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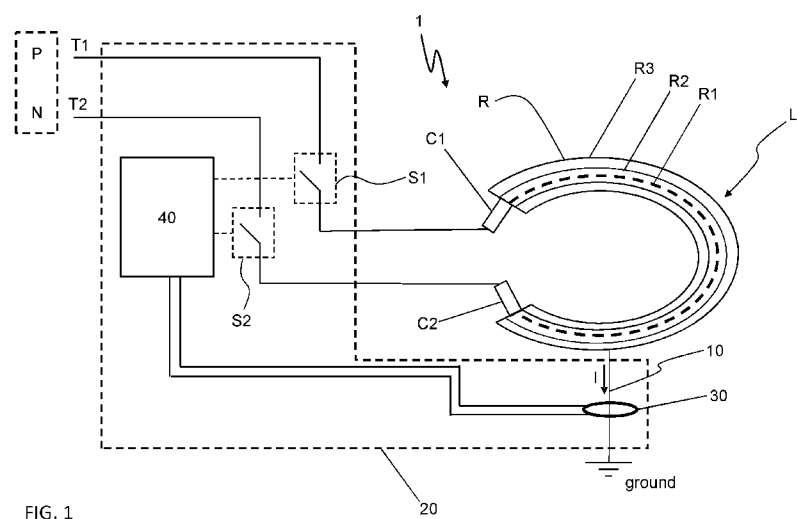


FIG. 1

(57) Abstract: Household appliance with a safety circuit, comprising at least one electrical load connected to a power mains supply, said at least one electrical load being provided with a ground connection branch, said household appliance further comprising a safety circuit provided with: a detection element associated with said ground connection branch and configured to detect a leakage current flowing in said ground connection; a comparison module configured to compare said leakage current with a preset threshold. Said module of comparison is further configured to disconnect said at least one electrical load from said power mains when the leakage current turns out to be higher than said preset threshold.

"Household appliance with a safety circuit"

5

DESCRIPTION

[TECHNICAL FIELD]

This invention relates to a household appliance with safety circuit.

10

[PRIOR ART]

As it is known, the household appliances are equipped, internally, of one or more electric loads that are suitably fed in order to contribute to the execution of the functions to which the household appliance is responsible.

15

By the way of an example may be considered the heating resistors present in the dishwasher and in washing machines, which have the task of heating the water used for the washing cycles.

20

Typically, these resistors comprise an internal metal filament, an intermediate coating made of electrically insulating material, and an external coating of a metallic material. The metallic coating is connected to ground.

25

A possible failure of the mentioned heating resistors occurs when, following a hole / tearing / breaking the intermediate coating, the internal filament comes into contact with the external metallic coating. In this circumstance, when the resistor is fed to perform its function of heating, the current through the metal filament is entirely ground dispersed through the mentioned connection to ground.

30

This can lead to an uncontrolled heating of the component, up to cause a fire.

According to the state of the art, if the equipment is fed by electrical power mains built and maintained according to the standards of safety requirements, a circumstance such as that briefly described above should be avoided by the security system

that is part of the electrical power mains itself which, following a differential detection on the phase and neutral lines, recognizes the occurrence of a dangerous situation and cuts off the power supply to the household appliance.

5 However, there are circumstances where, for various reasons, this security system does not intervene, or is entirely absent.

The prior art therefore provides also additional safety systems mounted directly on the household appliances.

10 These additional safety systems are also based on differential phase-to-neutral detections.

The Applicant has noticed that the security systems that provide for a detection of the differential type are characterized by obvious operational problems.

15 First, this type of detection requires the reading of the current flowing in the two conductors, so that should be used two detecting elements, or a single detecting element (typically comprising a toroid of ferromagnetic material) of a particularly significant size. This clearly increases both the complexity and the costs of realization of this kind of security systems in addition to introducing positioning constraints by virtue of the size that the detecting element necessarily assumes.

20 Furthermore, in the case of single detecting element, having to be associated to the two phase and neutral conductors poses constraints to its positioning, typically being able to be positioned only on the power input of the household appliance, with this by creating constraints of considerable entity in the design phase and construction of the equipment.

[OBJECTIVES AND SYNTHESIS OF THE INVENTION]

25 Purpose of the present invention is therefore to provide a household appliance with safety circuit that allows to overcome the drawbacks pointed out above.

30 In particular, aim of the invention is to provide a household appliance equipped with a safety system supplementary to that in the power mains supply should itself be equipped.

Another purpose of the invention is to provide a household appliance equipped with a safety system that is of simple realization.

