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(54) **ELECTRONIC IGNITION CIRCUIT FOR OIL BURNERS**

ELEKTRONISCHE ZÜNDSCHALTUNG FÜR ÖLBRENNER

CIRCUIT D'ALLUMAGE ELECTRONIQUE POUR BRULEURS A COMBUSTIBLE LIQUIDE

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Description

[0001] The present invention relates to an electronic ignition circuit for oil burners, in particular a high voltage high frequency ignition circuit, where the circuit comprises an oscillator and a high frequency transformer wound on a core, and a transformer for such a circuit.

[0002] In the oil burners typically for heating in single-family houses, electric ignition is employed.

[0003] In such burners a blower creates an airflow into which the oil is sprayed through a spray nozzle to form an oil mist in the airflow. In order to ignite the oil an ignition spark gap is located in the vicinity of, but not too close to the spray nozzle. Typically the spark gap is located downstream from the blower and the spray nozzle with respect to the airflow. The distance from the spray nozzle to the spark gap in the direction of the airflow is, however, quite small, e.g. approximately 1-2 mm. The spray nozzle and the spark gap are usually off-set slightly in the direction across the airflow, so as to prevent the oil mist from reaching the electrodes of the spark gap. Other arrangements are of course possible. In particular, the spark gap could be located upstream from the spray nozzle. The important thing, however, is that the ignition spark gap is located sufficiently far away from the spray nozzles, or rather the oil mist, to prevent soot forming on the electrodes from unburned oil from the oil mist.

[0004] On the other hand the spark gap must be located close enough to the spray nozzle to allow the arc formed in the spark gap to actually reach the oil mist and ignite it. When the arc is formed between the electrodes of the spark gap it will be deformed inter alia by the airflow so as to extend downstream into the oil mist. This, however, cools the arc, and under certain conditions, the part of the arc, which extends into the oil mist, may only be able to ignite the oil mist with a delay, or even not be able to ignite the oil mist at all. In both cases unburned oil products are blown away into the environment causing pollution thereof.

[0005] As already stated, the present invention in particular relates to high voltage high frequency ignition. In fig. 1 a known electronic circuit for producing the arc is shown. The circuit comprises a spark gap G connected to the secondary of a high voltage high frequency transformer T1. The high frequency transformer T1 is wound on a ferrite rod. An example of such a high frequency high voltage transformer is found in US-A-4683518. The electronic circuit incorporates an oscillator circuit R1, R2, R3, R4, C3, C4, C5, C6, DZ1, DZ2, TR1 and T1. It should be noticed that the transformer T1 is coupled with the basis of the transistor TR1, so as to provide the feedback needed for the oscillator.

[0006] The electronic circuit further comprises a half-wave rectifier circuit D1, C2 as well as noise suppression circuitry L1, C1, R5, R6, the details of which are not considered relevant for the present invention and will not be described in further detail.

[0007] The oscillator is fed with the half-wave rectified current from the half-wave rectifier, and thus produces high frequency bursts to the high frequency transformer T1.

[0008] Though a prior art ignition unit with the above circuit has worked well over a number of years, the size of the components in the circuit places limitations on the size of the ignition unit. The size of the unit also limits the freedom in locating it. Both the size of the unit and the limitation in locating it puts constraints on the size of the burner, which makes it difficult to build compact burners. An example of a high frequency high voltage transformer with a reduced size is found in US-A-4 358 813. According US-A-4 358 813 the core on which the transformer is wound forms a closed magnetic path.

[0009] It is a first object of the invention to build more compact oil burners.

[0010] It is a second object of the invention to improve the ignition in oil burners.

[0011] According to a first aspect of the present invention, these objects are met by an electronic ignition circuit for oil burners according to the opening paragraph, wherein the core on which the high frequency transformer is wound forms a substantially closed magnetic path for the magnetic flux generated by the windings of the transformer, when current flows through the windings, characterized is that the core comprises two parts between which a gap is provided.

[0012] By the use of a core forming a substantially closed magnetic path for the magnetic flux a substantial reduction in the size of the transformer is achieved, because not only the core itself but also the windings may be reduced in size. Moreover, having a core comprising two parts between which a gap is provided allows for easy assembly of the transformer.

