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- (71) Applicant: **GENERAL ELECTRIC TECHNOLOGY GMBH** [CH/CH]; Brown Boveri Strasse 7, CH-5400 Baden (CH).
- (72) Inventors: **LEMAIRE, Julien**; 204 Rond-Point du Pont de Sevres, 92100 Boulogne-Billancourt (FR). **BUGUIN, Arnaud**; 3, Ave André Malraux, 92300 Levallois-Perret (FR).
- (74) Agent: **FISCHER, Michael**; General Electric Technology GmbH, Global Patent Operation - Europe, Brown Boveri Strasse 7, CH-5400 Baden (CH).

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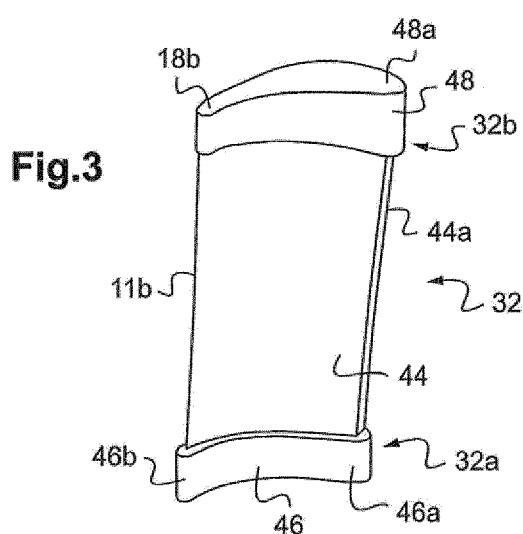
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(54) Title: STATIC BLADE FOR A TURBINE DIAPHRAGM AND ASSOCIATED TURBINE DIAPHRAGM



(57) Abstract: Static blade (32) for an axial flow turbine comprising an aerofoil portion (44) having a leading edge (44a), a trailing edge (44b), a pressure side and a suction side and radially inner and outer reinforcement portions (46, 48) integral with said aerofoil portion (44). Each reinforcement portion (46, 48) closely follows the shape of the section of the aerofoil portion (44).



STATIC BLADE FOR A TURBINE DIAPHRAGM AND ASSOCIATED TURBINE DIAPHRAGM

5 The present invention relates to the construction of rings of static blades for axial flow turbines, and in particular, steam turbines.

 In particular, the present invention relates to turbine diaphragms.

10 A steam turbine is a rotating machine intended to convert the thermal of the steam into mechanical energy for driving an alternator, a pump or any other rotary mechanical receiver. Generally, steam turbines comprise a high-pressure module, a medium-pressure module and a low-pressure module.

15 A steam turbine generally comprises symmetrical or non-symmetrical single or double flow inner body enclosing a rotor equipped with mobile blades and supporting fixed or stationary blades forming a diaphragm suspended in said inner body. The diaphragms are adapted to guide the flow of steam in a specific direction towards the mobile blades of the rotor, thereby accelerating the steam flow.

20 The present invention is related to known types of construction diaphragms called “spacer band diaphragms” and “platform diaphragms”.

 In the so called “spacer band diaphragm” type of construction 10, shown in Figure 1a, the blade aerofoils 11 are fixed radially to an inner ring 12 and to an outer ring 13 by means of inner and outer annular bands 14, 15, which are folded from flat strip. Through-holes 16 are cut in said bands 14, 15, for example by means of laser, to match the cross-section of the aerofoil shape. The ends of the aerofoils 11 are then inserted in said through-holes 16 and fillet welded into place. The inner band 14 is in turn welded to the inner ring 12 and the outer band 15 is in turn welded to the outer ring 13. Such type of construction involves a relatively small amount of machining of the blades compared to other types of construction used in steam turbines.

30 For example, in the so called “platform diaphragms” type of construction 20, shown in Figure 1b, the blade aerofoils 21 has a section substantially in the shape of a vane having its two opposite ends

2

integral with radially inner and outer platforms 22, 23. The blade
aerofoils and the platforms are machined from solid bars or by forgings.
A complete annulus of static blades is built up by assembling
successive combined aerofoil-platforms components between an inner
5 and an outer ring (not shown) and by welding the platforms to said
rings. Thanks to the platforms, such diaphragm has better mechanical
strength compared to the spacer band type, but has much higher
manufacturing costs.

