(12) UK Patent Application (19) GB (11) 2 046 537 A

(21) Application No 8010775
(22) Date of filing 31 Mar 1980
(30) Priority data
(31) 2913627
(32) 5 Apr 1979
(33) Fed Rep of Germany (DE)
(43) Application published 12 Nov 1980
(51) INT CL³
H02M 5/42
B23K 9/10
(52) Domestic classification
H2F 9F1 9F3 9J14 9K1 9K2 9K3 9L1 9N3X 9P1 9R21B 9R49B 9R9B 9RXB 9S1 9T1 9T2 9T4A 9T5 SRA
H2H 23G 25G 25Y B8 WA
(56) Documents cited
GB 1441374
GB 1440609
GB 1405736
GB 1388481
GB 1376758
GB 1271951
GB 1195768
(58) Field of search
H2F
H2H
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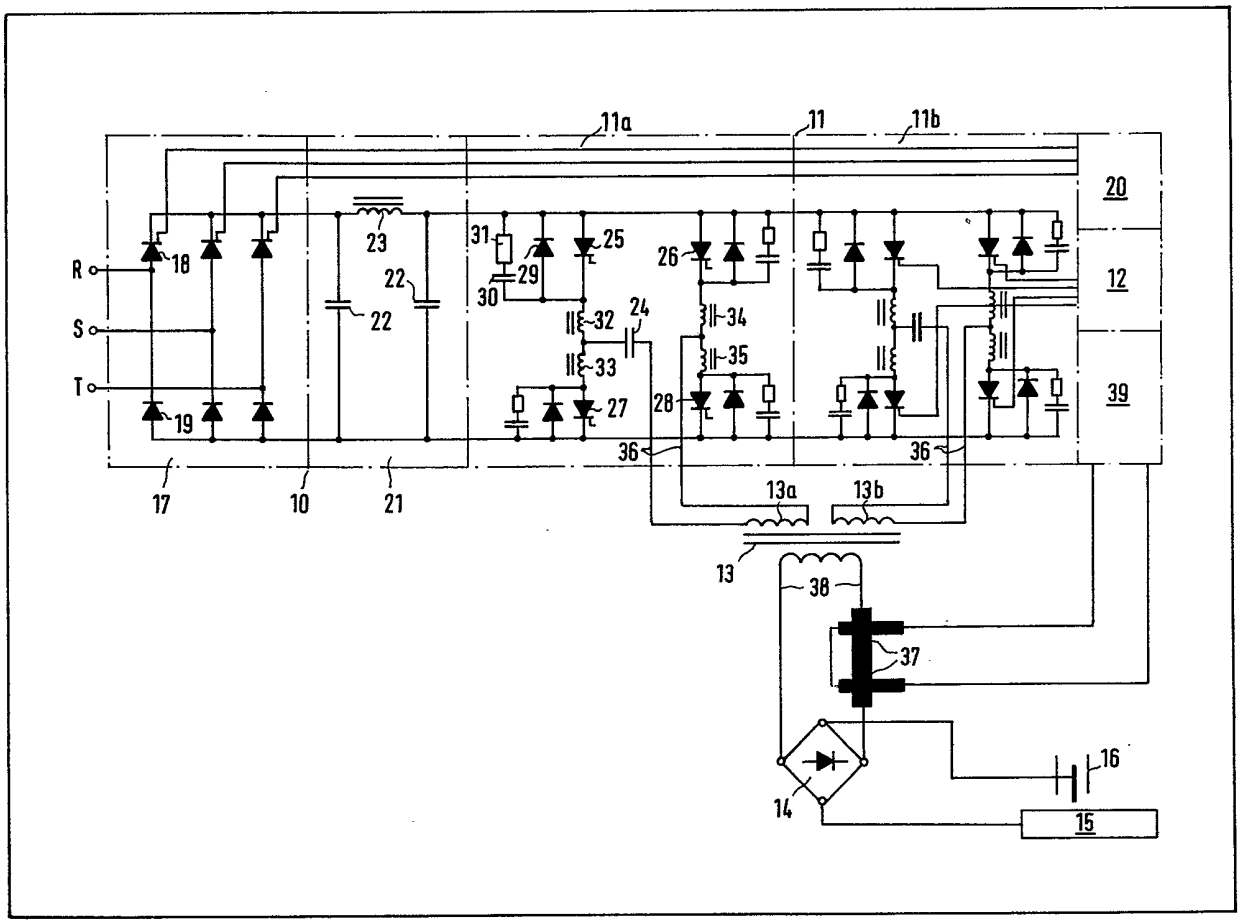
(54) **Converter for supplying arc welder**

