(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 130 682 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**05.09.2001 Bulletin 2001/36**

(51) Int Cl.7: **H01Q 23/00**, H01Q 1/12

(21) Application number: **01301181.2**

(22) Date of filing: **09.02.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **29.02.2000 US 515564**

(71) Applicant: **Visteon Global Technologies, Inc.**
**Dearborn, Michigan 48126-2490 (US)**

(72) Inventors:
- **Tannery, George Fowler**
  **Ypsilanti, MI 48197 (US)**
- **Sheikh-Movahhed, Mohammad-Reza**
  **Ann Arbor, MI 48104 (US)**

(74) Representative: **McLean, Robert Andreas et al**
**Dummett Copp,**
**25 The Square,**
**Martlesham Heath**
**Ipswich IP5 3SL (GB)**

(54) **Antenna assembly**

(57) This invention generally relates to an antenna assembly and more particularly to a vehicular antenna assembly having a single antenna element which is adapted to receive a long/medium wave signal and a very high frequency signal and further having a pair of circuits which are each respectively adapted to process a unique one of the received signals. The antenna assembly (10) has a single antenna element (12) which receives signals (14,16). Antenna assembly (10) includes a first processing circuit assembly (18) for processing and/or amplifying signal (16) and a second processing circuit assembly (20) for processing and/or amplifying amplitude modulated signal (14). The processed and/or amplified signals (14,16) are combined and communicated to a receiver by use of bus or coaxial cable (72).

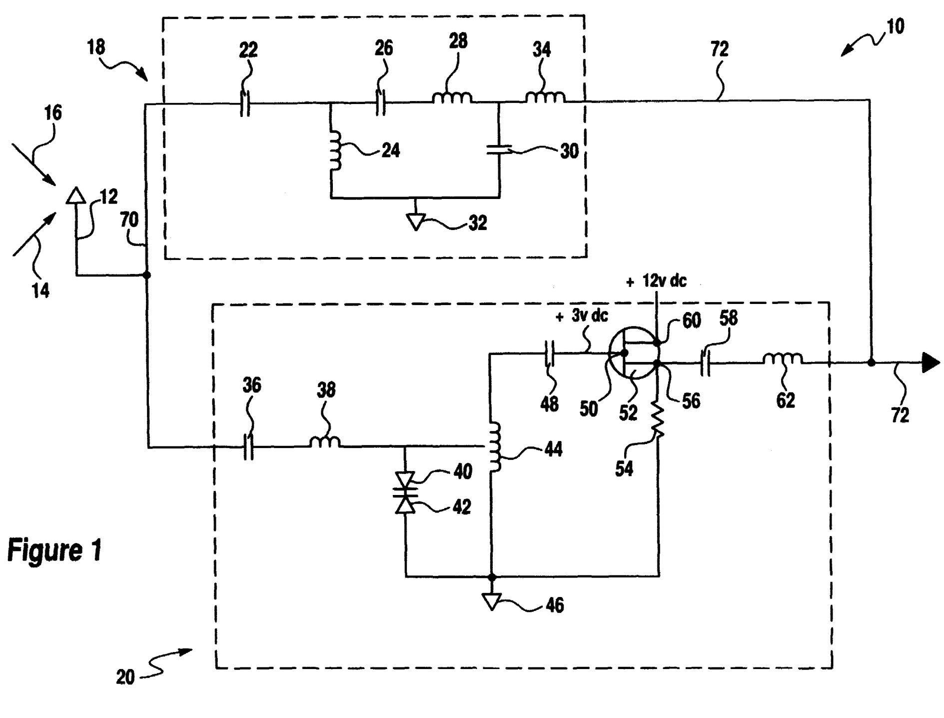


Figure 1

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## Description

(1) Field of the Invention

**[0001]** This invention generally relates to an antenna assembly and more particularly to a vehicular antenna assembly having a single antenna element which is adapted to receive a long/medium wave signal and a very high frequency signal and further having a pair of circuits which are each respectively adapted to process a unique one of the received signals.

(2) Background of the Invention

**[0002]** Antenna assemblies are used to receive electromagnetic signals, to process these signals, and to communicate the processed signals to a receiver where they are selectively and audibly presented to a user of the receiver. For example and without limitation, antenna assemblies are used within vehicles to receive long/ medium wave and very high frequency signals (i.e. radio signals), to process these signals, and to couple these processed signals to a radio receiver, effective to allow the driver or the passengers of these vehicles to selectively hear and enjoy the information contained within the received signals.