10 The object of the present invention is to remedy the above
drawbacks.

It is a particular object of the present invention to provide a
type of diaphragm construction which has good performance
characteristics as well as being economical to manufacture.

15 In one embodiment, a static blade for an axial flow turbine
comprises an aerofoil portion having a leading edge, a trailing edge, a
pressure side and a suction side, and radially inner and outer
reinforcement portions integral with said aerofoil portion.

Each reinforcement portion closely follows the shape of the
section of the aerofoil portion.

20 Thanks to the reinforcement portion, the mechanical strength of
the spacer band diaphragm is increased without increasing the
manufacturing costs.

Advantageously, each reinforcement portion has a section
substantially bigger than the section of the aerofoil portion. The
25 section of the reinforcement portion has a rounded and enlarged shape
corresponding to the leading edge surrounding the leading edge of the
aerofoil portion and a thinner part corresponding to the trailing edge
surrounding the trailing edge of the aerofoil portion.

30 The static blade may be made of an alloy steel material, for
example, comprising 12% of chrome.

According to a second aspect, the invention relates to an axial
flow turbine diaphragm construction comprising an annulus of a
plurality of identical static blades as described previously, an inner and
outer spacer bands having through-holes therein shaped to receive the
35 inner and outer reinforcement portions of each static blade, and a

3

radially inner and outer diaphragm rings surrounding the annular spacer bands.

In an embodiment, each reinforcement portions are welded to the corresponding spacer band by welds.

5 The welds are, for example, located at each leading and trailing edges of each reinforcement portions.

In an embodiment, the inner spacer band is welded to the inner ring and the outer band is welded to the outer ring.

10 The present invention will be better understood from studying the detailed description of a number of embodiments considered by way of entirely non-limiting examples and illustrated by the attached drawings in which:

- Figure 1a illustrates the known spacer band turbine diaphragm type of construction;

15 - Figure 1b illustrates a fixed blade with integral platforms for use in the known platform turbine diaphragm type of construction;

- Figure 2 is a three-dimensional perspective view of a part of a steam turbine diaphragm according to an embodiment of the invention;

20 - Figure 3 is a three-dimensional perspective view of a static blade for use in the diaphragm construction of Figure 2;

- Figure 4 is an upper view of the static blade of Figure 3; and

- Figure 5 is a radial cross-section of a static blade of Figure 3, welded onto spacer bands of the steam turbine diaphragm of Figure 2.

25 The following detailed description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Additionally, the drawings are not necessarily drawn to scale.

30 As illustrated on Figure 2, a part of a steam turbine diaphragm of a turbine comprises a nozzle unit having a plurality of identical static blade aerofoils 32 fixed radially to an inner ring 34 and to an outer ring 36 by means of inner and outer annular spacer bands 38, 40, which are folded from flat strip.

The inner and outer rings 34, 36, as well as the inner and outer spacer bands 38, 40 are concentric.

35 The inner and the outer spacer bands 38, 40 are each provided with through-holes 38a, 40a. As illustrated, the through-holes are open

at both ends to receive the static blades. The through-holes 38a, 40a may be, for example, cut in said spacer bands 38, 40, for example by means of laser, to match the cross-section of the aerofoil shape. The ends of the aerofoils 32 are then inserted in said though-holes and
5 fillet welded into place. The inner spacer band 38 is in turn welded to the inner ring 34 and the outer band 40 is in turn welded to the outer ring 36.

As illustrated on Figures 3 and 4, each static blade 32 has an
aerofoil portion 44 having an elongated body having an inner end 32a
10 brought into contact with the inner spacer band 38 and an outer end 32b, opposite to said inner end 32a, brought into contact with the outer spacer band 40.

The inner and outer ends 32a, 32b are connected respectively to the inner and outer spacer bands 38, 40 by welding by way of a weld
15 bead arranged between said ends and said spacer bands. In this way each static blade is welded both to the inner spacer band and to the outer spacer band.

Each static blade 32 has, for example, a section substantially in the shape of a vane, as shown on Figure 4, having a rounded and
20 enlarged shape corresponding to the leading edge 44a and a thinner part corresponding to the trailing edge 44b.

