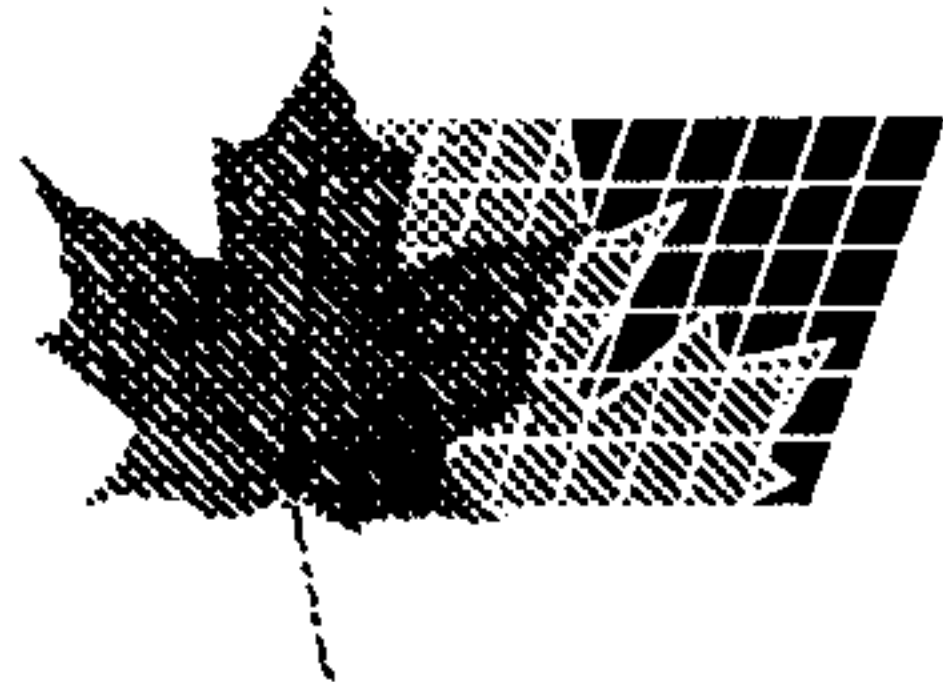




(72) YASUHARA, Yoshimichi, JP

(72) NARUTO, Masafumi, JP

(72) OKUBO, Masayuki, JP

(73) MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD., JP

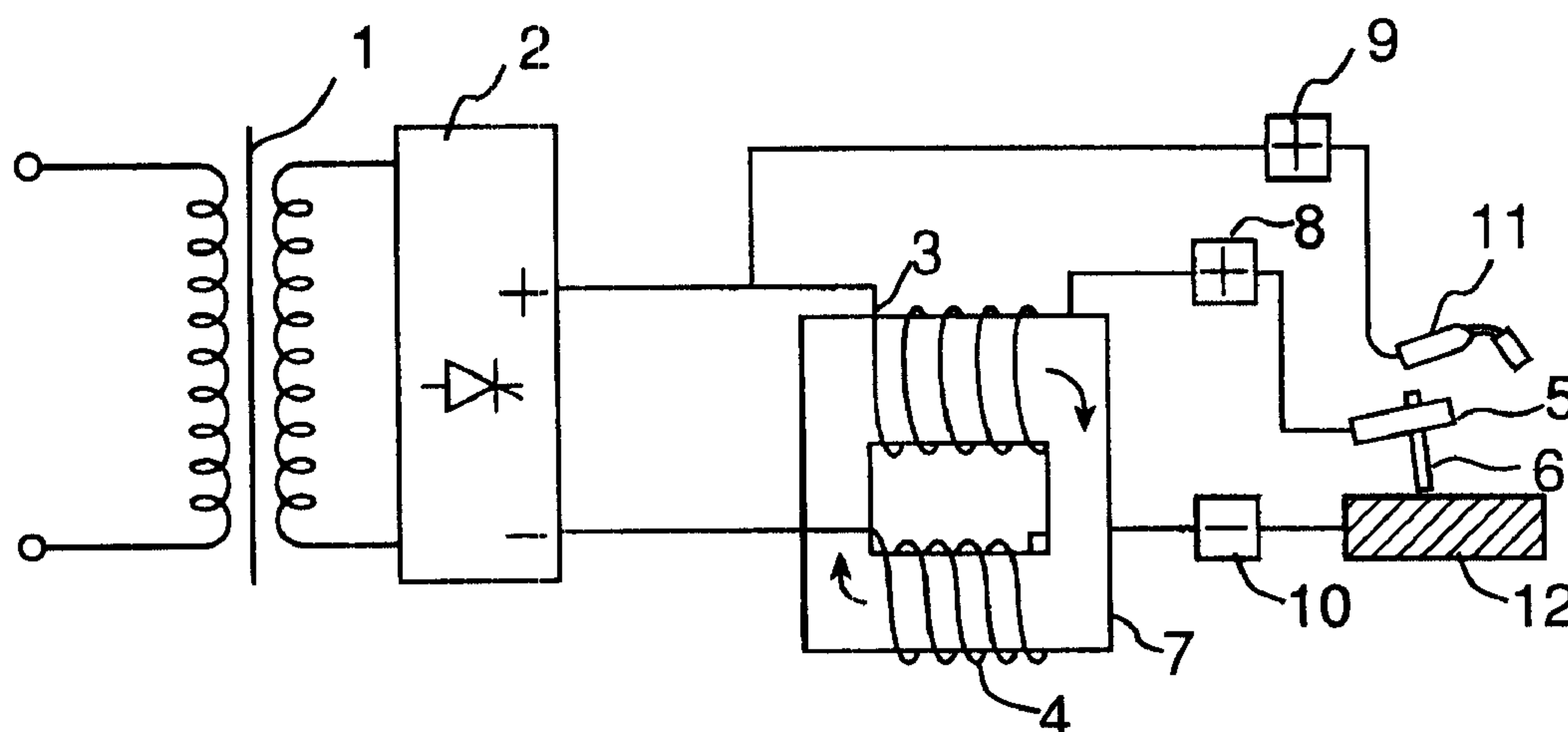
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(54) MATERIEL DE SOUDAGE A ARC A CARACTERISTIQUE DE
COURANT CONSTANT ET DE TENSION CONSTANTE DONT
LE COUT ET LE POIDS ONT ETE REDUITS

