(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 899 488 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.07.2015 Bulletin 2015/31

(51) Int Cl.:
F28G 3/16 *(2006.01)* ***F28D 7/02*** *(2006.01)*
F28D 21/00 *(2006.01)*

(21) Application number: **14152924.8**

(22) Date of filing: **28.01.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Cheap Heat B.V.**
7586 BX Overdinkel (NL)

(72) Inventor: **Van der Voort, Eduard Thomas Jacobus**
7586 GW Overdinkel (NL)

(74) Representative: **'t Jong, Bastiaan Jacob**
Inaday Patent B.V.
Hengelosestraat 141
7521 AA Enschede (NL)

(54) Heat exchanger with cleaning device

(57) The invention relates to a heat exchanger for exchanging heat between a gas, such as flue gas, and a fluid comprising:
- a flue gas channel;
- a fluid conducting, coil shaped pipe arranged in the flue gas channel, wherein the axis of the coil shaped pipe extends, in use, substantially vertical and in gravitational direction; and
- spraying means arranged above the coil shaped pipe, which spraying means have at least one nozzle directed towards the coil shaped pipe to spray cleaning fluid on the coil shaped pipe.

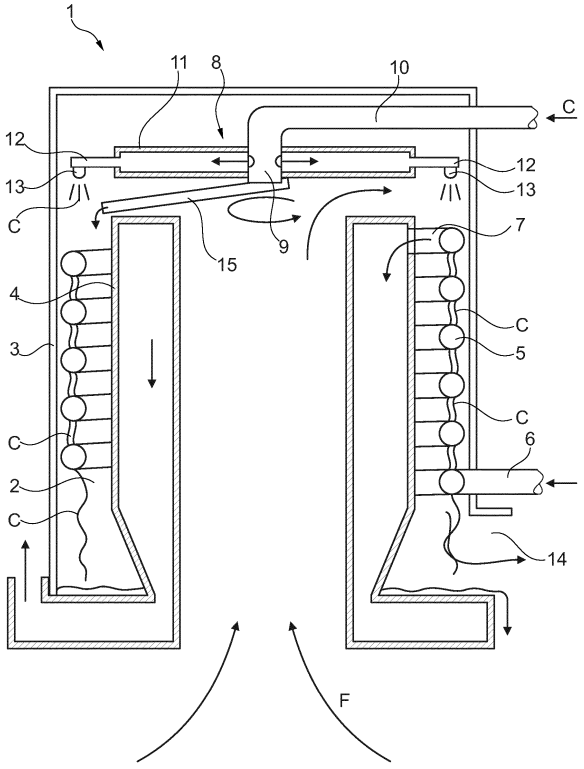

Fig. 1

EP 2 899 488 A1

Description

[0001] The invention relates to a heat exchanger for exchanging heat between a gas, such as flue gas, and a fluid comprising:

- a flue gas channel;
- a fluid conducting, coil shaped pipe arranged in the flue gas channel, wherein the axis of the coil shaped pipe extends, in use, substantially vertical and in gravitational direction.

[0002] Such a heat exchanger is for example known from US 4407237. This known heat exchanger has a coil shaped pipe arranged in a vertical, cylindrical flue gas channel. At the axial center of the coil shaped pipe, a tube is arranged, which is supplied with a cleaning fluid. The wall of the tube is provided with a plurality of openings such that cleaning fluid can be sprayed radially from the tube onto the coil shaped pipe. The tube is further driven to rotate around the axial axis, such that the spray of cleaning fluid evenly covers the coil shaped pipe.

[0003] Besides the complexity of the driven spray tube, this heat exchanger according to the prior art sprays in radial direction onto the coil shaped pipe. As a result, the dust and ash particles are sprayed from the coil shaped tube against the cylindrical wall of the heat exchanger, where the particles could again cake to the wall.

[0004] Furthermore a substantial amount of water is needed to clean the coil shaped pipe. The water only passes a single pipe and then is collected for the most part against the cylindrical wall.

[0005] Another disadvantage of the known heat exchanger is that the flue gases cannot be too hot, as otherwise the gearbox used to drive the spray tube will fail due to excessive heat.

[0006] Depending on the entry temperature of the fluid in the coil shaped pipe, condensation could occur on the coil shaped pipe. This condensation will take some of the ash and dust particles along. However, if the fluid needs to be heated to higer temperatures, for example above 60°C, then at least part of the coil shaped pipe will be at such a high temperature, that condensation no longer occurs. At this part of the heat exchanger, dust and ash particles will still accumulate on the coil shaped pipe.

