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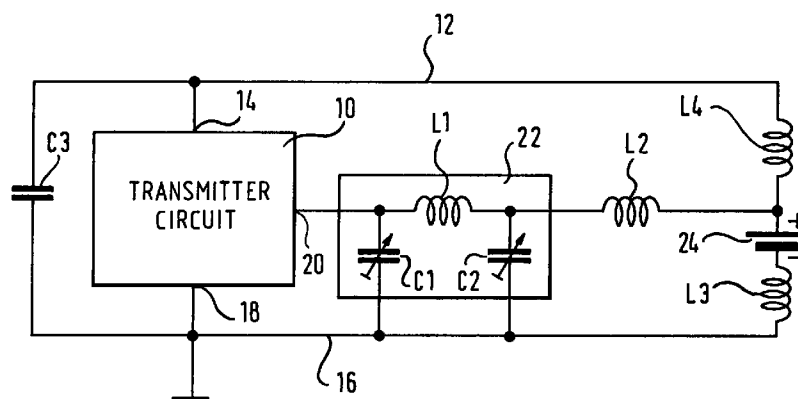
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(54) **A circuit arrangement for the transmission of an RF signal**

(57) The circuit comprises a transmit circuit (10) for the production of the RF signal. Furthermore said arrangement comprises an antenna (24) for the radiation of the RF signal and an impedance matching circuit (22) placed between the antenna (24) and the output (20) of the transmit circuit (10). A battery (24) serves for the application of the operating or power voltage between a

positive operating voltage line (12) and the ground line (16) are decoupled from the battery (24) with respect to the RF signal and the RF signal is applied by the output (20) of the transmit circuit (10) to the positive terminal of the battery (24) so that the part connected with such terminal of the battery (24) constitutes the antenna.

Fig.1



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Description

The invention relates to a circuit arrangement for the transmission of an RF signal comprising a transmit circuit for the production of the RF signal, an antenna for the radiation of the RF signal, an impedance matching circuit arranged between the antenna and the output of the transmit circuit and a battery for the application of the operating voltage between a positive operating voltage line and a ground line.

The amount of electrical power or water used by private or industrial customers has so far been determined by reading meters on the premises. In this respect it is necessary for the persons employed for this purpose to go to the premises where the respective meter is installed, to note down the readings and then to pass them to a central office for processing. Attempts are now being made to use a transmit module to transmit the readings for the electricity or water consumed by means of a RF signal containing the respective readings. The RF signal may for example be received with the aid of receiving systems in vehicles, which drive past the buildings wherein the respective meters are installed. Taking the readings will then no longer involve personal attendance and inspection of the meters.

However radio modules to be installed on the meter have to meet stiff requirements. More particularly such a module must be small in size and cheap for it to be able to be mounted in or on the meter without an excessive amount of space being required.

One object of the invention is to provide a circuit of the type initially mentioned such that it can be mounted with only a small space requirement on an electricity or water meter while at the same time not entailing high manufacturing costs.

This object is to be fulfilled in a circuit arrangement of this type as specified above, since the positive operating voltage line and the ground line are decoupled from the battery with respect to the RF signal and the RF signal from the output of the transmit circuit is applied to a terminal of the battery so that the part of the battery connected with this terminal constitutes the antenna.

A particular reason for its being possible for the circuit arrangement in accordance with the invention to be produced in a particularly space saving and cheap form is that it does not require any antenna of its own, but rather utilizes as an antenna those metal parts, which in batteries currently available are connected with a terminal of the battery. There is also a saving as regards costs for a separate antenna.

One embodiment of the invention will now be described with reference to the drawings in more detail.

Figure 1 is a circuit diagram of the circuit arrangement in accordance with the invention.

Figure 2 is a diagrammatic representation of one possible application of the circuit in accordance with the invention in connection with an electricity or water meter.

The circuit arrangement depicted in figure 1 comprises a transmit circuit 10 with an operating voltage or power connection 14 itself connected with an operating voltage or power line 12 and a ground connection 18 connected a ground line 16.

