

Description

Background of the Invention

The present invention generally pertains to frequency dividers and is particularly directed to an improved frequency divider for use as an electronic tag in a presence detection system.

A presence detection system utilizing a frequency divider as an electronic tag is described in GB-A-2017454. Such system includes a transmitter for transmitting a scanning signal at a first frequency in a surveillance zone; an electronic tag including an active frequency divider for detecting electromagnetic radiation at the first frequency and for transmitting a presence signal in response thereto at a second frequency that is a submultiple of the first frequency; and a receiver for detecting electromagnetic radiation at the second frequency to thereby detect the presence of the electronic tag in the surveillance zone. The electronic tags are attached to articles of which detection is desired for enabling detection of the presence of such articles in the surveillance zone. Such presence detection systems are useful for detecting shoplifting, as well as for other applications.

A few examples of such other applications include detecting the presence of a person or vehicle carrying an electronic tag in a surveillance zone; detecting the presence of articles bearing electronic tags within a surveillance zone along an assembly line, and detecting the presence of keys attached to electronic tags in a surveillance zone at the exit of an area from which such keys are not to be removed.

The electronic tag is encased in a small card-shaped container that can be attached to an article in such a manner that it cannot be removed from the article without a special tool. When used in shoplifting detection systems, a sales clerk uses such a special tool to remove the electronic tag from the merchandise that is paid for; and the surveillance zone is located near the doorway for enabling detection of articles from which the electronic tags have not been removed.

The electronic tag described in the aforementioned GB-A-2017454 includes a complex frequency divider. This may be powered by an expensive long-life miniature battery, or by self-energisation from the received signal. Other prior art frequency dividers also utilize either a battery or an external power supply.

Another presence detection system for the protection of merchandise is described in GB-A-1129761. Such system includes a first resonant LC circuit that is resonant at a first frequency for detecting electromagnetic radiation at the first frequency; a second resonant LC circuit that is resonant at a second frequency for transmitting electromagnetic radiation at the second frequency; and a semiconductor switching device having gain that couples the first and second resonant circuits for causing the second circuit to transmit electromagnetic radiation at the second frequency solely in response to energy at the first

frequency provided in the first circuit upon receipt of electromagnetic radiation at the first frequency. The first resonant circuit that receives the electromagnetic radiation at the first frequency is a part of a power supply circuit that rectifies the received energy to provide a DC supply voltage to the semiconductor switching device. The second resonant circuit may be tuned to a selected second frequency that is unreleased to the first frequency of the first resonant circuit.

Further presence detection systems for the protection of merchandise are described in GB-A-1297279. One such system includes a receiving coil and a Colpitts oscillator having a resonant LC circuit for transmitting electromagnetic radiation at the resonant frequency of the resonant circuit solely in response to unrectified energy provided in the coil upon receipt of electromagnetic radiation by the coil.

Summary of the Invention

The present invention is a frequency divider that may be operated without a battery or any external power supply. Accordingly, the frequency divider of the present invention is portable, and inexpensive and is ideally suited for use as an electronic tag in a presence detection system.

According to the present invention, there is provided a frequency divider, comprising a first circuit that is resonant at a first frequency for detecting the electromagnetic radiation at the first frequency; a second circuit that is resonant at a second frequency for transmitting electromagnetic radiation at the second frequency; and a semiconductor switching device having gain coupling the first and second circuits for causing the second circuit to transmit electromagnetic radiation at the second frequency solely in response to energy at the first frequency provided in the first circuit upon receipt of electromagnetic radiation at the first frequency, characterized in that the second circuit is resonant at a second frequency that is an integer submultiple of the first frequency, and the energy to which the semiconductor switching device responds is unrectified.

Additional features of the present invention are described in the description of the preferred embodiments given by way of example.

Brief Description of the Drawing

Figure 1 is a schematic circuit diagram of a preferred embodiment of the frequency divider of the present invention.

Figure 2 illustrates the waveform of the emitter voltage in the frequency divider of Figure 1.

Figure 3 illustrates the waveform of the collector voltage in the frequency divider of Figure 1.

Figure 4 illustrates the waveform of the base voltage in the frequency divider of Figure 1.

Figure 5 is a schematic circuit diagram of an alternative preferred embodiment of the frequency divider of the present invention.

Figure 6 is a schematic circuit diagram of

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another alternative preferred embodiment of the frequency divider of the present invention.