(54) ARC WELDING APPARATUS WITH CONSTANT CURRENT
AND VOLTAGE CHARACTERISTICS

SECTION 8 CORRECTION
SEE CERTIFICATE
CORRECTION - ARTICLE 8
VOIR CERTIFICAT



(57) An arc welding apparatus having output terminals of a constant current characteristic and a constant voltage characteristic is provided at low cost with a reactor appropriate for both characteristics. A current control circuit 2 controls a secondary output current of a welding transformer 1 by means of a current control device, while a first reactor 3 and a second reactor 4 are constructed so that magnetic flux formed by a first winding 3a and magnetic flux formed by a second winding 4a, which are wound around an annular iron core 7, overlap each other. The other terminal of the first reactor 3 is connected to a constant current characteristic output terminal 8, while the other terminal of the second reactor 4 is connected to a welding base metal use output terminal 10. A constant voltage characteristic output terminal 9 and one terminal of the first reactor 3 are connected to the positive side of the current control circuit 2, while one terminal of the second reactor 4 is connected to the negative side of the current control circuit 2.





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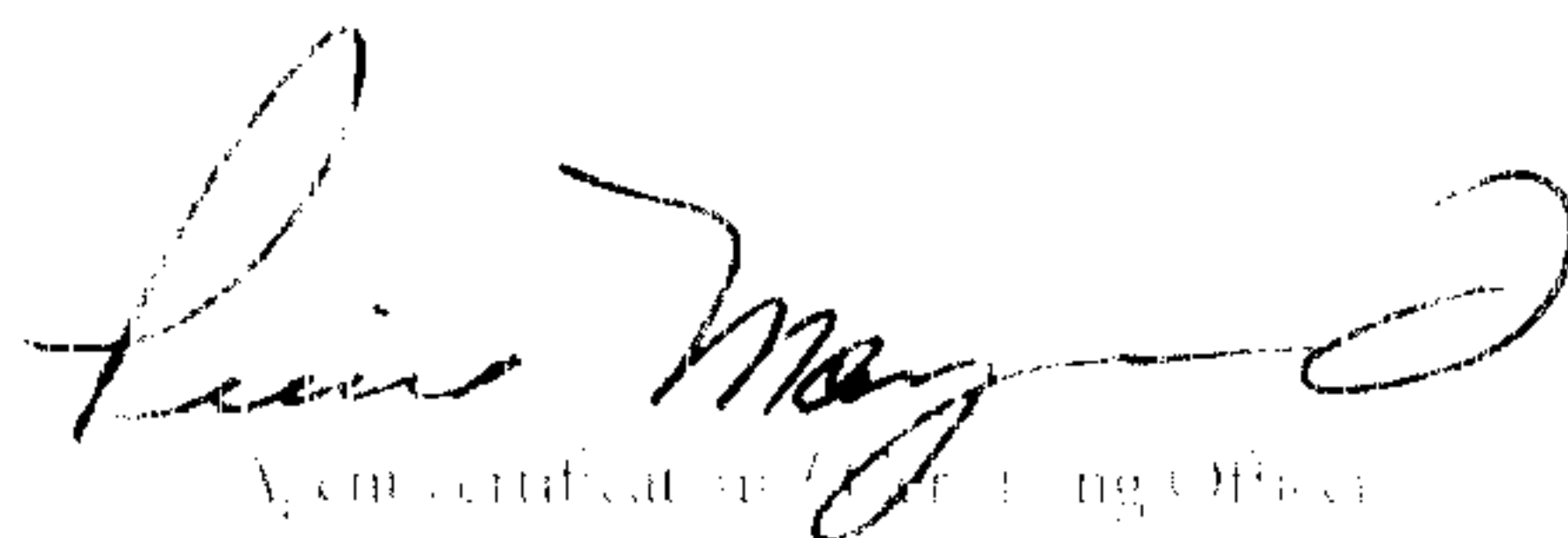
Granted: April 24, 2001

Les corrections suivantes sont faites en
raison de l'article 8 de la *Loi sur les
brevets* et le document doit être lu tel
que corrigé.

