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- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

(54) Title: BEATER PLATE FOR BEATER MILL ASSEMBLY

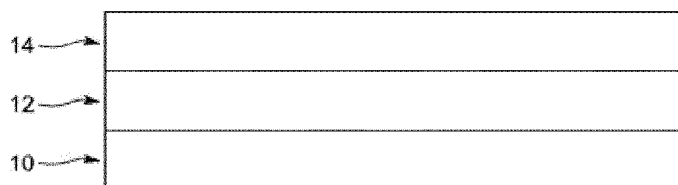


FIG. 3

(57) **Abstract:** Disclosed is a beater plate (10) for a dynamic beater wheel (100) in a beater mill assembly (1000) for pulverizing coal. The beater plate (10) includes a layer of hard-faced surface (12). The layer of hard-faced surface (12) is obtained by hardfacing a surface of the beater plate receiving the coal. The beater plate (10) further includes a layer of coating (14) comprising hard particles. The layer of coating (14) is disposed over the layer of hard-faced surface (12). The hard particles of the layer of the coating are uniformly dispersed in the metal matrix of the beater plate (10), and wherein the hard particles are having more than 50wt% of particles of the coating uniformly dispersed in the metal matrix of the plate (10). Also disclosed is a process of making the beater plate (10), and configuration of the beater plate (10) with the dynamic beater wheel (100).



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BEATER PLATE FOR BEATER MILL ASSEMBLY

FIELD OF THE INVENTION

5 The present invention generally relates to a beater mill assembly, and, more particularly, to a beater plate for a dynamic beater wheel in a beater mill assembly.

BACKGROUND OF THE INVENTION

10 Beater mill assemblies with beater wheel assembly are used for preparation of brown coal in power stations. The beater wheel assembly is arranged upstream of the beater mill and comminutes the brown coal before it reaches the beater mill. The beater wheel assembly includes concentrically arranged static and dynamic beater wheels to be rotatable along a rotational axis. Further, the dynamic beater wheel includes a plurality of beating arms which
15 are arranged radially with respect to the rotational axis and at whose outer ends' beater plates are arranged.

 These solid beater plates are generally composed of steel and are subject to severe wear because of the abrasive components of the brown coal.

 Since the beating arms and other components of the beater wheel assembly will be
20 damaged if the beater plate wear is excessive, the beater plates are required to be replaced. The wear on the beater plates cannot be detected during operation of the beater mill. For this purpose, the mill must be shut down, and the beater plates must be visually checked for wear. The beater mill is shut down on an unnecessarily large number of occasions for checking and then for replacing if found severely worn-out.

25 Accordingly, there exists a need of beater plates that may generally have elongated working cycle against severe wear because of the abrasive components of the brown coal to avoid shutting down of the beater mill assembly on an unnecessarily large number of occasions for checking and then for replacing if found serve worn-out.

30 SUMMARY OF THE INVENTION

 In view of the foregoing disadvantages inherent in the prior art, the general purpose of the present invention is to provide a beater plate for a dynamic beater wheel in a beater

mill assembly to include all advantages of the prior art, and to overcome the drawbacks inherent in the prior art.

As such, the object of the present invention is to provide a beater plate for a dynamic beater wheel in a beater mill assembly that may generally have elongated working cycle
5 against severe wear because of the abrasive components of the brown coal.

An object of the present invention is to provide a beater plate that may have been improved in terms of its material constituents and may include various layers of suitable coatings to enhance the overall working cycle thereof.

In one aspect of the present invention, a beater plate for a dynamic beater wheel in
10 a beater mill assembly for pulverizing coal is provided. The beater plate may include a layer of hard-faced surface of a predetermined thickness range, and a layer of coating including hard particles may be disposed over the layer of hard-faced surface up to a predetermined thickness range. The layer of hard-faced surface may be obtained by hardfacing a surface of the beater plate receiving the coal. The hard particles of the layer of the coating are
15 uniformly dispersed in the metal matrix of the beater plate, and wherein the hard particles are having more than 50wt% of particles of the coating.