An RF signal produced by the transmit circuit 10 is supplied at an output 20 and to an impedance matching circuit 22, which comprises two variable capacitors C1 and C2 and a coil L1. The impedance matching circuit 22 has the form of a p element, in which the capacitors C1 and C2 are at one end connected with ground, whereas the other ends are connected together by the coil L1. The one end of the coil L1 is in this case connected with the output 20 of the transmit circuit 10, and the other end of the coil L1 is connected with the output of the impedance matching circuit 22. The coil L2 transfers the output signal of the impedance matching circuit 22 to the metallic outer casing of a battery 24, whose internal pole is connected via a coil L3 with the ground line 16. In the illustrated working embodiment of figure 1 the external casing of the battery 24 constitutes the positive terminal, but however it is also possible to utilize a battery whose external casing constitutes the negative terminal. The positive terminal of the battery 24 is connected via a coil L4 with the operating voltage or power line 12 so that the positive operating or power voltage may be applied to the terminal 14 of the transmit circuit 10. Between the positive operating voltage line 12 and the ground line 16 a further capacitor C3 is arranged.

In the case of the employment of a currently used type of battery, as for instance a lithium battery, as the battery 24 the positive terminal will act as an antenna, and the coil L2 will function as an antenna extension coil. The coil L2 is so dimensioned with that the RF signal may be supplied to the positive terminal of the battery 24. On the other hand the coil L4 is of such a size that it functions as a blocking element for the RF oscillation, which is supplied to the positive terminal of the battery 24. The coil L4 consequently only transmits the positive operating voltage to the operating voltage line 12, whereas the RF signal is radiated by the battery 24 acting as an antenna. The capacitor C3 has the purpose of conducting away to ground the RF fractions, with which the operating voltage at the operating voltage or power line 12 might be modulated. In order for the battery to actually operate as an antenna, the negative terminal is decoupled from the ground line by the coil L3 so that an RF signal transmitted to the battery 24 may not be conducted away to ground.

By means of a suitable adjustment of the capacitors C1 and C2 and the select of a suitable size of the coil L1, it is possible to arrive at an impedance match, which has the consequence that the RF signal provided at the output 20 of the transmit circuit 10 is transmitted with a high efficiency to the positive terminal of the battery 24.

In practice it has been seen the in the case of the use of a lithium battery, whose outer casing is the plus pole, for the intended purpose the battery is suitable as an antenna. However a battery will also radiate in a sat-

isfactory manner, if its external casing is connected with the minus pole.

Figure 2 diagrammatically indicates how the circuit arrangement to be described here may be designed in an advantageous manner and how it can be connected with a water meter. In this case the transmit circuit 10 and all other components of the circuit arrangement of figure 1 with the exception of the battery 24 are in one block 26 on a printed circuit board 28 composed of three layers, that is to say an upper conductor board layer 30, a middle conductor board layer 32 and a lower conductor board layer 34. In a first embodiment, which is represented in figure 2, conductive paths are formed on the basis of the upper conductor layer 30, which produce the desired circuit connections between the components of the circuit. The middle conductor board layer 32 in this case constitutes the ground line 16 and on the lower conductor board layer 34 conductive paths are also formed, which may produce circuit connections between the components. In a conventional fashion the through hole connections between the conductive paths of the upper conductor layer 30 and the lower conductor layer 34 are produced, such through hole connections not being connected with the conductor layer 32. The conductor layer 32, which acts as an electrical counter-weight to the antenna constituted by the battery 24, is recessed in the part underneath the battery since it would otherwise interfere with the counter-weight function.

In a further embodiment, which is not illustrated in figure 2, the middle conductor layer 32 is employed as a ground line. In this case as well the layer 34 underneath the battery 24 is removed so that it can perform its function as a counter-weight to the antenna.

The printed circuit board 28 is located together with the components mounted on it in a housing 36 of plastic, which is metallized on the internal and external surfaces 38 and 40.

The housing 36 is placed in position with the aid of attachment means (not illustrated) on the metallic housing 42 of a water meter 44, which is only indicated diagrammatically in figure 2. It is standard practice for the conduction layer 32 or 34, which is connected with the ground line, to be connected with the housing 42 of the water meter, because there is then optimum efficiency as regards radiation in the RF signal. However in cases where such a galvanic coupling is not possible, it is possible to produce a satisfactory capacitive coupling between the conductor layer of the printed circuit board 28 and the housing 38 consisting of metal, this also being something responsible for an improvement in the electrical counter-weight as regards the antenna constituted by the battery 24.

