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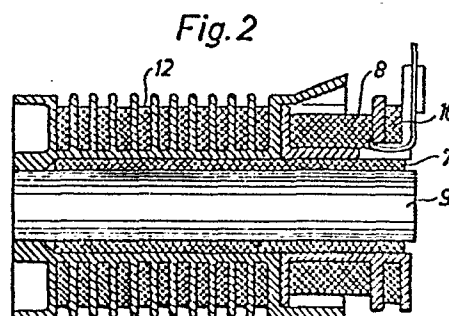
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54 Apparatus in spark generators.

57 Ignition apparatus, e.g. for oil burners, comprising an oscillator circuit (20) to which is connected a transformer with a primary (7,8) and a secondary circuit (12), the secondary circuit being connected to spark electrodes (13,14). The oscillator circuit is, for example, connected to an AC mains (1,2) via a rectifier (5) so that when a rectified half-wave occurs there is operating voltage for the oscillator (20) which starts high-frequency spark generation. The transformer is implemented such that close coupling exists between a primary winding part (7) and the secondary winding (12) and that there is also close coupling between a second primary winding path (8) and a winding (16) controlling an oscillation energy circuit. The second primary winding path (8) and the feed-back winding (16) are geometrically arranged laterally on the transformer core (9) in relation to the primary winding.



APPARATUS IN SPARK GENERATORS

In connection with e.g. oil burners it is usual for igniting the burner flame to arrange a sparking unit with sparking electrodes located in the flame section of the burner. Such ignition electrodes were earlier connected to a transformer coupled to mains voltage, i.e. ignition sparks were obtained with a frequency synchronous with the mains frequency. It was necessary to dimension such ignition transformers so that they could withstand an open spark circuit as well as one that is short-circuited, and in practice this resulted in large heavy core dimensions.

It is a general desire to control the ignition sequence so that, inter alia, the ignition voltage and thus the necessary insulation on the secondary side may be kept within reasonable limits, also during varying spark gap conditions from open circuit to short-circuiting. A number of solutions have been proposed, which include the arrangement of transistor-controlled oscillation circuits. A typical such arrangement has been described in the Norwegian patent publication No. 125 113. The disadvantage with such known arrangements is in general that they are too complex in their implementation, and furthermore they still need the transformer part itself to be dimensioned to withstand considerably higher voltages than those which are required for initiating the sparking sequence itself. In practice there are a number of insulation problems in conjunction with such transformers or the alternative of having an input voltage stabilizer, and it is naturally desirable to dispense with such solutions which means increased product costs. The function of such apparatus is such that by rectifying, for example, half periods of an alternating current (A.C.) mains these are allowed to control the spark interval, during each spark interval, the sparks obtaining a frequency equal to the oscillation frequency of an oscillator included in the circuit. This means that the relatively high frequency oscillation of the oscillator is

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started as soon as a half period has risen to a given level, whereby sparks are formed from the secondary side of a transformer as long as the conditions created by the half periods are present. It is naturally possible to feed such an arrangement with pure direct current (D.C.).

The present invention relates to an improvement of the types of apparatus mentioned above, and as will be understood, voltages for the open, i.e. broken, circuit can be kept within values which allow considerably simpler insulation of the high-tension section than previously, due to a special implementation of the transformer section itself. Furthermore, the circuit is such that short-circuiting of the sparking side does not result in injurious action on the participating circuit components.

The characterizing features of the present invention are apparent from the following claims.

An embodiment of the invention will now be described in detail with reference to the accompanying drawing.

Figure 1 is a schematic diagram of an apparatus in accordance with the invention.

Figure 2 illustrates a practical structure of the transformer included in the circuit.