In one embodiment, the predetermined thickness range of the layer of hard-faced surface may be about 4mm to about 10mm. Further, the predetermined thickness range of the layer of coating including hard particles may be about 100 microns to about 5000
20 microns. Furthermore, the hard particles size range may be about 100 nanometers to 30 microns.

In one embodiment, the layer of hard-faced surface is obtained by a hardfacing electrodes having solid core electrodes designed to provide weld deposits capable of wear resistance.

25 In one embodiment, the layer of coating is uniformly dispersed by a High Velocity Air-Fuel (HVOF) coating process. In one embodiment, HVOF coating process may be done using one of LPG, propane or propylene gases as a fuel.

In one embodiment, beater plate is of wear resistant material including Manganese Steel. In other embodiments, the beater plate is of wear resistant material including High
30 Chromium Cast Iron, Spheroidal Graphite Iron (SGI), and Carbon steel materials.

In one embodiment, the hard particles in the layer of coating is carbide including one of:

- a Tungsten carbide (WC) having 80 to 94 Wt% of the particles of the coating,
- a Chromium carbide (CrC) having 50 to 93 wt% of the particles of the coating,

a Silicon carbide (SiC) having 50 to 93% wt% of the particles of the coating,
a Titanium carbide (TiC) having 50 to 94 wt% of the particles of the coating,
a Boron carbide (B₄C) having 50 to 95 wt% of the particles of the coating.

In other embodiment, the hard particles in the layer of coating may include one of:
5 Borides (Fe, Cr, Ti, Mo, W), Nitrides (Al, Cr, Si, Ti, Ta), Oxides (Al, Cr, Hf, Zr, Ti),
Boronitrides (BN), Silicon and Chrome oxynitrides.

In other embodiment, the coating content may also include Cobalt-chrome (CoCr),
Cobalt (Co), Nickel-Chromium (NiCr), Nitronic 60, High Chromium (Cr) cast iron, bearing
steel, such as EN31, IN625, IN718, IN706.

10 In further aspect of the present invention, a process of making beater plate for a
dynamic beater wheel in a beater mill assembly for pulverizing coal is provided. The process
includes: hardfacing a surface of the beater plate to obtain a layer of hard-faced surface of a
predetermined thickness range. After hardfacing, coating of a layer comprising hard
particles may be done. The layer of coating is disposed over the layer of hard-faced surface
15 up to a predetermined thickness range. The hard particles of the layer of the coating are
uniformly dispersed in the metal matrix of the beater plate, and wherein the hard particles
are having more than 50wt% of particles of the coating.

In one embodiment, hardfacing the surface may include hardfacing electrodes
having solid core electrodes designed to provide weld deposits capable of wear resistance.

20 In one embodiment, the layer of coating is uniformly dispersed by a High Velocity
Air-Fuel (HVOF) coating process. In one embodiment, HVOF coating process may be done
using one of LPG, propane or propylene gases as a fuel.

In one further aspect of the present invention, a dynamic beater wheel in a beater
mill assembly for pulverizing coal is provided. The dynamic beater wheel includes a
25 plurality of beating arms and a plurality of beater plates. The plurality of beating arms may
be arranged radially with respect to a rotational axis. Further, each beater plate of the
plurality of beater plates detachably coupled to a respective beating arm of the plurality of
beating arms across outer portion, away from the rotational axis. The beater plate includes
a layer of hard-faced surface of a predetermined thickness range, and a layer of coating
30 comprising hard particles, disposed over the layer of hard-faced surface up to a
predetermined thickness range. The layer of hard-faced surface is obtained by hardfacing a
surface of the beater plate receiving the coal. Further, the hard particles of the layer of the
coating are uniformly dispersed in the metal matrix of the beater plate, and wherein the hard
particles are having more than 50wt% of particles of the coating.