5 A further purpose is to provide a household appliance equipped with a safety system that does not impose extremely stringent constraints, both in the design phase and in the construction phase, in terms of flexibility in the positioning of the electrical / electronic components.

10 These and still other purposes are substantially achieved by a household appliance with safety circuit as described in the attached claims.

In particular, according to a first aspect, object of the present invention is a household appliance with a safety circuit, comprising at least one electrical load connected to a power mains supply, said at least one electrical load being associated with a ground connection branch, said household appliance further comprising a safety circuit provided with:

- a detection element associated with said branch and configured to detect a leakage current flowing in said branch;
- 20 - a comparison module configured to compare the leakage current with a preset threshold;

in which said comparison module is further configured to disconnect said at least one electrical load from the power mains when said leakage current turns out higher than said preset threshold.

25 Preferably, said comparison module is configured to disconnect said at least one electric load from both a phase line, and a neutral line, of said power mains supply.

30 Preferably, said household appliance is equipped with at least two connection terminals configured to be connected to the phase line and to the neutral line of said power mains supply.

Preferably, said at least one electric load has a first connection to one of said connection terminals through a first switch, and a second connection to the other connection terminal

through a second switch.

Preferably, said comparison module is configured to open said first and second switches if said leakage current is higher than said preset threshold.

5 Preferably, said at least one electric load comprises a heating resistor to heat the wash water used by said household appliance in at least one wash cycle.

10 Preferably, said heating resistor comprises an internal metal filament, an intermediate coating made of electrically insulating material, and an external coating made of metallic material.

Preferably, the ground connection branch of said at least one electric load is a connection between said external coating and ground.

15 Preferably, said at least one electric load is a plurality of electric loads, each one having a first connection to one of said connection terminals through a respective main switch, and a second connection to the other connection terminal.

20 Preferably, the second connections of said electric loads are connected to the respective terminal of said household appliance through a common switch.

Preferably, said comparison module is configured to open said main switches and the common switch if said leakage current is higher than said preset threshold.

25 Preferably, each electric load has a connection to the ground connection branch.

According to another aspect, the object of the present invention is a filter for electric noise suppression, adapted for use in household appliance, said filter comprising:

30 - a first capacitor connected across connection terminals of said household appliance and adapted to filter differential mode noise ;

- a second capacitor and a third capacitor respectively connected across a respective one of said connection terminals and a ground node, said second and third capacitor being adapted to

filter noise to ground;

- a detection element associated with a ground connection branch afferent to said ground node, said detection element being configured to detect a leakage current flowing in said branch, said
5 detection element being adapted to cooperate with a comparison module of said household appliance.

According to a further aspect, the object of the present invention is a safety circuit suitable to be used in said household appliance.

10 [BRIEF DESCRIPTION OF THE DRAWINGS]

Some examples of preferred and advantageous embodiments are described by way of a non-limiting examples referring to the attached figures, in which:

- Figure 1 shows the block diagram of a first embodiment of
15 an household appliance with safety circuit according to the present invention, in which some parts have been deleted to better illustrate others;

- Figure 2 shows the block diagram of a second embodiment of
20 an household appliance with safety circuit according to the present invention, in which some parts have been deleted to better illustrate others;

- Figure 3 shows the block diagram of a modification of the embodiment of Figure 2.

[DETAILED DESCRIPTION OF THE INVENTION]

25 With reference to the attached figures, with number 1 has been indicated overall an household appliance with safety circuit according to the present invention.

By the way of an example, the household appliance 1 may be a dishwasher or a laundry washing machine.

30 In general, the household appliance 1 is a household appliance in which, for normative and / or security issues, at least one electric load is ground connected.

In more detail, the household appliance 1 comprises at least one electric load L1-Ln.

Figure 1 shows an embodiment in which there is a single electric load L1 (constituted, as will be more clear in the following, by a heating resistor R).

Figure 2 shows an embodiment in which there are several
5 electric loads L1-Ln.

By the way of an example, the electric load L1 of the embodiment of Figure 1 can be one of the electric loads of the embodiment of Figure 2.

As mentioned above, the aforesaid at least one electric load
10 L1-Ln is associated to a ground connection branch 10.

In the embodiment of Figure 1, the branch 10 is constituted by a connection across the electrical load L1 and the ground.

In the embodiment of Figure 2, the branch 10 is a branch to which direct ground connections Y1-Yn are afferent and coming from
15 each electric load L1-Ln.