(57) In an arrangement for direct-current and/or alternating-current arc welding, comprising an inverter (11) for generating an alternating converter output current the frequency of which is higher than the mains frequency, the inverter (11) is connected via a rectifier (10) to a three-phase supply network RST and, furthermore, its output is connected via a transformer (13) to a workpiece (15) and to a welding electrode (16). In order to make welding possible with high powers and a wide control range, even at high inverter output current frequencies which are inaudible over the whole control range, the rectifier (10) is constructed as a three-phase bridge rectifier (17) containing thyristors (18) which is driven by a phase-shift control circuit (20), and several individual inverters (11a, 11b) are connected in parallel with one another with the output (36) of each converter being connected to a respective primary winding (13a, 13b) of the transformer (13). A transductor (37) is connected into the secondary circuit (38) of the transformer (13) for continuous adjustment via device (39) of the welding current/voltage.



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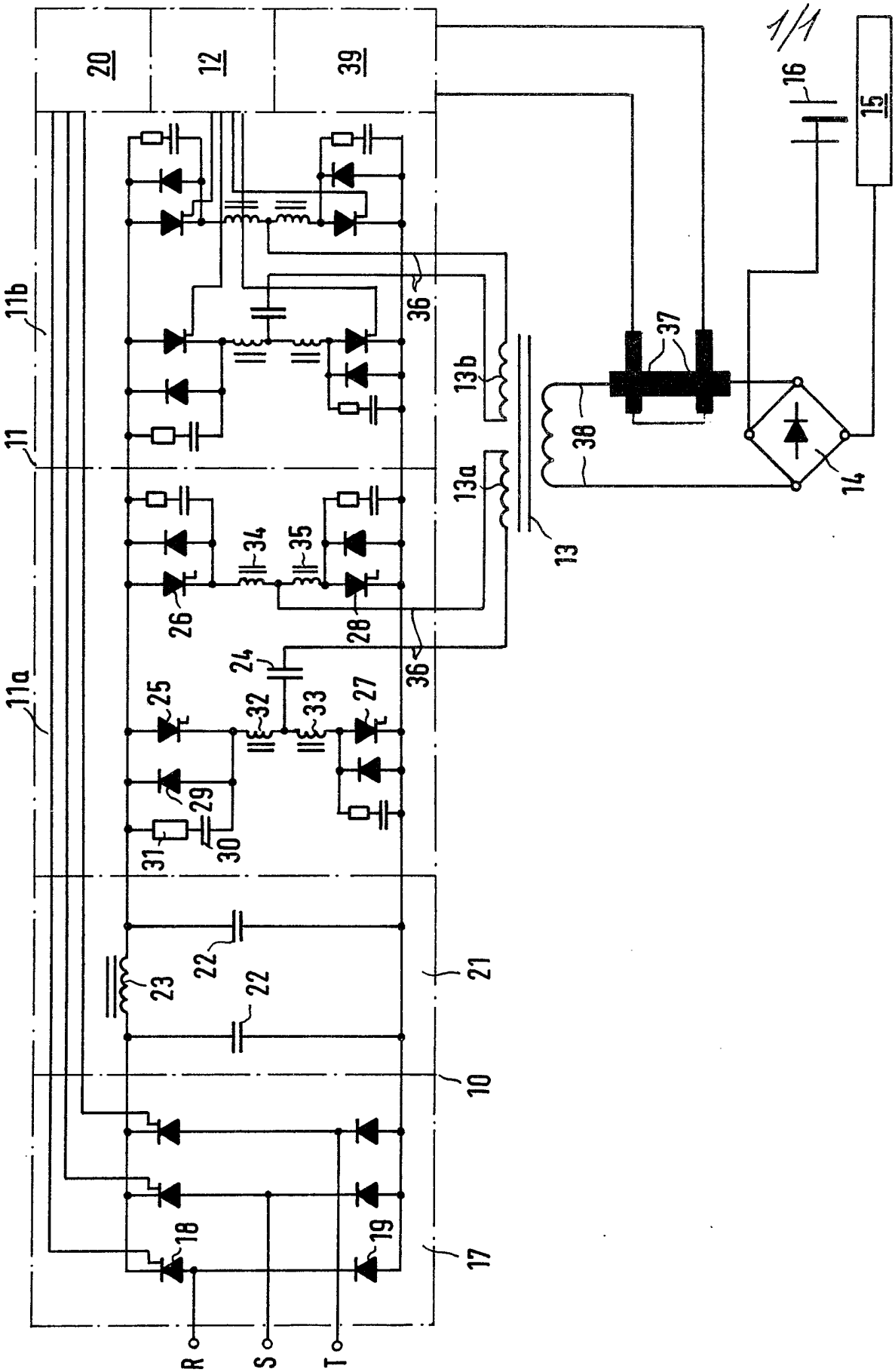
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SPECIFICATION