This together with the other aspects of the present invention, along with the various features of novelty that characterize the present invention, is pointed out with particularity in the claims annexed hereto and forms a part of the present invention. For a better understanding of the present invention, its operating advantages, and the specified object
5 attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated exemplary embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

10 The advantages and features of the present invention will become better understood with reference to the following detailed description and claims taken in conjunction with the accompanying drawings, wherein like elements are identified with like symbols, and in which:

FIG. 1 illustrates a perspective view of the beater mill assembly, in accordance with
15 an embodiment of the present invention;

FIGS. 2A and 2B illustrate side and front views of a dynamic beater wheel of the beater mill assembly, in accordance with an embodiment of the present invention; and

FIG. 3 illustrates a side view of a plate adapted to be configured on the dynamic beater wheel, in accordance with an embodiment of the present invention.

20 Like reference numerals refer to like parts throughout the description of several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

25 For a thorough understanding of the present invention, reference is to be made to the following detailed description, including the appended claims, in connection with the above-described drawings. Although the present invention is described in connection with exemplary embodiments, the present invention is not intended to be limited to the specific forms set forth herein. It is understood that various omissions and substitutions of
30 equivalents are contemplated as circumstances may suggest or render expedient, but these are intended to cover the application or implementation without departing from the spirit or scope of the claims of the present invention. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising,” or “having” and variations thereof herein is

meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

The terms, “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items.

5 The present invention provides a beater plate for a dynamic beater wheel in a beater mill assembly for pulverizing coal. The beater plate may include a layer of hard-faced surface of a predetermined thickness range, and a layer of coating including hard particles disposed over the layer of hard-faced surface up to a predetermined thickness range. The layer of hard-faced surface is obtained by hardfacing a surface of the beater plate receiving
10 the coal. The hard particles of the layer of the coating are uniformly dispersed in the metal matrix of the beater plate, and wherein the hard particles are having more than 50wt% of particles of the coating uniformly dispersed in the metal matrix. The present invention also provides a process of making the beater plate, and configuration of the beater plate with the dynamic beater wheel.

15 Referring to FIG. 1, a perspective view of the beater mill assembly (1000) for pulverizing coal is provided, in accordance with an embodiment of the present invention is illustrated. As can be seen in FIG. 1, the beater mill assembly (1000) includes the beater wheel assembly (1010). The beater wheel assembly (1010) is arranged upstream of the beater mill assembly (1000) and comminutes the brown coal, as indicated by arrows in FIG.
20 1. The beater wheel assembly (1010) includes concentrically arranged and dynamic (100) and static (200) beater wheels to be rotatable along a rotational axis (120).

 Further, as seen in FIGS. 2A and 2B, side and front views of the dynamic beater wheel (100) of the beater mill assembly (1000) are depicted in accordance with an embodiment of the present invention. As seen, the dynamic beater wheel (100) includes a
25 plurality of beating arms (110) and a plurality of beater plates (10). The plurality of beating arms (110) may be arranged radially with respect to a rotational axis (120). Further, each beater plate of the plurality of beater plates (10) is detachably coupled to a respective beating arm of the plurality of beating arms (110) across outer portion, away from the rotational axis (120).

30 Referring now to FIG. 3, a side view of the plate (10) adapted to be configured on the dynamic beater wheel (100) is illustrated, in accordance with an embodiment of the present invention. In one embodiment of the present disclosure, the beater plate (10) may be of wear resistant material including Manganese Steel. However, without departing from the scope of the present disclosure, in other embodiments, the beater plate (10) may be of

wear resistant material including, but not limited to, High Chromium Cast Iron, Spheroidal Graphite Iron (SGI), and Carbon steel materials.

As shown in FIG. 3, the beater plate (10) may include a layer of hard-faced surface (12) and a layer of coating (14).

