

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 932 008 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.07.1999 Bulletin 1999/30

(51) Int. Cl.⁶: **F28D 1/053**, F28F 1/16

(21) Application number: **99100364.1**

(22) Date of filing: **15.01.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventor: **Niboli, Silvestro**
25078 Vestone (IT)

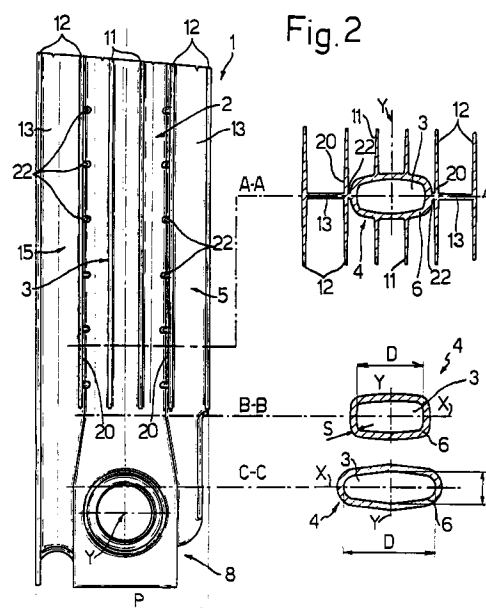
(74) Representative:
Jorio, Paolo, Dr. Ing. et al
Studio Torta S.r.l.,
Via Viotti, 9
10121 Torino (IT)

(30) Priority: **16.01.1998 IT TO980038**

(71) Applicant:
FONDITAL FONDERIE ITALIANE NUOVA
VALSABBIA S.p.A.
25078 Vestone (IT)

(54) **Radiator, in particular for heating systems, with a high resistance to internal pressure**

(57) A radiator (1) having at least one module (2) including: a tubular portion (3) with a flat cross section (4); opposite top and bottom ends (7,8) having respective lateral hydraulic fittings (10) substantially aligned along a minor axis of the cross section; and a finned portion (5) formed integrally in one piece with a lateral wall (13) of the tubular portion (3); the finned portion including first fins (11) originating directly from the tubular portion, and second fins (12) originating transversely from respective front ribs (13) in turn originating from the tubular portion (3) and perpendicular to the first fins (11); the ribs being substantially aligned with a major axis of the cross section; the cross section (4) having a dimension (D), measured along the major axis, smaller than or equal to 45% of the depth (P) of the module (2), also measured along the major axis, and a wall thickness (S) ranging between 2.4 and 4.5mm; and a root portion (20) of each rib (13) having no fins, and having a number of respective ridges (22) connecting the root portion (20) to the lateral wall (6) of the tubular portion (3) and to a second fin immediately adjacent to the tubular portion.



EP 0 932 008 A2

Description

[0001] The present invention relates to a radiator, in particular a light-alloy radiator suitable for installation in civil and industrial heating systems, and characterized by a geometry imparting a high resistance to internal pressure.

[0002] As is known, modern heating system radiators may comprise a number of standard modules packed side by side in fluidtight manner and connected to the system piping. The modules may be molded from light alloy, and comprise a tubular portion, along which the heat exchange fluid flows, and a finned portion formed integrally in one piece with the tubular portion, and which receives the heat conveyed by the heat exchange fluid and exchanges this heat with the environment by convection and radiation.

[0003] To enable compact, side by side connection of the modules, the tubular portion normally has a flat cross section, as shown for example in Figure 1, which is normally constant along the whole length (height) of the tubular portion, and is substantially in the form of a lozenge, rectangle or double isosceles trapezium with rounded edges and maximum transverse dimensions measured parallel to two perpendicular axes of symmetry indicated X (major axis, i.e. parallel to the major dimension) and Y (minor axis). From the end edges of the lozenge at opposite ends of the major axis X, there originate two ribs, from which originate a number of transverse fins; and further fins originate directly from the lateral wall of the tubular portion, and in particular from the same end edges as the ribs.

[0004] Radiators comprising known modules of the above type have a low resistance to internal pressure. In particular, when burst tested, known radiators are damaged by a 14-24 bar internal heat exchange fluid pressure, while radiators capable of withstanding higher pressures normally have a tubular portion with a thicker lateral wall, which increases both weight and cost.

[0005] It is an object of the present invention to provide a low-cost, lightweight radiator for civil heating systems, which may be molded from light alloy (or similar), and which provides for both effective heat exchange and a burst resistance well in excess of that of known radiators, e.g. of over 30 bars.