Figure 7 is a schematic circuit diagram of still another alternative preferred embodiment of the frequency divider of the present invention.

Description of the Preferred Embodiments

Referring to Figure 1, a preferred embodiment of the frequency divider of the present invention includes a first LC circuit consisting of a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; and a transistor Q1. The first LC circuit is resonant at the first frequency; and the second LC circuit is resonant at a second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q1 is a bipolar pnp transistor. The emitter of the transistor Q1 is connected to the other side 14 of the first LC circuit. The collector of the transistor Q1 is connected to one side 16 of the second LC circuit; and the base of the transistor Q1 is connected to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The operation of the frequency divider shown in Figure 1 is described with reference to the waveforms of the voltages at the transistor terminals as illustrated in Figures 2, 3 and 4. The zero voltage reference point in the frequency divider is the center tap 10 of the second coil L2. These waveforms were taken from an oscilloscope and show only the free running conditions. They do not show the starting conditions.

At the start, all portions of the frequency divider are at zero volts. The transistor Q1 becomes turned on to enable conduction between the emitter and the collector when the emitter-to-base voltage exceeds 0.6 volts. Accordingly, when the first LC circuit L1, C1 detects electromagnetic radiation at the first frequency of such intensity as to provide a voltage across the first coil L1 in excess of 0.6 volts, the transistor Q1 is turned on. Once the transistor Q1 is turned on, current begins to flow to the second coil L2 from the first coil L1. The resultant current build-up in the second coil L2, augments the forward bias of the transistor Q1 and the free running operation of the frequency divider commences.

Referring to the waveforms of Figures 2, 3 and 4, during the free-running conditions, the transistor Q1 is turned on at point A in each cycle when the emitter voltage is at approximately 0.3 volts and the base voltage is at approximately -0.3 volts. The emitter voltage then flattens out as

current flows from the first inductor L1 to the second inductor L2.

The transistor Q1 remains on and conducting until the voltage across the first coil L1 (as represented by the emitter waveform of Figure 2) decreases to the point that the forward bias of the transistor Q1 cannot be sustained.

At point B in each cycle, the transistor Q1 is off and not conducting because its base-to-emitter junction and its collector-to-emitter junction both are reverse biased.

At point C in each cycle, the transistor Q1 is still off and not conducting because the collapsing field across the second coil L2 creates a positive bias on the base which is sufficient to prevent the transistor from becoming turned-on even though the emitter voltage rises above its value at point A.

When point A in each cycle is reached again, the transistor Q1 is turned on and current again flows from the first inductor L1 to the second inductor L2.

The frequency divider of Figure 1 is operable at relatively high power levels. Even though high level signals detected by the first resonant circuit L1, C1 increase the emitter voltage at point C in each cycle, the correspondingly greater amount of energy transferred to the second coil L2 causes the positive bias on the base of the transistor Q1 to also increase sufficiently at point C in each cycle to keep the transistor Q1 off. Excessive current between the base of the transistor Q1 and the other side 18 of the second coil L2 can be limited by a resistance, a capacitance or a parallel combination thereof.

The resonant frequency of the second circuit L2, C2 may be other than one-half the resonant frequency of the first circuit L1, C1. However, the frequency divider is more efficient when the frequency is divided in half. Efficiency is a measure of the power of the signal transmitted by the second circuit L2, C2 divided by the power of the signal detected by the first circuit L1, C1.

An npn bipolar transistor can be substituted for the pnp transistor Q1 without any loss in efficiency. The frequency divider also is operable if other semiconductor switching devices having gain are used in place of the pnp bipolar transistor Q1, but at varying efficiencies. For example, other types of bipolar transistors or field effect transistors can be used.

It is not necessary that the first coil L1 be positioned orthogonally to the second coil L2. The relative positioning of the first and second coils L1 and L2 should be such that they are not mutually coupled. Mutual coupling means coupling to such an extent as to decrease the efficiency of the frequency divider.

There is a decrease in the efficiency of the frequency divider if the center tap 10 of the second coil L2 is not located in the middle one-third of the second coil L2.

