



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.03.2017 Bulletin 2017/11

(51) Int Cl.:
D06F 58/10 (2006.01) **D06F 58/20 (2006.01)**
D06F 58/02 (2006.01) **D06F 58/26 (2006.01)**

(21) Application number: **15382449.5**

(22) Date of filing: **14.09.2015**

(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
 Designated Validation States:
MA

(72) Inventor: **AGILAGA SADURNI, Romualdo, Sr.**
08552 Tarradell (ES)

(74) Representative: **Igartua, Ismael Galbaian S.Coop.**
Polo de Innovación Garaia
Goiru Kalea 1 - P.O. Box 213
20500 Arrasate-Mondragón (ES)

(71) Applicant: **Fagor, S. Coop.**
20500 Arrasate-Mondragon (ES)

(54) **LAUNDRY DRYING MACHINE**

(57) Laundry drying machine (1) comprising a cabinet (2) inside which a rotating drum (3) is arranged. The machine (1) also comprises a main air circuit through which a main airflow (F) coming from the outside circulates and is conditioned by a heating element (4) before being directed to the drum (3) so that it dries the clothes

contained in the drum (3), and at least one additional air circuit through which an additional airflow (f') also coming from the outside circulates. Said additional airflow (f') is directed to the drum (3) after circulating through the inside of the machine (1), so that said additional airflow (f') is mixed with the main airflow (F) in the drum (3).

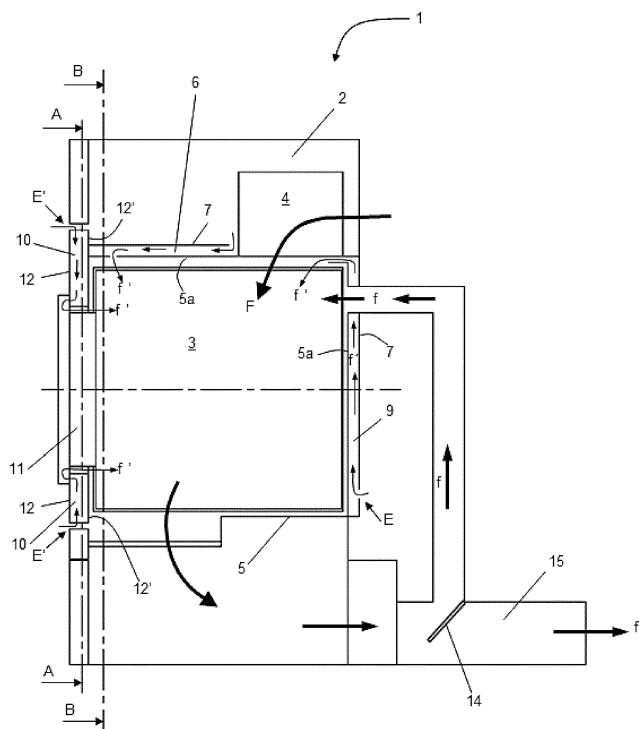


Fig. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to laundry drying machines, particularly to laundry dryers as such and with washing machines comprising drying functions.

PRIOR ART

[0002] A laundry dryer is a machine that has become indispensable in most households in recent years, so much so that the functions of a laundry dryer have also been incorporated in a conventional washing machine.

[0003] In general, a laundry dryer consists of passing a hot airflow through the drum to extract moisture from the clothes contained in said drum. There are generally two types of laundry dryers depending on the treatment performed on the air leaving the drum. In this sense there are, for example, condensation laundry dryers, also referred to as heat pump dryers, comprising a heat exchanger in which moisture contained in the airflow leaving the drum is condensed and extracted, and it is heated again to reintroduce said airflow into the drum. On the other hand, there are clothes dryers comprising a heating element for heating the airflow intended for circulating through the drum. The airflow at the outlet of the drum is discharged to the outside, although there are variants in which part of said leaving airflow is used, being reintroduced into the circuit.

[0004] US2012246962A1 describes a laundry dryer of the type comprising a heat pump. Said dryer comprises a cabinet inside which a rotating drum, containing the clothes to be dried, is arranged. A main airflow is circulated through the drum in a closed circuit going through the heat pump. The main airflow is cooled in an evaporator in said heat pump to condense and extract moisture from the air leaving the drum, and said main airflow is again heated in a compressor before redirect said airflow to the drum again. The dryer of US2012246962A1 also comprises an inlet port arranged on the surface of the cabinet allowing the entry of an additional airflow which is discharged through the lower part of the dryer. Said airflow discharges the heat generated in the inner devices of the dryer, such as in the heat pump, for example.

DISCLOSURE OF THE INVENTION

[0005] The object of the invention is to provide a laundry drying machine as defined in the claims.

[0006] The laundry drying machine of the invention comprises a cabinet inside which a rotating drum is arranged. The machine also comprises a main air circuit through which a main airflow coming from the outside circulates and is conditioned by a heating element before being directed to the drum so that it dries the clothes contained in the drum, and at least one additional air circuit through which an additional airflow also coming

from the outside circulates. Said additional airflow is directed to the drum after circulating through the inside of the machine, so that said additional airflow is mixed with the main airflow in the drum.