5 The beater plate (10) may include the layer of hard-faced surface (12) of a predetermined thickness range. The hard-faced surface (12) may be obtained by depositing weld material over the surface of the plate (10). For example, the surface of the plate (10) may be hard-faced by depositing weld material, such as solid core electrodes. Various welding processes or welding materials as available in the art may be used for such
10 deposition. Further, such deposition of the weld material may incorporate hard particles into the metal matrix of the beater plate (10), for example, up to around 50 wt% of the total deposition of the weld material, over the surface of the plate (10). In one embodiment, the predetermined thickness range of the layer of hard-faced surface (12) obtained by depositing weld material over the surface of the plate (10) may be about 4mm to about 10mm.
15 However, without departing from the scope of the present disclosure, the predetermined thickness range of the layer of hard-faced surface (12) may vary according to industrial requirement of the plate (10).

As described above, the obtained hard-faced surface (12) has hard particles deposited into the metal matrix of the plate (10) is up to around 50wt%. Such deposition
20 may provide wear resistance to the plate (10) during coal pulverization. However, hard particles incorporated into the metal matrix of the plate (10) being up to around 50wt% may prevent wear resistance of the plate (10) only up to certain extend, and therefore to further incorporate the hard particles, for more than 50wt%, the disclosure includes further embodiment.

25 In one of the preferred embodiment of the present disclosure, in order to further increase the efficacy of the plate (10) and prevent from the wear resistance to increase its operating life, there may be provided the layer of coating having hard particles that may be uniformly dispersed into the metal matrix of the beater plate (10), which may be more than 50wt% of the coating.

30 For doing so, in such embodiment, the plate (10) includes the layer of coating (14) disposed over the layer of hard-faced surface (12) up to a predetermined thickness range. In one embodiment, the layer of coating (14) is uniformly dispersed by a High Velocity Air-Fuel (HVOF) coating process. In one embodiment, HVOF coating process may be done using one of LPG, propane or propylene gases as fuel. The layer of coating includes hard

particles, which by the HVAF coating process, are incorporated into the metal matrix of the beater plate (10) for more than around 50 wt% of the total particles of the coating over the surface of the plate (10). For example, the hard particles, which by the HVAF coating process may be uniformly dispersed into the metal matrix of the beater plate (10) to be around 57wt% to 90wt% of the total particles of the coating over the surface of the plate (10). Due to such dispersion of the hard particles into the metal matrix of the plate (10), the wear resistance of the plate (10) may be drastically improved, thereby increasing the life of plate (10). In one embodiment, the predetermined thickness range of the layer of coating (14) including hard particles may be about 100 microns to about 5000 microns. Further, the hard particles thickness range may be about 100 nanometers to 30 microns. However, without departing from the scope of the present disclosure, the hard particles thickness range may vary according to industrial requirement of the plate (10).

In one embodiment, the hard particles in the layer of coating (14) is carbide including one of:

- a Tungsten carbide (WC) having 80 to 94 Wt% of the particles of coating,
- a Chromium carbide (CrC) having 50 to 93 wt% of the particles of coating,
- a Silicon carbide (SiC) having 50 to 93% wt% of the particles of coating,
- a Titanium carbide (TiC) having 50 to 94 wt% of the particles of coating,
- a Boron carbide (B₄C) having 50 to 95 wt% of the particles of coating.

In other embodiment, the hard particles in the layer of coating (14) may include one of: Borides (Fe, Cr, Ti, Mo, W), Nitrides (Al, Cr, Si, Ti, Ta), Oxides (Al, Cr, Hf, Zr, Ti), Boronitrides (BN), Silicon and Chrome oxynitrides.

In other embodiment, the coating content may also include Cobalt-chrome (CoCr), Cobalt (Co), Nickel-Chromium (NiCr), Nitronic 60, High Chromium (Cr) cast iron, bearing steel, such as EN31, IN625, IN718, IN706.

In further aspect of the present invention, a process of making beater plate (10) for a dynamic beater wheel (100) in a beater mill assembly (1000) for pulverizing coal is provided. The process includes: hardfacing a surface of the beater plate to obtain a layer of hard-faced surface (12) of a predetermined thickness range. Subsequent to hardfacing, coating a layer (14) comprising hard particles may be done. The layer of coating (14) may be disposed over the layer of hard-faced surface (12) up to a predetermined thickness range, as discussed above, and not repeated herein for the sake of brevity of the present disclosure. The hard particles are uniformly dispersed in a metal matrix of the beater plate (10), and in that the hard particles are having more than 50wt% of particles of the coating hardfacing.