As illustrated on Figure 3 and 4, the inner and outer ends 32a, 32b of the each static blade 32 are provided respectively with an inner and outer reinforcement portion 46, 48. Each reinforcement portion 46,
25 48 has a section slightly bigger than the section of the aerofoil portion 44, as shown on Figure 4, having a rounded and enlarged shape corresponding to the leading edge 46a, 48a and a thinner part corresponding to the trailing edge 46b, 48b.

Each reinforcement portion 46, 48 surrounds the periphery of
30 the whole section of the corresponding end so as to have a section substantially bigger than the section of the aerofoil portion 44. The shape of the reinforcement portions 46, 48 thus approximates the shape of the section of the aerofoil portion 44 in its whole, i.e at and near the leading and trailing edges 44a, 44b, as well as the suction side and
35 the pressure side of the aerofoil portion 44.

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The first and second reinforcement portions 46, 48 are slid into their matching through-holes 38a, 40a of the spacer bands 38, 40 as shown on Figure 5. Once all the static blades 32 have been assembled into the spacer bands 38, 40, they must be securely welded into position. Each leading and trailing edges of each reinforcement portions are welded to the corresponding spacer band by welds 50a, 50b and 52a, 52b. The welds 50a, 50b and 52a, 52b are shown in hatched lines on Figure 4.

The static blades 32 are made of an alloy steel material, having for example, 12% of chrome.

Thanks to the reinforcement portions provided at each end of the aerofoil portions, the static blade is strengthen.

Thanks to the invention, the diaphragm construction has good mechanical strength, while being economical and easy to manufacture.

CLAIMS

1. Static blade (32) for an axial flow turbine comprising:
an aerofoil portion (44) having a leading edge (44a), a trailing
5 edge (44b), a pressure side and a suction side,
radially inner and outer reinforcement portions (46, 48) integral
with said aerofoil portion (44),

wherein each reinforcement portion (46, 48) closely follows the
shape of the section of the aerofoil portion (44).

10 2. Static blade according to claim 1, wherein each
reinforcement portion (46, 48) has a section substantially bigger than
the section of the aerofoil portion (44), having a rounded and enlarged
shape corresponding to the leading edge (46a, 48a) surrounding the
leading edge (44a) of the aerofoil portion (44) and a thinner part
15 corresponding to the trailing edge (46b, 48b) surrounding the trailing
edge (44b) of the aerofoil portion (44).

3. Static blade according to claim 1 or 2, made of an alloy steel
material.

4. Static blade according to claim 3, wherein the alloy steel
20 material comprises 12% of chrome.

5. An axial flow turbine diaphragm construction comprising:
an annulus of a plurality of identical static blades according to
any of the preceding claims,