[0006] According to the present invention, there is provided a radiator comprising at least one module, in turn comprising a tubular portion with a flat cross section; opposite top and bottom ends having respective lateral hydraulic fittings substantially aligned along a minor axis of the cross section; and a finned portion formed integrally in one piece with a lateral wall of the tubular portion; the finned portion including first fins originating directly from the tubular portion, and second fins originating transversely from respective front ribs in turn originating from the tubular portion and perpendicular to the first fins; the ribs being substantially aligned with a major axis of the cross section; characterized in that the cross section has a dimension, measured along the major axis, smaller than or equal to approximately 45% of the depth of the module, also measured along the major axis.

[0007] Moreover, a root portion of each rib has no fins, and comprises a number of respective ridges connecting the rib both to the lateral wall of the tubular portion, and to a respective second fin carried by the rib and immediately adjacent to the tubular portion.

[0008] The geometry defined by the above parameters provides for achieving radiators capable of resisting internal pressures of over 35-40 bars, while at the same time maintaining a relatively thin tubular portion wall (2.4 to 4.5 mm) and, hence, light weight and low cost, and maintaining overall module dimensions perfectly compatible with currently used heating systems (module depth of over 80 mm; any module height, measured along the tubular portion axis; and high-density side by side packing in confined spaces).

[0009] These favourable, unexpected characteristics, determined experimentally, are attributed to the favourable stress distribution achieved by the geometry of the present invention, which, defined by an appropriate combination of dimensional and shape parameters, enables the tubular portion to better distribute the stress induced by internal pressure, while at the same time enabling the fins to contribute actively in absorbing at least part of the stress and so improving the mechanical resistance of the tubular portion.

[0010] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a cross section of a known radiator module (with a lozenge-shaped water chamber);

Figure 2 shows, not to scale, various cross sections at various heights of a radiator module in accordance with the present invention;

Figure 3 shows three smaller-scale views of the Figure 2 radiator module: namely, a longitudinal section (Figure 3a), a rear view (Figure 3b), and a side view (Figure 3c).

[0011] Number 1 in Figures 2 and 3 indicates as a whole a radiator for civil and industrial heating systems, and of which only one module 2 is shown for the sake of simplicity. As is known, radiator 1 may comprise any number of modules 2 connected side by side in a group and in fluidtight manner to one another.

[0012] For which purpose, each module 2 comprises a tubular portion 3 having a substantially vertical longitudinal axis and a flat radial cross section 4; and a finned portion 5 formed integrally in one piece with a lateral wall 6 of tubular

portion 3. Section 4 is flat by comprising widely differing transverse dimensions measured parallel to two perpendicular axes of symmetry indicated X and Y. More specifically, since the X axis dimension is greater than the Y axis dimension, the X axis is hereinafter referred to as the "major axis", and the Y axis as the "minor axis".

[0013] The opposite top and bottom longitudinal ends 7, 8 of tubular portion 3 are provided, laterally, with respective cylindrical hydraulic fittings 10 substantially aligned along the minor axis Y of the corresponding cross section 4, i.e. with the respective axes of symmetry substantially coaxial with the Y axis of section 4 located at the same height as the axes of fittings 10, i.e. in the same longitudinal position (with respect to the axis of symmetry of portion 3) as fittings 10.

[0014] Each module 2 is preferably injection molded from light alloy or similar material, for which purpose, the bottom end 8 is open, and is closed, in use, in known manner by a welded plug 8a.

[0015] Finned portion 5 comprises a first number of fins 11 originating directly from tubular portion 3; and a second number of fins 12 originating transversely from respective front ribs 13, in turn originating from tubular portion 3 and perpendicular to fins 11. Ribs 13 are substantially aligned with the major axis X of all the cross sections 4 of tubular portion 3.

[0016] According to a first characteristic of the invention, each cross section 4 of tubular portion 3 has an inside dimension D, measured along major axis X, smaller than or equal to approximately 45% of the depth P of module 2, also measured parallel to the X axis of the corresponding section 4 (Figure 2). That is, for each section 4, the following inequality applies :

$$D \leq 0.45 P \quad (1)$$

[0017] Equation (1) applies in particular to cross section 4 in plane C-C (Figure 2), i.e. to section 4 corresponding to the bottom end (i.e. closest to fittings 10 of end 8) of a finned portion 15 of tubular portion 3, defined by the longitudinal portion of portion 3 provided with fins 11.