In one embodiment, hardfacing the surface may include hardfacing electrodes having solid core electrodes designed to provide weld deposits capable of wear resistance.

In one embodiment, the layer of coating is uniformly dispersed by a High Velocity Air-Fuel (HVOF) coating process. In one embodiment, HVOF coating process may be done
5 using one of LPG, propane or propylene gases as a fuel.

In light of the foregoing the plate (10) and the beater mill assembly (1000) having the plate (10), provide various advantages and improvements over existing art. In particular, the present invention provides such a beater plate that may generally have elongated working cycle against severe wear because of the abrasive components of the brown coal.
10 The present invention further provides a beater plate that may have been improved in terms of its material constituents and includes various layers of suitable coatings to enhance the overall working cycle thereof. Advantageously, the beater plate of the present invention is improved and includes the layer of coating having hard particles, which by the HVOF coating process, are incorporated into the metal matrix of the beater plate for more than
15 around 50 wt% of the total particles of the coating over the surface of the plate. More specifically, the hard particles, which by the HVOF coating process may be uniformly dispersed into the metal matrix of the beater plate may be around 57wt% to 90wt% of the total particles of the coating over the surface of the plate. Due to such dispersion of the hard particles into the metal matrix of the plate, the wear resistance of the plate may be drastically
20 improved, thereby increasing the life of plate.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the present invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The
25 embodiments were chosen and described in order to best explain the principles of the present invention and its practical application, to thereby enable others skilled in the art to best utilize the present invention and various embodiments with various modifications as are suited to the particular use contemplated. It is understood that various omission and substitutions of equivalents are contemplated as circumstance may suggest or render
30 expedient, but such are intended to cover the application or implementation without departing from the spirit or scope of the claims of the present invention.

WE CLAIM:

1. A beater plate (10) for a dynamic beater wheel (100) in a beater mill assembly (1000) for pulverizing coal, the beater plate (10) comprising:

5 a layer of hard-faced surface (12) of a predetermined thickness range, wherein the layer of hard-faced surface (12) is obtained by hardfacing a surface of the beater plate receiving the coal,

a layer of coating (14) comprising hard particles, the layer of coating (14) disposed over the layer of hard-faced surface (12) up to a predetermined thickness range,

10 wherein the hard particles of the layer of the coating are uniformly dispersed in the metal matrix of the beater plate (10), and wherein the hard particles are having more than 50wt% of particles of the coating.

2. The beater plate (10) as claimed in claim 1, wherein beater plate (10) is of
15 wear resistant material including Manganese Steel.

3. The beater plate (10) as claimed in claim 1, wherein beater plate (10) is of wear resistant material including High Chromium Cast Iron, Spheroidal Graphite Iron (SGI), and Carbon steel materials.

20

4. The beater plate (10) as claimed in claim 1, wherein the predetermined thickness range of the layer of hard-faced surface (12) is about 4mm to about 10mm.

5. The beater plate (10) as claimed in claim 1, wherein the layer of hard-faced
25 surface (12) is obtained by a hardfacing electrodes having solid core electrodes designed to provide weld deposits capable of wear resistance.

6. The beater plate (10) as claimed in claim 1, wherein the layer of coating (14) is uniformly dispersed by a High Velocity Air-Fuel (HVOF) coating process.

30

7. The beater plate (10) as claimed in claim 6, wherein HVOF coating process is done using one of LPG, propane or propylene gases as a fuel.

8. The beater plate (10) as claimed in claim 1, wherein the predetermined thickness range of the layer of coating (14) comprising hard particles is about 100 microns to about 5000 microns.

5 9. The beater plate (10) as claimed in claim 1, wherein the hard particles thickness range is about 100 nanometers to 30 microns.

