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

(11) EP 3 633 308 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.04.2020 Bulletin 2020/15

(51) Int Cl.:
F28F 9/06 (2006.01) *F16L 37/08* (2006.01)
F28D 1/053 (2006.01)

(21) Application number: 18198864.3

(22) Date of filing: 05.10.2018

(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:
KH MA MD TN

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(54) A HEAT EXCHANGER TUBE MANIFOLD WITH EXTERNAL COLLARS

(57) A heat exchanger tube manifold is disclosed in accordance with an embodiment of the present invention. The heat exchanger tube manifold includes a plurality of spaced apart external collars, wherein at least part of the external collars receives and covers a predetermined length "L" of at least one heat exchanger tube.

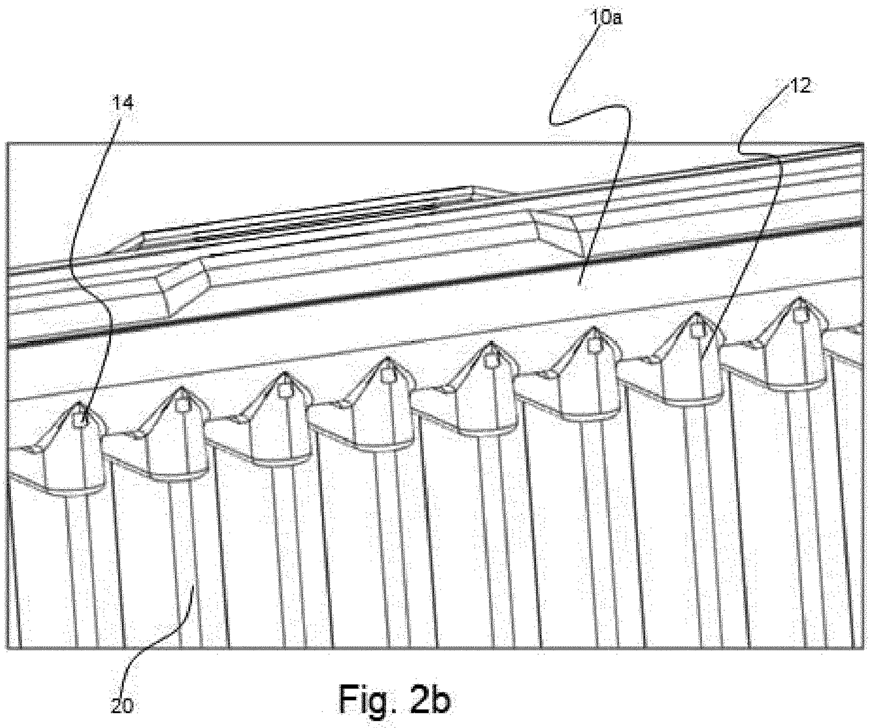

Fig. 2b

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Description

[0001] The present disclosure relates to a heat exchanger system, particularly, the present disclosure relates to a heat exchanger tube manifold for a heat exchanger system.

[0002] Conventional heat exchanger, such as for example, a condenser includes a pair of heat exchanger tube manifolds and a plurality of heat exchanger tubes connecting and configuring fluid communication between the heat exchanger tube manifolds. Each of the heat exchanger tube manifolds includes a tank and a header that are crimped to each other to configure a secure connection there-between. The header includes a plurality of apertures that receives heat exchanger tubes. In case insertion of the heat exchanger tubes and tube positioning inside the manifold is not controlled, the position of the ends of the heat exchanger tubes inside the manifold is non-uniform, i.e. the ends of the heat exchanger tubes are not at same level, causing non-uniform, in-homogeneous distribution of the heat exchanger fluid in the heat exchanger tubes and also causing increase in internal pressure drop that in turn prevents the heat exchanger tubes from retaining the heat exchanger fluid for longer duration. As a result, the non-uniform, in-homogeneous distribution of the heat exchanger fluid in the heat exchanger tubes and the increase in internal pressure drop in the heat exchanger system cause adverse impact on the thermal performance and the efficiency of the heat exchanger. Further, the heat exchanger tubes between the heat exchanger tube manifold and the starting of the fins is prone to corrosion, thereby adversely impacting the service life and performance of the heat exchanger.

[0003] Although, few of the prior art documents such as for example, US4825941 and US5046555 disclose means for preventing over insertion of heat exchanger tubes in the heat exchanger manifold. However, most of the proposed solutions involve configuring changes in delicate heat exchanger tubes, such as, for example, configuring a shoulder at a predetermined distance from end of each of the heat exchanger tubes. However, such shoulder on the heat exchanger tube is inefficient and non reliable in controlling tube insertion and tube positioning inside the heat exchanger tube manifold and also causes stress concentration that in turn may cause failure of the delicate heat exchanger tubes. Further, configuring of shoulders on multiple delicate heat exchanger tubes is inconvenient and time consuming process. Still further, the shoulder fails to control outward movement of the heat exchanger tubes from the heat exchanger tube manifold. Furthermore, none of the prior art suggests any provision for protecting portion of the heat exchanger tubes between the heat exchanger tube manifold and the starting of the fins against corrosion, while simultaneously controlling heat exchanger tube insertion and heat exchanger tube positioning inside the heat exchanger tube manifold.

