TIG WELDING POWER SOURCES WITH A BRIDGE CIRCUIT PROVIDING HIGH IMPEDANCE FOR CONTROLLING AC ARC WELDING PROCESSES

FIG. 1

A TIG welding power source (100) for providing controlled AC arc welding processes is provided. In the AC TIG arc welding power source (100) embodiments, configurations of main and auxiliary bridge circuits (160, 170) allow for the directional switching of the output welding current through the welding output circuit path and selectively provide one or more high impedance paths to rapidly decay the arc current. The high impedance path aids in the low spatter transfer of molten metal balls from consumable to a workpiece (W), via an arc generated by a tungsten electrode (E), and further aids in the maintaining or the re-establishing of an arc between the tungsten electrode (E) and the workpiece (W) during welding.
### INTERNATIONAL SEARCH REPORT

**PCT/IB2013/002117**

#### A. CLASSIFICATION OF SUBJECT MATTER

|------|----------|-----------|----------|-----------|

#### B. FIELDS SEARCHED

**Minimum documentation searched** (classification system followed by classification symbols)

B23K

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

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

EPO-Internal, WPI Data

#### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>JP H10 71468 A (SHOWA ALUMINUM CORP) 17 March 1998 (1998-03-17) abstract: figures paragraphs [0036], [0015], [0017]; table 2</td>
<td>1-4, 9-13, 15</td>
</tr>
<tr>
<td>A</td>
<td>US 3 775 585 A (T. OKADA) 27 November 1973 (1973-11-27) col umn 1, l ines 33-39; figures</td>
<td>1, 9, 15</td>
</tr>
<tr>
<td>A</td>
<td>GB 1 069 512 A (BRITISH WELDING RES ASS) 17 May 1967 (1967-05-17) page 5, l ines 44-72 page 6, l ine 107 - page 7, l ine 18; figures</td>
<td>1-4, 9-13, 15</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:
  
  "A" document defining the general state of the art which is not considered to be of particular relevance
  
  "E" earlier application or patent but published or filed before the international filing date
  
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another document or other special reason (as specified)
  
  "O" document referring to an oral disclosure, use, exhibition or other means
  
  "P" document published prior to the international filing date but later than the priority date claimed

**St** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"A" document member of the same patent family

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Date of the actual completion of the international search: 31 March 2014

Date of mailing of the international search report: 12/06/2014

Name and mailing address of the ISA:

European Patent Office, P.B. 5618 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Fax (+31-70) 340-3016

Authorized officer:

Jeggy » Thierry
### Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 64(a).

### Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

**see additional sheet**

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

   1-4, 9-13, 15

**Remark on Protest**

□ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

□ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

□ No protest accompanied the payment of additional search fees.
Thi s International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 9-13, 15

TIG welding power source with an auxiliary bridge circuit for introducing high impedance with AC output current having a frequency of at least 1 kHz and an average output of at least 100 amps.

2. claims: 5-8, 14

TIG welding power source with an auxiliary bridge circuit for introducing high impedance with AC output current having a frequency between 500 and 999 Hz and an average output of at least 100 amps, with each of said positive and negative portion of the waveform having a peak to average current between 1.09 and 1.004.
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
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<tbody>
<tr>
<td>JP 2002224828 A</td>
<td>13-08-2002</td>
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