Claims

1. A circuit arrangement for the transmission of an RF signal comprising a transmit circuit (10) for the production of the RF signal, an antenna (24) for the radiation of the RF signal, an impedance matching

circuit (22) arranged between the antenna (24) and the output (20) of the transmit circuit (10) and a battery (24) for the application of the operating voltage between a positive operating voltage line (12) and a ground line (16), characterized in that the positive operating voltage line (12) and the ground line (16) are decoupled from the battery (24) with respect to the RF signal and the RF signal from the output (20) of the transmit circuit (10) is applied to a terminal of the battery (24) so that the part of the battery (24) connected with this terminal constitutes the antenna.

2. The circuit arrangement as claimed in claim 1, characterized in that the application of the RF signal to the terminal of the battery (24) is performed via an antenna extension coil (22).
3. The circuit arrangement as claimed in claim 1 or in claim 2, characterized in that the RF signal is applied to the terminal of the battery (24) connected with the external casing of the battery.
4. The circuit arrangement as claimed in claim 1, in claim 2 or in claim 3, characterized in that the transmit circuit (10), the impedance matching circuit (22) and the battery (24) are mounted on a printed circuit board (28) having an upper and a lower conductor layer (30 and 34) with conductive paths and a middle conductor layer (32) galvanically separated therefrom and in that the ground line (16) is connected with the middle conductor layer (32) and constitutes an electrical counter-weight to the antenna formed by the battery (24).
5. The circuit arrangement as claimed in claim 1, in claim 2 or in claim 3, characterized in that the transmit circuit (10), the impedance matching circuit (22) and the battery (24) are mounted on a printed circuit board (28) having an upper and a middle layer conductor layer (30 and 32) with conductive paths and a lower conductor layer (34) galvanically separated therefrom and in that the ground line (16) is connected with the lower conductor layer (34) and constitutes an electrical counter-weight to the antenna formed by the battery (24).
6. The circuit arrangement as claimed in claim 4 or in claim 5, characterized in that the conductor layer (32; 34) connected with the ground line (16) is galvanically connected with the housing (42) of the electricity or water meter (44).
7. The use of the circuit arrangement as claimed in claim 4 or in claim 5 in the case of an electricity or water meter (44) with a metallic housing (42), the RF signal to be transmitted containing data on readings taken from the electricity or water meter (44), characterized in that the circuit arrangement is accom-

modated in a plastic housing (36) internally and externally metallized in order to produce a capacitive coupling between the ground-connected conductor layer (32; 34) and the housing (38) of the electricity or water meter (44).