[0013] In a first preferred embodiment the core comprises at least one essentially E shaped core and a yoke.

[0014] In a second preferred embodiment the yoke also comprises a second essentially E shaped core.

[0015] In a third preferred embodiment the gap is formed between the central leg of the E shaped core and the yoke.

[0016] Preferably, the core weighs less than 14 g.

[0017] All of the above embodiments improve the advantage of using a MOS-FET transistor in the oscillator circuit.

[0018] Thus, in a further preferred embodiment of the electronic circuit the oscillator comprises a MOS-FET transistor.

[0019] The use of a MOS-FET is advantageous as it is more power efficient as compared to traditional bipolar transistors, and thus contributes to the overall efficiency of the electronic circuit. Moreover it allows a greater deflection of the arc.

[0020] According to a second aspect the present invention provides a burner comprising the above electronic circuit is provided.

[0021] According to a third aspect the invention involves the use, in an electronic ignition circuit for oil burners, of a high voltage high frequency transformer comprising a core forming a substantially closed magnetic path for the magnetic flux generated by the windings of the transformer, when current flows through the windings, characterized in that the core comprises two parts (1a, 1b) between which a gap (6) is provided.

[0022] According to a fourth aspect the invention relates to a high voltage high frequency ignition transformer for oil burners, where the transformer comprises a core forming a substantially closed magnetic path for the magnetic flux generated by the windings of the transformer, when current flows through the windings, characterized in that the core comprises two parts (1a, 1b) between which a gap (6) is provided.

[0023] The present invention will now be described in greater detail by means of a non-limiting example and with reference to the drawings on which,

Fig. 1 is a diagram of an electronic ignition circuit for oil burners,

Fig. 2 is a perspective view in partial section of a substantially closed core employed in a preferred embodiment of the present invention to form a substantially closed magnetic path for the magnetic flux generated by the windings of the transformer,

Fig. 3 is a schematic drawing of an ignition spark gap an oil burner, and

Figs. 4a-4c illustrate the ignition arc under different experimental conditions.

[0024] Fig. 1 is a diagram of an electronic ignition circuit for oil burners. Except for the high voltage high frequency transformer T1, which is in the present invention substituted by a high voltage high frequency transformer T1', this circuit corresponds to a prior art circuit. For the sake of convenience, i.e. to avoid having two substantially identical figures, reference will be made to fig. 1 also in the context of the present invention, only with T1' replacing T1.

[0025] As already mentioned, the circuit comprises a spark gap G connected to the secondary of a high voltage high frequency transformer T1'. The spark gap of the burner is located remote from the ignition unit containing the electronic circuit including the high voltage, high frequency transformer T1'. The electronic ignition circuit incorporates an oscillator circuit R1, R2, R3, R4, C3, C4, C5, C6, DZ1, DZ2, TR1 and T1'. It should be noticed that the transformer T1' is coupled with the basis of the transistor TR1, so as to provide the feedback needed for the oscillator.

[0026] The electronic circuit further comprises a half-wave rectifier circuit D1, C2 as well as noise suppression circuitry L1, C1, R5, R6, the details of which are not considered relevant for the present invention and will not be described further.

[0027] The transformer T1' is shown in perspective view and partial section in fig. 2. The transformer T1' has a substantially closed core 1 comprising two parts 1a and 1b, which are in the preferred embodiment identical, both being substantially E shaped and both preferably of a ferrite material. The two parts are arranged in an opposing mirror image configuration. For convenience, only one of the E shapes will be described below. The middle leg 2 of the E is preferably cylindrical, so as to match a likewise cylindrical bobbin 3 on which the windings 4a, 4b, 4c are wound. The two outer legs 5 of the E are essentially rectangular in cross section. It is, however preferred that the inner side is curved, cf. fig. 2, so as to match the outer shape of the bobbin 3. Evidently also the outer side may be curved, e.g. so that the cross sections are circular segments matching the outer shape of the bobbin 3. The middle leg 2 is slightly shorter than the two outer legs 5. Thus, when the outer legs 5 of the two respective parts 1a, 1b abut, a gap 6 is formed between the middle legs 2.