**[0003]** Many of these vehicle antenna assemblies are "hidden" or include a pair of antenna elements, at least one of which is typically printed or disposed upon the back window of a vehicle and the other of which is typically and substantially hidden from view (i.e., only a very small portion of this other element is visible), thereby aesthetically improving the appearance of the vehicle.

**[0004]** While these "hidden" type of vehicle antenna assemblies do receive and allow these received signals to be selected by and audibly presented to a user, they suffer from some drawbacks. For example, each of these antenna elements are respectively adapted to only receive a unique one of the long/medium wave and very high frequency signals. A single processing and/or amplification assembly is typically used within the antenna assembly, is typically coupled to the antenna elements, and is adapted to amplify and process both signals (i.e. remove or filter undesired signal components of the respective signals) and to communicate the amplified and/or processed signals to a radio receiver.

**[0005]** The use of these two antenna elements increases the overall cost and complexity of the antenna assembly and the use of a single amplifier substantially prevents the disparate signals from being optimally amplified due to the great frequency range over which the single amplifier must operate and the inability of commercially available and relatively cost effective amplifiers to provide desired amplification over this relatively large dynamic operating range. These types of antenna assemblies also typically utilize a relatively complicated and costly tank type circuit to process the signals.

**[0006]** Moreover, the window heating element is typically used as one of the antenna elements in these vehicular "hidden" type antenna assemblies. While this arrangement obviates the need for a separate antenna element while allowing an existing vehicle component to provide additional functionality, it requires the use of a relatively expensive choke assembly to electrically isolate the heating element from the radio receiver. Further, to improve upon the amplification of these assemblies, additional and relatively costly automatic gain control type amplifiers are typically required to be added to the antenna assembly.

**[0007]** There is therefore a need for a new and improved antenna assembly which overcomes some or all of the previously delineated drawbacks of prior antenna assemblies and which allows long/medium wave and very high frequency signals to be processed and amplified in an efficient and cost effective manner.

Summary of the Invention

**[0008]** It is a first object of the present invention to provide an antenna assembly which overcomes some or all of the previously delineated drawbacks of prior antenna assemblies.

**[0009]** It is a second object of the present invention to provide an antenna assembly which overcomes some or all of the previously delineated drawbacks of prior antenna assemblies and which includes a single antenna which is adapted to receive both long/medium and very high frequency signals.

**[0010]** It is a third object of the present invention to provide an antenna assembly which overcomes some of all of the previously delineated drawbacks of prior antenna assemblies and which includes first and second circuit assemblies which are respectively adapted to receive and amplify the received signals.

**[0011]** According to a first aspect of the present invention an antenna assembly is provided for use with a first and a second signal. The assembly includes an antenna which receives the first and second signals; a first assembly which is coupled to the antenna and which receives and amplifies the first signal; and a second assembly which is coupled to the antenna and which receives and amplifies the second modulated signal.

**[0012]** According to a second aspect of the present invention a method for receiving a first and a second signal is provided for use with a radio receiver. The method includes the steps of providing an antenna; utilizing the antenna to receive both the first and the second signal; separately amplifying and filtering the received first and second signals; and coupling the separately amplified first and second signals to the radio receiver.

**[0013]** These and other aspects, features, and advantages of the present invention will become apparent by reading the following detailed description of the preferred embodiment of the invention and by reference to the following drawing.

Brief Description of the Drawings

**[0014]** The invention will now be described in further detail, by way of example with reference to the accompanying drawings, in which:

Figure 1 is an electrical schematic diagram of an antenna assembly which is made in accordance with the teachings of the preferred embodiment of the invention; and

Figure 2 is an electrical schematic diagram of an electrical power supply circuit which may be used by the antenna assembly of the preferred embodiment of the invention.