The alternative preferred embodiment of the frequency divider of the present invention shown in Figure 5 includes a first LC circuit consisting of

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a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; a transistor Q2; and resistances R1 and R2. The first LC circuit is resonant at the first frequency; and the second LC circuit is resonant at a second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q2 is a programmable unijunction transistor (PUT). The anode of the transistor Q2 is connected to the other side 14 of the first LC circuit. The cathode of the transistor Q2 is connected to one side 16 of the second LC circuit; and the gate of the transistor Q2 is connected to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The resistances R1 and R2 determine the switching threshold of the transistor Q2.

The alternative preferred embodiment of the frequency divider of the present invention shown in Figure 6 includes a first LC circuit consisting of a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; a transistor Q3; and resistances R3 and R4. The first LC circuit is resonant at the first frequency; and the second LC circuit is resonant at a second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q3 is an SCR. The anode of the SCR Q3 is connected to the other side 14 of the first LC circuit. The cathode of the SCR Q3 is connected to one side 16 of the second LC circuit; and the gate of the SCR Q3 is connected to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The resistances R3 and R4 determine the switching threshold of the SCR Q3.

The alternative preferred embodiment of the frequency divider of the present invention shown in Figure 7 includes a first LC circuit consisting of a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; a transistor Q4; and a resistance R5. The first LC

circuit is resonant at the first frequency; and the second LC circuit is resonant at the second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q4 is a p-junction, enhancement mode field effect transistor (FET). The source of the transistor Q4 is connected to the other side 14 of the first LC circuit. The drain of the transistor Q4 is connected to one side 16 of the second LC circuit; and the gate of the transistor Q4 is connected by the resistance R5 to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The free running operation of the frequency dividers shown in Figures 2, 3 and 4 is generally equivalent to that of the frequency divider of Fig. 1 as discussed above with relation to Figures 2, 3 and 4.

The frequency divider of the present invention is encased within a card-shaped container for use as an electronic tag in a presence detection system.

Claims

1. A frequency divider, comprising
 - a first circuit (L1, C1) that is resonant at a first frequency for detecting electromagnetic radiation at the first frequency;
 - a second circuit (L2, C2) that is resonant at a second frequency for transmitting electromagnetic radiation at the second frequency; and
 - a semiconductor switching device (Q1, Q2, Q3, Q4) having gain coupling the first and second circuits (L1, C1, L2, C2) for causing the second circuit (L2, C2) to transmit electromagnetic radiation at the second frequency solely in response to energy at the first frequency provided in the first circuit (L1, C1) upon receipt of electromagnetic radiation at the first frequency, characterized in that
 - the second circuit (L2, C2) is resonant at a second frequency that is an integer submultiple of the first frequency, and
 - the energy to which the semiconductor switching device (Q1, Q2, Q3, Q4) responds is unrectified.
2. A frequency divider according to claim 1 characterized in that the semiconductor switching device (Q1) is a bipolar transistor selected from a group consisting of npn transistors and pnp transistors.
3. A frequency divider according to claim 1 characterized in that the semiconductor switching device (Q2, Q3) is a bipolar transistor selected from a group consisting of programmable unijunction transistors and SCRs.
4. A frequency divider according to claim 1

a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; a transistor Q2; and resistances R1 and R2. The first LC circuit is resonant at the first frequency; and the second LC circuit is resonant at a second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q2 is a programmable unijunction transistor (PUT). The anode of the transistor Q2 is connected to the other side 14 of the first LC circuit. The cathode of the transistor Q2 is connected to one side 16 of the second LC circuit; and the gate of the transistor Q2 is connected to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The resistances R1 and R2 determine the switching threshold of the transistor Q2.

The alternative preferred embodiment of the frequency divider of the present invention shown in Figure 6 includes a first LC circuit consisting of a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; a transistor Q3; and resistances R3 and R4. The first LC circuit is resonant at the first frequency; and the second LC circuit is resonant at a second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q3 is an SCR. The anode of the SCR Q3 is connected to the other side 14 of the first LC circuit. The cathode of the SCR Q3 is connected to one side 16 of the second LC circuit; and the gate of the SCR Q3 is connected to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The resistances R3 and R4 determine the switching threshold of the SCR Q3.

The alternative preferred embodiment of the frequency divider of the present invention shown in Figure 7 includes a first LC circuit consisting of a first inductance coil L1 and a first capacitance C1 connected in parallel with the first coil L1; a second LC circuit consisting of a second inductance coil L2 and a second capacitance C2 connected in parallel with the second coil L2; a transistor Q4; and a resistance R5. The first LC

circuit is resonant at the first frequency; and the second LC circuit is resonant at the second frequency that is one-half the first frequency.