[0004] Accordingly, there is a need for a heat exchanger tube manifold that include means for protecting portion of the heat exchanger tubes between the heat exchanger tube manifold and the starting of the fins against corrosion, while simultaneously controlling tube insertion and tube positioning inside the heat exchanger tube manifold. Further, there is a need for a heat exchanger tube manifold that ensures uniform and homogeneous distribution of heat exchange fluid in all the heat exchanger tubes. Furthermore, there is a need for a heat exchanger tube manifold that is capable of enhancing thermal performance and efficiency of the heat exchanger.

[0005] An object of the present invention is to provide a heat exchanger tube manifold that obviates problems faced in conventional heat exchanger tube manifold arising due to uncontrolled and non-uniform tube insertion and tube positioning therein.

[0006] Another object of the present invention is to provide a heat exchanger tube manifold that is capable of controlling tube insertion and tube positioning within the heat exchanger manifold, while simultaneously protecting portion of the heat exchanger tubes between the heat exchanger tube manifold and start of the fins against corrosion.

[0007] An object of the present invention is to provide a heat exchanger tube manifold that provides an additional mechanical resistance to heat exchange tubes in area between a heat exchanger tube manifold and fins against high mechanical and thermo-mechanical stresses caused by e.g. pressure cycling and thermal cycling.

[0008] Yet another object of the present invention is to provide a heat exchanger tube manifold that ensures uniform and homogeneous distribution of the heat exchange fluid in all the heat exchanger tubes and prevents pressure drop.

[0009] Still another object of the present invention is to provide a heat exchanger tube manifold that is capable of enhancing thermal performance and efficiency of the heat exchanger and also enhances service life and reduces maintenance of the heat exchanger.

[0010] In the present description, some elements or parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements which are similar but not identical. No idea of priority should be inferred from such indexation, as these terms may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

[0011] A heat exchanger tube manifold is disclosed in accordance with an embodiment of the present invention. The heat exchanger tube manifold includes a plurality of spaced apart external collars, wherein at least part of the external collars receives and covers a predetermined length "L" of at least one heat exchanger tube.

[0012] Specifically, at least one of external collars and corresponding portions of the heat exchanger tube manifold adjacent to the external collars include at least one mechanical stopper, wherein the mechanical stopper prevents receiving the at least one heat exchanger tube beyond the predetermined length "L" inside the at least one of the external collar and the heat exchanger tube manifold.

[0013] Typically, each of the external collars is integrally formed with the heat exchanger tube manifold by a single step molding process.

[0014] Alternatively, each of the external collars is detachably mounted with respect to the heat exchanger tube manifold.

[0015] In accordance with an embodiment, the at least one mechanical stopper is an inwardly protruding member configured on interior walls of at least one of the external collar and the heat exchanger tube manifold.

[0016] Alternatively, the at least one mechanical stopper is a snap fit arrangement configured between an external surface of the at least one heat exchanger tube and the interior walls of at least one of the external collar and the heat exchanger tube manifold.

[0017] Specifically, the snap fit arrangement includes a first snap fit engagement element configured on interior walls of at least one of the external collar and the heat exchanger tube manifold that configures snap fit engagement with at least one corresponding, complimentary second snap fit engagement element configured on the external surface of the at least one heat exchanger tube.

[0018] In accordance with another embodiment of the present invention the at least one mechanical stopper is a threaded fastening arrangement between at least a portion of an external surface of the at least one heat exchanger tube having circular section and at least a portion of the interior walls of at least one of the external collar and the heat exchanger tube manifold.

[0019] Specifically, the threaded fastening arrangement includes first threading configured on at least a portion of the exterior walls of the at least one heat exchanger tube that is complimentary to and engages with second threading configured on at least a portion of interior walls of at least one of the external collar and the heat exchanger tube manifold, in an engaged configuration of the at least one heat exchanger tube with respect to the external collar and the heat exchanger tube manifold, the external collar covers and permits receiving the predetermined length "L" of the at least one heat exchanger tube inside at least one of the external collar and the heat exchanger tube manifold.

[0020] Alternatively, the at least one mechanical stopper is a ball and socket arrangement that configures engagement between the external surface of the at least one heat exchanger tube and interior walls of at least one of the external collar and the heat exchanger tube manifold.

[0021] Specifically, the ball and socket arrangement includes at least one spring loaded ball configured on interior walls of the at least one of the external collar and the heat exchanger tube manifold that is received in a corresponding socket configured on the external surface of the at least one heat exchanger tube.

[0022] Alternatively, the ball and socket arrangement includes at least one spring loaded ball configured on the external surface of the at least one heat exchanger tube that is received in a corresponding socket configured on interior walls of at least one of the external collar and the heat exchanger tube manifold.

[0023] A heat exchanger is disclosed in accordance with an embodiment of the present invention, the heat exchanger includes a pair of spaced apart heat exchanger tube manifolds, wherein at least one heat exchanger tube manifold of the pair of heat exchanger tube manifolds is as disclosed above. The heat exchanger further includes a plurality of heat exchanger tubes that connect the heat exchanger tube manifolds. The heat exchanger further includes a plurality of fins that start from a portion spaced away from at least one of the heat exchanger tube manifolds and extend along at least a portion of the length of the heat exchanger tubes, wherein each of the external collars extends from at least one of the heat exchanger tube manifolds till start of the fins configured adjacent the heat exchanger tubes.

