

METHOD OF CONTROLLING A PENETRATION BEAD IN ONE-SIDE WELDING.

The present invention relates to one-side welding and more particularly to a penetration bead control method for maintaining substantially uniform the width of a penetration bead in the one-side welding
5 of large plates.

One-side welding has been used widely since it is not only capable of welding base metals from their open side and providing an excellent penetration bead without turning over the base metals but also
10 capable of effecting welding efficiently and economically.

The width of a penetration bead becomes nonuniform depending on the shape of a groove and thus causes weld defects. It is therefore necessary to prevent the occurrence of nonuniformity in the width of the
15 penetration bead.

It is an object of the present invention to provide a one-side welding control method which reduces the foregoing disadvantages of the conventional one-side welding methods and which is capable of controlling
20 the width of a penetration bead through an electric control so that it becomes substantially uniform.

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In accordance with the invention, there is provided a one-side welding method for welding a pair of base metals from the open side thereof by holding a metal plate in close contact with the back of said base metals through an inorganic material such as a flux, comprising the steps of;

detecting a voltage or current generated by the arc leaking through between the base metals and reaching the metal plate through the flux during a welding; and

controlling a welding current, arc voltage and welding speed singly or in any combination thereof so as to maintain said detected voltage or current at a predetermined value, whereby a penetration bead having a substantially uniform width is made.

In one-side welding of base metals, the voltage or current generated during the welding between the base metals and a metal plate attached as a backing to the back of the base metals through an inorganic material such as a flux has an excellent correlation with the width of a penetration bead. The voltage or current generated between the base metals and the metal plate is detected during the welding and the welding parameters are adjusted so as to maintain the detected voltage or current at a predetermined value thereby

1 maintaining the width of the penetration bead uniform at a desired value by an on-line operation and its advantage is very great.

Other and further objects, features and advantages of the invention will appear more fully from the following description taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

10 Fig. 1 is a schematic diagram showing the principle of a method for controlling the width of a penetration bead by detecting the voltage between base metals and a metal plate.

15 Fig. 2 is a correlative diagram showing the relation between the voltage across the base metals and the metal plate and the penetration bead width.

20 Fig. 3 is a block diagram of an apparatus for controlling the welding current so as to maintain the voltage between the base metal and the metal plate equal to a predetermined reference voltage.

Fig. 4 is a schematic diagram showing the principle of a method for controlling the width of a penetration bead by detecting the current between base metals and a metal plate.

25 Fig. 5 is a correlative diagram showing the relation between the current flow between the base metals and the metal plate.

Fig. 6 is a block diagram of an apparatus for controlling the welding current so as to maintain the

1 current flow between the base metals and the metal plate
equal to a predetermined reference current.

Detailed Description of the Preferred Embodiments

5 Fig. 1 shows the principle of a one-side welding
method by the submerged arc welding using two electrodes
for completing the welding by a single pass. In the Figure,
numeral 1 designates base metals, 2 an inorganic material
such as a flux and held in close contact with the back
10 of the base metals 1 by a backing copper plate 3, 4A a
leading electrode, 4B a trailing electrode, and 5A and 5B
welding power sources.

In the one-side welding shown in the Figure, the weld-
ing is started in a condition where the backing copper plate
15 3 is not electrically connected to the base metals 1 and
therefore the voltage between the backing copper plate 3 and
the base metals 1 is zero at the start of the welding.
After the welding has been started, if a satisfactory
penetration bead is formed, the arc leaking through between
20 the base metals 1 reaches the backing copper plate 3 through
the flux 2 and a voltage V is generated between the base
metals 1 and the backing copper plate 3.

The voltage V between the base metals 1 and the backing
copper plate 3 is measured by a voltage detector 6, and Fig.
25 2 shows the result of the study on the relation between the
voltage V and the penetration bead width. As shown in the
Figure, it is apparent that there is an excellent correlation
between the voltage V across the base metals 1 and the
backing copper plate 3 and the penetration bead width and

thus it is found that the utilization of the voltage V makes possible the control of the penetration bead width in the one-side welding by an on-line operation which has not been practiced in the past with the conventional one-side welding methods.

Fig. 3 shows a block diagram of an apparatus for detecting the voltage V and adjusting the welding current to maintain the detected voltage V at a constant value.