[0028] The interconnections 7 between the outer legs 5 and the central leg 2 are slightly tapered, so as to present a trapeze shaped cross section.

[0029] On the bobbin 3 four windings are located in appropriate grooves. There are two secondary high voltages windings 4b and 4c each distributed between several grooves, three for each respective secondary winding in fig. 2, so as to reduce the voltage between adjacent turns. The two secondary windings are connected in series, so as to have a neutral point between them. In the burner this neutral point may be grounded using the metal parts of the burner, thereby reducing electrocution hazards, and the risk of undesired sparks to conducting parts of the burner. In the bobbin 3 there is a further groove in which the primary low voltage winding 4a is located. Together with the primary winding 4a the coupling winding 4d (not shown in fig. 2), which is connected to the basis of the transistor TR1, is located.

[0030] In the preferred embodiment the core used is a pair of ETD 45G 19 14 07 - 050 core parts, supplied by Iskra Feriti, Ljubljana, Slovenia. The use of these two core parts gives a gap of approximately 1 mm. The overall dimensions for each core part is approximately 19,6 mm x 7,4 mm, giving the core an overall weight of approximately 13,4 g, which is a substantial reduction over the rod core presently employed by the applicant, weighing approximately 16 g.

[0031] Moreover, the use of this core, which forms a substantially closed magnetic path for the magnetic flux generated by the windings of the transformer, when current flows through the windings, reduces the amount of copper needed for the transformer windings with approximately 20 percent.

[0032] With a view to the above, preferred embodiment, it is appropriate to mention that substantially closed in the present context is not to be understood as a including a fully closed magnetic circuit. Such fully closed magnetic circuits, do not give rise to the advantages of the invention, as will be apparent from description of experiments given below.

[0033] Moreover, the use of the core according to the present invention, which forms a substantially closed magnetic path for the magnetic flux, makes the use of a MOS-FET type transistor as the transistor TR1 in the oscillator circuit. The MOS-FET generates sharper flanks in the high frequency oscillations produced, and gives rise to a larger deflection of the arc, as will be described below in connection with Figs. 4a-4c. Further, the use of a MOS-FET transistor is more energy efficient.

[0034] It should also be mentioned that though, in the preferred embodiment, a pair of identical core parts are used, other core part configurations may be used. I.e. the configuration of the two parts of the core may be any conventional e.g. such as C-I, C-C, E-I, E-C, E-E, or C-T.

[0035] Experiments have shown that the gap is essential for the behaviour of the arc in the airflow.

[0036] Fig. 3 illustrates a spark gap G with two electrodes 12, 13 and two terminals 14 and 15 for connection to secondary of the ignition transformer T1' via a cable (not shown). When high voltage is applied to the spark gap a plasma arc is formed between the electrodes 12, 13.

[0037] Partly because of the airflow, as mentioned initially, the arc is blown away from the electrodes. At the same time the airflow cools the arc. It has been found that in a given air flow the distance that the arc is blown away from the spark gap depends on the high voltage high frequency transformer T1' in the electronic ignition circuit.

[0038] Figs. 4a-4c illustrate the ignition arc under experimental conditions, during tests performed with different high voltage high frequency transformers inserted in the electronic circuit of fig 1. The darker areas illustrate the central channels of hot, highly luminous plasma emitting white light, whereas the grey areas illustrate the outer cloud of colder blue/white luminous plasma. The scale coves 0-2 cm.

[0039] Fig. 4a illustrates the arc, which is achieved if a closed core is used for the high voltage high frequency transformer. Fig. 4b illustrates the arc, which is achieved with the prior art high voltage high frequency transformer. Fig. 4c illustrates the arc achieved using the high voltage high frequency transformer of the preferred embodiment using ETD 45G 19 14 07 - 050 core parts and a gap of 1 mm.

[0040] As can be seen, the luminous cloud of plasma extends about 13 mm from the tips of the electrodes in Fig. 4b where the prior art transformer T1 is used in the ignition circuit. If instead, the transformer according to the present invention is used as illustrated in fig. 4c the luminous cloud of plasma extends more than 15 mm from the tips of the electrodes. On the other hand, if a transformer with a closed core is used, the arc is only deflected slightly and the luminous cloud extends only about 5 mm from the electrodes.