[0024] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying figures, wherein:

FIGURE 1 illustrates a heat exchanger in accordance with an embodiment of the present invention, also is illustrated an enlarged view of a heat exchanger tube manifold for the heat exchanger with spaced apart external collars receiving heat exchange tubes therein in accordance with an embodiment of the present invention;

FIGURE 2a illustrates an isometric view of the heat exchanger tube manifold of **FIGURE1** without the heat exchanger tubes received in the external collars, also is illustrated a mechanical stopper configured on each of the external collars;

FIGURE 2b illustrates another isometric view of the heat exchanger tube manifold of **FIGURE** 1 with the heat exchanger tubes received in the respective external collars; and

FIGURE 3 illustrates still another isometric view of the heat exchanger tube manifold of **FIGURE 1** depicting the mechanical stoppers interacting with and preventing further insertion of the heat exchanger tubes inside the heat exchanger tube manifold.

[0025] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, said figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

[0026] Disclosed is a heat exchanger tube manifold with spaced apart external collars receiving a pre-determined length of heat exchange tubes therein for controlling heat exchanger tube insertion and heat exchanger tube positioning inside the heat exchanger tube manifold and also simultaneously protecting portion of the heat exchanger tubes between the heat exchanger tube manifold and starting of the fins lodged between adjacent heat exchanger tubes against corrosion. Although, the heat exchanger tube manifold of the present invention is used in heat exchangers, such as radiators, condensers and evaporators used in vehicles, however, the heat exchanger tube manifold of the present invention is also applicable to any other heat exchangers such as for example, radiators used in non-vehicular systems such as generators.

[0027] Referring to **FIGURE 1** of the accompanying drawings, a schematic representation of a heat exchanger **100** in accordance with an embodiment of the present invention is depicted. The heat exchanger **100** includes a pair of the heat exchanger tube manifolds **10a** and **10b,** a plurality of spaced apart external collars **12** configured on at least one of the heat exchanger tube manifolds **10a** and **10b**, a plurality of heat exchanger tubes **20** and a plurality of fins **30** (illustrated in enlarged view in **FIGURE 1**). Also, is illustrated an enlarged view of the heat exchanger tube manifold **10a** with the plurality of spaced apart external collars **12** receiving the heat exchange tubes **20** therein in accordance with an embodiment of the present invention. The heat exchanger tubes **20** facilitate connection and fluid communication between the heat exchanger tube manifolds **10a** and **10b**. The fins **30** lodged between adjacent heat exchanger tubes **20** facilitate in improving surface contact between the air and the heat exchanger tubes **20** of the heat exchanger core for improving heat exchange between air passing outside the heat exchanger tubes **20** and the and heat exchange fluid flowing inside the heat exchanger tubes **20**.

[0028] As the external collars **12** can be configured on at least one of the exchanger tube manifolds **10a** and **10b** that are commonly identical and disposed at opposite sides of the heat exchanger core, as such every embodiment disclosed henceforth for the heat exchanger tube manifold **10a** and the external collars **12** configured thereon may also be applicable for the heat exchanger tube manifold **10b** and the external collars **12** configured thereon. For sake of brevity of present document, enlarged view depicting the details of only the of the exchanger tube manifolds **10a** and the external collars **12** configured thereon is illustrated in the Figures and described in the description.

[0029] Each of the external collars **12** is integrally formed with the heat exchanger tube manifold **10a** by a single step molding process. Alternatively, each of the external collars **12** is detachably mounted with respect to the heat exchanger tube manifold **10a.** At least one of the external collars **12** and the heat exchanger tube manifold **10a** receives and covers a pre-determined length "L" of at least one heat exchanger tube **20** as illustrated in **FIGURE 2b. FIGURE 2a** illustrates an isometric view of the heat exchanger tube manifold **10a** without the heat exchanger tubes **20** received in the external collars **12. FIGURE 2b** illustrates another isometric view of the heat exchanger tube manifold **10a** with the heat exchanger tubes **20** received in the respective external collars **12**. Generally, the external collars **12** are of the same material as that of the heat exchanger tube manifold **10a.** However, the present invention is not limited to any particular configuration, material of the external collars **12** and the manner in which the external collars **12** are configured on the heat exchanger manifold **10a**, as far as each of the external collars **12** is extending from the heat exchanger tube manifold **10a** and at least one of the external collars **12** in conjunction with the heat exchanger tube manifold **10a** adjacent thereto receives and covers a predetermined length "L" of the at least one heat exchanger tube **20**. Specifically, at least one of the external collars **12** and corresponding portions of the heat exchanger tube manifold **10a** adjacent to the external collars **12** include at least one mechanical stopper **14**, wherein the at least one mechanical stopper **14** prevents receiving the at least one heat exchanger tube **20** beyond the predetermined length "L" inside the at least one of the external collar **12** and the heat exchanger tube manifold **10a. FIGURE 3** illustrates still another isometric view of the heat exchanger tube manifold **10a** depicting the mechanical stoppers **14** interacting with and preventing further insertion of the heat exchanger tubes **20** inside the heat exchanger tube manifold **10a.** Such a configuration of the heat exchanger manifold **10a** facilitates in controlling tube insertion and tube positioning within the heat exchanger manifold **10a**, thereby resulting in improved flow distribution of the heat exchanger fluid and uniform distribution of the heat exchanger fluid in all the heat exchanger tubes **20**. Also, such configuration prevents further pressure drop across the heat exchanger tubes and improves thermal performance and efficiency of the heat exchanger **100**. The fins **30** starts from a portion spaced away from the heat exchanger tube manifold **10a** and extend along at least a portion of the length of the heat exchanger tubes **20**. Such configuration protects portion of the heat exchanger tubes **20** between the heat exchanger tube manifold **10a** and the starting of the fins **30** against corrosion, while simultaneously controlling heat exchanger tube insertion and heat exchanger tube positioning inside the heat exchanger tube manifold **10a**.