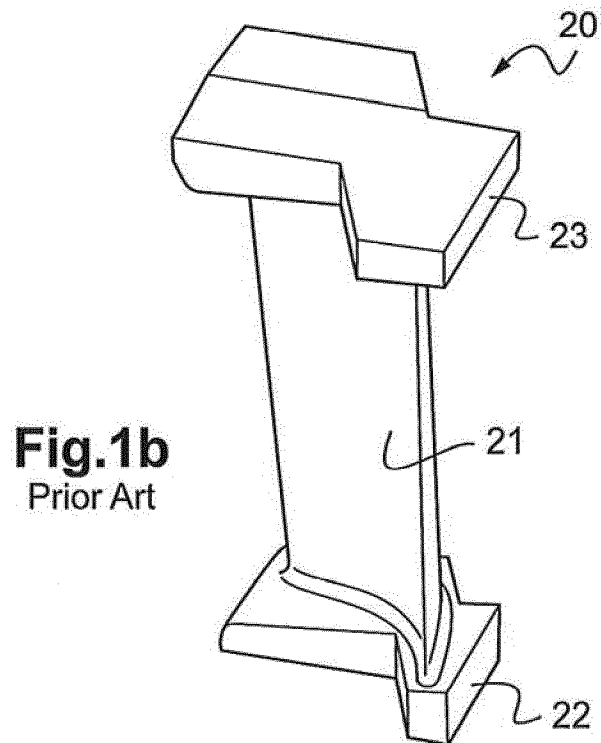
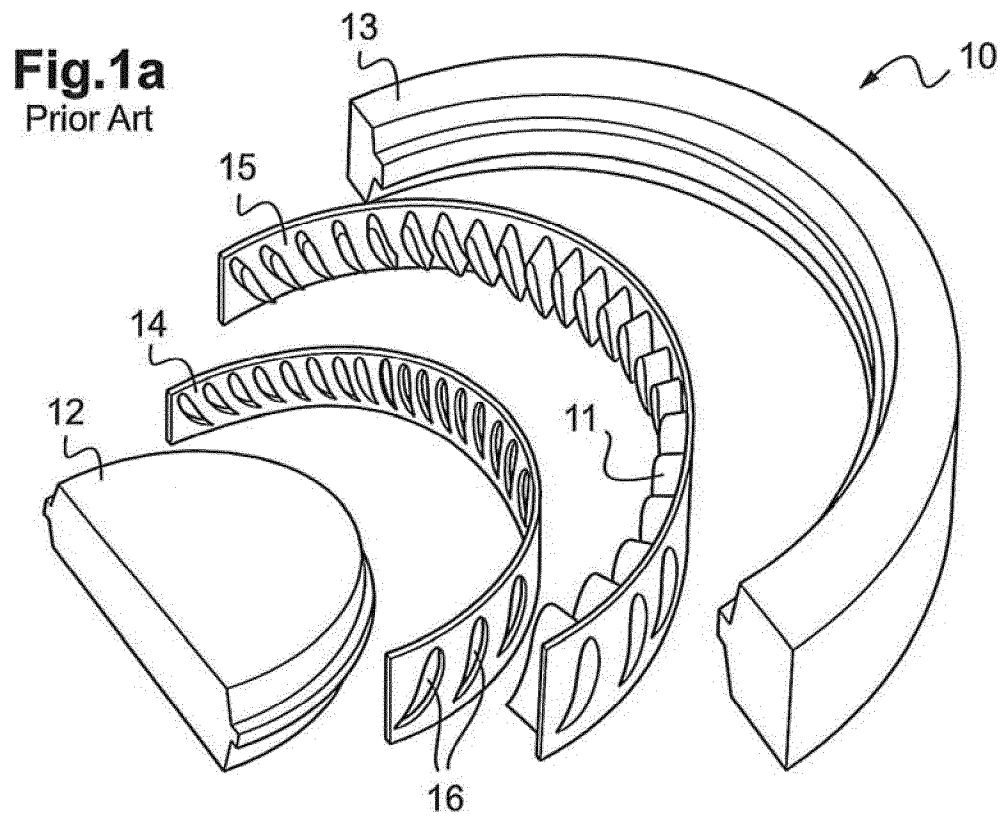
an inner and outer spacer bands (38, 40) having through-holes
25 (38a, 40a) therein shaped to receive the inner and outer reinforcement
portions (46, 48) of each static blade (32), and