[0041] Thus, not only does the present invention provide a longer arc of blue/white plasma reaching deeper into the oil mist for ignition, but also the white-hot central arc channel reaches as far using the present invention as does the colder blue/white plasma when using the prior art.

[0042] Accordingly a much better ignition of the oil mist is achieved.

Claims

1. Electronic ignition circuit for oil burners, in particular a high voltage high frequency ignition circuit, said circuit comprising an oscillator and a high frequency transformer (T1') wound on a core (1), said core forming a substantially closed magnetic path for the magnetic flux generated by the windings of the transformer (T1'), when current flows through the windings (4a-4d) **characterized in that** the core (1) on which the high frequency transformer is wound comprises two parts (1a, 1b) between which a gap (6) is provided.

2. Electronic ignition circuit according to any preceding claim, **characterized in that** the core comprises at least one essentially E shaped core (1a) and a yoke (1b).

3. Electronic ignition circuit according to claim 2, **characterized in that** the yoke (1b) comprises a second essentially E shaped core.

4. Electronic ignition circuit according to any one of claims 2 to 3, **characterized in that** the gap (6) is formed between the central leg of the E shaped core (1a) and the yoke (1b).

5. Electronic ignition circuit according to any one of the preceding claims, **characterized in that** the core (1) is a ferrite core.

6. Electronic ignition circuit according to any one of the preceding claims, **characterized in that** the oscillator comprises a MOS-FET transistor (TE1).

7. Electronic ignition circuit according to any one of the preceding claims, **characterized in that** the core (1) weighs less than 14 g.

8. Oil burner comprising an electronic ignition circuit according to any one of the preceding claims.

9. The use, in an electronic ignition circuit for oil burners, of a high frequency transformer (T1') comprising a core (1) comprising two parts (1a, 1b) between which a gap (6) is provided, and forming a substantially closed magnetic path for the magnetic flux, generated by the windings (4a-4d) of the transformer (T1'), when current flows through the windings (4a-4d).

10. High frequency ignition transformer for oil burners, comprising a core (1) forming a substantially closed magnetic path for the magnetic flux, generated by the windings (4a-4d) of the transformer (T1'), when current flows through the windings (4a-4d), **characterized in that** the core (1) comprises two parts (1a, 1b) between which a gap (6) is provided.

11. High frequency ignition transformer according to any one of claims 9 or 10, **characterized in that** the core (1) is a ferrite core.

12. High frequency transformer according to any one of claims 9 to 11, **characterized in that** the core (1) weighs less than 14 g.

Patentansprüche

1. Elektronischer Zündungskreislauf für Ölbrenner, insbesondere Hochspannungs- und Hochfrequenzzündungskreisläufe, wobei der Kreislauf einen Oszillator und einen Hochfrequenztransformer (T1') aufweist, der um einen Kern (1) gewickelt ist, der einen im wesentlichen geschlossenen magnetischen Weg für den magnetischen Fluss bildet, der von den Wicklungen des Transformers (T1') erzeugt wird, wenn Strom durch die Wicklungen (4a-4d) fliesst, **dadurch gekennzeichnet, dass** der Kern (1), um den der Hochfrequenztransformer gewickelt ist, zwei Teile (1a, 1b) aufweist, zwischen denen eine Öffnung (6) vorgesehen ist.

2. Elektronischer Zündkreislauf nach Anspruch 1, **dadurch gekennzeichnet, dass** der Kern zumindest einen im wesentlichen E-förmigen Kern (1a) und einen Joch (1b) aufweist.

3. Elektronischer Zündkreislauf nach Anspruch 2, **dadurch gekennzeichnet, dass** das Joch (1b) einen zweiten im wesentlichen E-förmigen Kern aufweist.

4. Elektronischer Zündkreislauf nach Anspruch 2 oder 3, **dadurch gekennzeichnet, dass** die Öffnung (6) zwischen dem zentralen bein des E-förmigen Kerns (1a) und dem Joch (1b) gebildet ist.

5. Elektronischer Zündkreislauf nach jedem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Kern (1) ein Ferritkern ist.

6. Elektronischer Zündkreislauf nach jedem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Oszillator einen MOS-FET Transistor (TR1) aufweist.

