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Applicant: Valmet Technologies Oy
02150 Espoo (FI)
- (72)

Inventors:
• Hurri, Pekka
33900 Tampere (FI)
- Nickull, Jan
33900 Tampere (FI)
• Nieminen, Markku
33900 Tampere (FI)
• Kippola, Tero
33900 Tampere (FI)
• Koskelainen, Jukka
33900 Tampere (FI)
• Periviita, Antti
33900 Tampere (FI)
- (74)

Representative: Kolster Oy Ab
Salmisaarenaukio 1
P.O. Box 204
00181 Helsinki (FI)

(54)

METHOD AND ARRANGEMENT FOR RENOVATING BOILER

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In this connection renovating a boiler is disclosed. The boiler may be a recovery boiler or a fluidized bed boiler, for example. The boiler comprises a furnace, walls, a roof, and a water and steam system. The roof comprises tubes that are a part of the water and steam system of the boiler. For the renovation new roof panels with support brackets at their ends are provided. Old roof
- panels are removed, and the new roof panels are positioned in place. The new roof panels are supported by the support brackets. The new roof panels are used as scaffoldings during the renovation. The tubes of the new roof panels are connected to the water and steam system of the boiler to form a part of the water and steam system of the boiler.

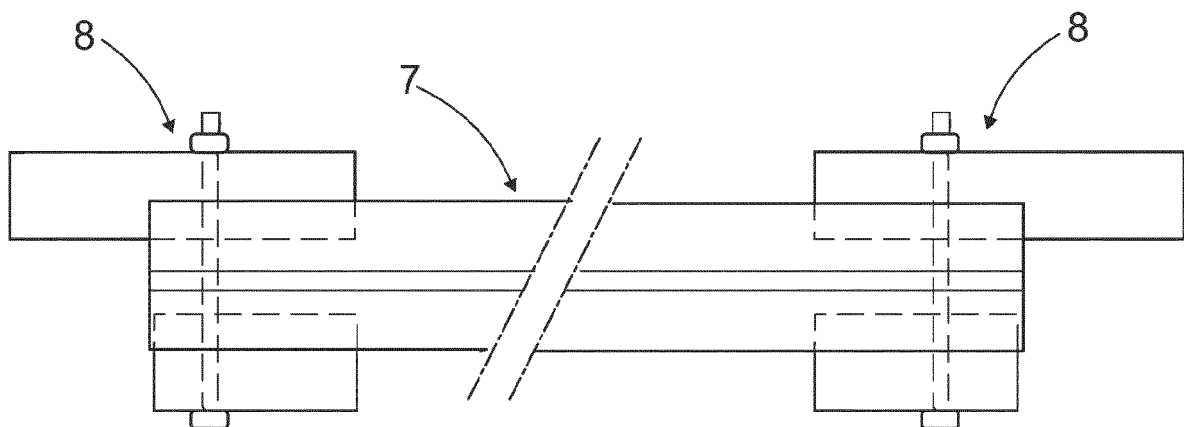


FIG. 3

Description

FIELD OF THE INVENTION

[0001] The invention relates to boilers such as recovery boilers or fluidized bed boilers, and particularly renovating such boilers.

[0002] Renovating a boiler is a demanding task. Typically, also, the renovation should be made in a tight time schedule.

BRIEF DESCRIPTION OF THE INVENTION

[0003] An object of the present invention is to provide a new method and arrangement for renovating a boiler. The invention is characterized by what is stated in the independent claims. Some embodiments of the invention are disclosed in the dependent claims.

[0004] In this connection renovating a boiler is disclosed. The boiler may be a recovery boiler or a fluidized bed boiler, for example. The boiler comprises a furnace, walls, a roof, and a water and steam system. The roof comprises tubes that are a part of the water and steam system of the boiler. For the renovation new roof panels with support brackets at their ends are provided. In this connection new roof panel means a roof panel that is after renovation positioned in place to replace an old roof panel. Old roof panel means a roof panel that has been in use in the boiler before renovation. Old roof panels are removed, and the new roof panels are positioned in place. The new roof panels are supported by the support brackets. The new roof panels are used as scaffoldings during the renovation. The tubes of the new roof panels are connected to the water and steam system of the boiler to form a part of the water and steam system of the boiler. The renovation is performed smoothly, reliably, and fast because the need for separate scaffoldings is reduced or in some cases even avoided. Furthermore, avoiding separate scaffoldings brings savings in material and transport, for example. Also, scaffolding work in the renovation is minimized. There is no need erect and alter temporary beams and planks which would take a lot of time.