10. The beater plate (10) as claimed in claim 1, wherein the hard particles in the layer of coating (14) is carbide including one of:

- 10 a Tungsten carbide (WC) having 80 to 94 Wt% of the particles of the coating,
a Chromium carbide (CrC) having 50 to 93 wt% of the particles of the coating,
a Silicon carbide (SiC) having 50 to 93% wt% of the particles of the coating,
a Titanium carbide (TiC) having 50 to 94 wt% of the particles of the coating,
a Boron carbide (B₄C) having 50 to 95 wt% of the particles of the coating.

15

11. The beater plate (10) as claimed in claim 1, wherein the hard particles in the layer of coating (14) comprises one of:

- Borides (Fe, Cr, Ti, Mo, W),
Nitrides (Al, Cr, Si, Ti, Ta),
20 Oxides (Al, Cr, Hf, Zr, Ti),
Boronitrides (cBN),
Silicon and Chrome oxynitrides.

12. The beater plate (10) as claimed in claim 1, wherein the coating content
25 comprises Cobalt-chrome (CoCr), Cobalt (Co), Nickel-Chromium (NiCr), Nitronic 60, High Chromium (Cr) cast iron, bearing steel (EN31).

13. A process of making beater plate for a dynamic beater wheel in a beater mill assembly for pulverizing coal, the process comprising:

30 hardfacing a surface of the beater plate to obtain a layer of hard-faced surface of a predetermined thickness range;

coating a layer comprising hard particles, the layer of coating disposed over the layer of hard-faced surface up to a predetermined thickness range,

wherein the hard particles of the layer of the coating are uniformly dispersed in a metal matrix of the beater plate (10), and wherein the hard particles are having more than 50wt% of particles of the coating.

5 14. The process as claimed in claim 13, wherein hardfacing the surface comprising hardfacing electrodes having solid core electrodes designed to provide weld deposits capable of wear resistance.

10 15. The process as claimed in claim 13, wherein the layer of coating is uniformly dispersed by a High Velocity Air-Fuel (HVOF) coating process.

16. The process as claimed in claim 15, wherein HVOF coating process is done using one of LPG, propane or propylene gases as a fuel.

15 17. A dynamic beater wheel (100) in a beater mill assembly (1000) for pulverizing coal, the dynamic beater wheel (100) comprising:

a plurality of beating arms (110) arranged radially with respect to a rotational axis (120);

20 a plurality of beater plates (10), each beater plate of the plurality of beater plates detachably coupled to a respective beating arm of the plurality of beating arms (110) across outer portion, away from the rotational axis (120), the beater plate (10) having,

a layer of hard-faced surface (12) of a predetermined thickness range, wherein the layer of hard-faced surface (12) is obtained by hardfacing a surface of the beater plate receiving the coal,

25 a layer of coating (14) comprising hard particles, the layer of coating (14) disposed over the layer of hard-faced surface up to a predetermined thickness range,

wherein the hard particles of the layer of the coating are uniformly dispersed in a metal matrix of the beater plate (10), and wherein the hard particles are having more than 50wt% of particles of the coating.