[0007] It is an object of the invention to provide a heat exchanger in which the above mentioned disadvantage are reduced or even removed.

[0008] This object is achieved with a heat exchanger according to the preamble, which is characterized by spraying means arranged above the coil shaped pipe, which spraying means have at least one nozzle directed towards the coil shaped pipe to spray cleaning fluid on the coil shaped pipe.

[0009] The advantage of arranging the spraying means above the coil shaped pipe is that the water sprayed on top of the upper winding of the pipe will flow along all the other windings taking along the dust and ash particles. The water with the particles can then be collected at the bottom.

[0010] Another advantage is that the water will have the time during its way along the windings to effectively exchange heat with the flue gas and the fluid within the coil shaped pipe.

[0011] In an embodiment of the heat exchanger according to the invention the spraying means comprise an arm rotatably arranged around the axis of the coil shaped pipe and the at least one nozzle is arranged on the arm distal from the rotation point of the arm.

[0012] With the rotating arm, the cleaning fluid can be distributed over the circular top side of the coil shaped pipe.

[0013] Preferably, the arm is elongate and extends on both sides of the rotation point of the arm. This ensures that the arm is balanced with respect to the rotation point of the arm.

[0014] In a preferred embodiment of the heat exchanger according to the invention, the arm comprises an expansion chamber arranged near the rotation point of the arm and a conduit extending from the expansion chamber to the at least one nozzle.

[0015] The arm will be arranged within the flow of the flue gas, as the arm is arranged above the coil shaped pipe. As a result the arm will be heated to high temperatures. As soon as cleaning fluid, such as water, enters the arm, the water will be heated and steam will be generated. This steam will propel the water out of the at least one nozzle and will hit the upper winding of the coil shaped pipe at a substantial speed, to achieve a good cleaning action.

[0016] By having an expansion chamber within the arm, sufficient space is available for generation of steam.

[0017] Another embodiment of the heat exchanger according to the invention further comprises a cleaning fluid supply line and the arm is rotatably arranged around a free end of the cleaning fluid supply line.

[0018] When the arm is rotatably arranged around the free end of the cleaning fluid supply line, the supply line can be stationary, while with suitable sealing, the cleaning fluid can be provided to the arm.

[0019] Preferably, the cleaning fluid supply line comprises a valve for intermittently opening and closing the supply line. With the valve, the supply of cleaning fluid can be activated at certain periods, such that the coil shaped pipe is cleaned at regular intervals.

[0020] Yet another embodiment of the heat exchanger according to the invention further comprises a drain gutter arranged underneath the rotatable arm and at least extending underneath the rotation point of the arm.

[0021] Due to the high temperatures of the flue gas the arm will be heated considerably. This will require costly seals to ensure a liquid tight connection between a cleaning fluid supply line and the arm. If such a connection is not liquid tight, some of the fluid will enter the flue gas channel, where the fluid will be evaporated causing a reduction in the efficiency of the heat exchanger. The

dripping fluid could also cause a burner to get extinguished.

[0022] Now by arranging a drain gutter, any leaking fluid can be directed to a position within the heat exchanger, where the fluid can be beneficial. For example, the leaking fluid can directed to the top of the coil shaped pipe, such that the fluid can contribute to the cleaning action.

[0023] In still a further embodiment of the heat exchanger according to the invention the at least one nozzle has at least a direction component tangential to the rotation point of the arm.

[0024] When cleaning liquid is supplied to the arm and exits the arm via the at least one nozzle, the tangential direction component of the exiting cleaning fluid will ensure that the arm will rotate and causing the cleaning fluid to be distributed evenly of the coil shaped pipe.

[0025] In a further embodiment of the heat exchanger according to the invention the spraying means comprise a fluid supply line arranged above the coil shaped pipe and having a number of spaced apart nozzles in fluid connection with the fluid supply line.

[0026] Instead of a rotating arm, one could also provide a ring shaped fluid supply line above the coil shaped pipe with which a number of nozzles are provided with cleaning fluid.

[0027] Preferably, the flue gas channel comprises two concentric, cylindrical walls arranged around the coil shaped pipe.

[0028] These and other features of the invention will be elucidated in conjunction with the accompanying drawings.

Figure 1 shows a schematic cross-sectional view of a first embodiment of the heat exchanger according to the invention.

Figure 2 shows a variant of the embodiment of figure 1.

[0029] Figure 1 shows an embodiment of a heat exchanger 1 according to the invention. The heat exchanger 1 has a flue gas channel 2, which is bordered by an outer, cylindrical wall 3 and an inner cylindrical wall 4. The inner cylindrical wall 4 is hollow, such that a fluid, like water can be held in the hollow wall 4.