Detailed Description of the Preferred Embodiment of the Invention

**[0015]** Referring now to Figure 1, there is shown an antenna assembly 10 which is made in accordance with the teachings of the preferred embodiment of the invention. As shown, antenna assembly 10 includes an antenna element 12 which, in one non-limiting embodiment of the invention, is adapted to receive both long wave and/or medium wave signal 14 and a very high frequency signal 16. Typically, signal 14 has a frequency of about 530 kHz to about 1710 kHz (i.e. a long wave type signal has a frequency in the lower half of this spectrum while a medium wave type signal has a higher frequency), and is frequently amplitude modulated while signal 16 has a frequency of about 76 MHz to about 108 MHz and is frequently frequency modulated. Signals 14, 16 may however be modulated by other techniques. Further, antenna element 12 may be printed upon, coated upon and/or adhered or disposed to and/or upon the back window of a vehicle (e.g. the window containing the heating elements), may comprise a "mast type assembly" which may be selectively retracted within the vehicle, or may be placed upon virtually any other portion of the vehicle's glass and/or hidden with the vehicle's trim assembly. Antenna element 12 may also comprise a non-vehicular antenna element (i.e. an antenna which is not deployed upon or within a vehicle).

**[0016]** Antenna element 12 is physically and electrically coupled to processing circuit assemblies 18, 20 which respectively receive and process the signal 16 and the signal 14 which is placed upon bus 70 by the antenna element 12. Particularly, processing assembly 18 includes a capacitor 22 which is physically and electrically coupled to the antenna element 12 by bus 70 and which typically has a capacitance value of about 10 pF although other capacitance values may be utilized. Capacitor 22 is physically and electrically coupled to an inductor 24 and to a capacitor 26. Typically, inductor 24 has an inductance value of about 270 nH and the capacitor 26 has a capacitance value of about 10 pF, although other respective values may be used. Capacitor 26 is also physically and electrically coupled to inductor 24.

**[0017]** Further, assembly 18 includes an inductor 28 which is physically and electrically coupled to capacitor 26 and to a capacitor 30. Typically, inductor 28 has an inductance value of about 270 nH while capacitor 30 has a capacitance value of about 10pF, although other respective values may be used. Inductor 24 and capacitor 30 are physically and electrically coupled to a source of electrical ground potential 32 which may comprise a portion of the body of a vehicle. Capacitor 30 and inductor 28 are coupled to an inductor 34 which typically has an inductance value of about 270 nH, although another value may be used. Inductor 34 is physically and electrically coupled to bus 72 which, in one non-limiting embodiment of the invention, comprises a co-axial cable which communicates the processed signal, emanating from circuit assembly 18, to a radio receiver (not shown). In one non-limiting embodiment of the invention, an amplifier (not shown) may be physically and electrically coupled to inductor 34 and to bus 72, effective to amplify the processed signal 16 before it is communicated to the radio receiver.

**[0018]** Assembly 20 includes a capacitor 36 which is physically and electrically coupled to the antenna element 12 by use of bus 70 and to an inductor 38. Typically, capacitor 36 has a capacitance value of about 47 μF and inductor 38 has an inductance value of about 3300 nH, although other respective values may be used. As shown, inductor 38 is physically and electrically coupled to a first diode 40. Diode 40 is physically and electrically coupled to a second diode 42 and the second diode 42 is physically and electrically coupled to a source of electrical ground potential 46 which may be substantially similar to source 32. In one non-limiting embodiment of the invention, diodes 40 and 42 are of the electrostatic discharge type and begin to "break down" or provide an electrical short type path to the electrical ground source 46 upon receipt of a signal having an amplitude of about 30 volts rms, thereby substantially preventing this signal from being destructively communicated to the inductor 44 and the transistor 52 of assembly 20 and protecting the circuit assembly 20 from damage due to the creation of a static charge or signal which may be produced, by way of example and without limitation, by the washing of the window of a vehicle incorporating the antenna element 12.

**[0019]** Diode 42 and inductor 38 are physically and electrically coupled to the inductor 44 which typically has an inductance value of about 3.76 μH and comprises a "step-up" transformer. Other inductive values may be used. Inductor 44 is also physically and electrically coupled to the source of electrical ground potential 46 and is physically and electrically coupled to a capacitor 48 which typically has a capacitance value of about 1000 pF, although another capacitance value may be used. As shown, the capacitor 48 is physically and electrically coupled to the gate terminal 50 of a field effect transistor

52. A resistor 54 which typically has a resistance value of about 500 Ω (other resistance values may be used) is physically and electrically coupled to the drain terminal 56 of the field effect transistor 52 and to the source of the electrical ground potential 46. A capacitor 58 is physically and electrically coupled to the drain terminal 56 of the field effect transistor 52 and to an inductor 62. Typically capacitor 58 has a capacitance value of about 0.1 μF while inductor 62 typically has an inductance value of about 3300 nH, although other respective values may be used. Inductor 62 is also physically and electrically coupled to the inductor 34 by use of bus 72.