The second coil L2 has a center tap 10 that is connected to one side 12 of the first LC circuit. The center tap 10 need not be at the center of the second coil L2, but may be positioned anywhere within approximately the middle third of the second coil L2.

The transistor Q4 is a p-junction, enhancement mode field effect transistor (FET). The source of the transistor Q4 is connected to the other side 14 of the first LC circuit. The drain of the transistor Q4 is connected to one side 16 of the second LC circuit; and the gate of the transistor Q4 is connected by the resistance R5 to the other side 18 of the second LC circuit.

The first coil L1 is positioned orthogonally in relation to the second coil L2 so as not to be mutually coupled thereto.

The free running operation of the frequency dividers shown in Figures 2, 3 and 4 is generally equivalent to that of the frequency divider of Fig. 1 as discussed above with relation to Figures 2, 3 and 4.

The frequency divider of the present invention is encased within a card-shaped container for use as an electronic tag in a presence detection system.

Claims

1. A frequency divider, comprising
 - a first circuit (L1, C1) that is resonant at a first frequency for detecting electromagnetic radiation at the first frequency;
 - a second circuit (L2, C2) that is resonant at a second frequency for transmitting electromagnetic radiation at the second frequency; and
 - a semiconductor switching device (Q1, Q2, Q3, Q4) having gain coupling the first and second circuits (L1, C1, L2, C2) for causing the second circuit (L2, C2) to transmit electromagnetic radiation at the second frequency solely in response to energy at the first frequency provided in the first circuit (L1, C1) upon receipt of electromagnetic radiation at the first frequency, characterized in that
 - the second circuit (L2, C2) is resonant at a second frequency that is an integer submultiple of the first frequency, and
 - the energy to which the semiconductor switching device (Q1, Q2, Q3, Q4) responds is unrectified.
2. A frequency divider according to claim 1 characterized in that the semiconductor switching device (Q1) is a bipolar transistor selected from a group consisting of npn transistors and pnp transistors.
3. A frequency divider according to claim 1 characterized in that the semiconductor switching device (Q2, Q3) is a bipolar transistor selected from a group consisting of programmable unijunction transistors and SCRs.
4. A frequency divider according to claim 1



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characterised in that the semiconductor switching device (Q4) is a field effect transistor.

5. A frequency divider according to claims 2, 3 or 4 characterised in that the first LC circuit (L1, C1) consists of a first inductance coil (L1) and a first capacitance (C1) connected in parallel with the first coil (L1); and

the second LC circuit (L2, C2) consists of a second inductance coil (L2), and a second capacitance (C2) connected in parallel with the second coil (L2).

6. A frequency divider according to claim 5 characterised in that the first inductance coil (L1) is positioned in relation to the second inductance coil (C2) so as not to be mutually coupled thereto.

7. A frequency divider according to claim 6, characterised in that the first coil (L1) is positioned orthogonally to the second coil (L2).

8. A frequency divider, according to claim 2 characterised in that the first LC circuit (L1, C1) consists of a first inductance coil (L1) and a first capacitance (C1) connected in parallel with the first coil (L1);

the second LC circuit (L2, C2) consists of a second inductance coil (L2), and a second capacitance (C2) connected in parallel with the second coil (L2);

the first inductance coil (L1), is positioned in relation to the second inductance coil (L2) so as not to be mutually coupled thereto;

the second inductance coil (L2) has a center tap (10) connected to one side (12) of the first coil; and

the bipolar transistor (Q1) has its emitter connected to the other side (14) of the first coil (L1), its collector connected to one side (16) of the second coil (L2) and its base connected to the other side (18) of the second coil (L2) for causing the second LC circuit to transmit electromagnetic radiation at the second frequency in response to the first LC circuit detecting electromagnetic radiation at the first frequency.