The following corrections are made
pursuant to section 8 of the *Patent Act*
and the document should read as
corrected.

In the Patent Grant:

1. The title has been corrected to read "Arc Welding Apparatus With Constant Current and Voltage Characteristics"


Agent in Charge, Patenting Office

May 14, 2001

Date

Canada

industrial

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ABSTRACT

An arc welding apparatus having output terminals of a constant current characteristic and a constant voltage characteristic is provided at low cost with a reactor appropriate for both characteristics. A current control circuit 2 controls a secondary output current of a welding transformer 1 by means of a current control device, while a first reactor 3 and a second reactor 4 are constructed so that magnetic flux formed by a first winding 3a and magnetic flux formed by a second winding 4a, which are wound around an annular iron core 7, overlap each other. The other terminal of the first reactor 3 is connected to a constant current characteristic output terminal 8, while the other terminal of the second reactor 4 is connected to a welding base metal use output terminal 10. A constant voltage characteristic output terminal 9 and one terminal of the first reactor 3 are connected to the positive side of the current control circuit 2, while one terminal of the second reactor 4 is connected to the negative side of the current control circuit 2.

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ARC WELDING APPARATUS WITH CONSTANT CURRENT
AND VOLTAGE CHARACTERISTICS

5

The present invention relates to an arc welding apparatus that has a constant current characteristic output means and a constant voltage characteristic output means.

10

A prior art arc welding apparatus construction is shown in Fig. 2.

15

In Fig. 2 are shown a transformer 1 for welding, a current control circuit 2 for controlling the secondary side output of the welding transformer 1 by means of a current control device, a holder 5 for manual welding, a welding rod 6 for manual welding, a constant current characteristic output terminal 8, a constant voltage characteristic output terminal 9, an output terminal 10 for welding base metal, a torch 11 for a CO₂ arc welding apparatus, a base material 12 for welding, a constant current characteristic coil 13 and a constant voltage characteristic coil 14. The constant current characteristic coil 13 and the constant voltage characteristic coil 14 have been wound around separate iron cores 13a and 14a, respectively, as shown in Fig. 2.

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This prior art arc welding apparatus operates to control an output voltage from the welding transformer 1 by means of the current control circuit 2 and supply an output from the current control circuit 2 to the constant
5 current characteristic output terminal 8 via the coil 13 and to the coil 14 via the constant voltage characteristic output terminal 9.

This prior art enables manual welding by connecting the manual welding holder 5 to the constant
10 current characteristic output terminal 8 and enables CO₂ arc welding by connecting the CO₂ arc welding apparatus torch 11 to the constant voltage characteristic output terminal 9. The prior art is constructed so that the coil 14 operates when performing CO₂ arc welding and the coil
15 13 operates when performing manual welding.

Fig. 3A shows a constant current characteristic of a power source for use in securing constant depth of penetration into the base metal while maintaining a welding current constant regardless of a change in arc
20 length according to a welding method such as manual welding and TIG (Tungsten Inert Gas arc) welding, which cannot automatically adjust the arc length. Assuming now that the arc length is L1 as shown in the figure in the case of, for example, manual welding, the operating point
25 is located at S1 in Fig. 3A that shows a relationship between

- 3 -

a welding current and a welding voltage. In this case, when the arc length extends to L2 due to hand movement or the like, the arc voltage increases, consequently moving the operating point from S1 to S2. However, with the
5 power source of the constant current characteristic of Fig. 3A, the welding current scarcely varies in accordance with the shift of the operating point to S2, and therefore, welding can be continued while securing the constant depth of penetration into the base metal. If a
10 power source of a constant voltage characteristic as shown in Fig. 3B is used, then the welding current sharply decreases in accordance with the shift of the operating point to S2, so that not only the securing of constant depth of penetration but also the continuation of welding
15 become difficult.

On the other hand, according to CO₂ arc welding and MIG (Metal Inert Gas arc) welding by which a welding wire is automatically fed, a power source of the constant voltage characteristic shown in Fig. 3B is used so as to
20 continue satisfactory welding by keeping the welding voltage, i.e., the arc length approximately constant regardless of a variation in welding current. Now if a welding wire feed speed is slowed down to extend the arc length from L1 to L2, then the arc voltage increases to
25 shift the operating point from S1 to S2. However, since

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the welding current sharply decreases in accordance with this shift as shown in the figure, the quantity of fusion of the welding wire reduces to automatically compensate for the reduction in feed speed for the restoration of the arc length to the original length L_1 , so that satisfactory welding can be continued. If a power source of the constant current characteristic shown in Fig. 3A is used, then the welding current scarcely varies even when the operating point shifts to S_2 . Therefore, the quantity of fusion of the welding wire does not reduce, as a consequence of which the reduction in feed speed cannot be compensated and arc disappears, resulting in disabled welding.