7. Elektronischer Zündkreislauf nach jedem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Kern (1) weniger als 14 g wiegt.

8. Ölbrenner mit einem elektronischen Zündkreislauf nach jedem der vorhergehenden Ansprüche.

9. Die Anwendung, in einem elektronischen Zündkreislauf für Ölbrenner, von einem Hochfrequenztransformer (T1') mit einem Kern (1) aus zwei Teilen (1a, 1b), zwischen denen eine Öffnung (6) vorgesehen ist, wobei der Kern einen im wesentlichen geschlossenen magnetischen Weg für den magnetischen Fluss bildet, der von den Wicklungen (4a-4d) des Transformers (T1') erzeugt wird, wenn Strom durch den Wicklungen (4a-4d) fliesst.

10. Hochfrequenz-Zündtransformer für Ölbrenner mit einem Kern (1), der einen im wesentlichen geschlossenen magnetischen Weg für den magnetischen Fluss bildet, der von den Wicklungen (4a-4d) des Transformers (T1') erzeugt wird, wenn Strom durch den Wicklungen (4a-4d) fliesst, **dadurch gekennzeichnet, dass** der Kern (1 zwei Teile (1a, 1b) aufweist, zwischen denen eine Öffnung (6) vorgesehen ist.

11. Hochfrequenz-Zündtransformer nach einem der Ansprüche 9-11, **dadurch gekennzeichnet, dass** der Kern (1) ein Ferritkern ist.

12. Hochfrequenztransformer nach einem der Ansprüche 9-11, **dadurch gekennzeichnet, dass** der Kern (1) weniger als 14 g wiegt.

Revendications

1. Circuit d'allumage électronique pour brûleurs à mazout, en particulier un circuit d'allumage électronique haute fréquence et haute tension, ledit circuit comprenant un oscillateur et un transformateur haute tension (T1') enroulé sur un noyau (1), ledit noyau formant un chemin magnétique sensiblement fermé pour le flux magnétique généré par les enroulements du transformateur (T1'), lorsque le courant passe par les enroulements (4a-4d), **caractérisé en ce que** le noyau (1) sur lequel le transformateur haute tension est enroulé comprend deux parties (1a, 1b) entre lesquelles un entrefer (6) est prévu.

2. Circuit d'allumage électronique selon la revendication précédente, **caractérisé en ce que** le noyau comprend au moins un noyau sensiblement en forme de E (1a) et une culasse (1b).

3. Circuit d'allumage électronique selon la revendication 2, **caractérisé en ce que** la culasse (1b) comprend un second noyau sensiblement en forme de E.

4. Circuit d'allumage électronique selon l'une quelconque des revendications 2 ou 3, **caractérisé en ce que** l'entrefer (6) est formé entre la jambe centrale du noyau sensiblement en forme de E (1a) et la culasse (1b).

5. Circuit d'allumage électronique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le noyau (1) est un noyau de ferrite.

6. Circuit d'allumage électronique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'oscillateur comprend un transistor à effet de champ à semi-conducteur à oxyde métallique (TR1) (MOSFET).

7. Circuit d'allumage électronique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le noyau (1) pèse moins de 14 g.

8. Brûleur à mazout comprenant un circuit d'allumage électronique selon l'une quelconque des revendications précédentes.

9. Utilisation, dans un circuit d'allumage électronique pour brûleurs à mazout, d'un transformateur haute tension (T1') comprenant un noyau (1) comprenant deux parties (1a, 1b) entre lesquelles un entrefer (6) est prévu et formant un chemin magnétique sensiblement fermé pour le flux magnétique généré par les enroulements (4a-4d) du transformateur (T1'), lorsque le courant passe par les enroulements (4a-4d).

10. Transformateur d'allumage haute tension pour brûleurs à mazout, comprenant un noyau (1) formant un chemin magnétique sensiblement fermé pour le flux magnétique généré par les enroulements (4a-4d) du transformateur (T1'), lorsque le courant passe par les enroulements (4a-4d), **caractérisé en ce que** le noyau (1) comprend deux parties (1a, 1b) entre lesquelles un entrefer (6) est prévu.