[0030] The mechanical stoppers **14** are uniformly configured on at least one of the external collars **12** and the corresponding portion of the heat exchanger tube manifold **10a** adjacent to the external collars **12** such that all the mechanical stoppers facilitate in defining same level for ends of all the heat exchanger tubes **20** relative to the at least one of the external collars **12** and the heat exchanger tube manifold **10a**, thereby ensuring better flow control inside the heat exchanger tubes **20**.

[0031] The at least one mechanical stopper **14** is for example an inwardly protruding member configured on interior walls of at least one of the external collar **12** and the heat exchanger tube manifold **10a**.

[0032] Alternatively, the mechanical stopper **14** is for example a snap fit arrangement configured between an external surface of the at least one heat exchanger tube **20** and the interior walls of at least one of the external collar **12** and the heat exchanger tube manifold **10a**. Specifically, the snap fit arrangement includes a first snap fit engagement element configured on interior walls of the at least one of the external collar **12** and the heat exchanger tube manifold **10** that configures snap fit engagement with at least one corresponding, complimentary second snap fit engagement element configured on the external surface of the at least one heat exchanger tube **20**. With such configuration of the mechanical stopper **14**, not only inward movement of the heat exchanger tubes **20** inside the heat exchanger manifold **10** is prevented but also outward movement of the heat exchanger tube **20** from the heat exchanger tube manifold **10** is also prevented.

[0033] In accordance with still another embodiment, the at least one mechanical stopper **14** is a threaded fastening arrangement between at least a portion of an external surface of the at least one heat exchanger tube **20**, having circular section and at least a portion of the interior walls of the at least one of the external collar **12** and the heat exchanger tube manifold **10a**. Specifically, the threaded fastening arrangement includes a first threading configured on at least a portion of the exterior walls of the at least one heat exchanger tube **20**, having circular section and that is complimentary to and engages with second threading configured on at least a portion of interior walls of at least one of the external collar **12** and the heat exchanger tube manifold **10a**. The first threading engages with the second threading to define an engaged configuration of the at least one heat exchanger tube **20** with respect to at least one of the external collar **12** and the heat exchanger tube manifold **10a**. Such threaded fastening arrangement enables the external collar **12** to permit receiving the predetermined length "L" of the at least one heat exchanger tube **20** inside at least one of the external collar **12** and the heat exchanger tube manifold **10a** but also cover the predetermined length "L" of the at least one heat exchanger tube **20**. With such configuration of the mechanical stopper **14**, not only inward movement of the heat exchanger tubes **20** inside the heat exchanger tube manifold **10** is prevented but also outward movement of the heat exchanger tube **20** from the heat exchanger tube manifold **10** is also prevented.

[0034] Alternatively, the at least one mechanical stopper **14** is a ball and socket arrangement that configures engagement between the external surface of the at least one heat exchanger tube **20** and the interior walls of at least one of the external collar **12** and the heat exchanger tube manifold **10a.** Wherein, the ball and socket arrangement includes at least one spring loaded ball configured on interior walls of at least one of the external collar **12** and the heat exchanger tube manifold **10a** that is received in a corresponding socket configured on the external surface of the at least one heat exchanger tube **20**. Else, the ball and socket arrangement includes at least one spring loaded ball configured on the external surface of the at least one heat exchanger tube **20** that is received in a corresponding socket configured on interior walls of at least one of the external collar **12** and the heat exchanger tube manifold **10a.** However, the present invention is not limited to any particular configuration of the at least one mechanical stoppers **14** as far as the mechanical stoppers facilitate in defining the same level for ends of all the heat exchanger tubes **20** relative to the at least one of the external collars **12** and the heat exchanger tube manifold **10a**.