[0005] According to an embodiment the new roof panels are used as scaffoldings during assembling of new superheaters. Thereby the erection of the superheaters and furnace roof may be executed simultaneously in a safe way.

[0006] According to an embodiment the support brackets are removed from the new roof panels after connecting the tubes of the new roof panels. Thereby the roof panels do not comprise extra parts when in use.

[0007] According to an embodiment the support brackets are detachable from the roof panel. Thereby the support brackets are easily removed from the roof panels.

[0008] According to an embodiment the support brackets comprise an upper part and a lower part, which upper part and lower part are preferably cylindrical parts, that

are positioned on opposite sides of the roof panel and connected by a bolt. Such roof panels are easily assembled, and they are reliably connected in the roof panels.

[0009] According to an embodiment the cylindrical upper part and lower part are pipes. Such a structure makes the support brackets light in weight and still firm and reliable in structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the following the invention will be described in greater detail by means of some embodiments with reference to the attached drawings, in which

Figure 1 schematically shows a side view of a recovery boiler;

Figure 2 schematically shows a top view of a roof panel;

Figure 3 schematically shows a side view of the roof panel of Figure 2;

Figure 4 schematically shows an end view of the roof panel of Figure 2;

Figure 5 schematically shows a side view of a bracket; and

Figure 6 schematically shows an end view of the bracket of Figure 5.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The method and the arrangement may be used in connection with a boiler that comprises a furnace, walls, a roof, and a water and steam system. The boiler may be a recovery boiler as disclosed in Figure 1, or a fluidized bed boiler such as a circulating fluidized bed (CFB) boiler or a bubbling fluidized bed (BFB) boiler, or any other suitable boiler, for example.

[0012] Figure 1 shows a recovery boiler 1. The recovery boiler 1 may be e.g. a soda recovery boiler, a black liquor recovery boiler, or a kraft recovery boiler.

[0013] The recovery boiler 1 comprises a furnace 2. Black liquor to be burnt is fed to the furnace 2. Also, combustion air is fed to the furnace 2.

[0014] The recovery boiler 1 also comprises walls 3 and a roof 4. The recovery boiler further comprises a water and steam system. The roof 4 comprises tubes that are a part of the water and steam system of the recovery boiler 1.

[0015] The recovery boiler 1 is also provided with superheaters 5. The superheaters 5 are elements formed by a plurality of parallelly located vertical tubes and provide parallelly in plural number in a transverse direction of the recovery boiler 1. The superheaters 5 contain steam flowing therein and heating up when the tubes are heated by hot flue gases from outside.

[0016] The roof 4 and the superheaters 5 are heat surfaces of the water and steam system of the recovery boiler 1. In the water and steam system water or steam or a mixture thereof is flowing. The water and steam system

may comprise also other heat surfaces such as screen tubes. The water and steam system may also comprise other components such as a drum or drums, supply headers, pipes and other tubes, for example. However, for the sake of clarity these other heat surfaces and other components are not shown in Figure 1.

[0017] The recovery boiler 1 also comprises a nose 6 that guides flow of the flue gases. Furthermore, the recovery boiler 1 may comprise boiler banks and economizers, for example. Also, a skilled person understands that the recovery boiler 1 may comprise also other parts or components which, however, are not shown in Figure 1 for the sake of clarity.

[0018] When there is a need for renovation for the boiler, first new roof panels are provided with support brackets at their ends. A roof panel 7 is shown in Figures 2, 3, and 4. The roof panel 7 comprises a plurality of parallel tubes 7a that extend from a first end of the panel 7 to the second end of the panel 7. The tubes 7a are connected to each other by plates or walls 7b. Thus two adjacent tubes 7a are connected by a wall 7b. The panel 7 in the Figures has four tubes 7a. The number of tubes 7a in the panel 7 may also be less than four or more than four.