11. Transformateur d'allumage haute tension selon l'une quelconque des revendications 9 ou 10, **caractérisé en ce que** le noyau (1) est un noyau de ferrite.

12. Transformateur d'allumage haute tension selon l'une quelconque des revendications 9 à 11, **caractérisé en ce que** le noyau (1) pèse moins de 14 g.

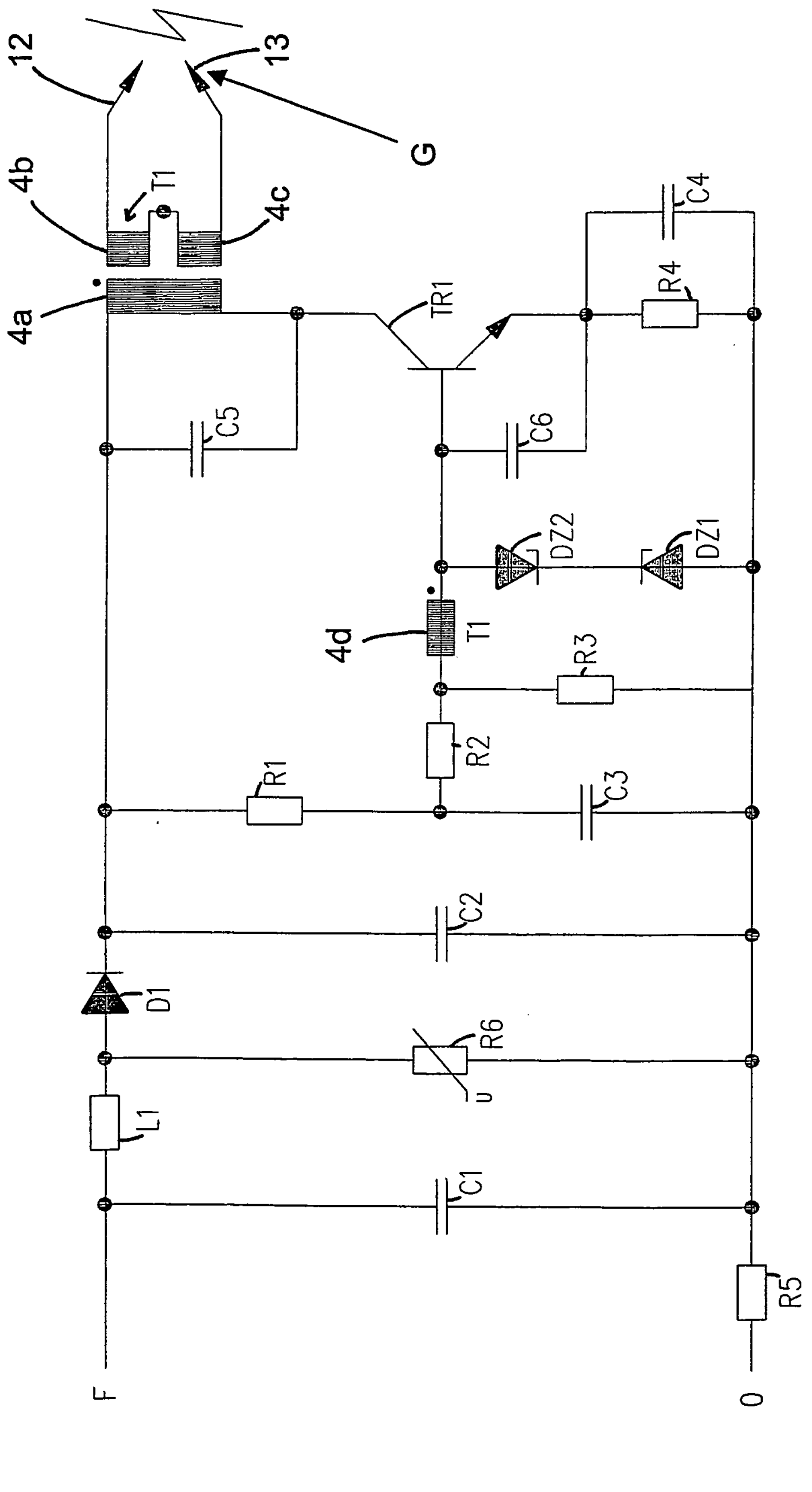
12
13
G
4b
T1
4c
4a
TR1
C4
R4
C5
C6
DZ2
DZ1
4d
T1
R3
R2
R1
C3
C2
D1
R6
U
L1
C1
R5
F
0