In particular, the ground connection branch 10 and / or connections Y1-Yn have an end in contact with a metallic part of at least one electric load L1-Ln.

According to this invention, the household appliance 1 has a
20 safety circuit 20.

The safety circuit 20 has the task of disconnecting at least one electric load L1-Ln from the power mains in case of a leakage current that flows in the branch 10 exceeds a determined threshold.

More particularly, the safety circuit 20 comprises a
25 detection element 30 associated with the ground connection branch 10 and configured to detect a leakage current I flowing in said branch.

For example, the detection element 30 may be a current transformer or a shunt resistor.

30 In Figures 1 and 2 the detector element 30 is schematically represented as a toroidal element placed around the branch 10.

The safety circuit 20 also comprises a comparison module 40 to compare with a preset threshold the leakage current I detected by the detection element 30.

The preset threshold can be defined both in hardware mode, that is, by setting a reference voltage through appropriate circuit elements dimensioned in an appropriate way, and in the software mode, that is programming a threshold value in a microprocessor
5 that implements said comparison module.

In more detail, imagining of using a current transformer, provided with a primary winding associated with the toroid and a secondary winding, the resolution of the measurement can be defined by the number of turns of the secondary one.

10 The maximum measurable capacity depends on the toroid, in particular, the limit is given by the saturation of the toroid itself. Advantageously the saturation limit of the toroid is higher than the preset threshold of intervention that is set in the comparison module 40.

15 The preset threshold is a limit beyond which there is a real danger that can cause fires.

By the way of an example, the preset threshold may be comprised between 250 mA and 3A.

20 Therefore, in case the leakage current I exceeds the preset threshold, the comparison module 40 provides to disconnect at least one electric load $L1-Ln$ from the power mains.

In particular, the comparison module provides to disconnect at least one load $L1-Ln$ from both a phase line P , and a neutral line N of the power mains. In this way it is performed a protection
25 with a so-called "bipolar" disconnection.

Preferably the household appliance 1 is equipped with at least two connection terminals $T1, T2$ configured to be connected to the phase line P and to the neutral line N of the power mains. The terminals $T1, T2$ can be part of or be included in an electrical
30 plug 50, which is connectable to a socket connected to a power mains.

An input filter F (Figures 2, 3), which will be better described in the following, is associated to two connection terminals $T1, T2$.

As schematically shown in figure 1, the electric load L1 has a first connection C1 which, through a first switch S1, connects the electric load L1 itself to one of the two terminals T1, T2, and a second connection C2, which, through a second switch S2 connects the electrical load L1 to the other terminal.

When the comparison module 40 acts to disconnect the electric load L1 from the power mains, it advantageously opens both the first switch S1, and the second switch S2, in order to perform the above mentioned bipolar disconnection.

As mentioned above, the electric load L1 schematically represented in figure 1 may be a heating resistor R1 of the household appliance used to heat water used in one or more wash cycles.

In a preferred embodiment, the heating resistor R comprises an internal metal filament R1, an intermediate coating R2 made of electrically insulating material, and an external coating R3 made of metallic material.

When, for some reason, the internal metal filament R1 is in contact with the external coating R3, for example, due to a breaking, a tearing and / or a hole of the intermediate coating R2, through the branch 10 flows a leakage current I of considerable entities (for example greater than 250 mA) and, following the measuring performed by the detection element 30, the comparison module 40 operates by disconnecting the electric load L1.

As above mentioned, in the embodiment of Figure 1, the branch 10 associated with the electric load L1 is a connection across the outer coating R3 and ground.

With reference to the embodiment schematically illustrated in figure 2, the household appliance 1 comprises a plurality of electric loads L1-Ln.

By the way of an example the electric loads L1-Ln may comprise a heating resistor R (as in the embodiment shown in Figure 1), an electric motor which is part of the household appliance 1, etc. ..

In general, the loads L1-Ln are electric loads which have at least a metallic part connected to the ground.

In the above example of an electric motor, the metallic part connected to the ground is represented from a group of little metal sheets of the stator.

Preferably each electric load L1-Ln 10 is connected to the ground connection branch through a respective connection Y1-Yn.

Therefore the ground connections Y1-Yn of all electric loads L1-Ln are afferent to the aground connection branch 10.

Preferably each electric load L1-Ln has a first connection X1-Xn, through a respective main switch MS1-MSn, to one of the connection terminals T1, T2, and a second connection Z1-Zn to the other connection terminal.

Preferably the latter connections Z1-Zn of the electric loads L1-Ln are connected to the respective terminal T1, T2 of the household appliance 1 through a common switch SX.