9. A frequency divider, according to claim 3, characterised in that the first LC circuit (L1, C1) consists of a first inductance coil (L1) and a first capacitance (C1) connected in parallel with the first coil (L1);

the second LC circuit (L2, C2) consists of a second inductance coil (L2), and a second capacitance (C2) connected in parallel with the second coil (L2);

the first inductance coil (L1) is positioned in relation to the second inductance coil (L2) so as not to be mutually coupled thereto;

the second inductance coil (L2) has a center tap (10) connected to one side (12) of the first coil (L1); and

the bipolar transistor (Q2, Q3) has its anode connected to the other side (14) of the first coil (L1), its cathode connected to one side (16) of the second coil (L1) and its gate connected to the other side (18) of the second coil (L1) for causing the second LC circuit to transmit electromagnetic radiation at the second frequency in response to the first LC circuit detecting electromagnetic radiation at the first frequency.

10. A frequency divider, according to claim 4, characterised in that the first LC circuit (L1, C1) consists of a first inductance coil (L1) and a first capacitance (C1) connected in parallel with the first coil;

the second LC circuit (L2, C2) consists of a second inductance coil (L2), and a second capacitance (C2) connected in parallel with the second coil (L2);

the first inductance coil (L1) is positioned in relation to the second inductance coil (L2), so as not to be mutually coupled thereto;

the second inductance coil (L2) has a center tap (10) connected to one side (12) of the first coil; and

the field effect transistor (Q4) has its source connected to the other side (14) of the first coil (L1) its drain connected to one side (16) of the second coil (L2) and its gate connected to the other side (18) of the second coil (L2) for causing the second LC circuit to transmit electromagnetic radiation at the second frequency in response to the first LC circuit detecting electromagnetic radiation at the first frequency.

11. A frequency divider according to claim 8, 9 or 10 characterised in that the resonant frequency of the second coil is one half the resonant frequency of the first coil.

12. A frequency divider according to claim 11, encased within a card-shaped container for use as an electronic tag in a presence detection system.

13. A frequency divider according to claims 8, 9 or 10, encased within a card-shaped container for use as an electronic tag in a presence detection system.

14. A frequency divider according to claims 1, 2, 3 or 4 characterised in that the resonant frequency of the second coil is one half the resonant frequency of the first coil.

15. A frequency divider according to claim 14, encased within a card-shaped container for use as an electronic tag in a presence detection system.

16. A frequency divider according to claims 1, 2, 3 or 4, encased within a card-shaped container for use as an electronic tag in a presence detection system.

Patentansprüche

1. Frequenzteiler mit einer ersten Schaltung (L1, C1) mit Resonanz bei einer ersten Frequenz zum Nachweisen elektromagnetischer Strahlung mit der ersten Frequenz, einer zweiten Schaltung (L2, C2) mit Resonanz bei einer zweiten Frequenz zum Senden elektromagnetischer Strahlung mit der zweiten Frequenz und einer Halbleiter-Schaltvorrichtung (Q1, Q2, Q3, Q4) mit Verstärkung, von welcher die erste und die zweite Schaltung (L1, C1, L2, C2) gekoppelt werden, so daß von der zweiten Schaltung (L2, C2) elektromagnetische Strahlung mit der zweiten Frequenz nur in Antwort auf Energie mit der ersten Frequenz in der ersten Schaltung (L1, C1) beim Empfangen elektromagnetischer Strahlung mit der ersten Frequenz gesendet wird, dadurch gekennzeichnet, daß die zweite Schaltung (L2, C2) Resonanz bei einer



zweiten Frequenz aufweist, welche ein ganzzahliger Teil der ersten Frequenz ist, und daß die Energie, auf welche die Halbleiter-Schaltvorrichtung (Q1, Q2, Q3, Q4) anspricht, nichtgleichgerichtet ist.

2. Frequenzteiler nach Anspruch 1, dadurch gekennzeichnet, daß die Halbleiter-Schaltvorrichtung (Q1) ein bipolarer Transistor in Form eines npn-Transistors oder eines pnp-Transistors ist.

3. Frequenzteiler nach Anspruch 1, dadurch gekennzeichnet, daß die Halbleiter-Schaltvorrichtung (Q2, Q3) ein bipolarer Transistor in Form eines programmierbaren Unijunction-Transistors oder eines SCR ist.

4. Frequenzteiler nach Anspruch 1, dadurch gekennzeichnet, daß die Halbleiter-Schaltvorrichtung (Q4) ein Feldeffekttransistor ist.

5. Frequenzteiler nach Anspruch 2, 3 oder 4, dadurch gekennzeichnet, daß die erste LC-Schaltung (L1, C1) aus einer ersten induktiven Spule (L1) und einer ersten Kapazität (C1) in Parallelschaltung zu der ersten Spule (L1) ist und daß die zweite LC-Schaltung (L2, C2) aus einer zweiten induktiven Spule (L2) und einer zweiten Kapazität (C2) in Parallelschaltung zu der zweiten Spule (L2) ist.