**[0020]** Further, a voltage of about 12 volts d.c. is applied to the source terminal 60 of the field effect transistor 52 and a voltage of about 3 volts d.c. is applied to the gate terminal 50 of the field effect transistor 52. These voltages may be created by use of the battery which resides within the vehicle in a known manner (e.g. terminal 60 may be connected to the vehicle battery while resistors may be used to reduce the battery voltage before it is communicated to the terminal 50). One example of an electrical power supply circuit which may be used by the antenna assembly 10 to provide the voltage signal to the terminal 50 of the field effect transistor 52 is shown in Figure 2.

**[0021]** As shown, electrical power supply circuit 100 includes first and second capacitors 102,104 which are electrically and physically connected in a parallel configuration and which are physically and electrically coupled to a source of about 12 volts d.c. (i.e. such as to a vehicular battery). Capacitors 102,104 have respective capacitance values of about 47 μF and 0.33 μF, although other values may be used. Capacitors 102 and 104 are physically and electrically coupled to a resistor 106 which typically has a resistance value of about 2.2 kΩ, although another resistance value may be used. Resistor 106 is physically and electrically coupled to resistor 108 and to capacitors 110 and 112. Particularly, as shown, capacitors 110,112 and resistor 108 are physically and electrically coupled in a parallel configuration and capacitors 110,112 have respective capacitance values of about 47 μF and 0.33 μF, although other values may be used. Resistor 108 typically has a resistance value of about 2.2 kQ, although another resistance value may be used. Capacitors 110,112 and resistor 108 are physically and electrically coupled to resistor 114 which is coupled to terminal 50 of the field effect transistor 52. Typically resistor 114 had a resistance value of about 100 kΩ (other resistance values may be used) and is coupled to the terminal 50 of the field effect transistor 52. In this manner, the field effect transistor 52 is operatively biased substantially in the middle of its dynamic operating range, effective to allow the field effect transistor 52 to amplify signals within substantially any portion of the frequency range utilized by the signals 14.

**[0022]** In operation, the received signals 14, 16 are placed onto bus 70 by antenna element 12 where they are both communicated to each of the assemblies 18 and 20. Capacitors 22,26 and inductor 24 cooperatively form a high pass filter having a cut-off value which is lower than about 76 MHz. Inductors 28,34 and capacitor 30 cooperatively provide a low pass filter having a cut-off value which is above about 108 MHz. Since the low pass and high pass filters are connected in an electrical series configuration within the circuit assembly 18, these filters cooperatively form a bandpass filter which is effective to substantially allow only the received signal 16 to be output onto bus 72 or amplified before being placed upon the bus 72. It should be apparent that assembly 18 does not substantially and undesirably attenuate the received signals 18 and that the bandpass functionality is achieved without the use of relatively expensive and complicated tank type circuits.

**[0023]** The received signals 14, 16 are also communicated to assembly 20 by use of bus 70. Particularly, capacitor 36 and inductor 38 cooperatively form a broadband pass filter, effective to allow signals having a frequency of about 550 kHz to about 1710 kHz to be communicated to the inductor 44. The inductor 44 typically resonates at a frequency of about 200 kHz, (although other resonating frequencies may be utilized), thereby communicating the received signals to the gate 50 of the field effect transistor 52 through the capacitor 48. The inductor 44 also matches the impedance of the field effect transistor 52 to the antenna element 12 in order to substantially prevent loss of power of the signals which are transferred from the antenna element 12 to the transistor 52. Capacitor 48 substantially prevents any of the direct current type of electrical signals to be communicated to the inductor 44 from the voltage sources coupled to the transistor 52 and/or to the transistor 52 from bus 70. The filtered signals are then communicated to the gate terminal 50 by capacitor 48 where they are amplified and output at terminal 56. The amplified signals are then communicated to the bus 72 by use of the inductor 62 and the capacitor 58 which matches the impedance between the transistor 52 and the bus 72 while substantially preventing signals having frequencies outside of the frequency range of signal 14 to be communicated onto the bus 72.

