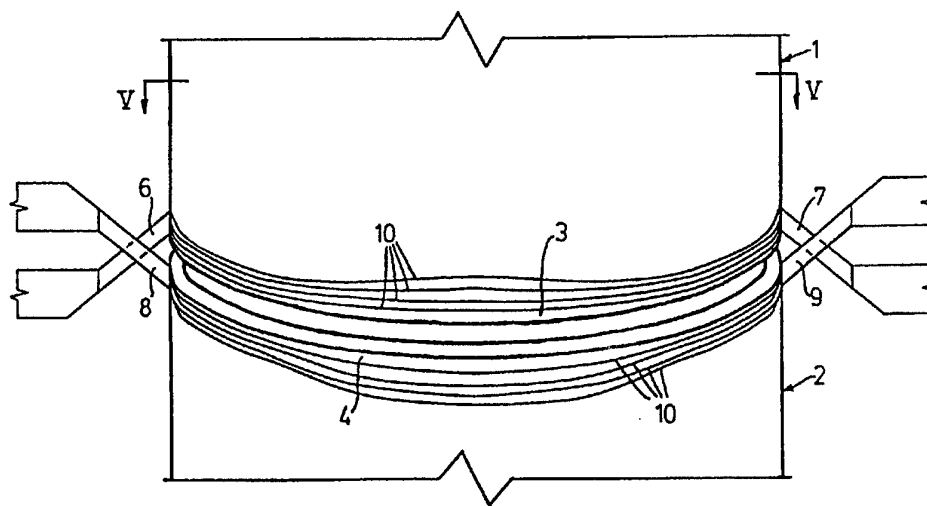




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(54) Title: A METHOD FOR HEATING CLOSELY SPACED END PORTIONS OF TWO PIPES



(57) Abstract

In a method for heating closely spaced end portions (3, 4) of two pipes (1, 2) to be joined by forge welding or the like two diametrically opposed contacts (6, 7; 8, 9) are attached to each end portion. High frequency alternating current is supplied through the contacts for resistance heating of the material in the end portions, the contacts (6, 7), for one of the pipes (1) being located in close proximity to and in the same axial plane as the contacts for the other pipe (2). In order to control the current flow in the immediate vicinity of the contacts and improve the current density in the areas midway between the contacts (6, 7; 8, 9), the contacts (6, 7) for one of the pipes (1) are arranged to form an angle (α) with the contacts (8, 9) for the other pipe (2). Further concentration of the current in the areas midway between the contacts may be obtained by placing ferrite bars (13) inside and/or outside the pipes (1, 2) in the joint area (3, 4).

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A Method for heating closely spaced
End Portions of two Pipes

5 The present invention relates to a method for heating
closely spaced end portions of two pipes to joined by forge
welding or the like, wherein two diametrically opposed
contacts are attached to each end portion, through which
contacts each end portion is supplied with high frequency
alternating current for resistance heating of the material
10 in the respective end portion, the contacts for one of the
pipes being located in close proximity to and in the same
axial plane as the contacts for the other pipe.

15 A method of this type is disclosed in US-PS 4 736 084,
which hereby is included by reference. This prior art
method is successfully used for joining solid work pieces
and thick-walled pipes, the heating current concentrating
itself in the material closest to the end surfaces of the
pipes due to their close proximity. However, for thin-
20 walled pipes, e.g. made from C/Mn steel, the proximity
effect may not be sufficiently high so that the current may
leak away from the joint surfaces of the pipes. Further-
more, the contact points or junctions between the pipe end
portions and the electrical contacts give rise to a wider
25 heating zone resulting in a colder portion in the joint
between the contacts.

The purpose of the present invention is to improve the
method in question so that it may successfully be used also
30 for thin-walled pipes and for materials having high thermal
and/or electrical conductivity.

In accordance with the invention, this is achieved by a
method as recited in the introductory paragraph, the method
35 being characterized in that the contacts for one of the
pipes at least close to the pipes are arranged to form an
angle with the contacts for the other pipe, whereby the

projections of the contacts onto said axial plane appear to cross each other.

5 According to an advantageous embodiment of the invention the contacts for one of the pipes are run through slots in the contacts for the other pipe.