[0019] The ends of the panel 7 are provided with brackets 8. In the embodiment disclosed in Figure 2 the panel 7 comprises two brackets 8 in both ends of the panel 7. One bracket 8 in each end of the panel 7 would be enough if the bracket is so wide that even one bracket prevents the panel 7 from turning or swinging. Each end of the panel 7 may also comprise more than two brackets 8.

[0020] In the renovation at least some of the old roof panels are removed. Thereby in the roof a gap is formed. The length of the tubes 7a of the new roof panel is shorter than the gap such that the new roof panels 7 fit to the gap. However, the brackets 8 extend beyond the ends of the panel 7 such that the length of the unit formed by the panel 7 and the brackets 8 is longer than the gap. The new roof panels are positioned in place in the gap. The new roof panels 7 are supported by the support brackets 8 above the gap. The length of the roof panel 7 may be from 2 to 8 meters, for example.

[0021] The new roof panels 7 and the brackets 8 are dimensioned such that they can be used as scaffoldings during the renovation. The dimensioning may be made such that the unit with the panel 7 and the brackets 8 sustain the weight of the panel 7 and at least two persons, for example. The new roof panels 7 may then be used as scaffoldings or as an assembling platform for performing service work or renovation.

[0022] After positioning in place of the new roof panels 7 the tubes 7a of the new roof panels 7 may at any phase of the renovation work be connected to the water and steam system of the boiler 1 to form a part of the water and steam system of the boiler. Thus, at first the new roof panels 7 may be used as scaffoldings without connecting the tubes 7a to the water and steam system of the boiler 1. The connecting may be made by welding, for example.

[0023] The new roof panels 7 may be used as scaffoldings during assembling of new superheaters 5. The superheaters 5 may comprise dozens of tubes that must be renewed. Assembling of new superheaters 5 may be performed also simultaneously with connecting the new roof panels 7. However, it could be beneficial to first assemble some of the superheaters 5 and only thereafter to connect the tubes 7a of the roof panels 7. However, performing different work phases at least partly simultaneously makes the renovation work efficient.

[0024] The support brackets 8 are removed from the new roof panels 7 after connecting the tubes 7a of the new roof panels 7. The brackets 8 may be lugs that are welded to the roof panels 7. The welding of the brackets 8 to the roof panels 7 must be made carefully such that the tubes 7a of the roof panel 7 are not harmed. Removing welded brackets 8 from the roof panel 7 requires breaking and harming the brackets 8. Therefore, preferably the support brackets 8 are detachable from the roof panel. A detachable support bracket 8 may be removed from the roof panel 7 without breaking or harming the roof bracket 8.

[0025] Figures 2 to 7 show detachable support brackets 8. The support bracket 8 comprises an upper part 9 and a lower part 10. The upper part 9 is positioned above the roof panel 7 and the lower part 10 is positioned below the roof panel 7. The lower part 10 and the upper part 9 are connected by a bolt 11. The bolt 11 may be secured to its place and the upper part 9 and the lower part 10 may be tightened by a nut 12. A nut is not necessary if the upper part 9 and possibly also the lower part 10 are provided with threads for the bolt 11.

[0026] A hole is formed to the wall 7b of the roof panel 7 and the bolt 11 is positioned through the panel 7 such that the bracket 8 is installed in place. The upper part 9 is longer than the lower part 10. Thereby, when the bracket 8 is installed in its place at the end of the roof panel 7 the lower part 10 does not extend beyond the end of the roof panel 7 but the upper part 9 extends beyond the end of the roof panel 7.

[0027] The upper part 9 and the lower part 10 may be cylindrical. Cylindrical parts accommodate very well to the tubes 7a of the roof panel 7. Thereby the bracket 8 may be attached firmly in connection with the roof panel 7.

[0028] The cylindrical parts may be made of a solid bar, for example. However, according to an embodiment the cylindrical parts may be pipes. When the cylindrical parts are pipes the support bracket can be made durable but simultaneously light in weight.

[0029] The diameter of the tubes 7a of the roof panel 7 may be from 40 to 80 mm, for example. The distance between adjacent tubes 7a of the roof panel 7 which is thus the width of the wall 7b of the roof panel 7 may be from 10 to 30 mm, for example. The thickness of the wall 7b of the roof panel 7 may be from 5 to 20 mm, for example.