[0035] Also is disclosed the heat exchanger **100** in accordance with an embodiment of the present invention. The heat exchanger **100** includes a pair of spaced apart heat exchanger tube manifolds **10a** and **10b**, wherein at least one heat exchanger tube manifold of the pair of heat exchanger tube manifolds **10a** and **10b** is as disclosed above. The heat exchanger **100** further includes a plurality of heat exchanger tubes **20** that connect the heat exchanger tube manifolds **10a** and **10b**. The heat exchanger **100** further includes the plurality of fins **30** that start from a portion spaced away from at least one of the heat exchanger tube manifolds **10a** and **10b** and extend along at least a portion of the length of the heat exchanger tubes **20**, wherein each of the external collars **12** extends from at least one of the heat exchanger tube manifolds **10a** and **10b** till start of the fins **30** configured adjacent the heat exchanger tubes **20**.

[0036] Several modifications and improvement might be applied by the person skilled in the art to a heat exchanger tube manifold as defined above, as long as the heat exchanger tube manifold includes a plurality of spaced apart external collars, wherein at least part of the external collars receive and cover a predetermined length "L" of at least one heat exchanger tube.

[0037] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described herein.

[0038] In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any technically operating combination of means.

Claims

1. A heat exchanger tube manifold (10a) comprising a plurality of spaced apart external collars (12), wherein at least part of the external collars (12) is adapted to receive and cover a predetermined length "L" of at least one heat exchanger tube (20).

2. The heat exchanger tube manifold (10a) according to the previous claim, wherein at least one of external collars (12) and corresponding portions of the heat exchanger tube manifold (10a) adjacent to the external collars (12) comprise at least one mechanical stopper (14), wherein the mechanical stopper is adapted to prevent receiving the at least one heat exchanger tube (20) beyond the predetermined length "L" inside the at least one of the external collar (12) and the heat exchanger tube manifold (10a).

3. The heat exchanger tube manifold (10a) according to any of the preceding claims, wherein each of the external collars (12) is integrally formed with the heat exchanger tube manifold (10a) by a single step molding process.

4. The heat exchanger tube manifold (10a) according to any of the preceding claims, wherein each of the external collars (12) is detachably mounted with respect to the heat exchanger tube manifold (10a).

5. The heat exchanger tube manifold (10a) according to any of the preceding claims, wherein the at least one mechanical stopper (14) is an inwardly protruding member configured on interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a).

6. The heat exchanger tube manifold (10a) according to any of the preceding claims, wherein the at least one mechanical stopper (14) is a snap fit arrangement configured between an external surface of the at least one heat exchanger tube (20) and the interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a).

7. The heat exchanger tube manifold (10a) according to the previous claim, wherein the snap fit arrangement comprises a first snap fit engagement element configured on interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a) and adapted to configure snap fit engagement with at least one corresponding, complimentary second snap fit engagement element configured on the external surface of the at least one heat exchanger tube (20).

8. The heat exchanger tube manifold (10a) according to any of the preceding claims, wherein the at least one mechanical stopper (14) is a threaded fastening arrangement between at least a portion of an external surface of the at least one heat exchanger tube (20) having circular section and at least a portion of the interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a).

9. The heat exchanger tube manifold (10a) according to the previous claim, wherein the threaded fastening arrangement comprises first threading configured on at least a portion of the exterior walls of the at least one heat exchanger tube (20) that is complimentary to and engages with second threading configured on at least a portion of interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a), in an engaged configuration of the at least one heat exchanger tube (20) with respect to at least one of the external collar (12) and the heat exchanger tube manifold (10a), the external collar (12) is adapted cover and permit receiving the predetermined length "L" of the at least one heat exchanger tube (20) inside at least one of the external collar (12) and the heat exchanger tube manifold (10a).

10. The heat exchanger tube manifold (10a) according to any of the preceding claims, wherein the at least one mechanical stopper (14) is a ball and socket arrangement adapted to configure engagement between the external surface of the at least one heat exchanger tube (20) and interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a).

11. The heat exchanger tube manifold (10a) according to the previous claim, wherein the ball and socket arrangement comprises at least one spring loaded ball configured on interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a) that is adapted to be received in a corresponding socket configured on the external surface of the at least one heat exchanger tube (20).

12. The heat exchanger tube manifold (10a) according to claim 11, wherein the ball and socket arrangement comprises at least one spring loaded ball configured on the external surface of the at least one heat exchanger tube (20) that is adapted to be received in a corresponding socket configured on interior walls of at least one of the external collar (12) and the heat exchanger tube manifold (10a).

14. A heat exchanger (100) comprising a pair of spaced apart heat exchanger tube manifolds (10a) and (10b), wherein at least one heat exchanger tube manifold of the pair of heat exchanger tube manifolds (10a) and (10b) is according to any of the preceding claims, said heat exchanger further comprises a plurality of heat exchanger tubes (20) adapted to connect the heat exchanger tube manifolds (10a) and (10b), said heat exchanger (100) further includes a plurality of fins (30) adapted to start from a portion spaced away from at least one of the heat exchanger tube manifolds (10a) and (10b) and extend along at least a portion of the length of the heat exchanger tubes (20), wherein each of the external collars (12) is adapted to extend from at least one of the heat exchanger tube manifolds (10a) and (10b) till start of the fins (30) configured adjacent the heat exchanger tubes (20).