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Fig. 1

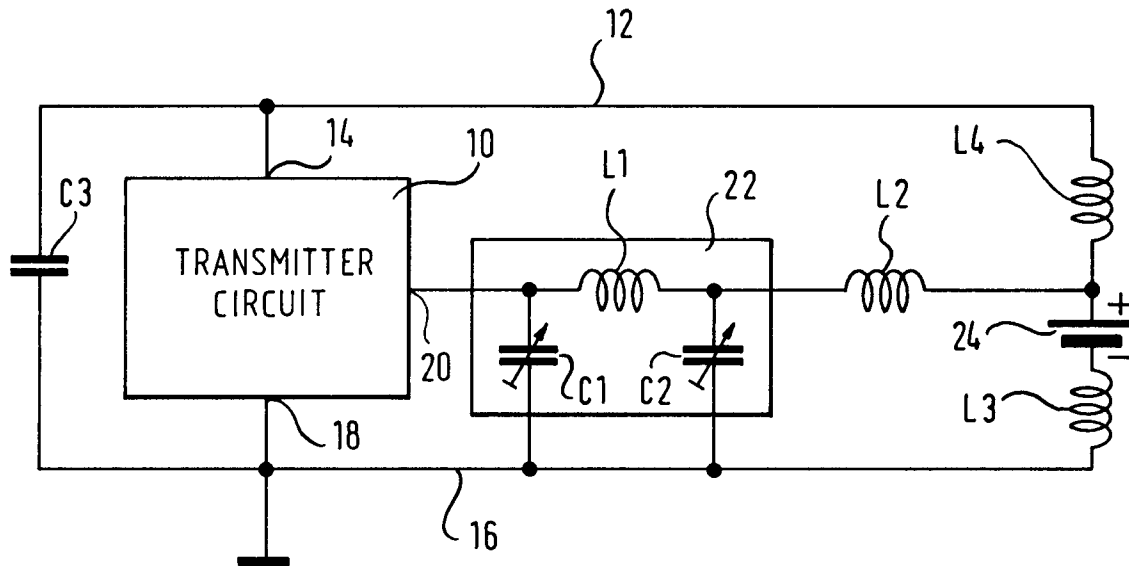
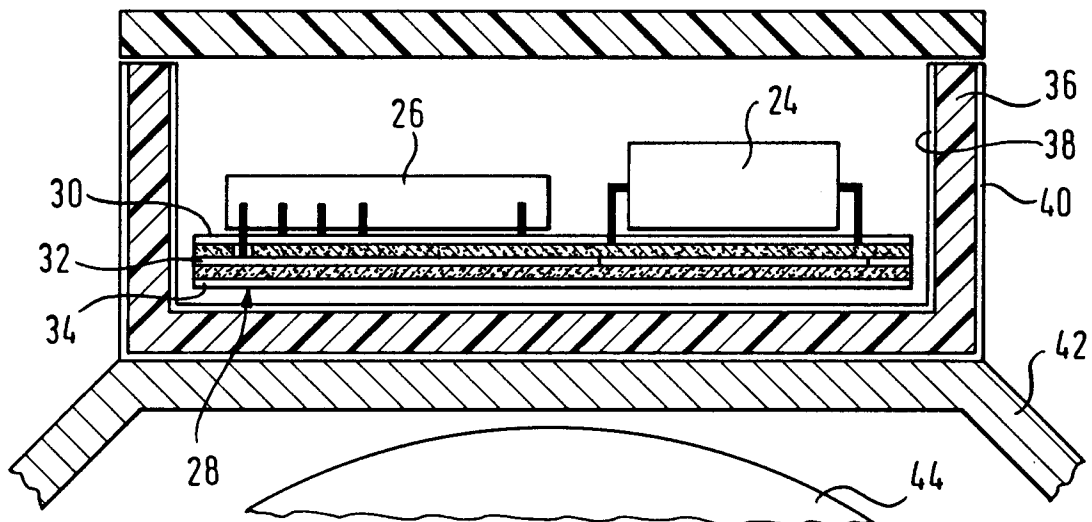


Fig. 2





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EUROPEAN SEARCH REPORT

Application Number
EP 94 12 0371

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	EP-A-0 531 125 (NEC) * column 4, line 18 - line 43; figures 1,2B,3 *	1 2-5	H01Q1/22 H01Q1/44 G08C17/02
Y	--- MOTOROLA TECHNICAL DEVELOPMENTS, vol. 19, June 1993 SCHAUMBURG, ILLINOIS US, pages 91-93, XP 000361491 HERTZ ET AL. 'HOUSING COVER PLATES: BATTERY CONTACT AND ELECTROMAGNETIC WAVE COUPLER' * the whole document *	1	
A	--- PATENT ABSTRACTS OF JAPAN vol. 10 no. 313 (E-448) [2369] ,11 June 1986 & JP-A-61 123303 (MATSUSHITA ELECTRIC) * abstract *	1	
A	--- EP-A-0 297 790 (NEC) * column 3, line 24 - column 5, line 40 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	--- US-A-5 227 805 (KING ET AL.) * claims 1-10; figures 5-7 *	1	H01Q G08C
A	--- US-A-4 904 995 (BONNER ET AL.) * claims 1,2; figures 1,2 *	7	
A	--- GB-A-2 268 032 (BADGER METER) * claim 1; figures 1-4 *	7	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 May 1995	Examiner Angrabeit, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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