Fig. 1

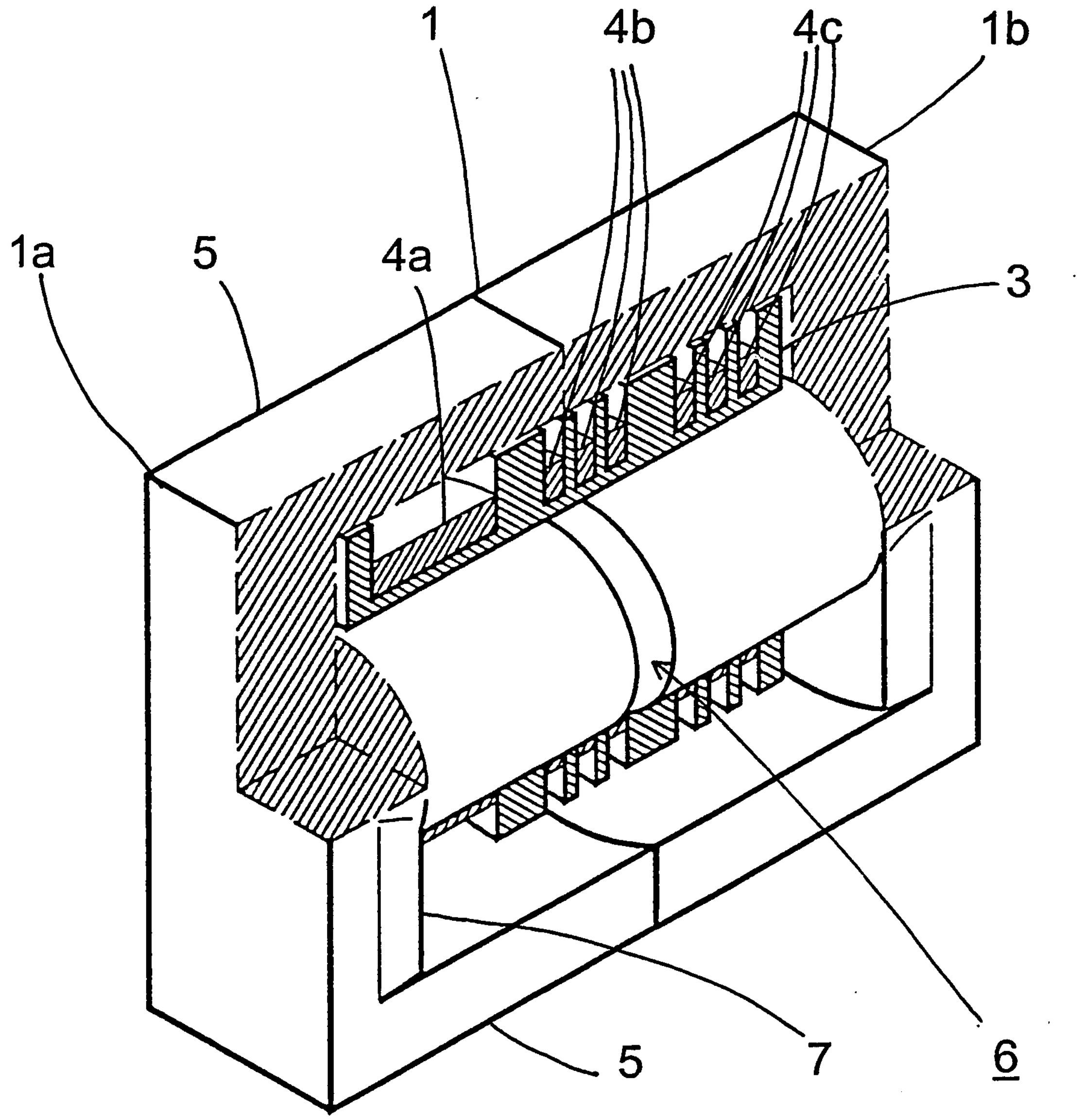

Fig. 2

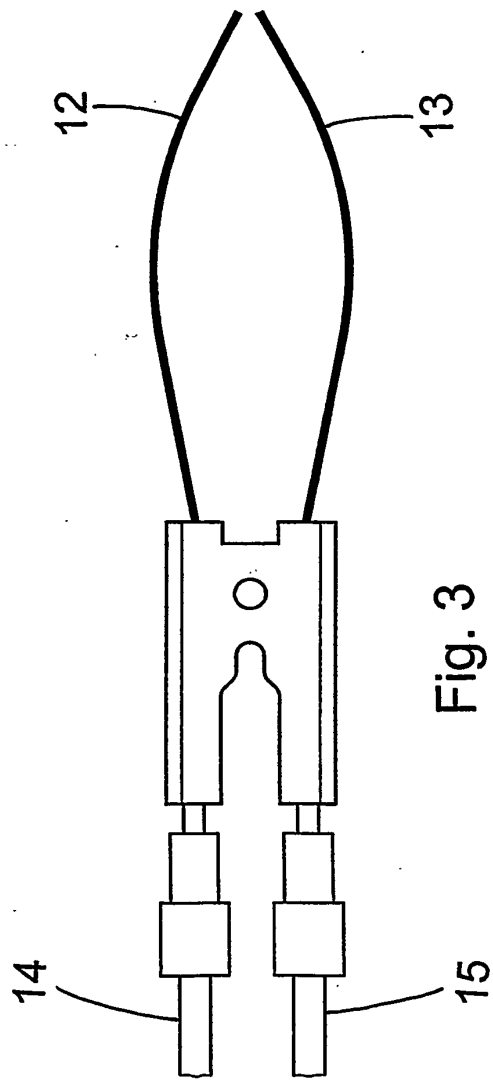

Fig. 3

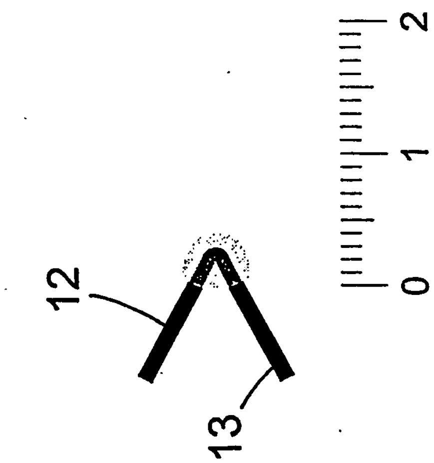