6. Frequenzteiler nach Anspruch 5, dadurch gekennzeichnet, daß die erste induktive Spule (L1) relativ zu der zweiten induktiven Spule (L2) derart angeordnet ist, daß sie mit dieser nicht gegenseitig gekoppelt ist.

7. Frequenzteiler nach Anspruch 6, dadurch gekennzeichnet, daß die Spule (L1) rechtwinklig zu der zweiten Spule (L2) angeordnet ist.

8. Frequenzteiler nach Anspruch 2, dadurch gekennzeichnet, daß die erste LC-Schaltung (L1, C1) aus einer ersten induktiven Spule (L1) und einer ersten Kapazität in Parallelschaltung zu der ersten Spule (L1) ist und die zweite LC-Schaltung (L2, C2) aus einer zweiten induktiven Spule (L2) und einer zweiten Kapazität (C2) in Parallelschaltung zu der zweiten Spule (L2) ist, daß die erste induktive Spule (L1) relativ zu der zweiten induktiven Spule (L2) derart angeordnet ist, daß sie mit dieser nicht gegenseitig gekoppelt ist, daß die zweite induktive Spule (L2) einen Mittenabgriff (10) aufweist, der an die eine Seite (12) der ersten Spule angeschlossen ist, und daß des bipolaren Transistors Q1 Emitter an die andere Seite (14) der ersten Spule (L1), sein Kollektor an die andere Seite (16) der zweiten Spule (L2) und seine Basis an die andere Seite (18) der zweiten Spule (L2) angeschlossen ist, so daß die zweite LC-Schaltung elektromagnetische Strahlung mit der zweiten Frequenz in Antwort auf das Abtasten elektromagnetischer Strahlung der ersten Frequenz durch die erste LC-Schaltung sendet.

9. Frequenzteiler nach Anspruch 3, dadurch gekennzeichnet, daß die erste LC-Schaltung (L1, C1) aus einer ersten induktiven Spule (L1) und einer ersten Kapazität (C1) in Parallelschaltung zu der ersten Spule (L1) besteht, daß die zweite LC-Schaltung (L2, C2) aus einer zweiten induktiven Spule (L2) und einer zweiten Kapazität (C2) in Parallelschaltung zu der ersten Spule (L2) besteht,

daß die erste induktive Spule (L1) relativ zu der zweiten induktiven Spule (L2) derart angeordnet ist, daß sie mit dieser nicht gegenseitig gekoppelt ist, daß die zweite induktive Spule (L2) einen Mittenabgriff (10) aufweist, der an die eine Seite (12) der ersten Spule (L1) angeschlossen ist, und daß die bipolare Transistor (Q2, Q3) mit seiner Anode an die andere Seite (14) der ersten Spule (L1), mit seiner Kathode an die eine Seite (16) der zweiten Spule (L1) und mit seiner Steuerelektrode an die andere Seite (18) der zweiten Spule (L1) angeschlossen ist, so daß von der zweiten LC-Schaltung elektromagnetische Strahlung mit der zweiten Frequenz in Antwort auf das Abtasten elektromagnetischer Strahlung mit der ersten Frequenz durch die ersten LC-Schaltung gesendet wird.

10. Frequenzteiler nach Anspruch 4, dadurch gekennzeichnet, daß die erste LC-Schaltung (L1, C1) aus einer ersten induktiven Spule (L1) und einer Kapazität (C1) in Parallelschaltung zu der ersten Spule besteht, die zweite LC-Schaltung (L2, C2) aus einer zweiten induktiven Spule (L2) und einer zweiten Kapazität (C2) in Parallelschaltung zu der zweiten Spule (L2) besteht, die erste induktive Spule (L1) relativ zu der zweiten induktiven Spule (L2) derart angeordnet ist, daß sie mit dieser nicht gegenseitig gekoppelt ist, die zweite induktive Spule (L2) einen Mittenabgriff (10) aufweist, der an die eine Seite (12) der ersten Spule angeschlossen ist, und der Feldeffekttransistor (Q4) mit seiner Quelle an die andere Seite (14) der ersten Spule (L1), seinem Abzug an die eine Seite (16) der zweiten Spule (L2) und seiner Steuerelektrode an die andere Seite (18) der zweiten Spule (L2) angeschlossen ist, so daß von der zweiten LC-Schaltung elektromagnetische Strahlung der zweiten Frequenz in Antwort auf das Abtasten elektromagnetischer Strahlung mit der ersten Frequenz durch die erste LC-Schaltung ausgesendet wird.