10 In areas of the joint remote from the contact points or junctions the heating current may tend to spread somewhat from the joint surfaces and reduce the rate of heating. To concentrate the current close to the joint also in these areas, it is suggested according to the invention to place ferrite bars parallel to the longitudinal axes of the pipes close to the pipe wall in diametrically opposed areas
15 between the contacts. These ferrite bars may be arranged both on the inside and on the outside of the pipes.

The effect of crossing the contacts increases with increasing angle between the contacts. Consequently, in accordance with the invention, the angle is adjusted in order to
20 avoid overheating of the pipe material between the contacts.

The invention will be described in more detail in the following in conjunction with the exemplifying embodiments shown in the appended drawings, where
25

Fig. 1 is a perspective view illustrating a prior art method,
30

Fig. 2 is a view similar to that in Fig. 1 but illustrating schematically an embodiment of the present invention,

35 Fig. 3 is an elevation view corresponding to the left part of Fig. 2 showing an alternate embodiment, partly in section along the line III - III in Fig. 4,

Fig. 4 is a section along the line IV - IV in Fig. 3, and

Fig. 5 is a section on the line V - V in Fig. 2.

5 Fig. 1 illustrating a prior art embodiment shows two pipes
1 and 2 having end portions 3 and 4, respectively, to be
joined by means of forge welding. Prior to joining the two
pipes their end portions 3, 4 are heated by means of a high
frequency alternating current supplied by a source 5
10 through contacts 6, 7 to the upper pipe 1 and 8, 9 to the
lower pipe 2.

The current density in the end portions 3, 4 is illustrated
by the lines 10. As apparent from these lines, the current
15 is less dense midway between the contacts 6, 7; 8, 9 and
also near the junctions between the contacts and the
respective pipe end portions. These effects lead to
insufficient heating of the middle areas and the material
between the contact pairs 6; 8 and 7; 9.

20 According to the invention, the contacts 6 - 9 are rear-
ranged as shown in Fig. 2, i.e. the contacts within each
pair 6; 8 and 7; 9 appear to cross each other in the plane
of the drawing, which corresponds to an axial plane 14
25 through the center line of the pipes 1, 2 and the contacts
(Fig. 5). As indicated by the current density lines, the
problem areas at the contact junctions and the middle areas
have greatly improved. At this time it is not fully
understood why these beneficial effects occur and therefore
30 no explanation will be attempted here.

Figs. 3 and 4 illustrate how the contacts 6 and 8 may be
formed to obtain the crossing effect. The contact 8 has
two spaced parallel bars forming a slot 11 therebetween
35 through which the contact 6 extends, an angle α being
formed between the crossing parts of the contacts. In
order to avoid an inadvertent short circuit between the

contacts in the crossing area, an insulating material like mica may be placed between the contacts 6 and 8 in the slot 11.

- 5 Crossing of the contacts 6, 8 has the effect of improving heating of the zone 12 between the contacts. By increasing the angle α the heating will be intensified and therefore it is necessary to determine the angle α for each application depending on material composition, pipe thickness and diameter, contact distance and electrical parameters in order to avoid overheating of the zone 12.

15 It is believed that the close spacing of the pipe portions 3 and 4 give rise to a "proximity effect" that keeps the current density strong near the joint between the pipe portions. However, even with crossing contacts there will be some tendency for the current density to be less midway between the diametrically opposed contacts 6, 7; 8, 9, as illustrated in Fig. 2. This effect may be due to the high magnetic permeability in the steel pipe and steel in tools inside the pipe or a screen around the pipe. In order to keep the current density high also in the areas between the contacts, it is suggested according to the invention to place elongate ferrite bars 13 parallel to the central longitudinal axes of the pipes 1, 2 near the pipe wall in those areas where the current density is to be improved, e.g. as shown in Fig. 5. The ferrite bars 13 are arranged symmetrically about a diamtral axial plane 14 through the pipes and contacts 6, 7; 8, 9. Ferrite bars may also be placed on the outside of the pipes 1, 2 instead of, or in addition to, the bars 13 on the inside.

The ferrite bars may consist of ferrite particles sintered in a mass of insulating material. The bars may have a cross-section of about 30 x 30 mm and a length of about 150 mm, for instance when used for welding pipes of 273 mm external diameter and 12,7 mm thickness. For such pipes,

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using an electrical effect of 180 kW at 100 V and a frequency of 15000 Hz, the necessary heating for forge welding the pipes to each other may be obtained in about 30 sec.

5

It will be understood the changes and modifications may be made in the exemplifying embodiments described in the specification and shown in the drawings without departing from the scope of the invention as defined in the following

10 claims.