Two interference-suppressing choke coils or chokes 3,4 are connected to the terminals 1, 2 in an A.C. mains. In series with the choke 3 there is connected a rectifier 5 in communication with an interference-suppressing capacitor 6, the other end of which is connected to the free end of the choke 4. The rectifier 5 is in series with a primary winding comprising two parts 7,8 of an ignition transformer 9, an oscillating circuit capacitor 10 being connected right across both primary windings, the free end of the winding part 8 also being connected to an oscillation energy generating circuit 11 forming part of an oscillator, as will be made clear later.

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The circuit 11 is in communication with the choke 4 and the capacitor 6, thus forming one path in the circuit of the apparatus. The ignition transformer 9 is provided with a secondary winding 12 which is in communication with electrodes 13,14 forming a spark gap 15. A feed-back coil 16 for controlling the circuit 11 is also associated with the ignition transformer core, the coil 16 being in current supplying connection with the rectifier 5 via a resistor 17 and a further resistor 18, at the connection point between the resistors 17 and 18 there being connected a capacitor 19 which is in communication with the choke 4. The elements 19-16 within the dashed line 20 form the oscillator of the circuit.

The device operates in the following way:-

It is assumed that a positive AC half-wave occurs at the terminal 1, resulting in that current begins to flow through the rectifier 5, thus allowing the oscillator circuit 20 to be fed with current. When the voltage has reached a given value, partly determined by the rising voltage to the circuit 11, the oscillation sequence is started, i.e. the oscillator begins to operate, which means that current pulses are formed through the primary windings 7 and 8, in turn resulting in spark jumping between the electrodes 13,14 in the spark gap 15.

During normal conditions the oscillator continues to operate as long as the rectified AC half period has a sufficient voltage value. The spark sequences which consequently occur at the spark gap 15 comprises spark showers taking place at intervals.

As will be clearly seen, the primary winding is divided into two part windings 7,8 which are geometrically separated and coupled in series. It should be noted here that the primary winding part 7 is strongly magnetically coupled to the secondary winding 12 while the primary winding part 8 is strongly magnetically coupled to the feed-back winding 16. A less strong coupling consequently exists between the winding part 8 and the primary winding 12. Such a state of coupling relationship may be achieved by an arrangement apparent from

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Figure 2, but this will be explained in detail later. The coupling condition described, inter alia, constitutes an oscillation circuit including the primary winding parts 7,8 together with the load on the secondary winding 12 and the capacitor 10. This oscillation circuit, by geometrical conditions, is such that the reverse voltage towards e.g. transistors in the circuit 11 is kept at a suitable level for all loadings in question, i.e. substantially constant, and there is further achieved that the output voltage is given a suitable load dependence, i.e. it can be kept under control for an open circuit. There is furthermore achieved that the feed-back winding will be independent of load to a substantial extent.

The divided primary winding also results in that the output voltage from the secondary side is kept at a uniform level during the half period of the mains frequency, which means that maximum secondary voltage is already obtained at a very early stage of the voltage half period and is thereafter kept at a substantially constant level. For the duration of the sparking sequence a series of spark voltages occur which are so close to each other in time that spark gap ionisation does not normally have time to cease, resulting in the occurrence of an essentially homogenous discharge for each half period the oscillator is in operation.

For an open circuit nothing much further than a normal voltage crest is consequently obtained for spark initiation, and this is something signifying a large advantage in relation to previous circuits of this type, in which the spark voltage rose in time with the growth of the mains voltage. This resulted in that very high voltage sequences were generated for an open circuit, which in turn affected the insulation conditions for the secondary circuit unfavourably. Furthermore, the reverse voltages in the circuit 11 were up to three times as great as the voltage conditions during operation, which of course meant durability problems for the components in previous structures.

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It has been found during measurements on the partial primary winding 8 that for a normally progressing sparking sequence both the windings 7 and 8 are in phase. For an open circuit, i.e. a large distance between the electrodes 13 and 14 so that no spark can occur, the phase relationship is altered, the inner primary together with built-in capacitances in the coil forming an oscillation circuit with the secondary side which, due to the geometrical implementation, in turn limits the total output voltage and the reverse voltage to the circuit 11.