By way of an example, Figure 2 shows that the first connections X1-Xn of the loads L1-Ln are afferent to the second terminal T2, through the main switches MS1-MSn, while the second connections Z1-Zn are afferent to the first terminal T1 through the common switch SX.

When the comparison module 40 determines that the leakage current I flowing in the branch 10 is higher than the preset threshold, then provides for opening both the main switches MS1-MSn, and the common switch SX.

As mentioned above, the household appliance 1 is advantageously provided with a filter F (Figures 2, 3).

The filter F is called a " machine filter ", i.e. a filter used for electric noise incoming in the household appliance from the power mains, and electric noise injected into the power mains from the household appliance itself.

The filter F preferably comprises a first capacitor C1 in the class "X" which is connected between the two connection terminals T1, T2.

The first capacitor C1 is adapted to filter differential mode noise.

The filter F preferably comprises a second capacitor C2 and a third capacitor C3, both in class "Y", respectively connected
5 across the connection terminal T1 and ground, and across the connection terminal T2 and ground.

The second and third capacitor C2, C3 are adapted to filter noise to ground.

In the embodiment of figure 3, the detection element 30 is
10 integrated in the filter F.

In particular, in the embodiment of Figure 3, the Y1-Yn connections coming from electric loads L1-Ln are afferent to ground node N, to which the second and the third capacitor C2, C3 are also connected; from the ground node N then it develops the
15 ground connection branch 10 on which operates the detection element 30.

This invention achieves important advantages.

Firstly, the household appliance according to this invention is equipped with an additional safety compared to the system that
20 each power mains network should provide.

Moreover, the safety circuit in the electrical household appliance according to the present invention results simple and economical realization.

In addition to what is mentioned above, the safety circuit
25 can be mounted inside the household appliance according to this invention with extreme flexibility, particularly with reference to the arrangement of the detection element.

CLAIMS

1. A household appliance with a safety circuit, comprising at least one electric load (L1-Ln) connected to an electric power mains, said at least one electric load (L1-Ln) being associated with a ground connection branch (10), said household appliance
5 (1) further comprising a safety circuit (20) equipped with:
 - a detection element (30) associated with said branch (10) and configured to detect a leak current (I) flowing in said branch (10);
 - 10 - a comparison module (40) configured to compare said leak current (I) with a preset threshold;wherein said comparison module (40) is also configured to disconnect said at least one electric load (L1-Ln) from said power mains if said leak current (I) turns out to be higher
15 than said preset threshold.
2. A household appliance according to claim 1, wherein said comparison module (40) is configured to disconnect said at least one electric load (L1-Ln) from both a phase line (P) and a neutral line (N) of said power mains.
- 20 3. A household appliance according to any one of the preceding claims, which is equipped with at least two connection terminals (T1, T2) configured to be connected to the phase line (P) and to the neutral line (N) of said power mains.
4. A household appliance according to claim 3, wherein said at least one electric load (L1-Ln) has a first connection (C1) to
25 one of said connection terminals (T1, T2) through a first switch (S1), and a second connection (C2) to the other connection terminal through a second switch (S2).
5. A household appliance according to claim 4, wherein said comparison module (40) is configured to open said first and second switches (S1, S2) if said leak current (I) is higher
30 than said preset threshold.
6. A household appliance according to any one of the preceding claims, wherein said at least one electric load (L1-Ln)

comprises a heating resistor (R) to heat wash water being used by said household appliance (1) in at least one wash cycle.

7. A household appliance according to claim 6, wherein said heating resistor (R) comprises an internal metal filament (R1),
5 an intermediate coating (R2) made of electrically insulating material, and an external coating (R3) made of metallic material.
8. A household appliance according to claim 7, wherein the ground
10 connection branch (10) of said at least one electric load (L1-Ln) is a connection between said external coating (R3) and ground.
9. A household appliance according to any one of the preceding
15 claims, wherein said at least one electric load (L1-Ln) is a plurality of electric loads, each one having a first connection (X1-Xn) to one of said connection terminals (T1, T2) through a respective main switch (MS1-MSn), and a second connection (Z1-Zn) to the other connection terminal.
10. A household appliance according to claim 9, wherein the second
20 connections (Z1-Zn) of said electric loads (L1-Ln) are connected to the respective terminal (T1, T2) of said household appliance (1) through a common switch (SX).
11. A household appliance according to claim 10, wherein said
25 comparison module (40) is configured to open said main switches (MS1-MSn) and said common switch (SX) if said leak current (I) is higher than said preset threshold.
12. A household appliance according to any one of claims 9 to 11,
wherein each electric load (L1-Ln) has a connection (Y1-Yn) to
said ground connection branch (10).
13. A filter (F) for electric noise suppression, adapted for use in
30 a household appliance (1) according to any one of the preceding claims, said filter (F) comprising:
 - a first capacitor (C1) connected across connection terminals T1, T2) of said household appliance (1) and adapted to filter differential mode noise;