30

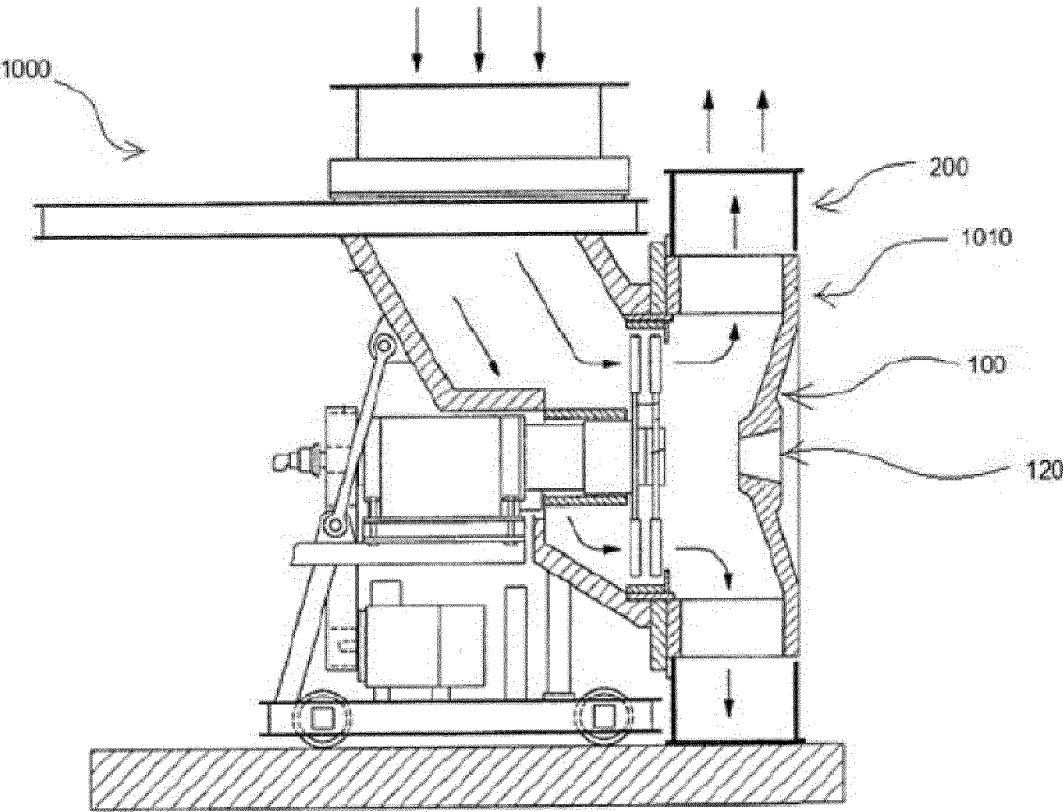


FIG. 1

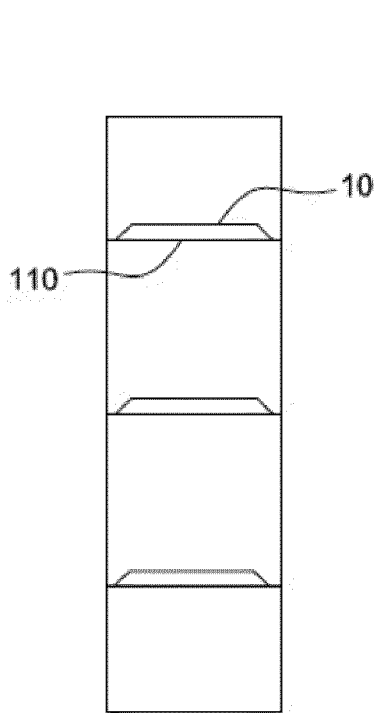


FIG. 2A

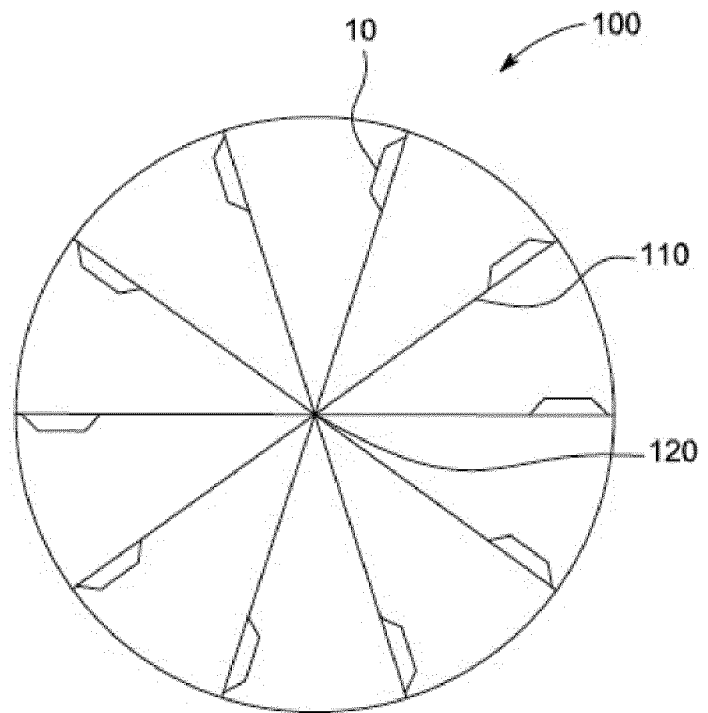


FIG. 2B

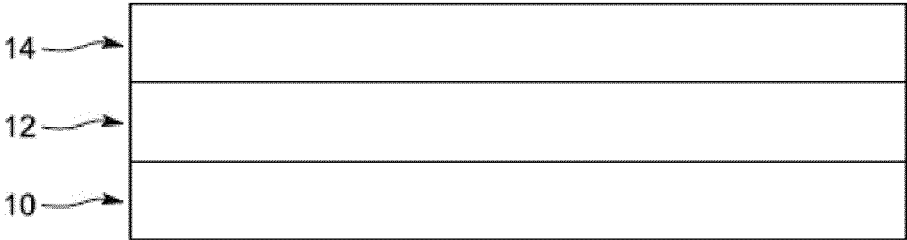


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/025256

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C28/00 B02C13/28 B02C13/13
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)
C23C B02C

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/34394 A1 (ALSTOM POWER BOILER GMBH [DE]) 2 May 2002 (2002-05-02)	1,4,13,17
Y	figures 4,5	1-3,5-17
X	DE 196 22 913 A1 (VERSCHLEIS TECHNIK DR ING HANS [DE]) 11 December 1997 (1997-12-11)	4
Y	figure 3	1,13,17
Y	US 3 766 354 A (BIERWITH S) 16 October 1973 (1973-10-16)	1-3,13,17
Y	figure IX	
Y	US 2010/276209 A1 (YONG ZHOU [US] ET AL) 4 November 2010 (2010-11-04)	1,6-13,15-17
	figures 6-9	
	-/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/025256

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2007/114313 A1 (KNOTTS BROOK H [US]) 24 May 2007 (2007-05-24) figure 1	1,5,14