[0030] The diameter of a cylindrical upper part 9 may be from 40 to 80 mm, for example. The diameter of a

cylindrical lower part 10 may be from 35 to 75 mm, for example. According to an embodiment the diameter of the upper part 9 may be equal to the diameter of the lower part 10. According to another embodiment the diameter of the upper part 9 may be larger than the diameter of the lower part 10. According to yet another embodiment the diameter of the upper part 9 may be smaller than the diameter of the lower part 10.

[0031] The upper part 9 of the bracket 8 that extends beyond the end of the roof panel 7 is subjected to bending forces. Therefore it is beneficial to form the diameter of the upper part 9 quite large. On the other hand, the lower part 10 of the bracket is at least mainly subjected to pressing force, only. Therefore the diameter of the lower part 10 need not be excessively large. A reasonably small diameter of the lower part 10 provides the effect that there is a useful amount of space under the roof panel 7 to perform welding of the tubes 7a of the roof panel 7 to the water and steam system of the boiler 1, for example. Therefore it is beneficial to dimension the upper part 9 and the lower part 10 such that the diameter of the upper part 9 is larger than the diameter of the lower part 10.

[0032] If the upper part 9 and/or the lower part 10 are formed of pipes the wall thickness of such pipe may be from 5 to 15 mm, for example. The diameter of the bolt may be from 5 to 20 mm, for example.

[0033] The length of the upper part 9 may be from 100 to 300 mm, for example. The length of the lower part 10 may be from 50 to 200 mm, for example.

[0034] It will be obvious to a person skilled in the art that, as technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A method of renovating a boiler, which boiler comprises a furnace, walls, a roof, and a water and steam system, the roof comprising tubes that are a part of the water and steam system of the boiler,

the method comprising
providing new roof panels with support brackets at their ends, removing old roof panels, positioning the new roof panels in place such that the new roof panels are supported by the support brackets,
using the new roof panels as scaffoldings during the renovation, and
connecting the tubes of the new roof panels to form a part of the water and steam system of the boiler.

2. A method as claimed in claim 1, wherein the boiler comprises superheaters and the new roof panels are

used as scaffoldings during assembling of new superheaters.

3. A method as claimed in claim 1 or 2, the method further comprising removing the support brackets from the new roof panels after connecting the tubes of the new roof panels.
4. A method as claimed in claim 3, wherein the support brackets are detachable from the roof panel.
5. A method as claimed in claim 4, wherein the support brackets comprise an upper part and a lower part that are positioned on opposite sides of the roof panel and connected by a bolt.
6. A method as claimed in claim 5, wherein the upper part and the lower part are cylindrical parts.
7. A method as claimed in claim 6, wherein the cylindrical upper part and lower part are pipes.
8. A method as claimed in claim 6 or 7, wherein the diameter of the upper part is larger than the diameter of the lower part.
9. A method as claimed in any one of the claims 5 to 8, wherein the upper part is longer than the lower part and the upper part is positioned to extend beyond the end of the roof panel and the lower part is positioned not to extend beyond the end of the roof panel.
10. An arrangement for renovating a boiler, which boiler comprises a furnace, walls, a roof, and a water and steam system, the roof comprising tubes that are a part of the water and steam system of the boiler,

the arrangement comprising
roof panels,
the roof panels comprising tubes that may form a part of the water and steam system of the boiler, and
support brackets,
which support brackets are positioned at the ends of the roof panels such that the roof panels may be positioned in place of a removed old roof panel such that the roof panels are supported by the support brackets, and the new roof panels are used as scaffoldings during the renovation.

11. An arrangement as claimed in claim 10, wherein the support brackets are detachable from the roof panel.
12. An arrangement as claimed in claim 11, wherein the support brackets comprise an upper part and a lower part that are positioned on opposite sides of the roof panel and connected by a bolt.