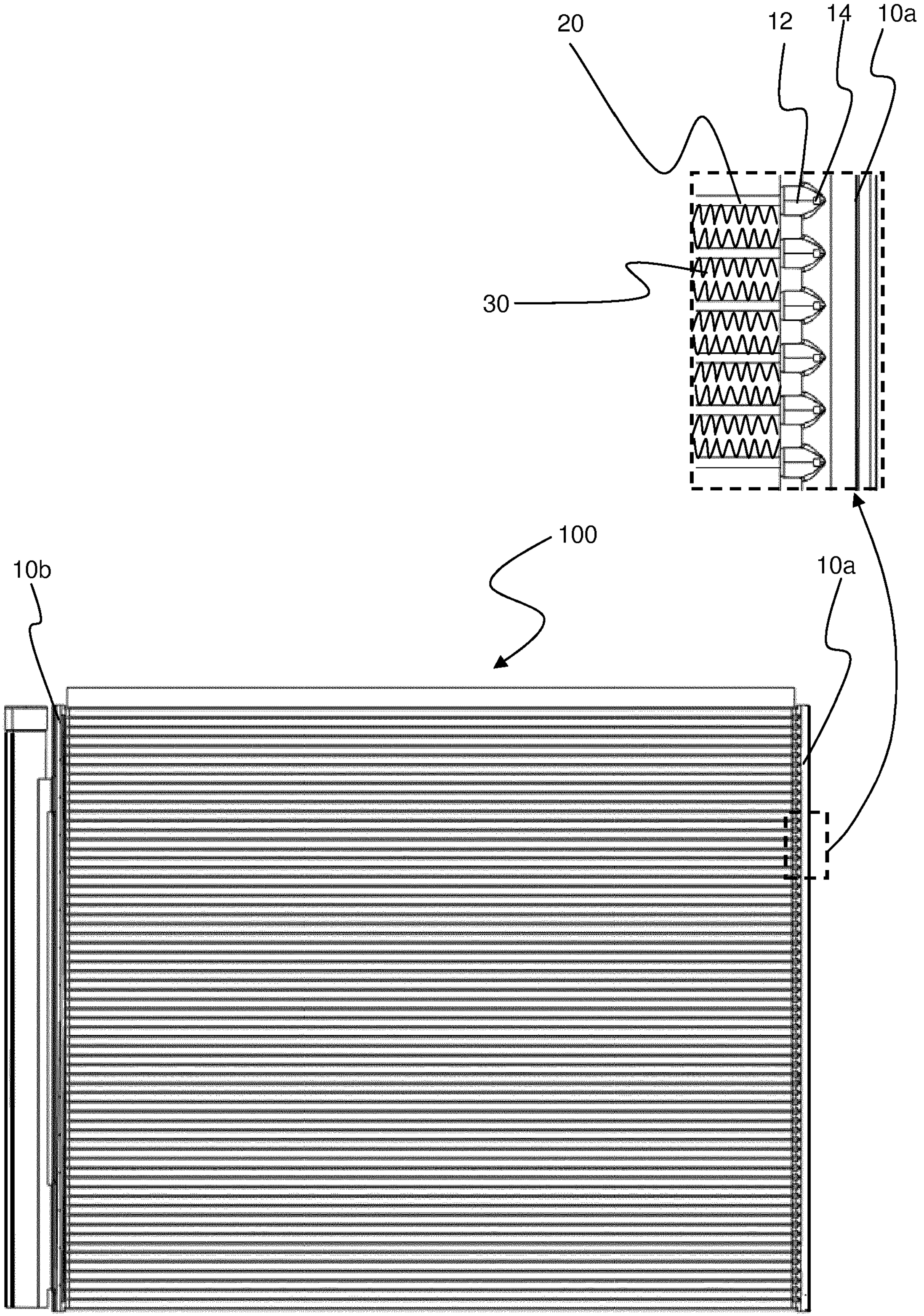

Fig. 1

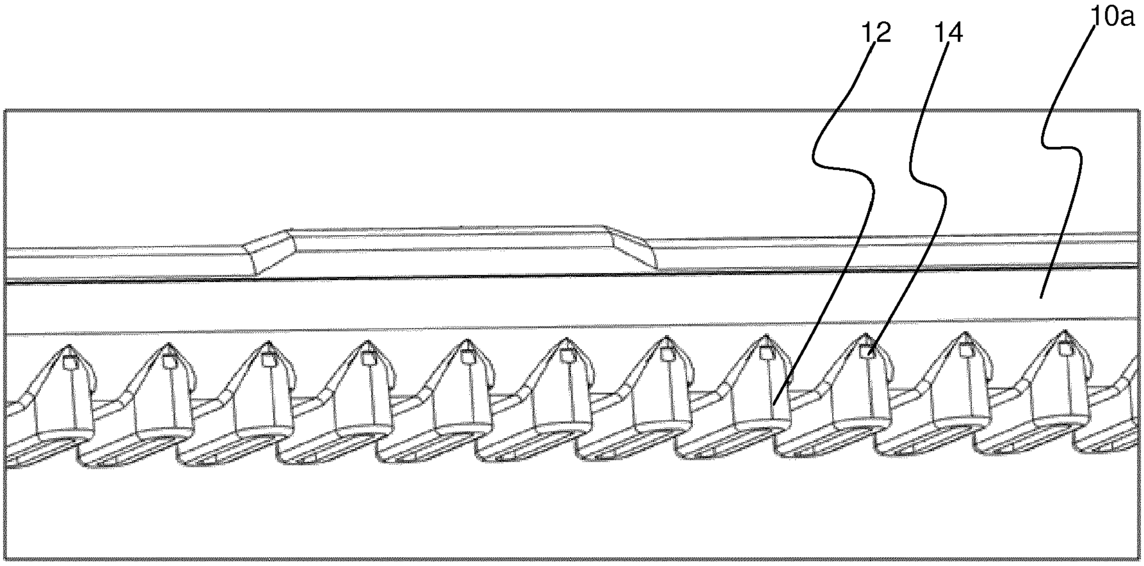

Fig. 2a

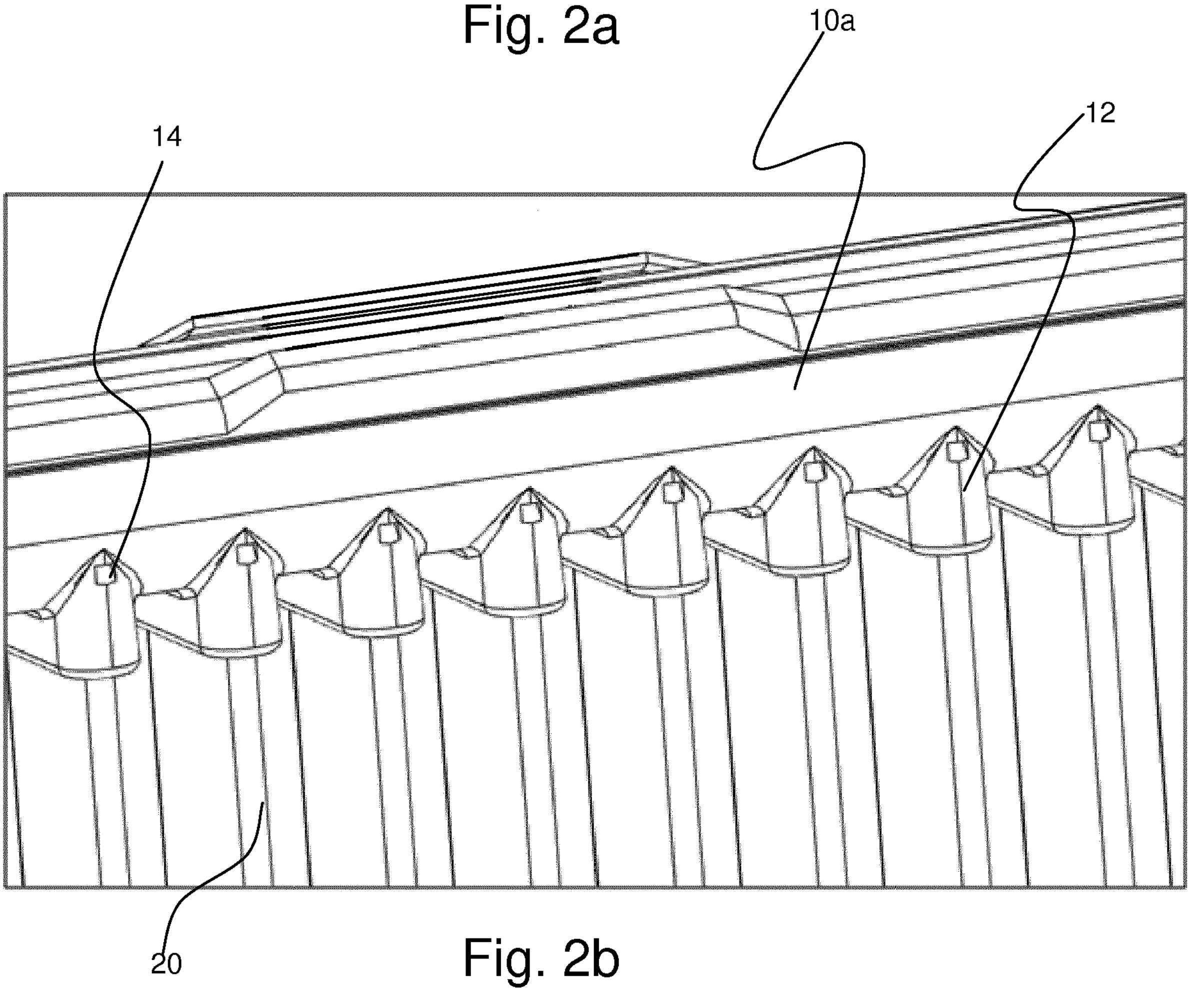

Fig. 2b

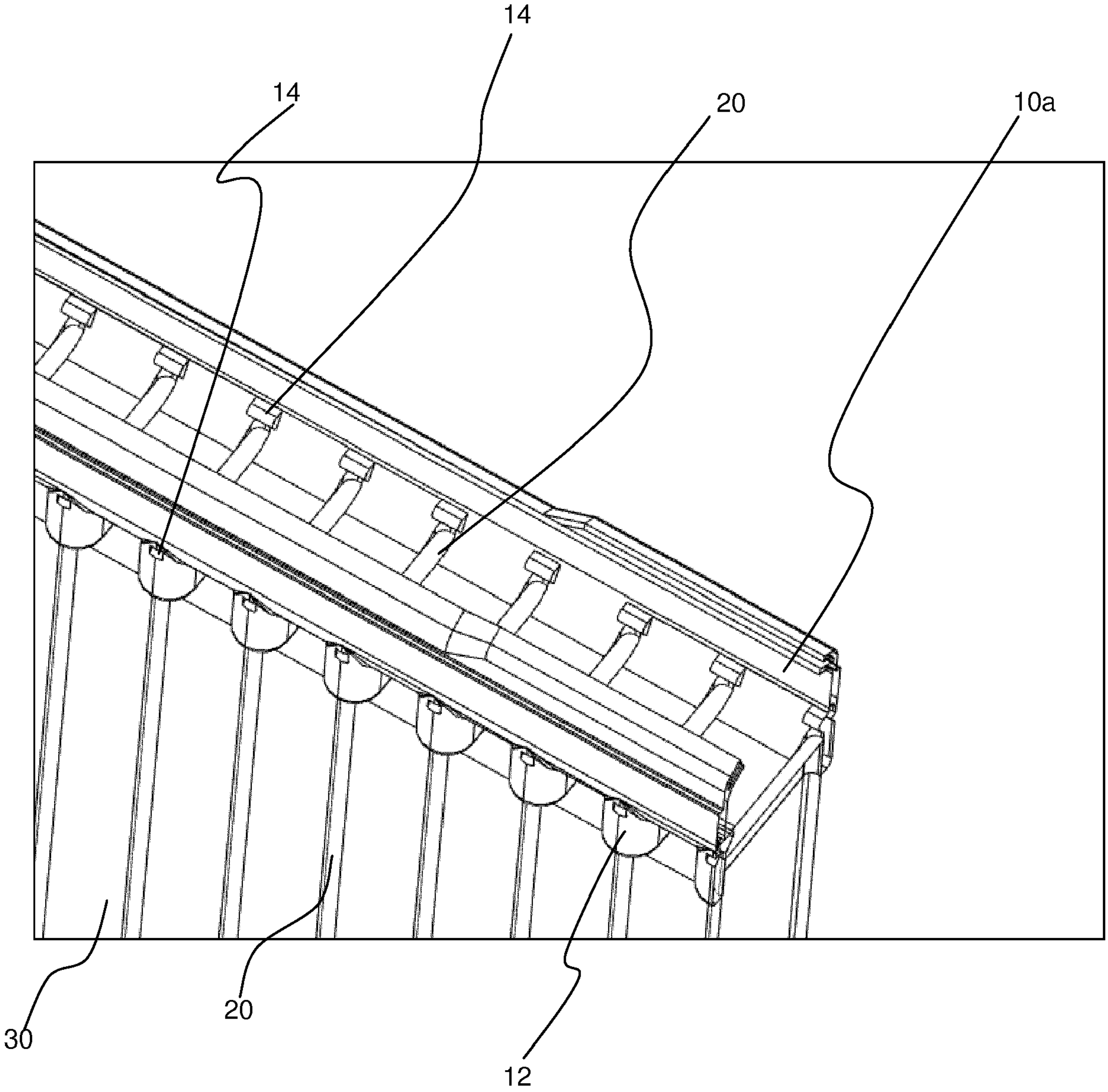

Fig. 3

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 8864

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 1 797 636 A (BUTLER GAY H) 24 March 1931 (1931-03-24) * the whole document * -----	1,2,4,5, 8,9	INV. F28F9/06 F16L37/08 F28D1/053
X	WO 2010/139485 A2 (GEOCLIMADESIGN AG) 9 December 2010 (2010-12-09) * page 5, line 31 - page 7, line 18; figures 1,2 * -----	1,2,4,5	
X	WO 2015/113145 A1 (HYDRONIC HEATING TECHNOLOGIES INC [CA]) 6 August 2015 (2015-08-06) * paragraph [0035] - paragraph [0042]; figure 3 * -----	1	
X	FR 3 056 736 A1 (VALEO SYSTEMES THERMIQUES [FR]) 30 March 2018 (2018-03-30) * abstract; figures 5,6a * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

F28F
F16L
F28D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	7 March 2019	Jessen, Flemming

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 18 19 8864

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
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07-03-2019

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 1797636	A	24-03-1931	NONE		
WO 2010139485	A2	09-12-2010	CN 102460056	A	16-05-2012
			DE 102009049941	A1	16-12-2010
			DE 202010018342	U1	05-10-2015
			EP 2440874	A2	18-04-2012
			WO 2010139485	A2	09-12-2010
WO 2015113145	A1	06-08-2015	CA 2975403	A1	06-08-2015
			US 2017184352	A1	29-06-2017
			WO 2015113145	A1	06-08-2015
FR 3056736	A1	30-03-2018	FR 3056736	A1	30-03-2018
			WO 2018060626	A1	05-04-2018

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

Patent documents cited in the description

- US 4825941 A **[0003]**
- US 5046555 A **[0003]**