[0007] In the machine of the invention, by means of the additional airflow the residual heat generated by the machine itself is used, on one hand, for drying the clothes contained in the drum, thereby contributing to energy savings of the machine, and the inside of the machine is cooled, on the other hand, preventing the outer walls of the drying machine from reaching high temperatures, being able to dispense with thermal insulators or, where appropriate, being able to use thermal insulators that are less thick and/or have lower insulation properties.

[0008] These and other advantages and features of the invention will become evident in view of the drawings and the detailed description of the invention.

DESCRIPTION OF THE DRAWINGS

[0009]

Figure 1 shows a first sectioned side view of a schematic depiction of the laundry drying machine according to one embodiment of the invention.

Figure 1A shows a first detail of the machine of Figure 1.

Figure 1B shows a second detail of the machine of Figure 1.

Figure 2 shows a first sectioned front view according to section B-B of the machine of Figure 1.

Figure 3 shows a second sectioned front view according to section A-A of the machine of Figure 1.

Figure 4 shows a sectioned side view according to section C-C of the machine of Figure 3.

DETAILED DISCLOSURE OF THE INVENTION

[0010] The laundry drying machine 1 according to one embodiment of the invention comprises a cabinet 2 inside which a rotating drum 3 containing the clothes to be dried is arranged. The machine 1 also comprises a main air circuit through which a main airflow F coming from the outside circulates and is conditioned by a heating element 4 which increases the temperature of said airflow F before being directed to the drum 3 for drying the clothes. The heating element 4 can comprise at least one resistor, a gas burner or a battery powered by vapor or thermal oil.

[0011] The machine 1 also comprises at least one additional air circuit through which an additional airflow f' also coming from the outside circulates. Said additional airflow f' is directed to the drum 3 after circulating through

the inside of the machine 1, so that said additional airflow f' is mixed with the main airflow F in the drum 3, as shown in the schematic depiction of Figure 1.

[0012] The additional airflow f' is conditioned, i.e., heated, by the heat accumulated inside the machine 1, and not by the heating element 4 directly.

[0013] In the drying machines known in the state of the art, heat accumulated inside the machine is transported either by conduction or convection to the outer walls of the machine, said walls reaching a high temperature, i.e., a temperature that can cause burns on or discomfort for the user. To prevent the user from getting burned or to prevent the surrounding apparatus from heating up, it is common to introduce a thermal insulator in the cabinet, which naturally increases the cost of the drying machine.

[0014] In the machine 1 of the invention, however, by means of the additional airflow f' coming from the outside, the inside of the machine 1 is cooled, on one hand, preventing the outer walls of the machine 1 from reaching high temperatures without having to use the thermal insulators used in the drying machines of the state of the art, and the residual heat generated by the machine 1 itself is used, on the other hand, for drying the clothes contained in the drum 3, thereby contributing to the energy savings of the machine 1.

[0015] The additional airflow f' coming from the outside, i.e., airflow at room temperature, absorbs at least part of the heat accumulated inside the cabin 2, whereby preventing the outer walls of the machine 1 from heating up, and is directed to the drum 3 for being mixed with the main airflow F , increasing the efficiency of the machine 1.

[0016] In the preferred embodiment of the invention, the machine 1 also comprises a recirculation circuit through which a recirculated airflow f , i.e., at least part of the main airflow F leaving the drum 3 and returning again to the drum 3, circulates, said recirculated airflow f also being mixed with the main airflow F in the drum 3, as schematically shown in Figure 1.

[0017] A gate 14 arranged at the outlet of the drum 3 in a discharge conduit 15 manages the amount of air f to be recirculated, allowing the passage of more, less or zero amount of air f , depending on the moisture and/or other parameters of the airflow leaving the drum 3.

[0018] The machine 1 according to the preferred embodiment of the invention also comprises a housing 5 surrounding the drum 3 and inside which said drum 3 is housed. In a washing machine, said housing 5 would resemble a tub, which is preferably cylindrical, but which in a laundry dryer as such does not have to be cylindrical.

[0019] The additional air circuit of the invention comprises at least one chamber 6 which is delimited by at least part of the outer wall 5a of the housing 5 and a surrounding wall 7 surrounding at least part of said outer wall 5a, as seen in Figure 1 and in more detail in Figure 1A.

[0020] In the embodiment of the invention shown in the drawings, said chamber 6 comprises at least one inlet conduit E arranged in the surrounding wall 7, as shown

in Figure 1A, to allow the entry of the additional airflow f' from the outside, and at least one outlet conduit S arranged in the outer wall 5a of the housing 5 to allow the passage of said additional airflow f' to the drum 3. In the preferred embodiment of the invention, the chamber 6 comprises an inlet conduit E and an outlet conduit S although the chamber 6 being able to comprise several inlet conduits and several outlet conduits, or the inlet conduit E having an elongated shape, extending along said outer wall 5a or transversely thereto, is not ruled out.

[0021] In the preferred embodiment of the invention, the chamber 6 is arranged in the upper part of the drum 3, preferably close to the heating element 4, and extends along the drum 3, as seen in Figure 1. The additional airflow f' coming from the outside at room temperature is considered "cold air" and absorbs during the passage thereof the heat accumulated inside the machine 1, mainly due to the heat given off by the heating element 4 and by the passage of the conditioned main airflow F , and it is directed to the drum 3 through the outlet conduit S for being mixed with the main airflow F . The side walls of the machine 1 are thereby prevented from heating up, since the additional airflow f' acts as a thermal insulator. However, said residual heat is used at the same time for drying the clothes contained in the drum 3 such that the performance of the machine 1 is optimized, contributing to energy savings.