C l a i m s:

1. A method for heating closely spaced end portions (3, 4) of two pipes (1, 2) to be joined by forge welding or the like, wherein two diametrically opposed contacts (6, 7; 8, 9) are attached to each end portion, through which contacts each end portion (3, 4) is supplied with high frequency alternating current for resistance heating of the material in the respective end portion, the contacts (6, 7) for one of the pipes (1) being located in close proximity to and substantially in the same axial plane (14) as the contacts (8, 9) for the other pipe (2), c h a r a c t e r i z e d in that the contacts (6, 7) for one of the pipes (1) at least near the pipes (1, 2) are arranged to form an angle (α) with the contacts (8, 9) of the other pipe (2) so that the projection of the contacts (6, 8; 7, 9) onto said axial plane (14) appear to cross each other.
2. A method according to claim 1, c h a r a c t e r i z e d in that the contacts (6, 7) for one of the pipes (1) are made to extend through a slot (11) in the contacts (8, 9) for the other pipe (2).
3. A method according to claim 1 or 2, c h a r a c t e r i z e d in that elongate ferrite bars (13) are arranged substantially parallel to the longitudinal axes of the pipes (1, 2) near the wall of the pipes in diametrically opposite areas between the contacts (6, 7; 8, 9).
4. A method according to claim 3, c h a r a c t e r i z e d in that the ferrite bars (13) are arranged both on the inside and on the outside of the pipes (1, 2).
5. A method according to a preceding claim, c h a r a c t e r i z e d in that the angle (α) formed

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between the crossing contacts (6, 8; 7, 9) is adjusted to avoid overheating of the pipe material (12) between the contacts.

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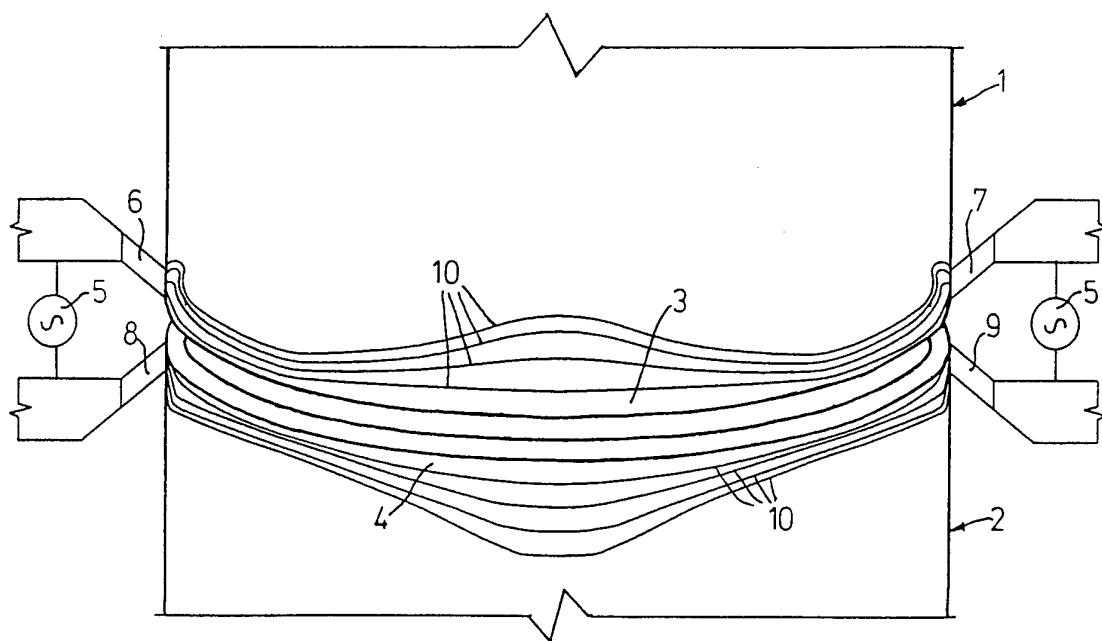