Generally, in CO_2 arc welding, importance is attached to the arc stability in a short-circuiting transfer region, and therefore, the quantity of inductance of a coil appropriate for CO_2 arc welding must be made smaller than the quantity of inductance of manual welding. Furthermore, the quantity of inductance of the coil must be made as large as possible in manual welding in order to secure the stability of arc.

Therefore, in the prior art, the cross-sectional area of an iron core 13a of the constant current characteristic coil 13 is made greater than the cross-sectional area of an iron core 14a of the constant voltage

- 5 -

characteristic coil 14, and the number of turns of the coil 13 of the constant current characteristic coil 13 is also made greater than the number of turns of the coil 14 of the constant voltage characteristic coil 14. As described above, in the prior art, two types of coils having different inductance values have been provided for different welding methods and they are connected across the output terminal 8 and the terminal 10 and across the terminal 9 and terminal 10, respectively.

However, since the magnitude of the inductance of the constant current characteristic coil 13 appropriate for manual welding is different from the magnitude of the inductance of the constant voltage characteristic coil appropriate for CO₂ arc welding in the prior art arc welding apparatus, the constant current characteristic coil 13 for manual welding and the constant voltage characteristic coil 14 for CO₂ arc welding have been wound around the separate iron cores 13a and 14a, respectively. Furthermore, the constant current characteristic coil 13 has been connected to the constant current characteristic output terminal 8, while the constant voltage characteristic coil 14 has been connected to the constant voltage characteristic output terminal 9. The above arrangement has led to the problem that the amount of use of iron core as well as the amount of use of coil are

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increased to cause an increase in manufacturing cost, an increase in weight of the arc welding apparatus and so on.

An object of the present invention is to solve
5 the aforementioned conventional problems.

In order to achieve this object, two coils wound around an identical annular iron core are used as a first coil and a second coil, whereby the first coil is connected to a constant current characteristic output
10 means and the second coil is connected to a base metal for welding.

With this arrangement, no current flows through the first coil when performing CO₂ arc welding, and a welding current flows through only the second coil
15 connected to the base metal for welding. When performing manual welding, a welding current flows through both the second coil connected to the base metal for welding and the first coil connected to the constant current characteristic output means, where magnetic flux formed
20 by these two coils takes effect in an overlapping manner.

According to the present invention, the following excellent effects can be produced. That is, the amount of iron used for the iron core material for the first and second coils and the amount of aluminum

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or copper serving as a coil material can be lowered, so that the direct material cost of the arc welding apparatus can be remarkably reduced. Furthermore, the circuit construction is simplified. This facilitates the assembling to allow for a reduction in the number of processes necessary for manufacturing the arc welding apparatus and allows for a reduction in the amount of iron needed and a reduction in the amount of aluminum or copper used for the first and second coils. Therefore, the total weight of the arc welding apparatus can be reduced. This facilitates and eases the physical movement of performing welding work consequently lightening the burden on the welder.

In one embodiment there is provided an arc welding apparatus which solely has a constant current characteristic output means for manual welding a constant voltage characteristic output means for CO₂ welding and includes a welding transformer and a current control circuit for controlling a secondary output current of the welding transformer, the current control circuit being

- 7a -

connected to one terminal of a first coil and one terminal of a second coil, the other terminal of the first coil being connected to the constant current characteristic output means, the other terminal of the second coil being
5 connected to a welding base metal use output means, the constant voltage characteristic output means being connected to a junction of the current control circuit and the first coil, and the first coil and the second coil being wound around an annular iron core so that magnetic
10 flux formed by the coils is directed in an identical direction.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of an arc welding
15 apparatus according to an embodiment of the present invention;

Fig. 2 is a block diagram of a prior art arc welding apparatus;

Fig. 3A is a graph showing a constant current
20 characteristic; and

Fig. 3B is a graph showing a constant voltage characteristic.

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An arc welding apparatus according to an embodiment of the present invention will be described in detail below with reference to Fig. 1.

5 In Fig. 1, the components 1, 2, 5, 6, 8, 11 and 12 are the same as those of the prior art, and therefore, no description is provided for them. The reference numerals 8 and 9 denote a constant current characteristic output terminal and a constant voltage characteristic
10 output terminal, serving as a constant current characteristic output means and a constant voltage characteristic output means, respectively. The reference numerals 3 and 4 denote a first coil and a second coil wound around an identical annular iron core 7, where one
15 terminal of the first coil 3 and one terminal of the second coil 4 are connected to the positive output side and to the negative output side of the current control circuit 2, respectively, and the other terminals are connected to the constant current characteristic
20 output terminal 8 and the welding base metal use output terminal 10, respectively.

 That is, the first coil 3 is connected between the positive side of the current control circuit 2 and the constant current characteristic output terminal 8, while
25 the second coil 4 is connected between the negative side

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of the current control circuit 2 and the welding base metal use output terminal 10.