[0022] In the preferred embodiment of the invention, as indicated, one of the walls of the chamber 6 is formed by the outer wall 5a of the housing 5, and the other wall is the surrounding wall 7 which surrounds at least part of said outer wall 5a, as seen in Figure 1A.

[0023] The walls of the drum 3 comprise a plurality of holes (not shown in the drawings) to allow air to circulate through the inside thereof.

[0024] In the preferred embodiment of the invention, the additional air circuit also comprises two lateral chambers 8 and 8'. Each chamber 8 and 8' is arranged on one side of the drum 3, as seen in Figure 2, and like in the first chamber 6 described, they also extend along the drum 3. In this case, the outlet conduit S also extends along the drum 3, as seen in Figure 4.

[0025] In the preferred embodiment of the invention, the first chamber 6 described is arranged in the upper part of the drum 3, preferably between the two lateral chambers 8 and 8', as shown in Figure 2.

[0026] According to the preferred embodiment of the invention, the additional air circuit also comprises a rear chamber 9 arranged in the rear part of the drum 3, as shown in the drawings 1 and 4. In the preferred embodiment of the invention, said rear chamber 9 is rectangular although it could also be circular or the like.

[0027] Like in the first chamber 6 that has been described, all the chambers described up until now are delimited by a wall coinciding with at least part of the outer wall 5a of the housing 5 and a surrounding wall 7 surrounding said part of the outer wall 5a, as shown in the drawings. The dimensions of said chambers are such

that they cover the largest possible part of outer wall 5a of the housing 5.

[0028] The inlet conduits E of the lateral chambers 8 and 8' and/or of the rear chamber 9 are arranged close to the lower part of the drum 3 and the corresponding outlet conduits S are arranged close to the upper part of the drum 3, as seen in Figures 1, 2 and 4. The corresponding additional airflow f' entering at room temperature through the lower part thereby absorbs the residual heat from inside the machine 1 as it moves upward and enters the drum 3 through the upper part, being mixed with the main airflow F, as schematically shown in Figures 1, 2 and 4. The corresponding additional airflow f' is thereby prevented from mixing with the airflow leaving the drum 3, preventing the corresponding additional flow f' from being able to be discharged without the residual heat from inside the machine 1 having been absorbed.

[0029] So in the preferred embodiment of the invention the chamber 6 arranged in the upper part of the drum 3 prevents the upper wall of the cabinet 2 from reaching high temperature values, the lateral chambers 8 and 8' prevent the side walls of the cabinet 2 from reaching high temperature values and the rear chamber 9 prevents the rear wall of the cabinet 2 from reaching high temperature values.

[0030] To prevent the front wall of the machine 1 from reaching high temperature values, the additional air conduit of the preferred embodiment of the invention comprises a front chamber 10 arranged in the front part of the cabinet 2, as shown in Figures 1, 1B and 4.

[0031] Said front chamber 10 is delimited by at least part of the outer wall 12 of the front part of the cabinet 2 and a surrounding wall 12' which surrounds at least part of said outer wall 12 and which is arranged inside the machine 1, as seen in Figure 1B.

[0032] The door 11 for accessing the drum 3 is arranged in the front part of the machine 1, as seen in Figures 1, 1B and 4. In the preferred embodiment of the invention, said door 11 is of the type comprising a porthole and at least one hinge on one side (not shown in the drawings) which allows opening and closing the door 11 by pivoting about said hinge. The door 11 comprises a protuberance, i.e., the porthole, preferably cylindrical, which projects towards the inside of the drum 3 and which is housed in an opening 16, preferably cylindrical-shaped, arranged in the front part of the cabinet 2 when the door 11 is closed. The door 11 also comprises an area having a larger diameter than the protuberance, cooperating with the outer wall 12 of the front part of the cabinet 2, providing a closure area 11 a, as shown in Figure 1B.

[0033] The front chamber 10 of the invention comprises at least one inlet conduit E' arranged in the outer wall 12 of the front part of the cabinet 2 but located outside said closure area 11 a to allow the entry of the corresponding additional airflow f', and at least one outlet conduit S' arranged also in said outer wall 12 but inside the closure area 11a. In the preferred embodiment of the

invention as shown in Figure 3, the outlet conduit S' is ring-shaped and surrounds the opening 16 in which the protuberance of the door 11 is housed, said additional airflow f' entering through the gap existing between the protuberance of the door 11 and the opening 16 of the front wall 12. In another embodiment of the invention not shown in the drawings, said additional airflow f' could be directly directed to the drum 3 if the outlet conduit S' were comprised in the surrounding wall 12'.

[0034] In the preferred embodiment of the invention, the front chamber 10 comprises two inlet conduits E', one arranged above the drum 3 and another below same, as shown in Figures 1 and 1B. Said inlet conduits E' are in the form of a groove and each conduit E' preferably extends along said front wall 12, as shown in Figure 3. To enhance understanding, said Figure 3 shows by means of arrows the flow direction of the air f' entering through the inlet conduits E' and leaving through the ring-shaped outlet conduit S'.