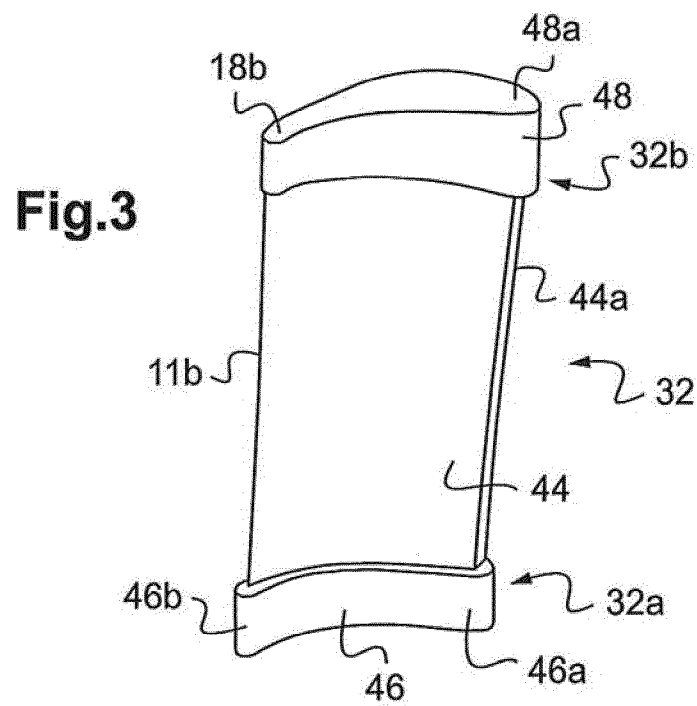
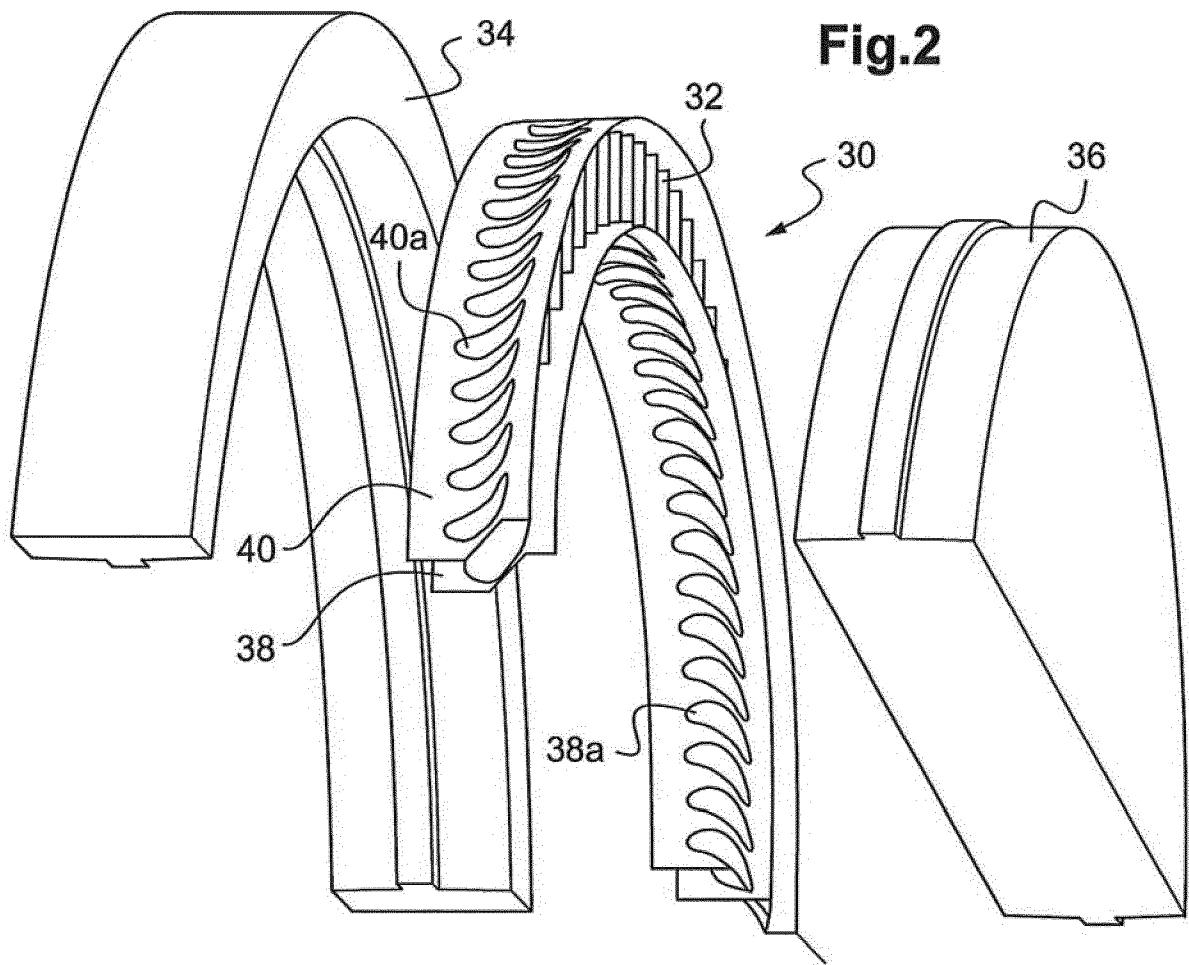
a radially inner and outer diaphragm rings (34, 36) surrounding
the annular spacer bands (38, 40).