Fig. 4a

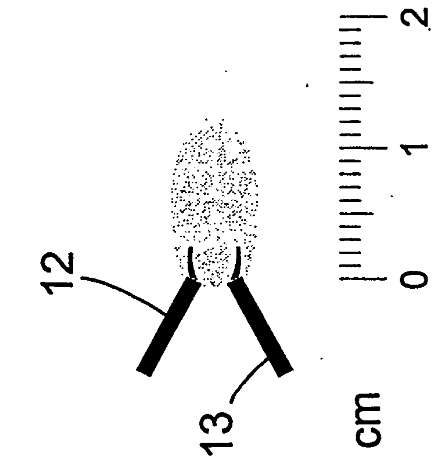

Fig. 4b

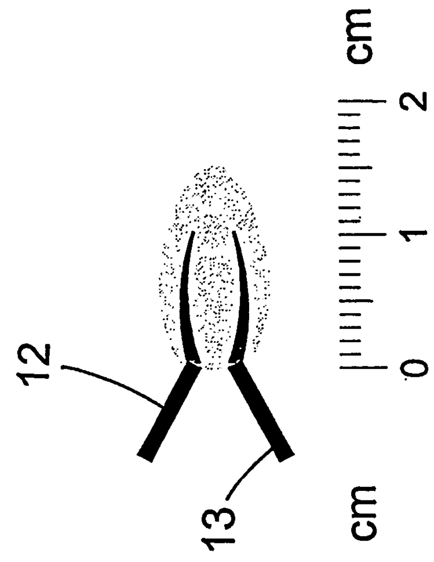

Fig. 4c