[0035] In the preferred embodiment of the invention, at least two of the chambers that have been described are communicated, i.e., the additional flows f' circulating through said chambers are mixed before entering the drum 3. Therefore, both lateral chambers 8 and 8', or even just one of them, for example, are communicated with the rear chamber 9, as seen in Figures 2 and 43, such that lateral flows f' can be mixed with flow f' coming from the rear chamber 9 before being directed to the drum 3.

[0036] However, in a variant of the invention all the chambers that have been described, i.e., chamber 6, lateral chambers 8 and 8', rear chamber 9 and front chamber 10, are independent from one another, i.e., the additional flows f' circulating through said chambers are not mixed outside the drum 3.

[0037] The machine 1 according to the invention also comprises at least one fan 13 arranged in the lower area of the cabinet 2, preferably at the outlet of the drum 3, to force the main airflow F.

[0038] In the preferred embodiment of the invention said fan 13 also forces the corresponding additional airflows f', and is even suitable for forcing the recirculated airflow f. Therefore, one fan 13 alone is capable of forcing all the airflows which must be circulated through the inside of the machine 1, i.e., the main airflow F, the recirculated airflow f and the corresponding additional airflows f'.

[0039] Although what has been described up until now refers to a laundry drying machine as such, it is also valid for washing machines comprising drying functions, or any other machine comprising drying functions.

Claims

1. Laundry drying machine comprising a cabinet (2) inside which a rotating drum (3) is arranged, a main air circuit through which circulates a main airflow (F)

- coming from the outside, which after being conditioned by a heating element (4) is directed to the drum (3) for drying the clothes, and at least one additional air circuit through which an additional airflow (f') also coming from the outside circulates, **characterized in that** said additional airflow (f') is directed to the drum (3) after circulating through the inside of the machine (1), said additional airflow (f') being mixed with the main airflow (F) in the drum (3).
2. Laundry drying machine according to claim 1, also comprising a recirculation circuit through which a recirculated airflow (f) circulates wherein at least part of the main airflow (F) leaving the drum (3) returns again to the drum (3) also mixing with the main airflow (F).
 3. Laundry drying machine according to claim 1 or 2, comprising a housing (5) inside which the drum (3) is housed, the additional air circuit comprising at least one chamber (6) delimited by at least part of the outer wall (5a) of said housing (5) and a surrounding wall (7) surrounding at least part of said outer wall (5a).
 4. Laundry drying machine according to claim 3, wherein the chamber (6) comprises at least one inlet conduit (E) arranged in the surrounding wall (7) to allow the entry of the airflow (f) coming from the outside, and at least one outlet conduit (S) arranged in the outer wall (5a) of the housing (5) to allow the passage of said airflow (f) to the drum (3), said chamber (6) being arranged in the upper part of the drum (3).
 5. Laundry drying machine according to claim 4, wherein the additional air circuit comprises two additional lateral chambers (8, 8'), each chamber (8, 8') being arranged on one side of the drum (3) such that they extend along the lateral contour of said drum (3), the other chamber (6) being arranged between said two lateral chambers (8, 8').
 6. Laundry drying machine according to claim 5, wherein the additional air circuit also comprises a rear chamber (9) arranged in the rear part of the drum (3).
 7. Laundry drying machine according to claim 6, wherein the inlet conduits (E) of the lateral chambers (8, 8') and/or of the rear chamber (9) are arranged close to the lower part of the drum (3), and the corresponding outlet conduits (S) are arranged close to the upper part of the drum (3).
 8. Laundry drying machine according to any of claims 3 to 7, wherein the additional air circuit also comprises a front chamber (10) arranged in the front part of the drum (3).
 9. Laundry drying machine according to claim 8, wherein the front chamber (10) comprises at least one inlet conduit (E') arranged outside the closure area (11 a) of the door (11) to allow the entry of the corresponding additional airflow (f') coming from the outside.
 10. Laundry drying machine according to claim 9, wherein the front chamber (10) comprises at least one outlet conduit (S') arranged inside the closure area (11 a) of the door (11) to allow the passage of said airflow (f') to the drum (3).
 11. Laundry drying machine according to any of claims 3 to 10, wherein all the chambers of the additional air circuit are independent.
 12. Laundry drying machine according to any of claims 3 to 10, wherein at least two chambers of the additional air circuit are communicated with one another.
 13. Laundry drying machine according to any of the preceding claims, comprising at least one fan (13) to force the main airflow (F) and the corresponding additional airflow (f).
 14. Laundry drying machine according to claim 13, wherein said fan (13) is also suitable for forcing the recirculated airflow (f).
 15. Laundry drying machine according to claim 13 or 14, wherein said fan (13) is arranged in the lower area of the cabinet (2), preferably at the outlet of the drum (3).