In the Figure, numeral 7 designates a converter for converting the voltage V generated between the base metals 1 and the backing copper plate 3 and detected by the voltage detector 6 to a dc signal. The converter 7 is required when the welding power source 5A is an ac power source and it is not needed if the welding power source 5A is a dc power source. The voltage signal generated from the converter 7 is passed through a filter 8 to remove noise and then applied to a comparator 9. The voltage signal applied to the comparator 9 is compared with a reference voltage signal 10 preset in accordance with a predetermined penetration bead width on the basis of the correlation between the penetration bead width and the voltage V across the base metals 1 and the backing copper plate 3 shown in Fig. 2. The comparator 9 produces a difference signal between the voltage signals, and the difference signal is applied to the welding power source 5A through an integrator 11. The welding power source 5A controls the welding current for the leading electrode 4A so as to reduce the applied difference signal to zero. In other words, the control is effected such that the voltage

- 1 signal across the base metals 1 and the backing copper plate
3 always becomes equal to the reference voltage signal 10.

By controlling in this way the welding current so as
to always maintain constant the voltage V across the base
5 metals 1 and the backing copper plate 3, it is possible to
effect the one-side welding with a penetration bead having
a predetermined width corresponding to the reference
voltage and thus it is possible to control the penetration
bead width easily.

- 10 While, in the above-described embodiment, the voltage V
generated across the base metals 1 and the backing copper
plate 3 during the welding is detected directly, by
measuring the voltage generated between the leading elec-
trode 4A and the base metals 1, i.e., the arc voltage and the
15 voltage between the leading electrode 4A and the backing
copper plate 3, obtaining the difference between the
voltages and controlling the welding current so as to
maintain the difference voltage at a constant value, it is
possible to control the penetration bead width uniform in
20 the like manner as the above-described embodiment.

- While, in the above-described embodiment, the welding
current in the leading electrode 4A is adjusted so as to
maintain the voltage V across the base metals 1 and the
backing copper plate 3 constant and thereby make the
25 penetration bead width uniform, as shown in Fig. 4, by
detecting a current I flowing between the base metals 1 and
the backing copper plate 3 by a current detector 12 and
adjusting the welding current in the leading electrode 4A
so as to maintain the current I at a constant value, it is

possible to make the width of a penetration bead uniform.

In the one-side welding shown in Fig. 4, at the start of the welding the current flow between the backing copper plate 3 and the base metals 1 is zero. After the welding has been started, if a satisfactory penetration bead is formed, the arc leaked through between the base metals 1 reaches the backing copper plate 3 and thus a current I flows between the base metals 1 and the backing copper plate 3.

10 The current I flowing between the base metals 1 and the backing copper plate 3 is measured by the current detector 12, and Fig. 5 shows the result of the study on the relation between the current I and the penetration bead width. As shown in the Figure, it is apparent that there is an
15 excellent correlation between the current I flowing between the base metals 1 and the backing copper plate 3 and the penetration bead width.

Fig. 6 shows a block diagram of an apparatus for detecting the current I and controlling the welding current so as
20 to maintain the detected current I at a constant value.

The current I flowing between the base metals 1 and the backing copper plate 3 is detected by the current detector 12 and the current signal is applied to a comparator 9 through a converter 7 and a filter 8. The current signal
25 applied to the comparator 9 is compared with a reference current signal 13 predetermined in accordance with a desired penetration bead width on the basis of the correlation between the penetration bead width and the current I between the base metals 1 and the backing copper plate 3 shown in

Fig. 5. The comparator 9 produces a difference signal between the current signals and the difference signal is applied to the welding power source 5A through an integrator 11. The welding power source 5A controls the welding current in the leading electrode 4A so as to reduce the applied difference signal to zero. In other words, the control is made so that the current signal between the base metals 1 and the backing copper plate 3 always becomes equal to the reference current signal 13.

As a result, the width of the penetration bead is maintained uniform with a penetration width value corresponding to the reference current.

While, in the above-described embodiments, the welding current is controlled, the arc voltage and the welding speed may be controlled singly or in combination.



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CLAIMS

1. A one-side welding method for welding a pair of base metals from the open side thereof by holding a metal plate in close contact with the back of said base metals through an inorganic material such as a flux, comprising the steps of;

detecting a voltage or current generated by the arc leaking through between the base metals and reaching the metal plate through the flux during a welding; and

controlling a welding current, arc voltage and welding speed singly or in any combination thereof so as to maintain said detected voltage or current at a predetermined value, whereby a penetration bead having a substantially uniform width is made.

2. A control method according to claim 1, wherein said detected voltage or current is maintained at the same value as a reference voltage or reference current predetermined in accordance with a desired penetration bead width.

3. A control method according to claim 1 or 2, wherein the voltage between said base metals and said metal plate is detected by a voltage detector connected between said base metals and said metal plate.

4. A control method according to claim 1 or 2, wherein the current between said base metals and said metal plate is detected by a current detector connected between said base metals and said metal plate.



- 1 5. A control method according to claim 1 or 2, wherein
the voltage between said base metals and said metal
plate is detected in terms of a voltage between a
leading electrode and said metal plate and said arc
5 voltage.
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