**[0024]** In this manner, the assembly 10 splits the received signals 14, 16 by in a "frequency band manner" (i.e. signals 14, 16 are respectively filtered, amplified, and "matched" by circuit assemblies 20, 18), and recombined onto bus 72 where they are communicated to a radio receiver. The use of the band pass filters provided by capacitor 36, inductor 38 and capacitor 58 and inductor 62 obviates the need for a choke assembly while allowing a single antenna element to be used for both signals and allowing the long/medium wave signal 14 to be separately amplified and filtered over its dynamic frequency range.

**[0025]** It is to be understood that the invention is not limited to the exact construction or method which has been previously delineated but that various changes may be made without departing from the scope of the invention as is more fully delineated within the following claims.

## Claims

1. An antenna assembly comprising:

   a member which receives a first and a second signal;
   a first assembly which receives the first and second signal and which outputs only the first signal; and
   a second assembly which receives the first and second signal and which outputs only the second signal.

2. The antenna assembly of Claim 1, wherein said first signal comprises a very high frequency signal.

3. The antenna assembly of Claim 2, wherein said first signal is frequency modulated.

4. The antenna assembly of Claim 2, wherein said second signal comprises a long wave type signal.

5. The antenna assembly of Claim 2, wherein said second signal comprises a medium wave type signal.

6. The antenna assembly of Claim 1, wherein said second assembly comprises an amplifier which amplifies said second signal.

7. The antenna assembly of Claim 6, wherein said amplifier comprises a field effect transistor.

8. The antenna assembly of Claim 7, wherein said second assembly comprises first and second bandpass filters.

9. The antenna assembly of Claim 8, wherein said second assembly comprises an inductor which resonates at a certain frequency.

10. The antenna assembly of Claim 9, wherein said first assembly comprises at least one bandpass filter.

11. The antenna assembly of Claim 9, wherein said member resides upon a glass window.

12. An antenna assembly for use within a vehicle of the type having a heater grid which is disposed upon a window and which receives first and second signals, said antenna assembly comprising:

    a first band pass filter which is coupled to said heater grid, which receives said first and second signals, and which outputs only said first signal; and
    a second band pass filter which is coupled to said heater grid, which receives said first and second signals, and which output only said second signal.

13. The antenna assembly of Claim 12, further comprising an amplifier which is coupled to said second band pass filter.

14. The antenna assembly of Claim 13, wherein said second band pass filter comprises an inductor which resonates at a certain frequency.

15. The antenna assembly of Claim 13, wherein said first signal comprises a very high frequency signal.

16. The antenna assembly of Claim 15, wherein said second signal comprises a long wave signal.

17. The antenna assembly of Claim 16, wherein said second signal comprises a medium wave signal.

18. The antenna assembly of Claim 13, wherein said first signal is frequency modulated and wherein said second signal is amplitude modulated.

19. A method for processing a first and a second signal received by an antenna disposed upon a vehicle, said method comprising the steps of:

    providing first and second filters;
    connecting said first and second filters to said antenna;
    communicating said first and second signals to said first and second filters;
    connecting said first filter to said second filter.