Arrangement for direct-current and/or alternating-current arc welding, comprising a converter which can be connected to alternating- or direct-current mains

The present invention relates to an arrangement for direct-current and/or alternating-current arc welding, comprising a converter for generating an alternating converter current the frequency of which is higher than the mains frequency, the converter being connected via a rectifier to a three-phase supply network and, furthermore, the converter output being connected, via a transformer and, if necessary, a rectifier or second converter, to a workpiece and to a welding electrode.

This pre-characterising clause refers to welding arrangements which have become known, for example, from German Offenlegungsschrift 17 65 775, German Offenlegungsschrift 26 51 510, German Offenlegungsschrift 27 20 347, Gerrnan Offenlegungsschrift 27 20 942 and RCA Application Note AN 66 28, entitled "Design and Applications of High Power Ultrasonic Converters Using ASCR's".

The advantage of these arrangements for arc welding, which have become known from the literature, is said to consist in that the converter makes it possible to raise the input frequency to the transformer following it considerably with respect to the power frequency used, for example to such an extent that the frequency is outside the human threshold of hearing, that is to say above 18 Kilohertz. This increase in frequency makes it possible to reduce the dimensions of the subsequent transformer, advantageously resulting in a reduction in the weight of the whole welding arrangement so that the welding arrangement is now lighter by a factor of about 10, in contrast to welding units which do not work with a converter.

In the above-mentioned literature converters are described which must generate an alternating output current having a frequency of up to 30 Kilohertz. The arrangement for arc welding of this type which has hitherto become known in practice and in which the converter is constructed with thyristors, works with a frequency of 1000 Hertz. This arrangement has the disadvantage that this frequency is within the audible range and that an unpleasant noise is produced during welding. The prevailing use of this low and disadvantageous frequency in converters with a power which makes welding possible is likely to be due to the fact that the requirements for a high cut-off voltage and high currents in the thyristors, on the one hand, and short commutated turn-off times, on the other hand, are mutually contradictory, for which reason semiconductor manufacturers have hitherto only been able to offer a compromise.

So that the converter can be connected to a 380-V supply network, for the required welding power, it is necessary to use thyristors having a high cut-off voltage in the converter. Considering the achievable commutated turn-off times of the thyristor, however, such thyristors cannot be operated at high frequencies (for example at more than 18 KHz).

From Application Note AN 66 28 thyristors have also become known which have commutated turn-off times of the order of 4 μsec. The cut-off voltage of these thyristors does not, however, allow them to be operated on the 380-V supply network. Connecting several of these thyristors in series is problematic at the frequencies of more than 18 Kilohertz being considered. It is possible to operate the converter on a 220-V supply network also at these high frequencies but the achievable output power (converter efficiency = 0.8) is 2.8 KW maximum. Only lower welding currents can be obtained with this output power.

A further requirement of the arc welding arrangements comprising a converter consists in that the output power must be continuously controllable over a wide range (up to 1:150) and the converter must work with inaudible frequencies even in the lowest control regions. The step switching arrangement which has hitherto become known does not meet this requirement.

It is the object of the present invention to produce a welding arrangement of the type mentioned initially which makes welding possible also at high powers, in which the alternating converter output current has frequencies which are inaudible over the whole control range.

According to the invention, in order to achieve this object it is proposed that the rectifier between the converter and the three-phase supply network is constructed as a three-phase bridge rectifier comprised of controllable semiconductors, and preferably thyristors, which can be driven by a phase-shift control circuit. This makes it possible to reduce the direct supply voltage for the converter to a safe value, depending on the respective thyristor specifications, so that, on the one hand, the thyristor cut-off voltage is not exceeded and, on the other hand, the higher power of the three-phase supply network can be utilized. The direct output voltage is here preferably stabilized to the required value by a regulating circuit, known in itself.

For achieving even higher powers it is proposed, as an advantageous development, that the converter is provided with several individual converters and the output transformer with several primary winding sections, one individual converter being in each case connected to one primary winding section. This makes it possible to obtain an output power of any desired magnitude.