In practice to obtain the desired result the ignition transformer in one embodiment is built as is apparent from Figure 2. On a core 9 of a magnetically conductive material, e.g. ferrite or the like, there is arranged a long winding closely coupled to the core and extending substantially along the entire length of the core, this winding being the winding 7 in the diagram according to Figure 1. Onto the winding 7 there is arranged a winding bobbin carrying the secondary winding 12, which lengthwise in relation to the core only takes up about two-thirds of the core length. On the remaining third and laterally in relation to the secondary winding 12 there is arranged the part winding 8, which is thus situated outside the winding 7. The feed-back winding 16 is arranged to one side of the part winding 8. In the practical embodiment the relationship between the windings 7 and 8 is such that the winding 8 has about half the turns of the winding 7. By the special geometrical arrangement shown here there are obtained the coupling conditions of intimacy between the different windings which are necessary for achieving the function described above. It was stated in the introduction that the primary winding part 7 was to be in close magnetic intimacy coupled with the secondary winding 12 and this is clearly apparent from Figure 2. Furthermore, the windings 8 and 16 are to be closely intimate with each other while the winding 8 is less closely intimate with the secondary winding 12. With the implementation now described, the flow paths in the transformer arrangement will change in response to the load present at the spark gap, i.e. in response to the current conditions

in the secondary winding 12.

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The invention can of course be implemented in many ways, but what is essential is that the previously mentioned degrees of
5 intimacy i.e. coupling between the different windings is maintained and the implementation in Figure 2 is only to be regarded as an example.

CLAIMS

1. Apparatus in spark generators, in which the spark generating circuits comprise an oscillator in communication with a spark voltage transformer, characterized in that the primary winding of the transformer (9) includes two windings (7,8) connected in series, of which the first (7) is closely coupled to the secondary winding (12) while the second (8) is closely coupled to a feed-back winding (16) in the oscillator (20), and loosely coupled to the secondary winding (12), whereby operational voltages in the apparatus may be kept independent of loading conditions which vary to a substantial extent.

2. Apparatus as claimed in claim 1, characterized in that the degree of coupling between the different windings (7,8,12,16) is caused by geometric orientation (Figure 2) and dimensioning relative each other and relative the core (9).

3. Apparatus as claimed in claim 1 or 2, characterized in that the first winding (7) on the primary side extends along the core (9) and along the secondary winding (12) as well as the second primary winding (8) and the feed-back winding (16).

4. Apparatus as claimed in any one of the preceding claims, characterized in that the secondary winding (12) and the second winding (8) on the primary side are arranged laterally in relation to each other (see Figure 2).

5. Apparatus as claimed in claim 4,
c h a r a c t e r i z e d in that the the feed-back
winding (16) is arranged laterally to the second winding
(8) of the primary side and remote from the secondary
winding (12).

6. Apparatus as claimed in any one of the preceding
claims, c h a r a c t e r i z e d in that the core
(9) is elongate (Figure 2) and that the first winding
(7) of the primary side is wound in close association
with the core (9) and extends along a substantial portion
of the core length, that the secondary winding (12) is
wound on to said first winding and extends along a
portion thereof, and in that on the remaining portion of
the first winding there are wound the second winding (8)
of the primary side and the feed-back winding (16).

7. Apparatus as claimed in any one of the preceding
claims, c h a r a c t e r i z e d in that the first
winding (7) of the primary side has substantially double
as many turns as the second winding (8).

8. Apparatus as claimed in any one of the preceding
claims, c h a r a c t e r i z e d in that the primary
windings (7,8) are included in the current supply path
(Figure 1) of the oscillator (20).

9. Apparatus as claimed in any of the preceding
claims, c h a r a c t e r i z e d in that primary and
secondary sides form a voltage limiting oscillation
circuit (7,8,12) for an open spark circuit.