11. Frequenzteiler nach Anspruch 8, 9 oder 10, dadurch gekennzeichnet, daß die Resonanzfrequenz der zweiten Spule die Hälfte der Resonanzfrequenz der ersten Spule beträgt.

12. Frequenzteiler nach Anspruch 11, eingekapselt in einem kartenförmigen Behälter zur Verwendung als eine elektronische Marke in einem Präsenzdetektorsystem.

13. Frequenzteiler nach Anspruch 8, 9 oder 10, eingekapselt in einem kartenförmigen Behälter zur Verwendung als elektronische Marke in einem Präsenzdetektorsystem.

14. Frequenzteiler nach den Ansprüchen 1, 2, 3 oder 4, dadurch gekennzeichnet, daß die Resonanzfrequenz der zweiten Spule die Hälfte der Resonanzfrequenz der ersten Spule beträgt.

15. Frequenzteiler nach Anspruch 14, eingekapselt in einem kartenförmigen Behälter zur Verwendung als elektronische Marke in einem Präsenzdetektorsystem.

16. Frequenzteiler nach Anspruch 1, 2, 3 oder 4, eingekapselt in einem kartenförmigen Behälter zur Verwendung als elektronische Marke in einem Präsenzdetektorsystem.



Revendications

1. Diviseur de fréquence comprenant un premier circuit (L1, C1) qui résonne à une première fréquence pour détecter un rayonnement électromagnétique à la première fréquence, un second circuit (L2, C2) qui résonne à une seconde fréquence pour émettre un rayonnement électromagnétique à la seconde fréquence et un dispositif de commutation à semi-conducteur (Q1, Q2, Q3, Q4) avec gain, couplant les premier et second circuits (L1, C1, L2, C2) pour astreindre le second circuit (L2, C2) à émettre un rayonnement électromagnétique à la seconde fréquence, uniquement en réponse à une énergie à la première fréquence fournie dans le premier circuit (L1, C1) à la suite de la réception d'un rayonnement électromagnétique à la première fréquence, caractérisé en ce que le second circuit (L2, C2) résonne à une seconde fréquence qui est un sous-multiple entier de la première fréquence, et en ce que l'énergie à laquelle répond le dispositif de commutation à semi-conducteur (Q1, Q2, Q3, Q4) n'est pas redressée.

2. Diviseur de fréquence suivant la revendication 1, caractérisé en ce que le dispositif de commutation (Q1) à semi-conducteur est un transistor bipolaire choisi parmi le groupe comprenant les transistors N P N et P N P.

3. Diviseur de fréquence suivant la revendication 1, caractérisé en ce que le dispositif de commutation à semi-conducteur (Q2, Q3) est un transistor bipolaire choisi parmi le groupe comprenant les transistors unijonction programmables et les redresseurs commandés au silicium (SCR).

4. Diviseur de fréquence suivant la revendication 1, caractérisé en ce que le dispositif de commutation à semi-conducteur (Q4) est un transistor à effet de champ.

5. Diviseur de fréquence suivant la revendication 2, 3 ou 4, caractérisé en ce que le premier circuit LC (L1, C1) consiste en une première bobine d'induction (L1) et une première capacité (C1) reliée en parallèle à la première bobine (L1); et le second circuit LC (L2, C2) consiste en une seconde bobine d'induction (L2) et une seconde capacité (C2) reliée en parallèle avec la seconde bobine (L2).

6. Diviseur de fréquence suivant la revendication 5, caractérisé en ce que la première bobine d'induction (L1) est disposée par rapport à la seconde bobine d'induction (L2) de manière à ne pas être couplées mutuellement.

7. Diviseur de fréquence suivant la revendication 6, caractérisé en ce que la première bobine (L1) est disposée orthogonalement par rapport à la seconde bobine (L2).