20. The method of Claim 19, further comprising the step of amplifying said first and second signals.

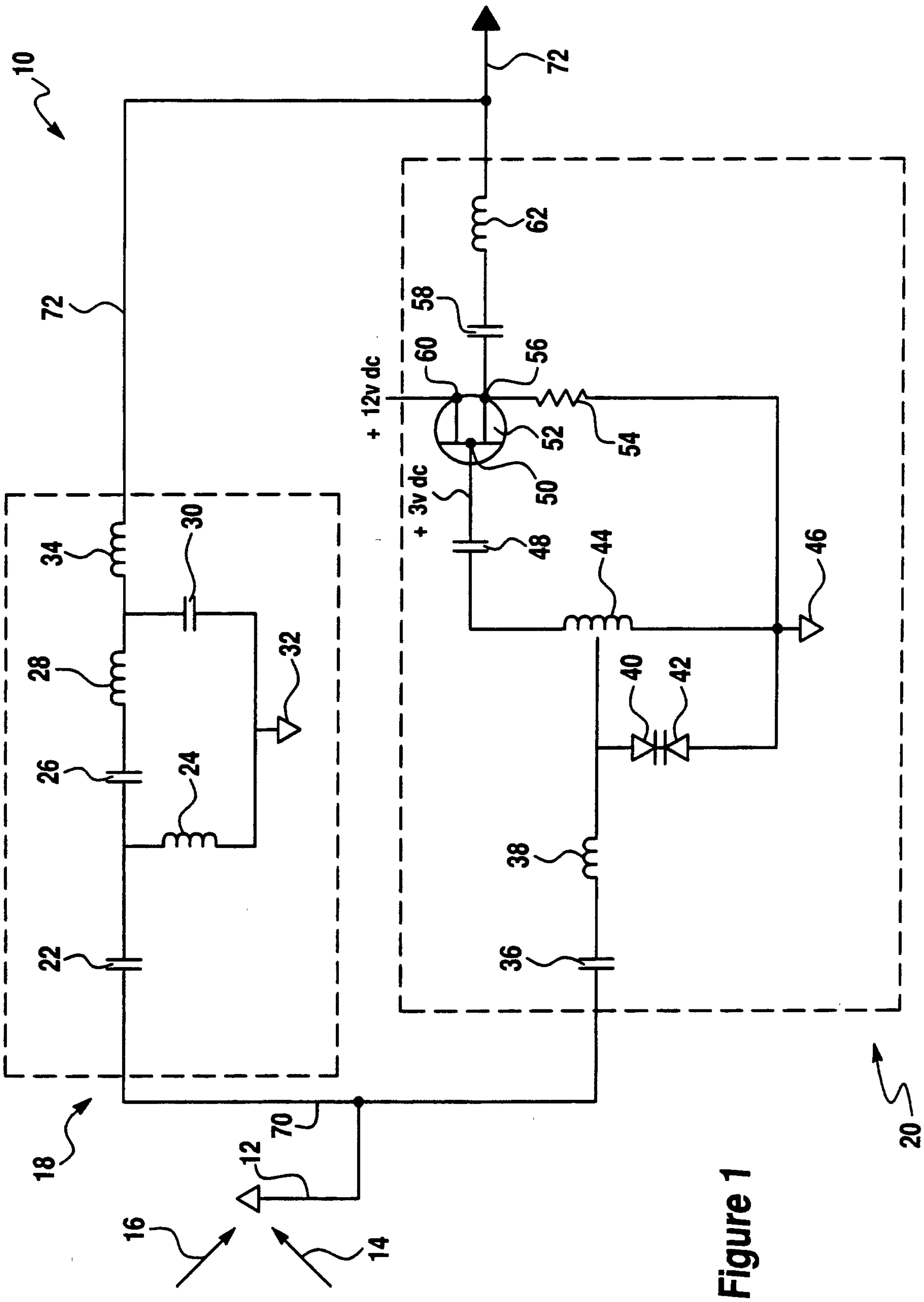
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Figure 1

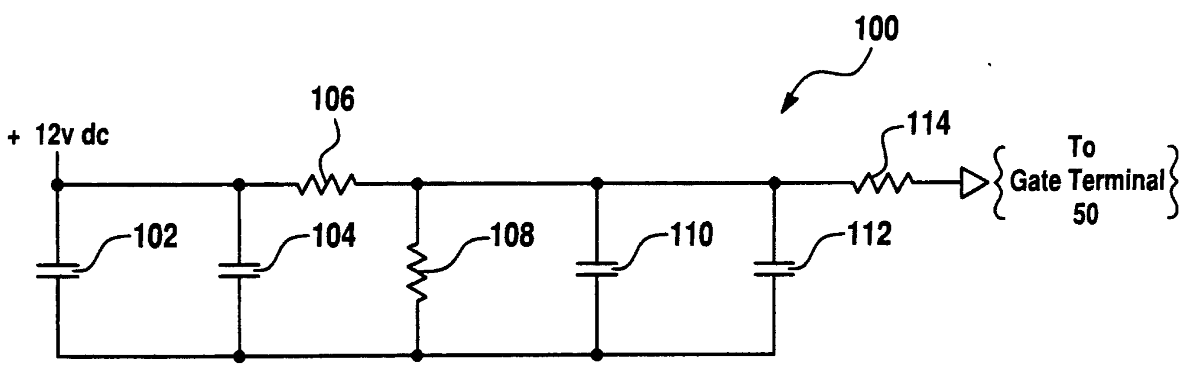


Figure 2