13. An arrangement as claimed in claim 12, wherein the upper part and the lower part are cylindrical parts.
14. An arrangement as claimed in claim 13, wherein the cylindrical upper part and lower part are pipes. 5
15. An arrangement as claimed in claim 13 or 14, wherein the diameter of the upper part is larger than the diameter of the lower part. 10
16. An arrangement as claimed in any one of the claims 12 to 15, wherein the upper part is longer than the lower part and the upper part extends beyond the end of the roof panel, but the lower part does not extend beyond the end of the roof panel. 15

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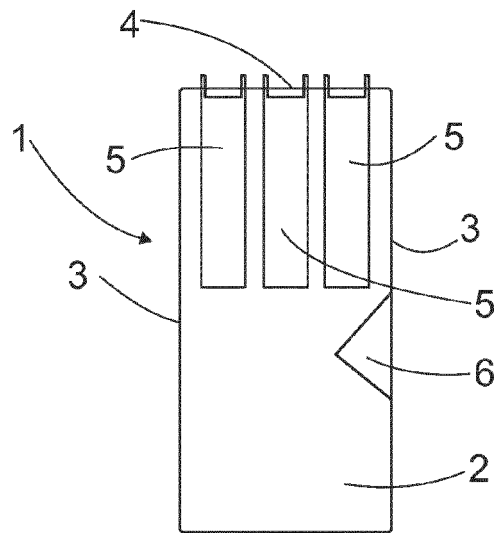