[0030] The heat exchanger 1 has further a coil shaped pipe 5 arranged in the flue gas channel 2. This coil shaped pipe 5 has an inlet opening 6, through which a fluid is supplied. The outlet opening 7 of the coil shaped pipe 5 is connected to the hollow inner wall 4.

[0031] When hot flue gases F enter the heat exchanger 1 axially along the inner wall 4, the gases F are guided to the top, where they enter the flue gas channel 2 and flow along the coil shaped pipe 5 to heat the fluid flowing through the coil. This heated fluid can for example be used for a boiler system or central heating system.

[0032] Above the coil shaped pipe 4, a rotating arm 8 is arranged. This arm 8 rotates around the free end 9 of a cleaning fluid supply line 10. The arm 8 has a central box-like part 11 and conduit parts 12 on which nozzles 13 are arranged. The box-like part 11 is heated by the flue gases F flowing past the arm 8 into the flue gas channel 2. When a cleaning fluid C is fed via the supply line 10 into the box-like part 11, the fluid C will evaporate and provide a pressure build, which will force part of the liquid fluid via the conduit parts out of the nozzles 13. The liquid fluid C is then sprayed on the top winding of the coil shaped pipe 5 to clean any build up dust and ash particles.

[0033] The cleaning fluid C will then flow along the subsequent windings of the coil shaped pipe 5 towards the bottom of the flue gas channel.

[0034] The cleaning fluid C together with the particles can then be collected at the outlet 14 of the flue gas channel 2. The cleaning fluid C can be filtered and then be reused, or the cleaning fluid C together with the particles can be drained. In the later case, it is of advantage to drain the fluid C in a pulsed manner, such that the particles do not have time to settle.

[0035] As the arm 8 is heated to high temperatures, it can be difficult to provide a liquid tight seal at the rotation point of the arm 8 around the free end 9 of the supply line 10. In order to avoid costly seals, a drain gutter 15 is arranged under the free end 9 and guides any leaked fluid towards the top of the coil shaped pipe 5.

[0036] Figure 2 shows a variant 20 of the embodiment of figure 1. The same features have been designated with the same reference signs.

[0037] Instead of a rotatable arm 8, as shown in the embodiment 1 of figure 1, a circular fluid supply line 21 is arranged above the coil shaped pipe 5. The supply line 21 is connected to the free end 9 of the cleaning fluid supply line 10. Along the length of the circular fluid supply line 21 a number of spaced apart nozzles 22 is arranged, such that cleaning fluid is sprayed over the circumference of the top side of the coil shaped pipe 5.

Claims

1. Heat exchanger for exchanging heat between a gas, such as flue gas, and a fluid comprising:

   - a flue gas channel;
   - a fluid conducting, coil shaped pipe arranged in the flue gas channel, wherein the axis of the coil shaped pipe extends, in use, substantially vertical and in gravitational direction;

   characterized by

   spraying means arranged above the coil shaped pipe, which spraying means have at least one nozzle directed towards the coil shaped pipe to spray cleaning fluid on the coil shaped pipe.

2. Heat exchanger according to claim 1, wherein the spraying means comprise an arm rotatably arranged

around the axis of the coil shaped pipe and wherein the at least one nozzle is arranged on the arm distal from the rotation point of the arm.

3. Heat exchanger according to claim 2, wherein the arm is elongate and extends on both sides of the rotation point of the arm.

4. Heat exchanger according to claim 2 or 3, wherein the arm comprises an expansion chamber arranged near the rotation point of the arm and a conduit extending from the expansion chamber to the at least one nozzle.

5. Heat exchanger according to any of the claims 2 - 4, further comprising a cleaning fluid supply line and wherein the arm is rotatably arranged around a free end of the cleaning fluid supply line.

6. Heat exchanger according to claim 5, wherein the cleaning fluid supply line comprises a valve for intermittently opening and closing the supply line.

7. Heat exchanger according to any of the claims 2 - 6, further comprising a drain gutter arranged underneath the rotatable arm and at least extending underneath the rotation point of the arm.

8. Heat exchanger according to any of the claims 2 - 7, wherein the at least one nozzle has at least a direction component tangential to the rotation point of the arm.

9. Heat exchanger according to claim 1, wherein the spraying means comprise a fluid supply line arranged above the coil shaped pipe and having a number of spaced apart nozzles in fluid connection with the fluid supply line.

10. Heat exchanger according to any of the preceding claims, wherein the flue gas channel comprises two concentric, cylindrical walls arranged around the coil shaped pipe.