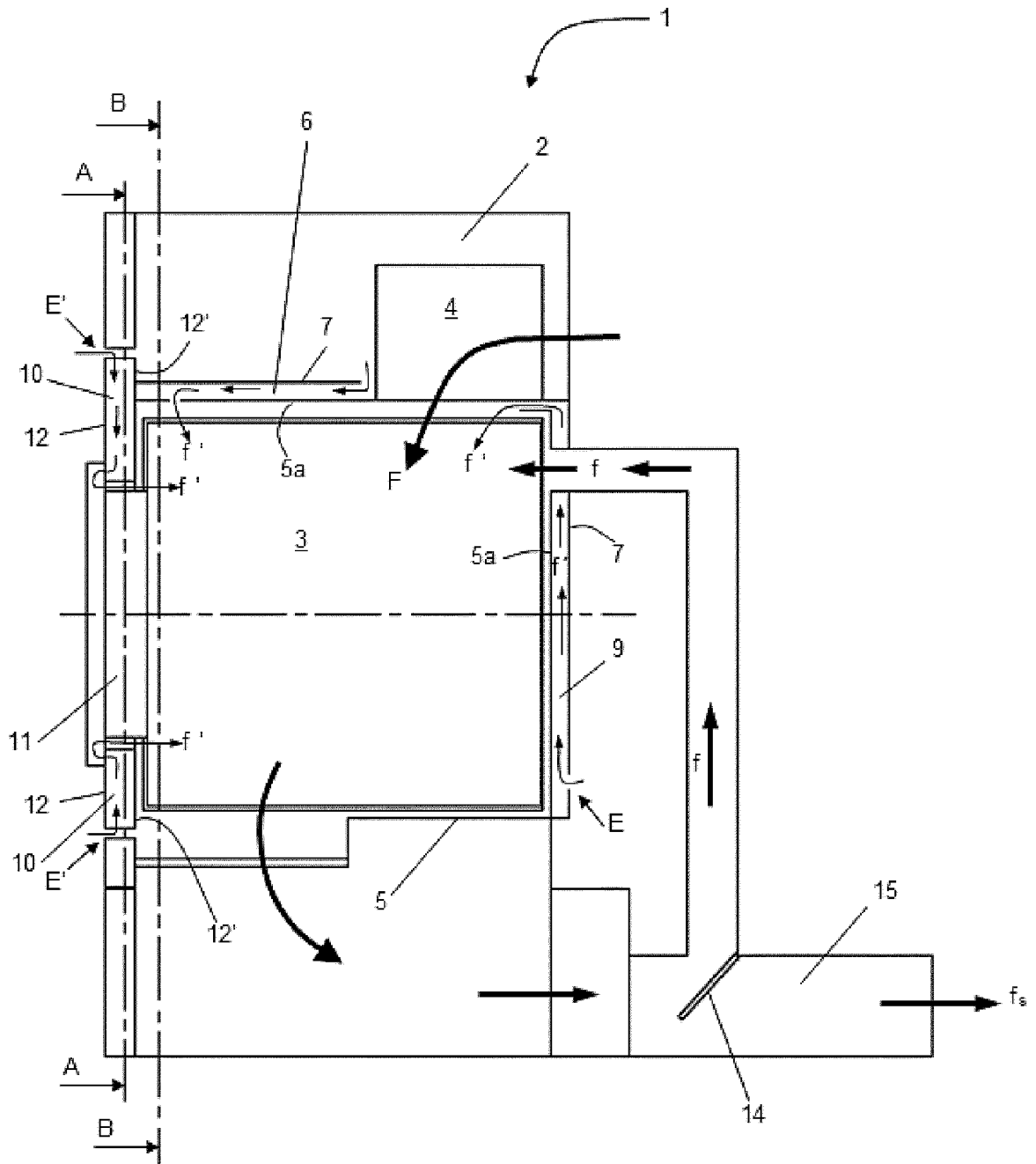


Fig.1

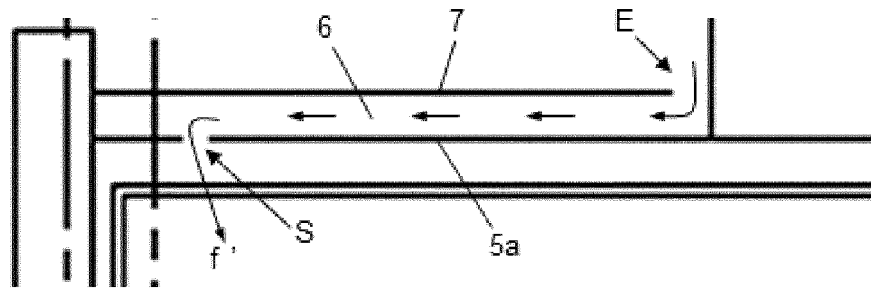


Fig.1A

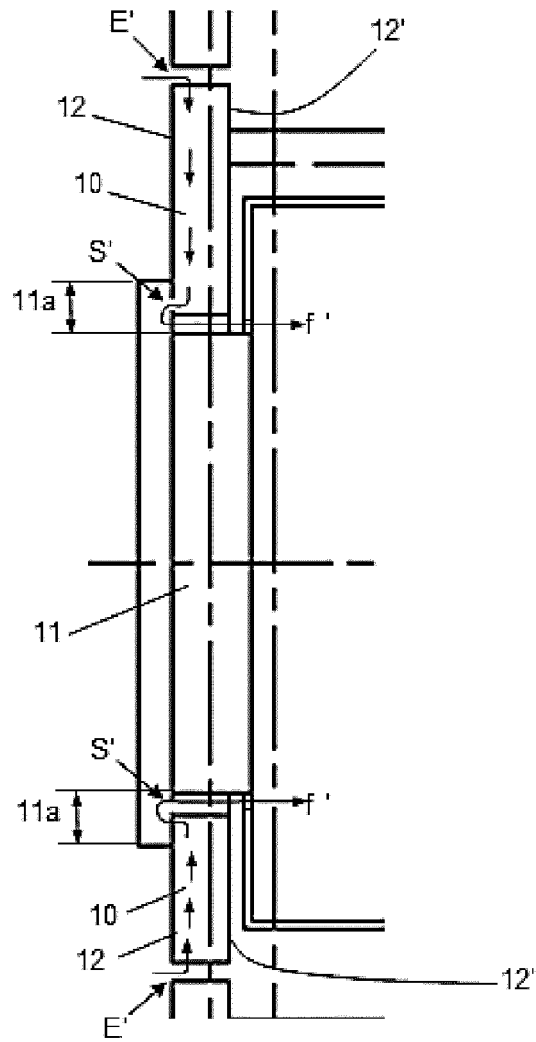


Fig.1B

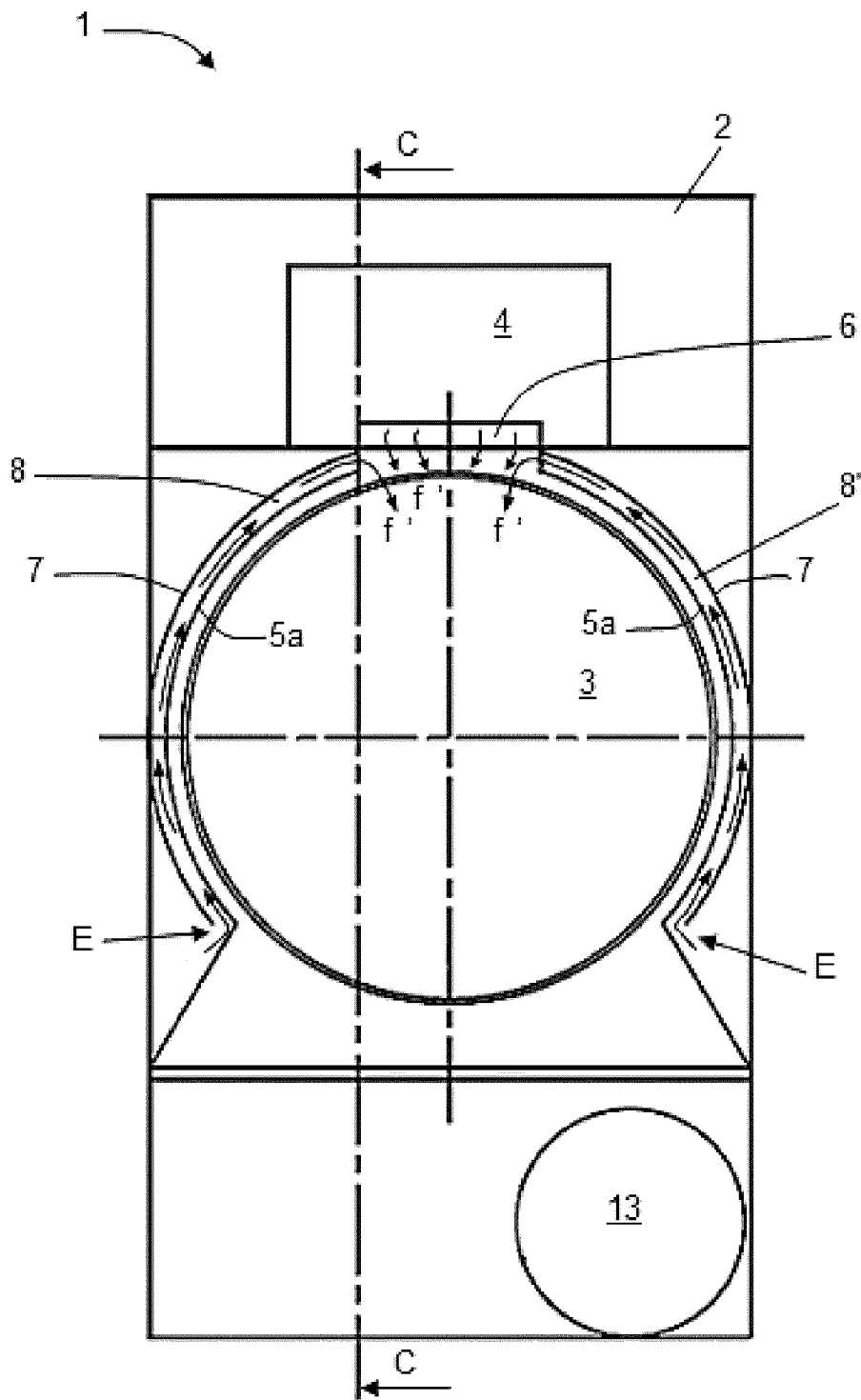


Fig.2

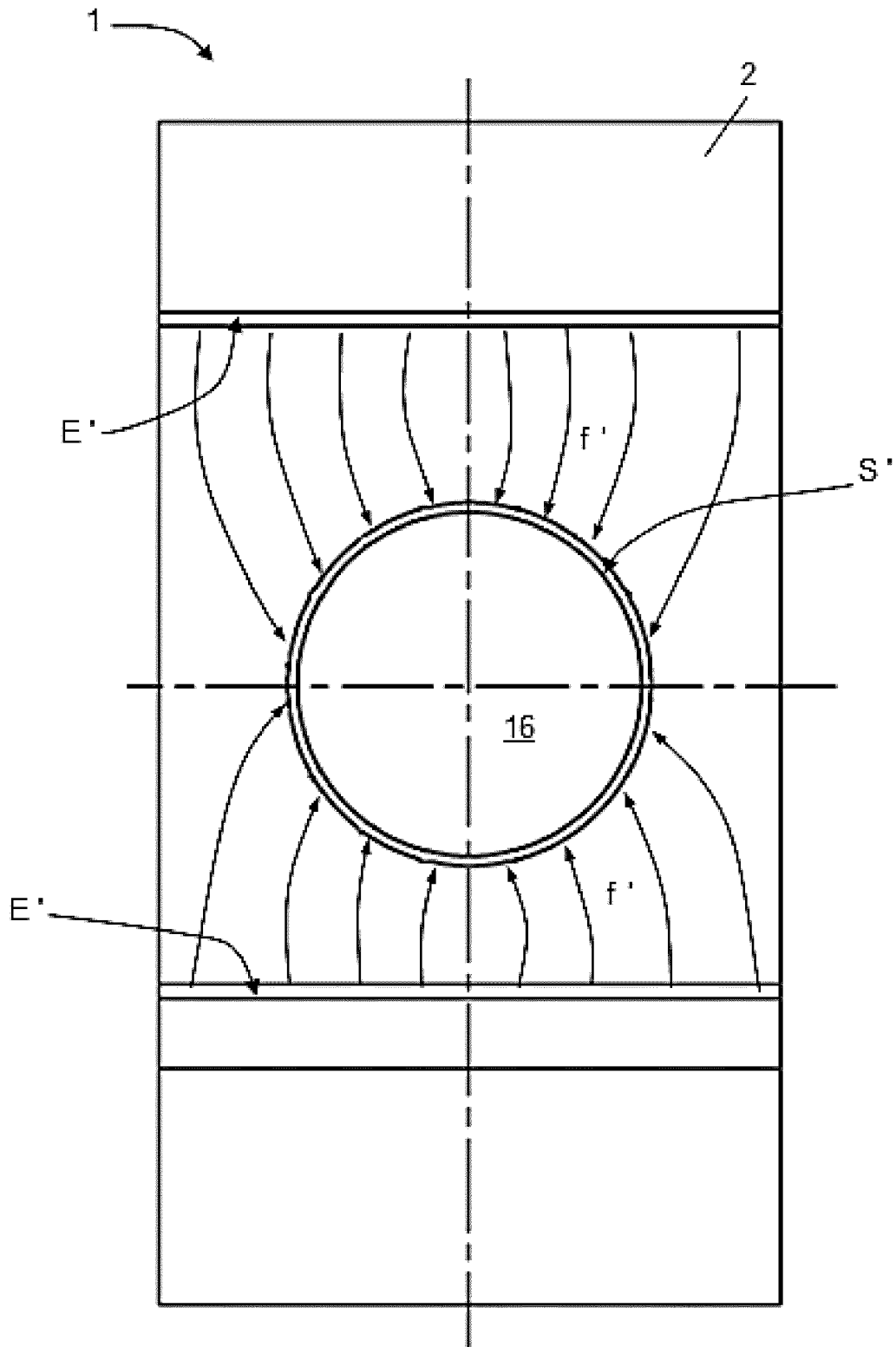


Fig.3

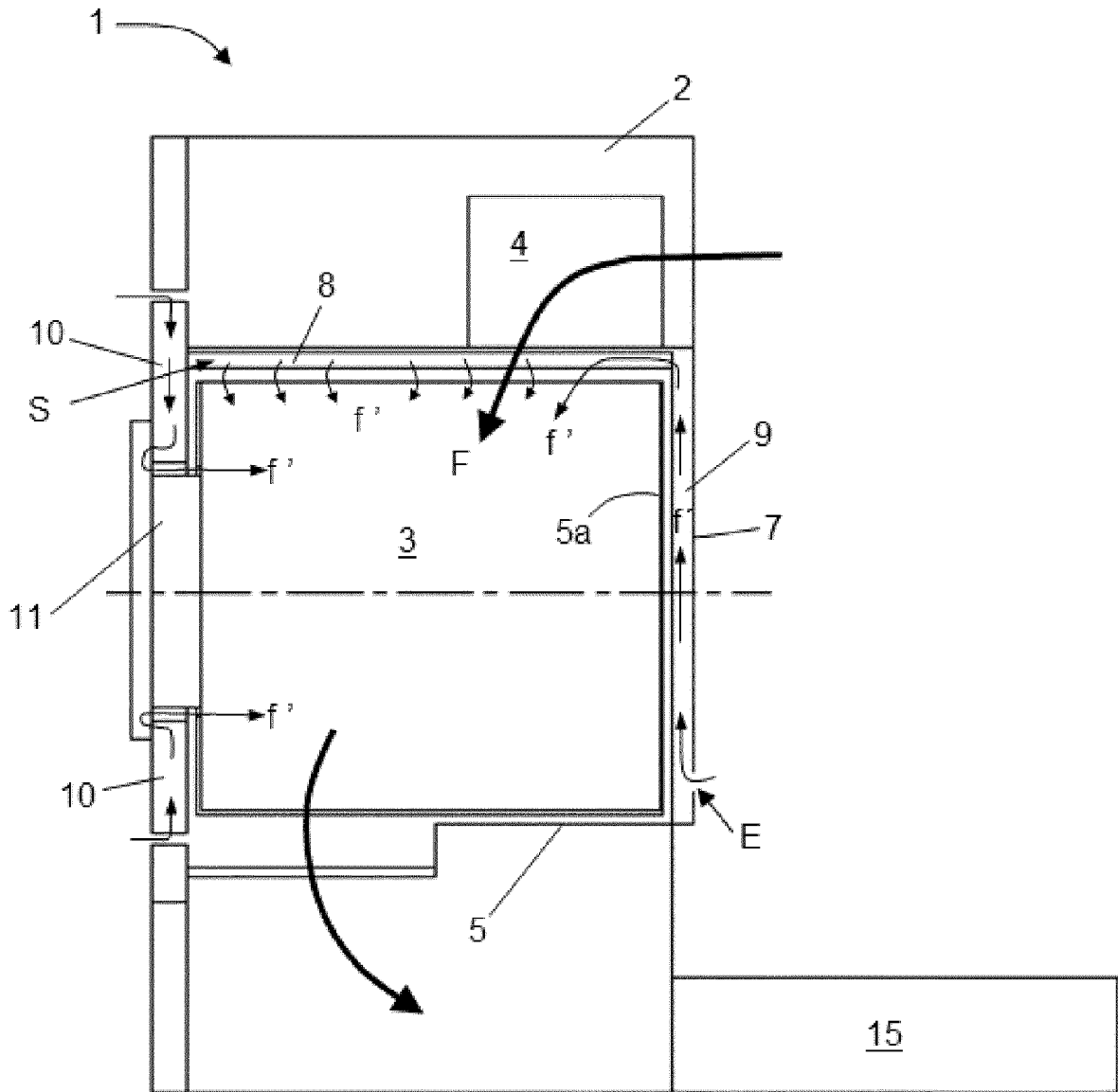


Fig.4



EUROPEAN SEARCH REPORT

Application Number
EP 15 38 2449

5

10

15

20

25

30

35

40

45

50

55

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	US 4 137 645 A (BULLOCK NORMAN J) 6 February 1979 (1979-02-06) * column 2, line 29 - column 4, line 63; figures 1,2,3,4,6 *	1-7, 11-15	INV. D06F58/10 D06F58/20 D06F58/02 D06F58/26	