FIG. 1

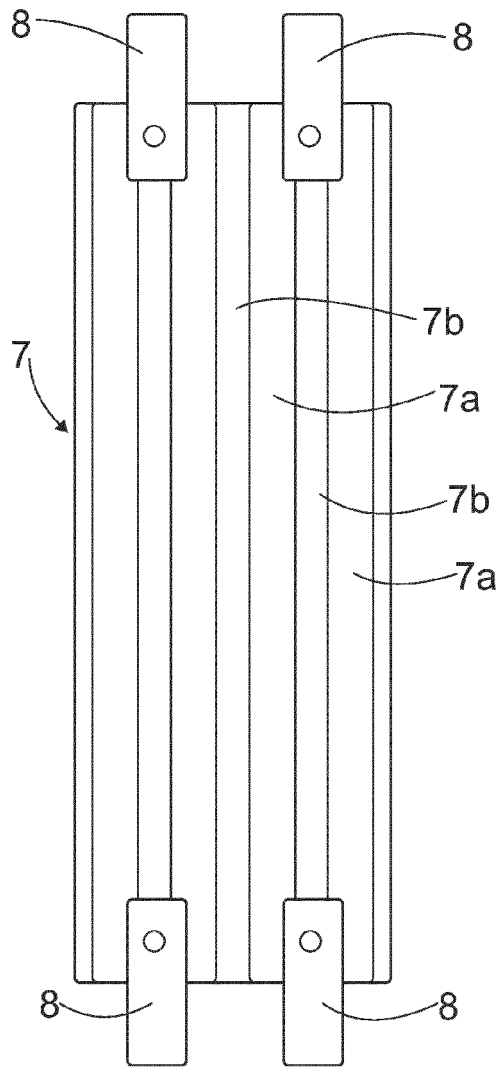


FIG. 2

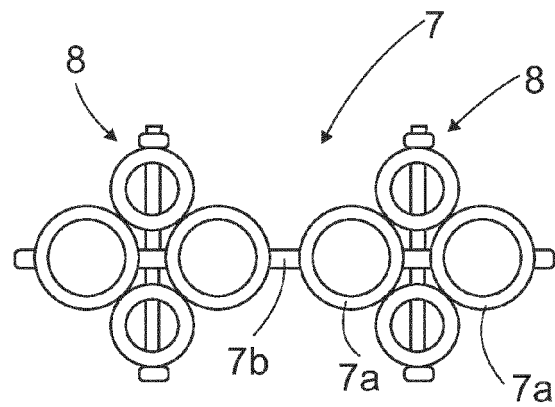


FIG. 4

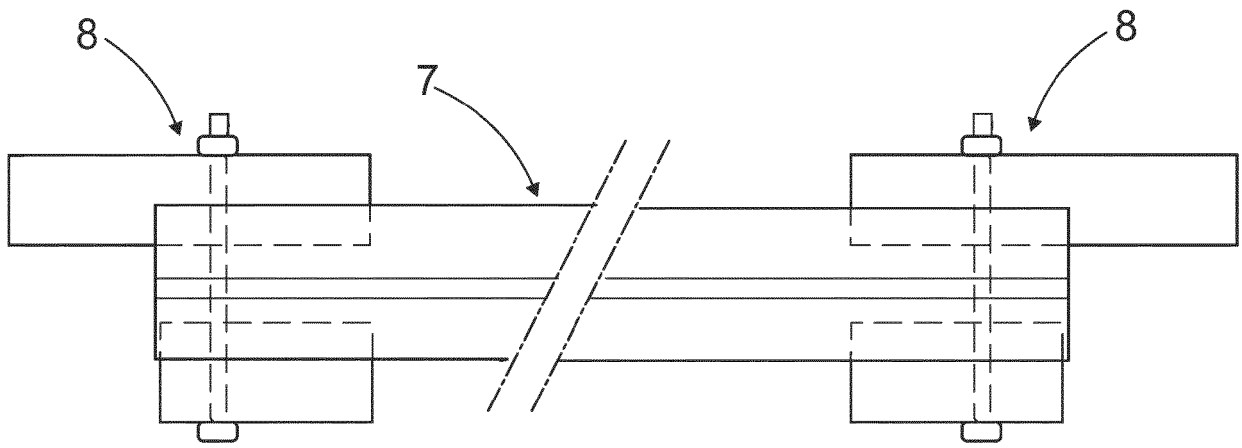


FIG. 3

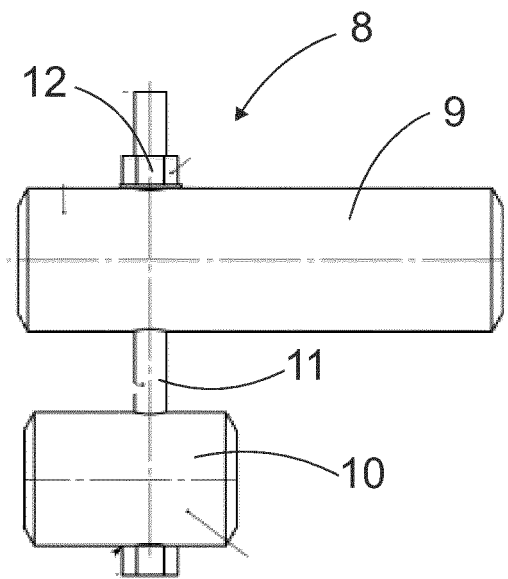


FIG. 5

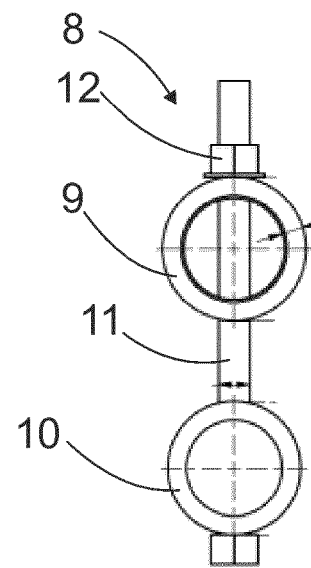


FIG. 6



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 3934

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 4 012 257 A1 (VALMET TECHNOLOGIES OY [FI]) 15 June 2022 (2022-06-15) * paragraph [0010] - paragraph [0092]; claims; figures * * abstract *	1-16	INV. F22B37/00 F22B37/10 F22B37/14 F22B37/20 F22B37/24 F28F9/013
A	US 5 343 978 A (VANAMBURG ROY R [US]) 6 September 1994 (1994-09-06) * column 3, line 23 - column 5, line 15; claims; figures * * abstract *	1-16	
A	DE 11 67 476 B (VER KESSELWERKE AG) 9 April 1964 (1964-04-09) * column 1, line 40 - column 2, line 48; claims; figures *	1-16	
A	US 4 474 143 A (WINCZE STEVEN P [US]) 2 October 1984 (1984-10-02) * column 1, line 51 - column 2, line 37; claims; figures * * abstract *	1-16	TECHNICAL FIELDS SEARCHED (IPC) F22B F28F
The present search report has been drawn up for all claims			

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EPO FORM 1503 03.82 (P04C01)

Place of search Munich	Date of completion of the search 25 April 2024	Examiner Zerf, Georges
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		

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 21 3934

5 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.

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