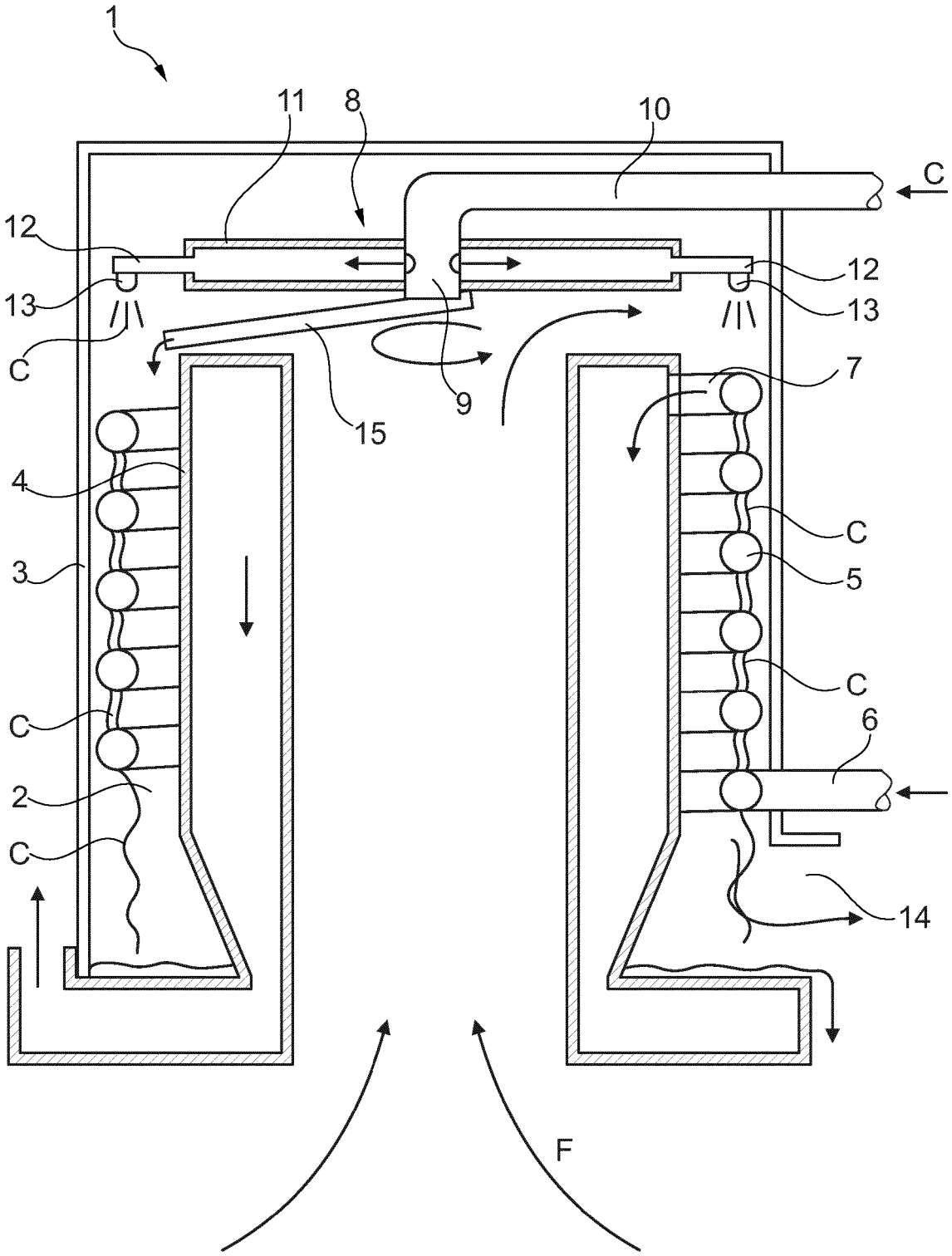

Fig. 1

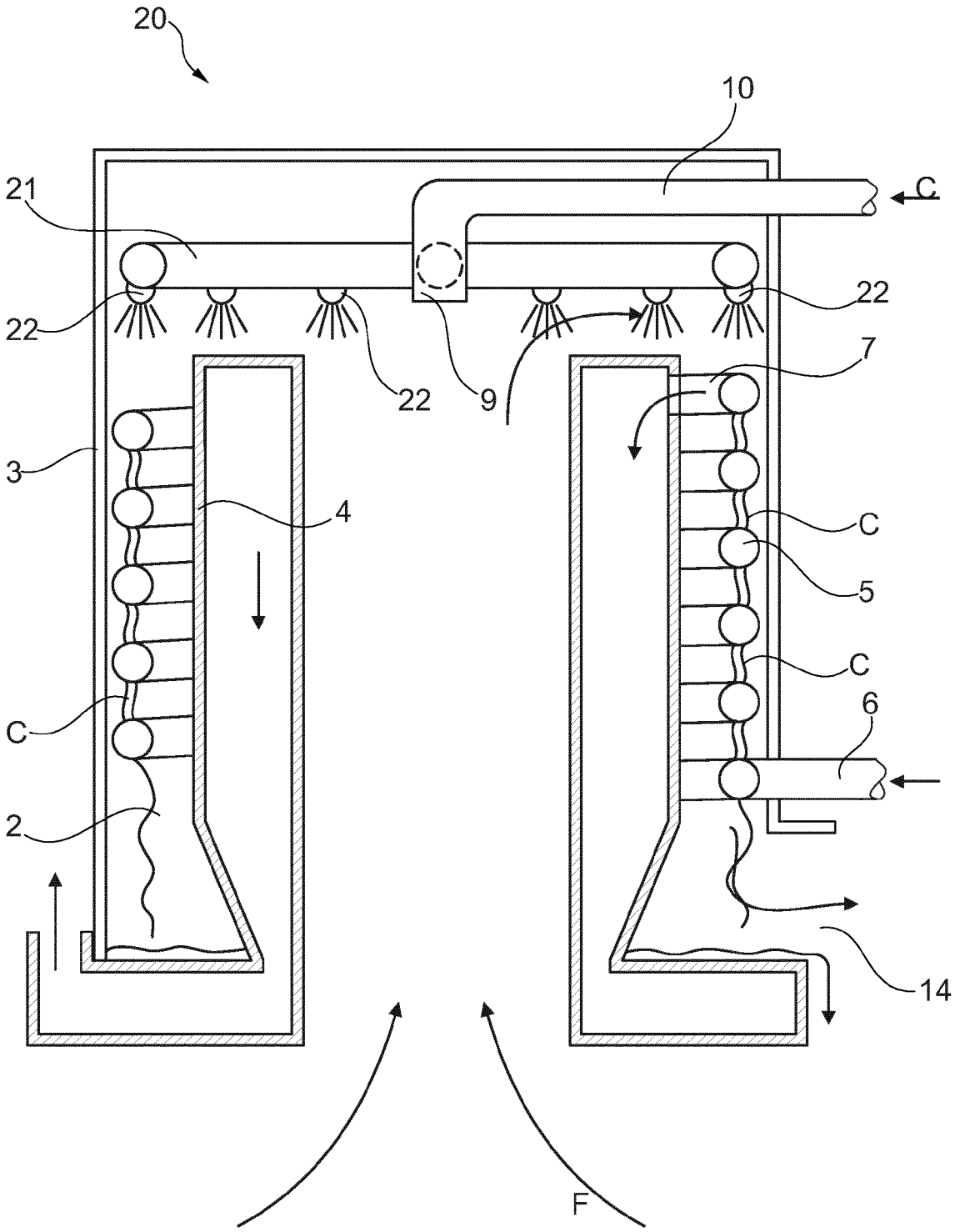

Fig. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 15 2924

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 1 729 567 A (COLLINS RICHARD J) 24 September 1929 (1929-09-24) * figures 2,4 *	1,2,4-7, 10 3,8,9	INV. F28G3/16 F28D7/02 F28D21/00
Y	WO 93/18362 A1 (KING COMPANY [US]) 16 September 1993 (1993-09-16) * figures 1,3,4 *	3,8,9	
A,D	US 4 407 237 A (MERRITT JR JOHN H [US]) 4 October 1983 (1983-10-04) * figure 3 *	1	
A	US 4 351 277 A (RYAN JERRY E ET AL) 28 September 1982 (1982-09-28) * figure 1 *	1,2	
A	DE 10 2007 006787 A1 (MEIKO MASCHINENBAU GMBH & CO [DE]) 14 August 2008 (2008-08-14) * figures 2-3 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
F28G
F28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 May 2014	Vassoille, Bruno

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 15 2924

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-05-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 1729567 A	24-09-1929	NONE	
WO 9318362 A1	16-09-1993	US 5279357 A	18-01-1994
		WO 9318362 A1	16-09-1993
US 4407237 A	04-10-1983	NONE	
US 4351277 A	28-09-1982	NONE	
DE 102007006787 A1	14-08-2008	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4407237 A **[0002]**