X	US 2 540 955 A (MOORE JAMES R) 6 February 1951 (1951-02-06) * column 7, line 69 - column 8, line 45; figure 7 *	1-4,8, 11-15		
X	US 3 995 988 A (FREZE BENJAMIN H) 7 December 1976 (1976-12-07) * column 1, line 56 - column 3, line 6; figure 1 *	1-4, 13-15		
X	AU 484 389 B2 (NEW WORLD APPLICANCES PTY. LTD.) 16 January 1975 (1975-01-16) * page 4, line 5 - page 5, line 6 * * page 7, lines 10-18; figure 1 *	1,2, 12-15		
X	JP 2010 125064 A (INAMOTO SEISAKUSHO KK) 10 June 2010 (2010-06-10) * abstract; figures 1-10 *	1,3,4,8, 11,12		TECHNICAL FIELDS SEARCHED (IPC)
A	EP 2 202 347 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 30 June 2010 (2010-06-30) * figure 1 *	1		D06F
A	EP 1 426 480 A2 (LG ELECTRONICS INC [KR]) 9 June 2004 (2004-06-09) * abstract; figure 2 *	1		
The present search report has been drawn up for all claims				
Place of search Munich		Date of completion of the search 16 February 2016	Examiner Kising, Axel	
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>				

EPO FORM 1503 03.82 (P04C01)

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

EP 15 38 2449

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.

16-02-2016

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4137645 A	06-02-1979	BE 857655 A1	01-12-1977
		CA 1078602 A	03-06-1980
		DE 2737567 A1	23-02-1978
		GB 1581468 A	17-12-1980
		JP S5324670 A	07-03-1978
		JP S6128359 B2	30-06-1986
		US 4065253 A	27-12-1977
		US 4137645 A	06-02-1979
		ZA 7704457 A	28-06-1978
-----	-----	-----	-----
US 2540955 A	06-02-1951	NONE	
-----	-----	-----	-----
US 3995988 A	07-12-1976	NONE	
-----	-----	-----	-----
AU 484389 B2	16-01-1975	NONE	
-----	-----	-----	-----
JP 2010125064 A	10-06-2010	JP 5301963 B2	25-09-2013
		JP 2010125064 A	10-06-2010
-----	-----	-----	-----
EP 2202347 A1	30-06-2010	DE 102008055087 A1	24-06-2010
		EP 2202347 A1	30-06-2010
		US 2010154248 A1	24-06-2010
-----	-----	-----	-----
EP 1426480 A2	09-06-2004	CN 1502742 A	09-06-2004
		EP 1426480 A2	09-06-2004
		KR 20040046459 A	05-06-2004
		US 2004098878 A1	27-05-2004
-----	-----	-----	-----

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 2012246962 A1 [0004]