5 The present embodiment has two major features as follows. The first feature is that the positive side of the current control circuit 2 is connected to the constant current characteristic output terminal 8 via the first coil 3 and directly to the constant voltage characteristic output terminal 9 and the welding base metal use output terminal 10 is connected to the negative side via the second coil 4.

10 By thus connecting the first coil 3 and the second coil 4, only the second coil 4 connected to the welding base metal use output terminal 10 becomes effective in the case of CO₂ arc welding, and both the first coil 3 and the second coil 4 operate in the case of manual welding. With this arrangement, a large quantity of inductance can be obtained with smaller quantities of use of iron core and coil than those of the prior art, and a coil having a small quantity of inductance for CO₂ arc welding can be achieved.

20 The second feature is that the magnetic flux formed by the first coil 3 and the second coil 4 is directed in an identical direction and arranged in an overlapping manner in the annular iron core 7. Therefore, an identical welding current flows through the first coil

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-10-

3 connected to the constant current characteristic output terminal 8 and the second coil 4 connected to the welding base material 12 when performing manual welding, and the magnetic flux formed by this current is directed in an identical direction. With this connection, the first and second coils 3 and 4 are connected in series with each other in the case of manual welding, increasing the total number of turns of the coil, so that the total quantity of inductance of the first and second coils 3 and 4 becomes a much larger value as compared with the quantity of inductance provided solely by the second coil 4 for CO₂ arc welding.

The number of turns of the second coil 4 is set to a value appropriate for CO₂ arc welding. The number of turns obtained by adding the number of turns of the first coil 3 to the number of turns of the second coil 4 is set to a value appropriate for performing manual welding. When performing manual welding, the first coil 3 and the second coil 4 are electrically connected in series with each other, when the magnetic flux formed by the first and second coils is directed in the identical direction and arranged in an overlapping manner, consequently achieving a coil having a large inductance capacity. The welding current flows through only the second coil 4 when performing CO₂ arc welding, and therefore, a small

- 11 -

inductance capacity appropriate for CO₂ arc welding is achieved.

5 The first coil 3 and the second coil 4 are wound around the identical annular iron core 7, and therefore, quantities of inductance appropriate for the respective welding methods can be formed with a small amount of material.

10 Although the present embodiment employs the constant current characteristic output terminal and the constant voltage characteristic output terminal as the constant current characteristic output means and the constant voltage characteristic output means, respectively, they can also be achieved by providing a switch between the outputs without using the terminals.

15 The present embodiment employs the holder for manual welding and the welding rod for manual welding as tools to be connected to the constant current characteristic output means and employs the torch for the CO₂ arc welding apparatus as tools to be connected to the constant voltage characteristic output means. However, it is acceptable to

20 employ a torch for TIG welding (Tungsten Inert Gas Arc Welding) and a non-consumable electrode as tools to be connected to the constant current characteristic output means and employ a torch for MIG welding (Metal Inert Gas Arc Welding) and MAG welding (Metal Argon Gas Arc Welding)

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as tools to be connected to the constant voltage
characteristic output means.

-13-

WHAT IS CLAIMED IS:

1. An arc welding apparatus which solely has a constant current characteristic output means for manual welding and a constant voltage characteristic output means for CO₂ welding and includes a welding transformer and a current control circuit for controlling a secondary output current of the welding transformer,
the current control circuit being connected to one terminal of a first coil and one terminal of a second coil, the other terminal of the first coil being connected to the constant current characteristic output means, the other terminal of the second coil being connected to a welding base metal use output means, the constant voltage characteristic output means being connected to a junction of the current control circuit and the first coil, and the first coil and the second coil being wound around an annular iron core so that magnetic flux formed by the coils is directed in an identical direction.
2. An arc welding apparatus which has a constant current characteristic output means, a constant voltage characteristic output means and a welding base metal use output means, and in which the coils are wound around an identical annular iron core so that magnetic flux formed by the first coil and the second coil that are connected

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to the constant current characteristic output means and the welding base metal use output means respectively is directed in an identical direction, enabling switching between a constant current characteristic and a constant
5 voltage characteristic.

3. An arc welding apparatus as claimed in claim 2, wherein the constant current characteristic output means is provided for shielded metal arc welding to be manually
10 performed.

4. An arc welding apparatus as claimed in claim 2, wherein the constant current characteristic output means is provided for TIG welding.
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5. An arc welding apparatus as claimed in claim 2, wherein the constant voltage characteristic output means is provided for CO₂ welding, MIG welding or MAG welding.