Y	----- A. K. CHATTOPADHYAY ET AL: "Experimental investigation on induction brazing of diamond with Ni-Cr hardfacing alloy under argon atmosphere", JOURNAL OF MATERIAL SCIENCE, vol. 26, no. 18, 1 September 1991 (1991-09-01), pages 5093-5100, XP055736711, Dordrecht ISSN: 0022-2461, DOI: 10.1007/BF00549897 the whole document	1,5,14
Y	----- US 2010/323213 A1 (AITCHISON TREVOR [GB] ET AL) 23 December 2010 (2010-12-23) figures -----	1,5,14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2020/025256

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0234394	A1	02-05-2002	AU 1582502 A 06-05-2002
		DE 10053652 A1 16-05-2002	
		WO 0234394 A1 02-05-2002	

DE 19622913	A1	11-12-1997	NONE

US 3766354	A	16-10-1973	CA 978312 A 25-11-1975
		DE 2314362 A1 11-10-1973	
		FR 2177960 A1 09-11-1973	
		GB 1418412 A 17-12-1975	
		IT 981285 B 10-10-1974	
		JP S4914349 A 07-02-1974	
		JP S5240306 B2 11-10-1977	
		SE 385442 B 05-07-1976	
		SU 586826 A3 30-12-1977	
		US 3766354 A 16-10-1973	

US 2010276209	A1	04-11-2010	US 2010276209 A1 04-11-2010
		WO 2010129507 A2 11-11-2010	

US 2007114313	A1	24-05-2007	NONE

US 2010323213	A1	23-12-2010	CA 2678874 A1 19-12-2010
		CA 2830935 A1 19-12-2010	
		US 2010323213 A1 23-12-2010	
		US 2015283792 A1 08-10-2015	
		WO 2010147685 A1 23-12-2010	