Fig. 1

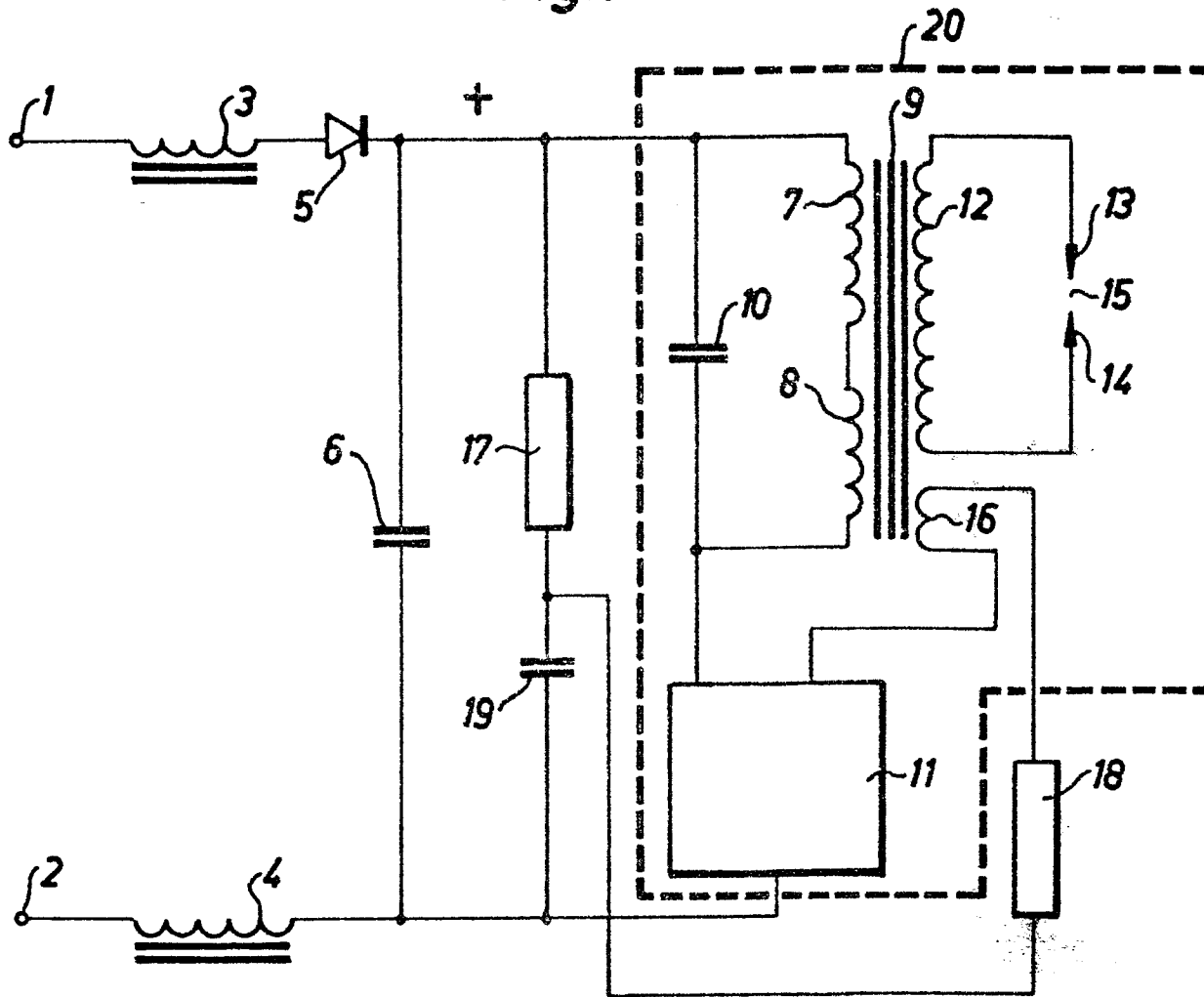


Fig. 2