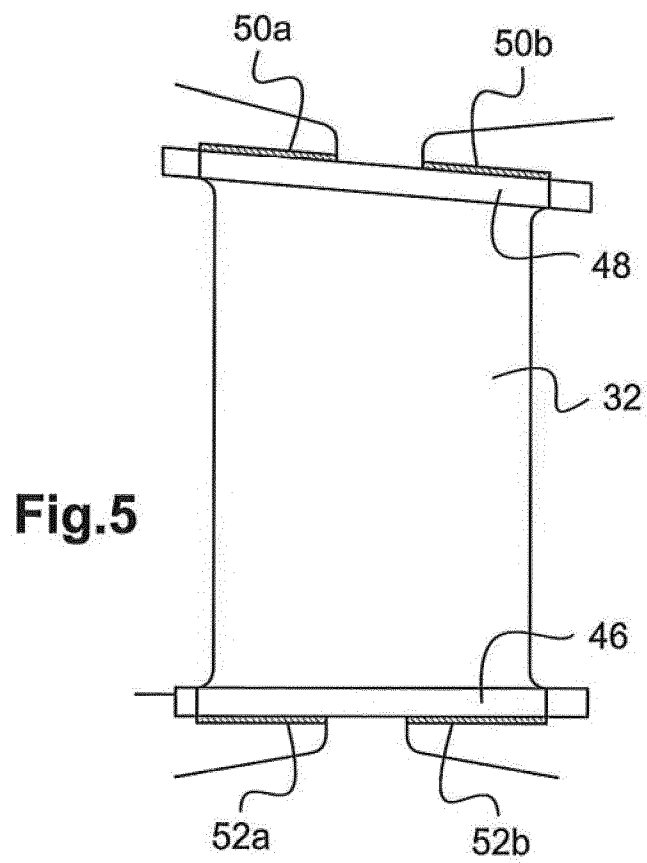
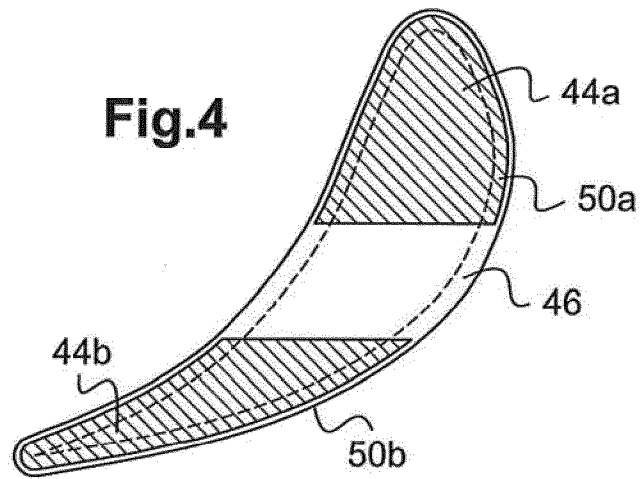
6. Axial flow turbine diaphragm construction according to
30 claim 5, wherein each reinforcement portions are welded to the
corresponding spacer band (38, 40) by welds (50a, 50b; 52a, 52b).

7. Axial flow turbine diaphragm construction according to
claims 2 and 6, wherein of the welds 50a, 50b; 52a, 52b) are located at
each leading and trailing edges (48a, 48b; 46a, 46b) of each
35 reinforcement portions (46, 48).

8. Axial flow turbine diaphragm construction according to any of claims 5 to 7, wherein the inner spacer band (38) is welded to the inner ring (34) and the outer band (40) is welded to the outer ring (36).







INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. F01D9/04 B23P15/04
ADD.

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)
F01D B23P

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

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X	EP 1 847 689 A2 (GEN ELECTRIC [US]) 24 October 2007 (2007-10-24) claims 4, 5, 7, 9; figures 2, 3 paragraph [0014] paragraph [0019] paragraph [0020]	1-8
X	EP 0 018 806 A1 (TRW INC [US]) 12 November 1980 (1980-11-12) claim 12; figures 1-3 page 5, line 8 - page 5, line 16 page 5, line 29 - page 6, line 2 page 7, line 1 - page 7, line 3 page 7, line 14 - page 7, line 18 page 10, line 22 - page 10, line 32 page 17, line 17 - page 17, line 33 ----- -/-	1-4



Further documents are listed in the continuation of Box C.



See patent family annex.

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Alaguero, Daniel

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/065220

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Information on patent family members

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