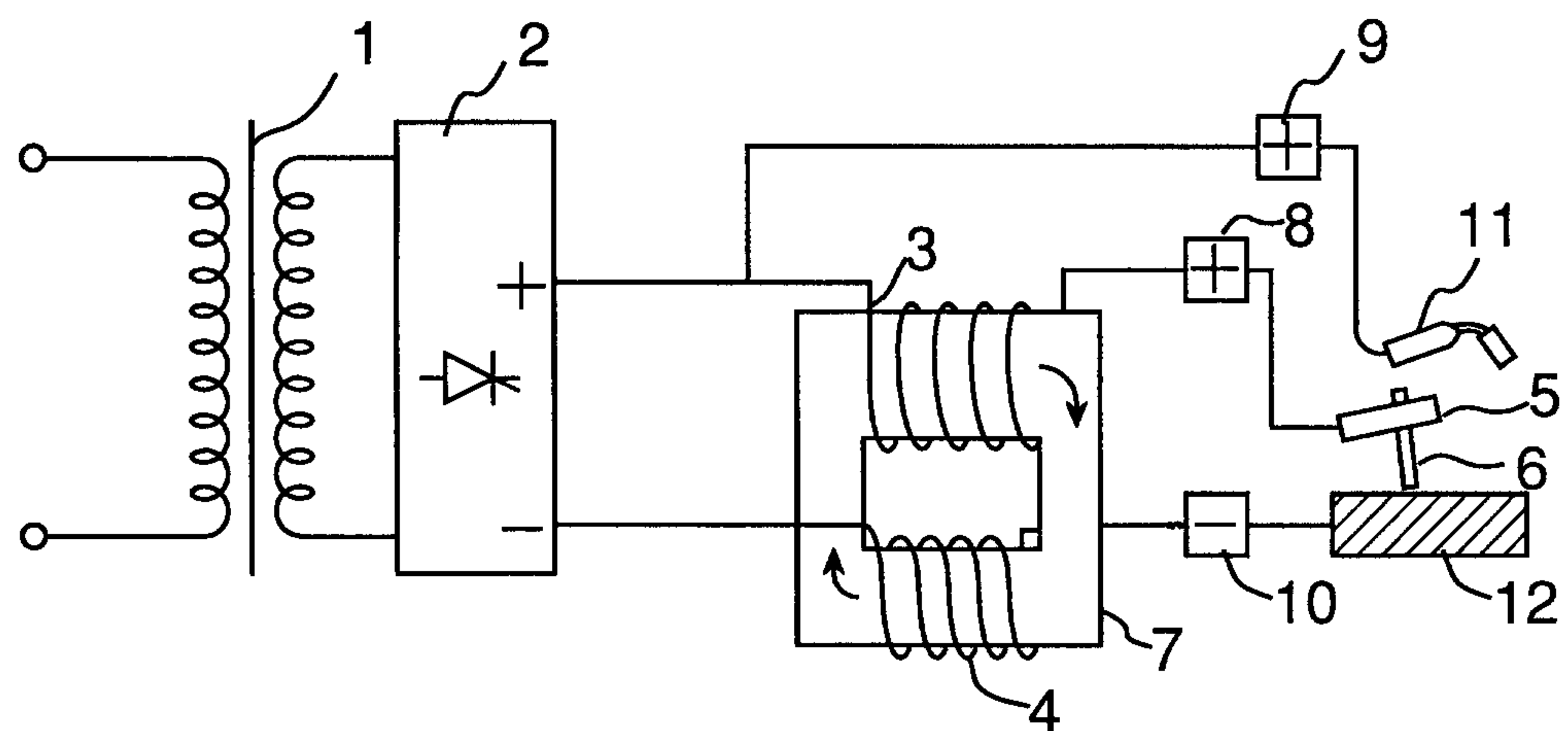
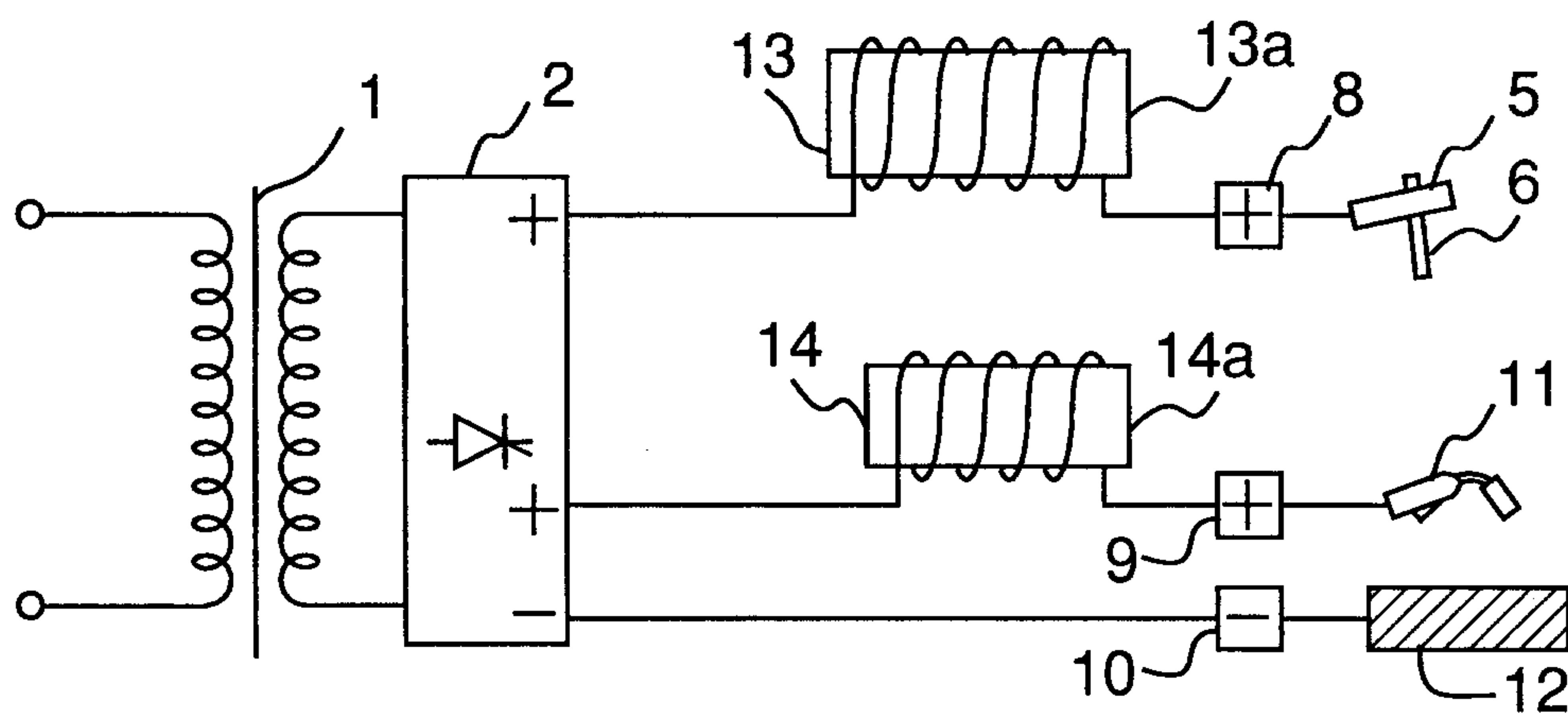