Fig. 1

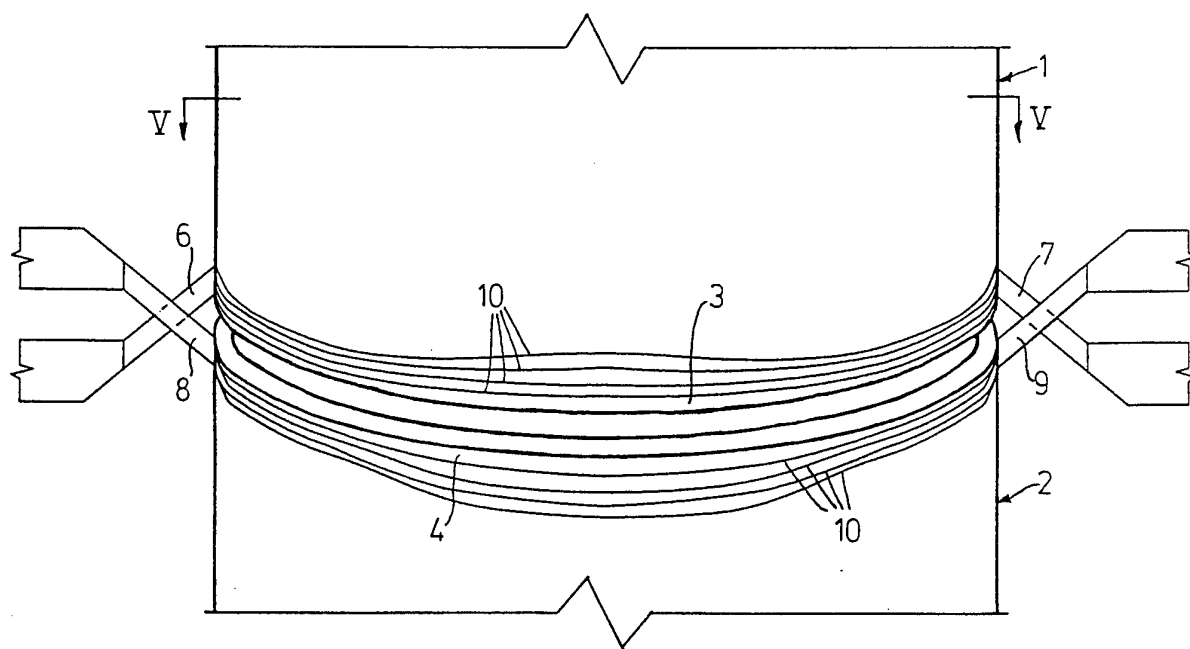
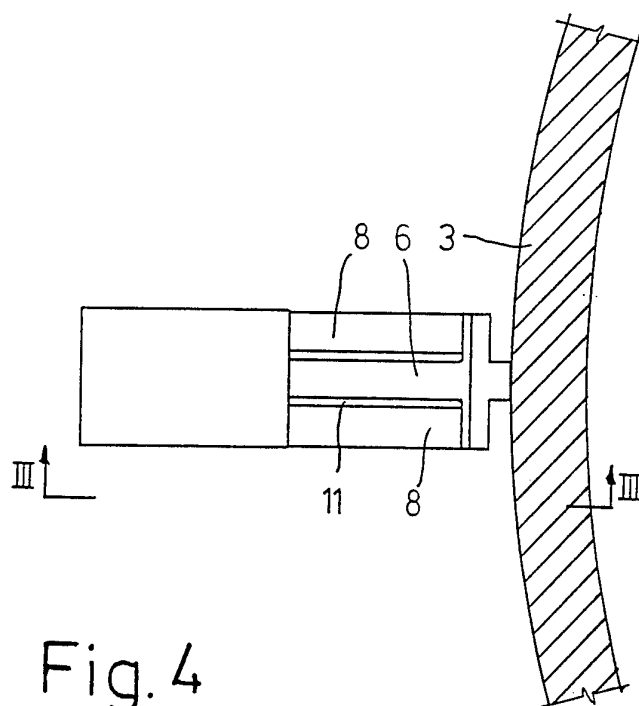
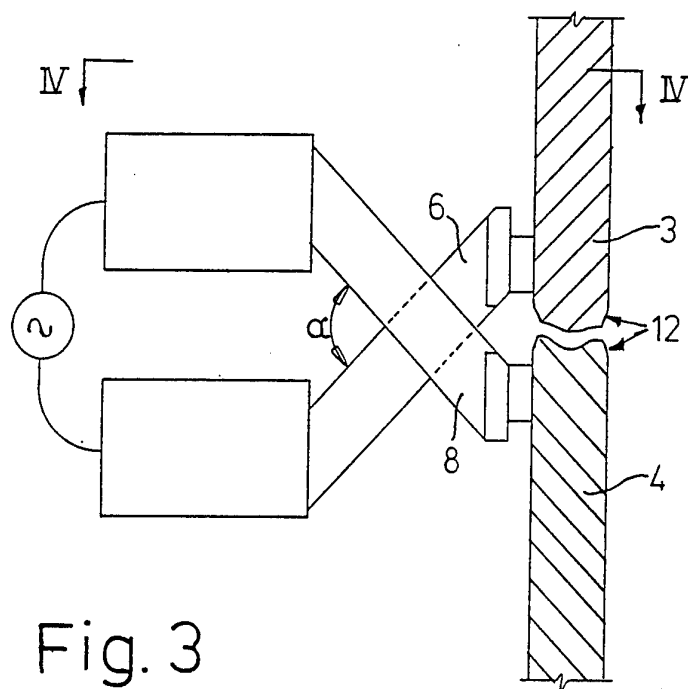