5 - a second capacitor (C2) and a third capacitor (C3),
respectively connected across a respective one of said
connection terminals (T1, T2) and a ground node (N), said
second and third capacitors (C2, C3) being adapted to
filter noise to ground;

10 - a detection element (30) associated with a ground
connection branch (10) afferent to said ground node (N),
said detection element (30) being configured to detect a
leak current (I) flowing in said branch (10), said
detection element (30) being adapted to cooperate with a
comparison module (40) of said household appliance (1).

14. A safety circuit (20) adapted for use in the household
appliance (1) according to any one of claims 1 to 12.

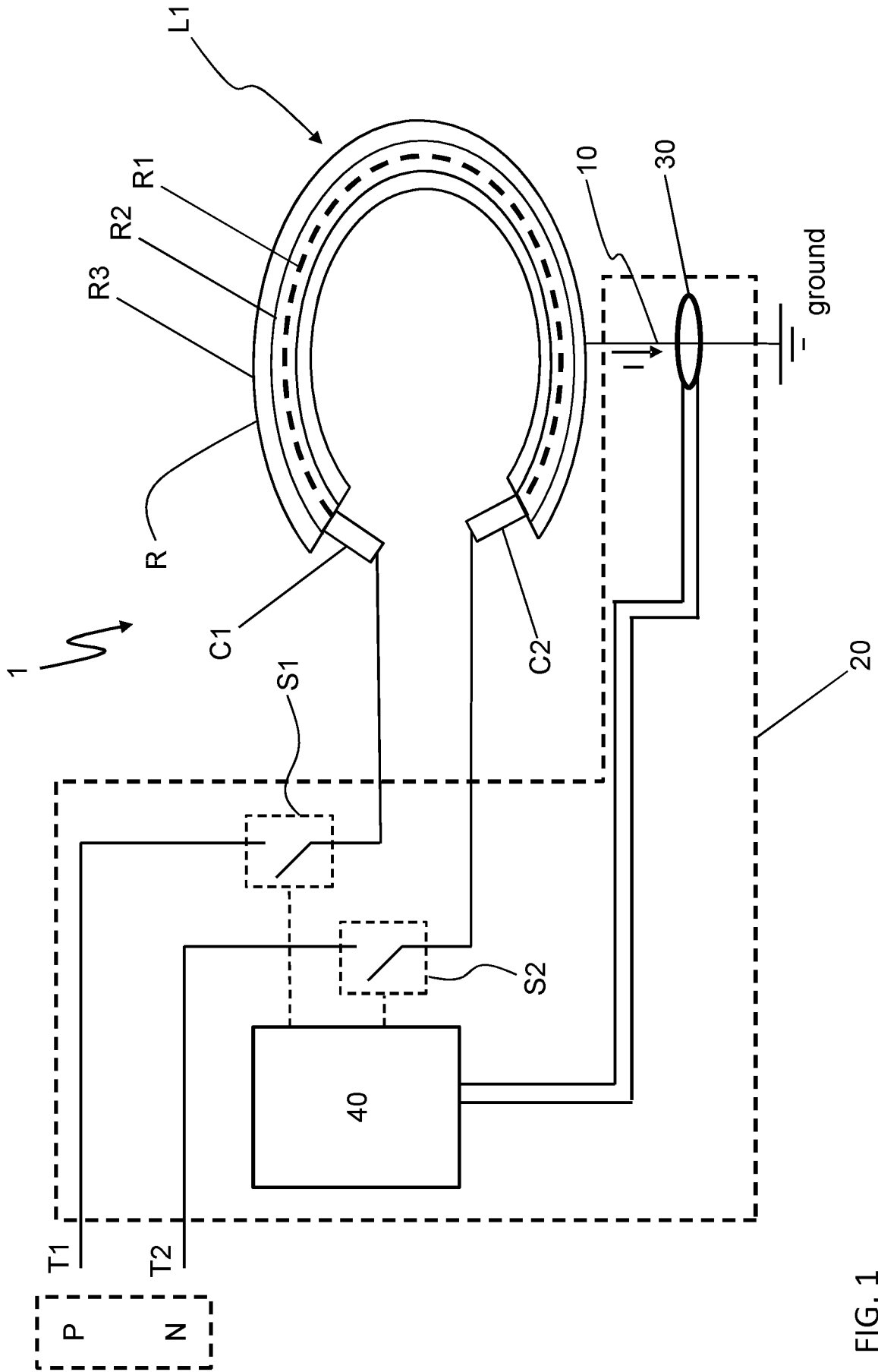


FIG. 1

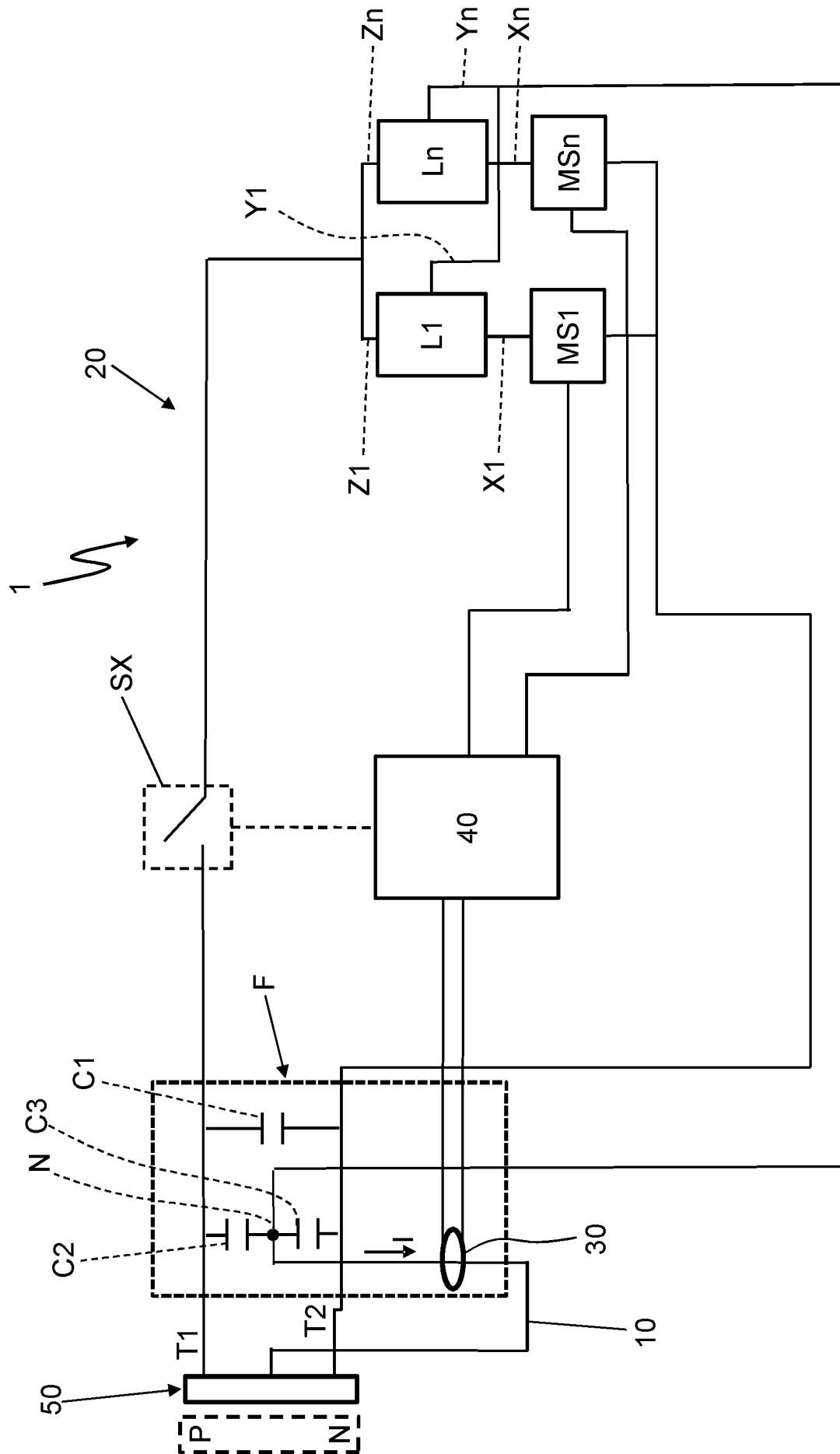


FIG. 3