In order to achieve continuous adjustment/control of the welding current/welding voltage over the whole power range, it is proposed, according to the invention, and the output of the converter/converters is followed by a transductor. Due to the high frequencies involved, this transductor can be of small and compact construction which makes it possible to achieve a very short time constant and thus fast regulation. The time constant is here of the order of magnitude which is usually only attainable with phase-shift control at the output (see also German Offenlegungsschrift 26 51 510).

The invention is explained in greater detail in the description which follows, indicating further advantageous characteristics and referring to the drawing.

The arrangement for arc welding shown in the

drawing is provided with a direct-current section 10 which is followed by a converter 11 with its associated control unit 12. The output of the converter 11 is electrically connected via a transformer 13 and a rectifier 14 to a workpiece 15 and a welding torch 16.

According to the invention, the direct-current section 10 consists of a three-phase bridge rectifier 17 which is connected to a three-phase supply network R S T and which comprises three controllable thyristors 18 and three diodes 19 (half-controlled bridge). The thyristors 18 are connected to a phase-shift control unit 20 which contains a voltage stabilizing circuit and is known in itself and not shown in greater detail. Naturally, a fully-controlled three-phase bridge rectifier can also be used advantageously. In addition, the direct-voltage section 10 also comprises a smoothing unit 21 containing smoothing capacitors 22 and the smoothing choke 23. The output of the direct-current section 10 is connected to one or several individual converters 11a, 11b and so forth.

Each of the individual converters 11a and 11b is constructed as a full-bridge thyristor converter and is provided with a commutating capacitor 24 which is associated with the controllable thyristors 25, 26, 27 and 28. The thyristors 25 to 28 are loaded in a manner known in itself with a de/dt circuit comprising a diode 29 and a capacitor 30 and a resistor 31 of appropriate size. In addition, the thyristors 25 to 28 are associated with load chokes 32, 33, 34 and 35 for limiting di/dt. The thyristors 25 to 28 are alternately driven by the control unit 12, in such a manner that the output frequency is preferably greater than 18 Kilohertz. The design of such control units is known and thus does not need to be explained in greater detail.

The output 36 of each converter 11a, 11b is associated with one primary winding section 13a, 13b of the transformer 13. According to the invention, the primary winding 13 is provided with a number of winding sections which corresponds to the number of individual converters provided.

In addition, the output 36 of the individual converter 11a, 11b is followed by a transductor 37 for the continuous adjustment of the welding current/welding voltage. In the illustrative embodiment, the transductor 37 is connected into the secondary circuit 38 of the transformer 13. The voltage or current of the transductor 37 is controlled in a manner known in itself by a device 39 which is not described in greater detail.

In the above-mentioned illustrative embodiments full-bridge-connected thyristor converters are provided. It is, of course, possible and lies within the scope of the invention to provide, instead of these bridge-connected converters, converters with different circuit arrangements. Converters using switching elements which are not thyristors, for example using transistors as switching elements, can also be used advantageously.

The above-mentioned arrangements for arc welding are not restricted to arc welding using a non-fusible electrode but can also be used to weld with fusible electrodes according to the manual electrode welding or the gas metal-arc welding method. The arrangement according to the present invention can be employed advantageously also for submerged-arc welding, plasma welding and cutting.

CLAIMS

1. An arrangement for direct-current and/or alternating current arc welding, comprising a converter for generating an alternating converter output current the frequency of which is higher than the mains frequency, the converter being connected via a rectifier to a three-phase supply network and the converter output being connected, via a transformer and, if necessary, a rectifier or second converter, to a workpiece and a welding electrode, characterised in that the rectifier (10) is constructed as a three-phase bridge rectifier (17) comprising controllable semiconductors (18), and preferably thyristors, which can be driven by a phase-shift control circuit (20).

2. An arrangement according to Claim 1, characterised in that the direct output voltage of the rectifier (17) is stabilized by a regulating circuit, known in itself.

3. An arrangement according to Claim 1 or 2, characterised in that the converter (11) is provided with several individual converters (11a, 11b) and the output transformer (13) with primary winding sections (13a, 13b) corresponding to the number of individual converters, one individual converter (11a and 11b) being in each case connected to one primary winding section (13a and 13b, respectively).

4. An arrangement, particularly according to one of Claims 1 to 3, characterised in that the output (36) of the converters (11) is followed by a transductor (37) for the continuous control/regulation of the welding current/welding voltage.

5. An arrangement according to one of Claims 1 to 4, characterised in that the alternating output current of the converter has a frequency of more than 18 Kilohertz.

6. An arrangement for direct-current and/or alternating-current arc welding substantially as hereinbefore described and as illustrated by the accompanying drawing.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1980.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.