Fig. 2

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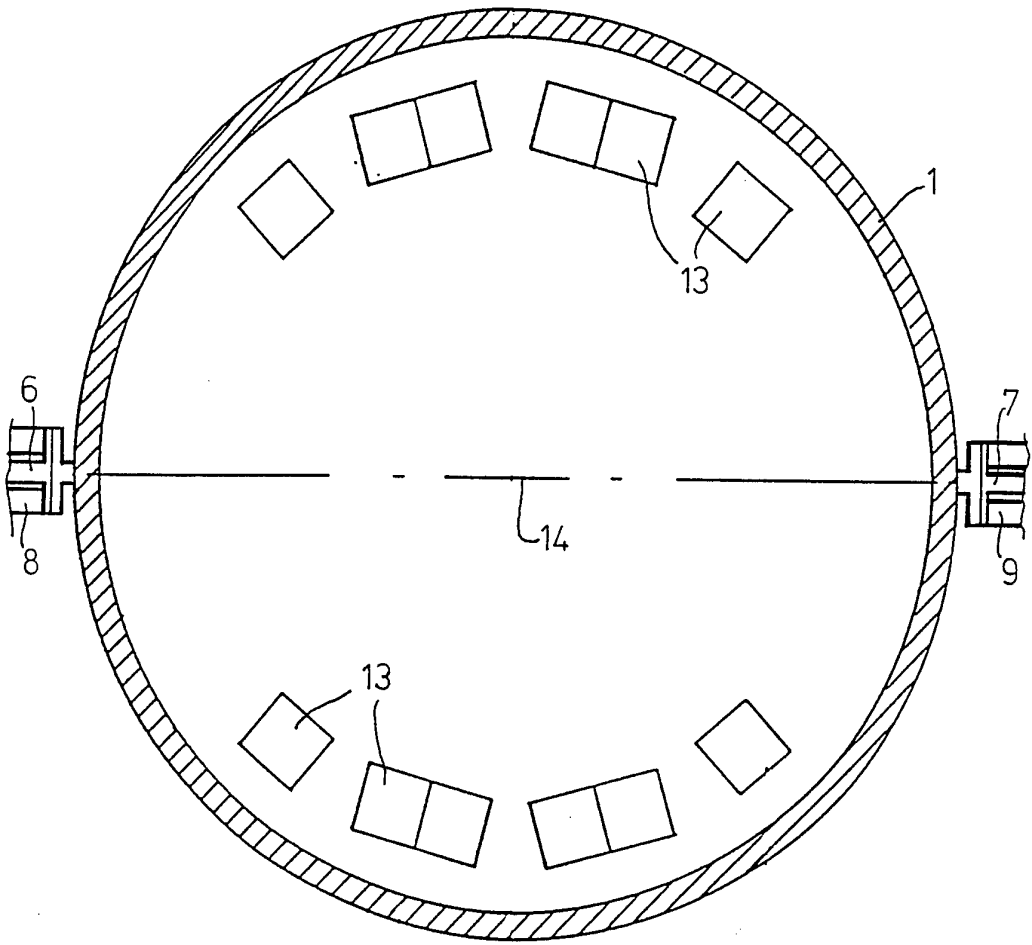


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 95/00115

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B23K 13/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4736084 A (PER H. MOE), 5 April 1988 (05.04.88), abstract -- -----	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

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17 November 1995

Date of mailing of the international search report

20.11.95.

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