8. Diviseur de fréquence suivant la revendication 2, caractérisé en ce que le premier circuit LC (L1, C1) consiste en une première bobine d'induction (L1) et une première capacité (C1) reliée en parallèle avec la première bobine (L1), le second circuit LC (L2, C2) consistant en une seconde bobine d'induction (L2) et une seconde capacité

(C2) reliée en parallèle avec la seconde bobine (L2), la première bobine d'induction (L1) étant disposée par rapport à la seconde bobine d'induction (L2) de manière à ne pas être couplées mutuellement, la seconde bobine d'induction (L2) comportant une prise intermédiaire (10) reliée à un côté (12) de la première bobine, et le transistor bipolaire (Q1) a son émetteur relié à l'autre côté (14) de la première bobine (L1), son collecteur relié à un côté (16) de la seconde bobine (L2) et sa base reliée à l'autre côté (18) de la seconde bobine (L2) pour astreindre le second circuit LC à émettre un rayonnement électromagnétique à la seconde fréquence en réponse à la détection par le premier circuit LC d'un rayonnement électromagnétique à la première fréquence.

9. Diviseur de fréquence suivant la revendication 3, caractérisé en ce que le premier circuit LC (L1, C1) consiste en une première bobine d'induction (L1) et une première capacité (C1) reliée en parallèle avec la première bobine (L1), le second circuit LC (L2, C2) consistant en une seconde bobine d'induction (L2) et une seconde capacité (C2), reliée en parallèle avec la seconde bobine (L2), la première bobine d'induction (L1) étant disposée par rapport à la seconde bobine d'induction (L2) de façon à ne pas être couplées mutuellement, la seconde bobine d'induction (L2) comportant une prise intermédiaire (10) reliée à un côté (12) de la première bobine (L1), et le transistor bipolaire (Q2, Q3) ayant son anode reliée à l'autre côté (14) de la première bobine (L1), sa cathode reliée à un côté (16) de la seconde bobine (L2) et sa grille reliée à l'autre côté (18) de la seconde bobine (L2) pour astreindre le second circuit LC à émettre un rayonnement électromagnétique à la seconde fréquence en réponse à la détection par le premier circuit LC d'un rayonnement électromagnétique à la première fréquence.

10. Diviseur de fréquence suivant la revendication 4, caractérisé en ce que le premier circuit LC (L1, C1) consiste en une première bobine d'induction (L1) et une première capacité (C1) reliée en parallèle avec la première bobine, le second circuit LC (L2, C2) consistant en une seconde bobine d'induction (L2) et une seconde capacité (C2) reliée en parallèle avec la seconde bobine (L2), la première bobine d'induction (L1) étant disposée par rapport à la seconde bobine (L2) de façon à ne pas être couplées mutuellement, la seconde bobine (L2) ayant une prise intermédiaire (10) reliée à un côté (12) de la première bobine, et le transistor (Q4) à effet de champ ayant sa source reliée à un autre côté (14) de la première bobine (L1), son drain relié à un côté (16) de la seconde bobine (L2) et sa grille reliée à l'autre côté (18) de la seconde bobine (L2) pour astreindre le second circuit LC à émettre un rayonnement électromagnétique à la seconde fréquence en réponse à la détection par le premier circuit LC d'un rayonnement électromagnétique à la première fréquence.

11. Diviseur de fréquence suivant la revendication 8, 9 ou 10, caractérisé en ce que la fréquence de résonance de la seconde bobine est la moitié



de la fréquence de résonance de la première bobine.

12. Diviseur de fréquence suivant la revendication 11, enfermé dans un conteneur en forme de carte destiné à être utilisé comme étiquette électronique dans un système détecteur de présence.

13. Diviseur de fréquence suivant la revendication 8, 9 ou 10, enfermé dans un conteneur en forme de carte destiné à être utilisé comme étiquette électronique dans un système détecteur de présence.

14. Diviseur de fréquence suivant la revendication 1, 2, 3 ou 4, caractérisé en ce que la fréquence

de résonance de la seconde bobine est la moitié de la fréquence de résonance de la première bobine.

15. Diviseur de fréquence suivant la revendication 14, enfermé dans un conteneur en forme de carte, destiné à être utilisé comme étiquette électronique dans un système détecteur de présence.

16. Diviseur de fréquence suivant la revendication 1, 2, 3 ou 4, enfermé dans un conteneur en forme de carte destiné à être utilisé comme étiquette électronique dans un système détecteur de présence.

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