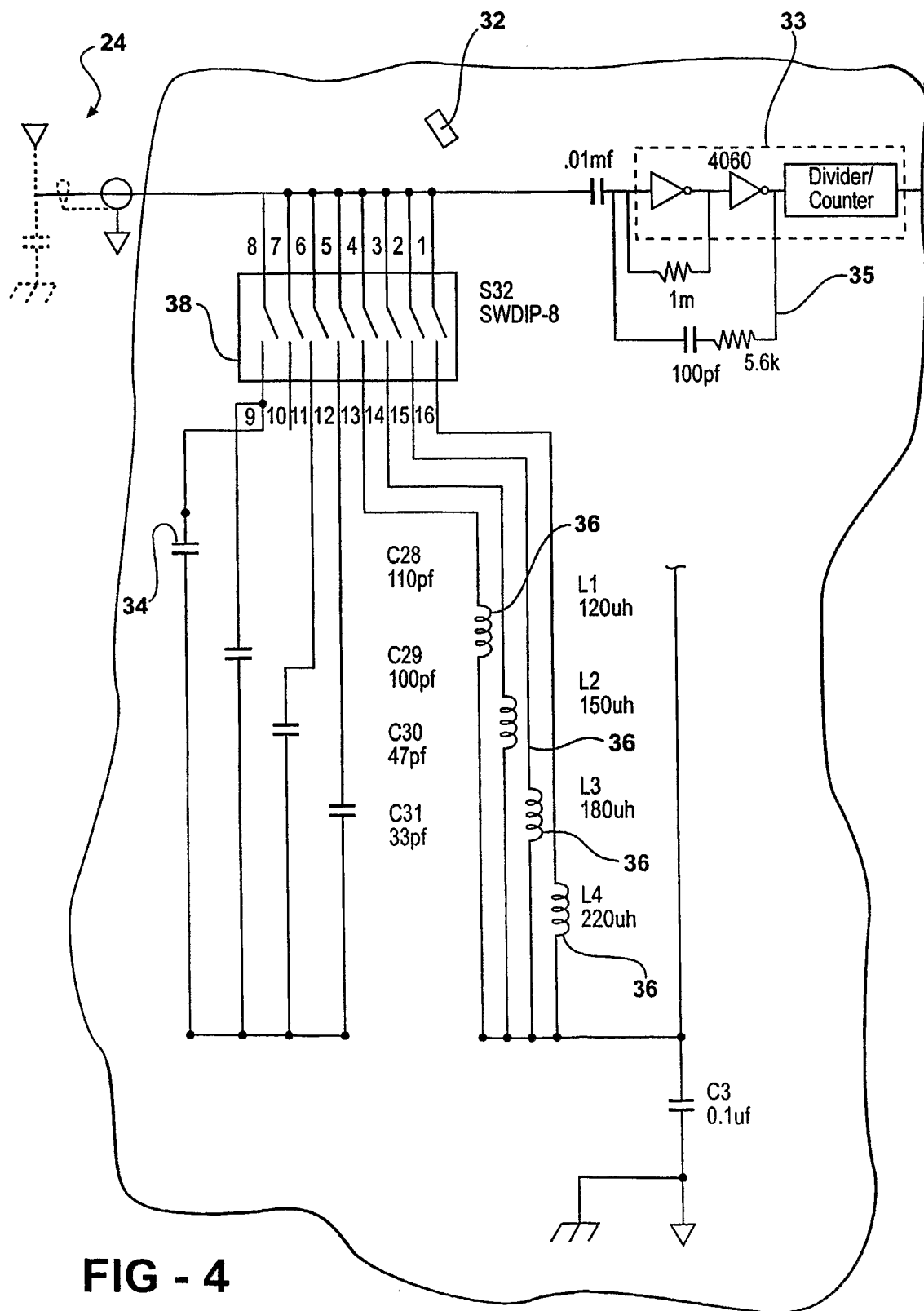


FIG - 4