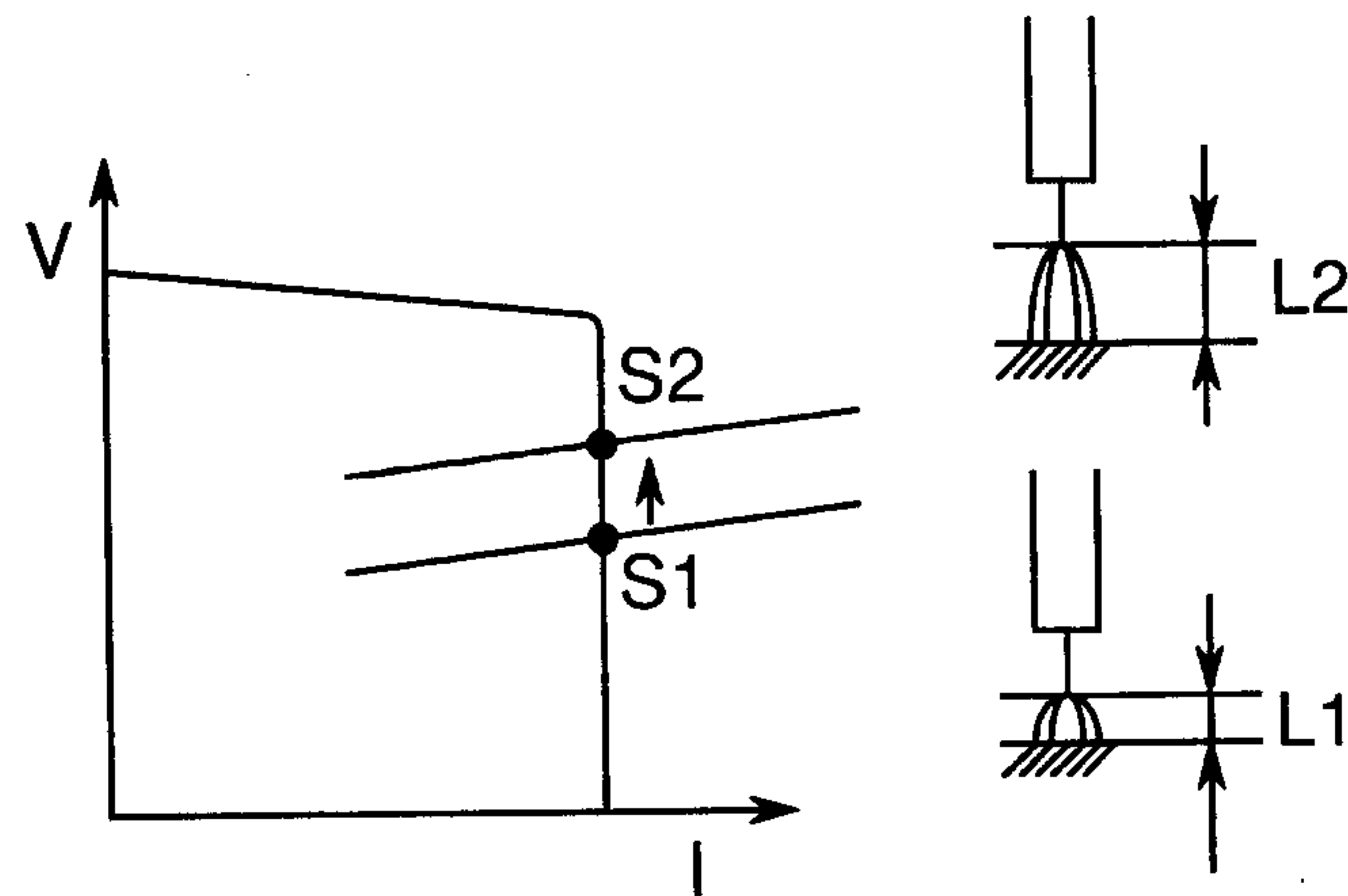
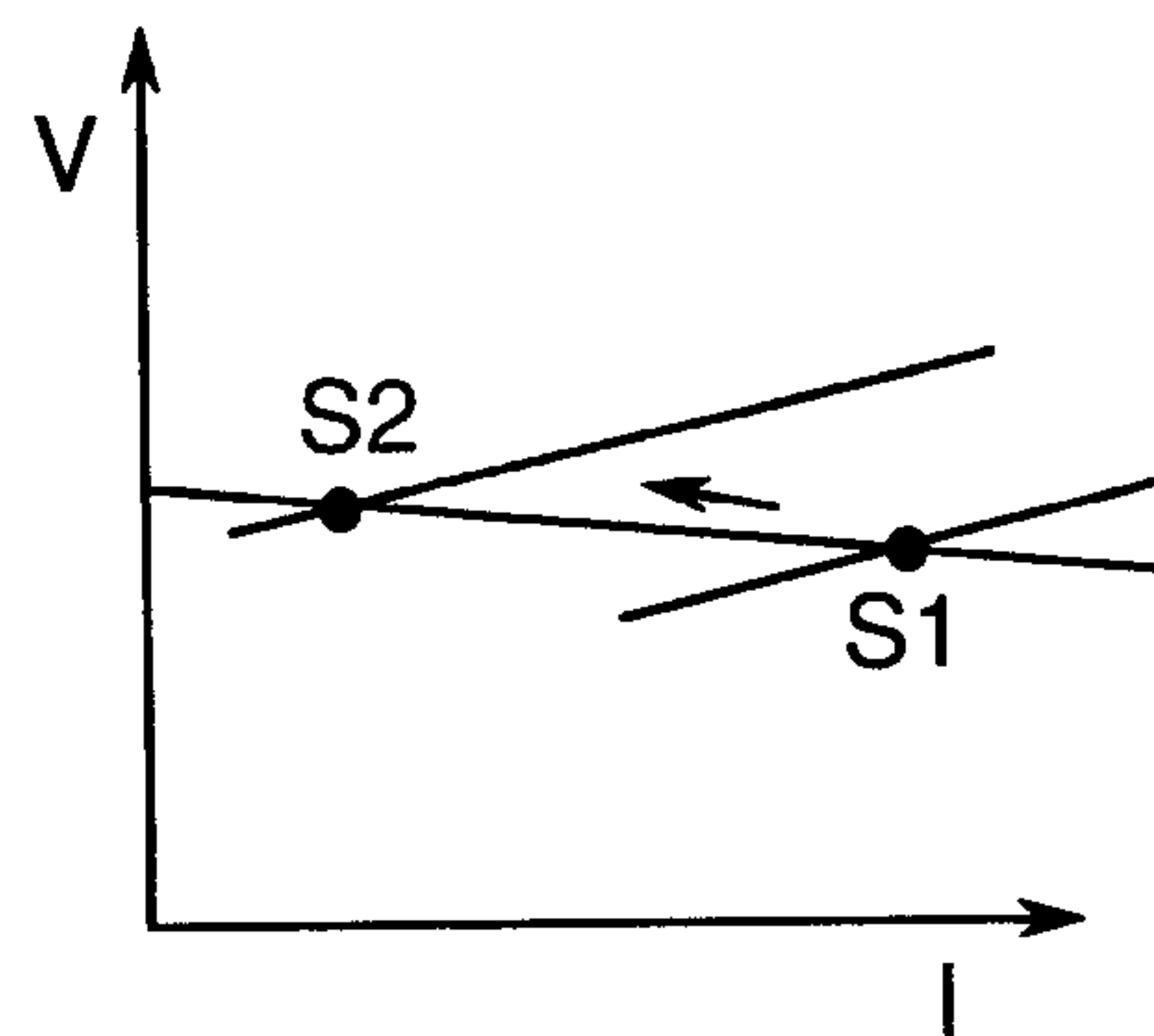
Fig. 1*Fig. 2 PRIOR ART*

Fig.3A

CONSTANT CURRENT
CHARACTERISTIC

Fig.3B

CONSTANT VOLTAGE
CHARACTERISTIC