[0018] Equation (1) also applies to the rest of finned portion 15, except that, modules 2 being injection molded, value D, as any injection expert will know, must be further reduced by the amount due to the draft angle.

[0019] Depending on the overall dimensions of module 2 (total length, i.e. height, of tubular portion 3, which may be of any length; and depth P, which must be over 80 mm), the thickness S of lateral wall 6 of tubular portion 3 ideally ranges between approximately 2.4 and 4.5 mm. These values refer to a "mean" thickness S calculated as the arithmetic mean of two wall 6 thicknesses measured at diametrically opposite points of respective section 4.

[0020] According to a preferred characteristic of the invention, each cross section 4 of tubular portion 3 has a dimension L, measured along minor axis Y, equal to or greater than approximately 15% of dimension D of the same cross section 4, measured along the major axis X. The following equation therefore applies :

$$L \geq 0.15 D \quad (2)$$

[0021] Equation (2) applies in particular to cross section 4 in plane C-C (Figure 2).

[0022] According to a third characteristic of the invention, each rib 13 has a root portion 20 with no fins 12, and which originates from a corresponding portion, with no fins 11, of lateral wall 6 of tubular portion 3; portion 20 of each front rib 13 comprises a number of respective ridges 22 along the whole length of finned portion 15; and ridges 22 are so formed as to connect each rib 13 both to the portion of lateral wall 6 of tubular portion 3 from which root portion 20 originates, and to the fin 12 closest to root portion 20, i.e. the one on rib 13 immediately adjacent to tubular portion 3.

[0023] Finally, as shown clearly in Figure 2, dimensions D and L, measured along major and minor axes X and Y, of each cross section 4 may vary along the axial extension of tubular portion 3, or may remain substantially constant along the whole axial extension of tubular portion 3, providing, obviously, equations (1) and (2) are met.

[0024] At least along the whole of finned portion 15, cross section 4 of tubular portion 3 may therefore be shaped as shown in planes A-A and B-B in Figure 2, i.e. in the form of a substantially rectangular ring with rounded corners and slightly outward-curving sides. Conversely, in plane C-C, it may resemble the lozenge shape, but with different dimensional ratios between the major and minor axes X and Y in accordance with equations (1) and (2).

[0025] The invention will now be described further by means of a test example.

EXAMPLE

[0026] To determine the actual difference in performance between the radiator described and a conventional radiator, six two-module groups, i.e. six different radiators, each comprising two side by side modules 2, were burst tested hydraulically.

[0027] Three known radiators - two manufactured by the present Applicant and one purchased - all had a cross section as shown in Figure 1, a depth P of over 80 mm, and a major inside dimension D of the water chamber (the conduit in which the heat exchange fluid flows) equal to or greater than 0.50 P (50% of P) (particularly at cross section 4 in plane

C-C in Figure 2).

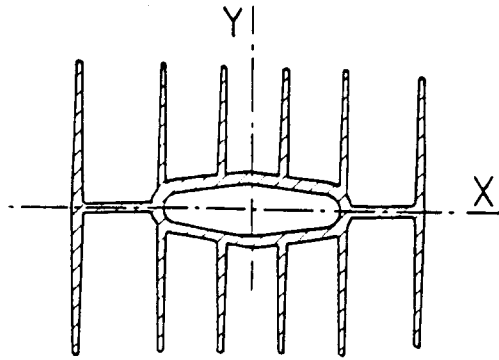
[0028] The above three radiators and three according to the present invention were tested successively by connecting them successively to a test circuit equipped with an adjustable-head pump. Once connected, the water pressure inside each radiator was raised gradually from 3 bars and by 1 bar per minute until the radiator burst. The pressure values were monitored continuously using a recording manometer, and the results are shown in Table 1.

TABLE 1

	KNOWN ART			INVENTION		
RADIATOR	1	2	3	4	5	6
BURST PRESSURE	14 bar	15 bar	21 bar	35 bar	40 bar	38 bar

Claims

1. A radiator comprising at least one module, in turn comprising a tubular portion with a flat cross section; opposite top and bottom ends having respective lateral hydraulic fittings substantially aligned along a minor axis of the cross section; and a finned portion formed integrally in one piece with a lateral wall of the tubular portion; the finned portion including first fins originating directly from the tubular portion, and second fins originating transversely from respective front ribs in turn originating from the tubular portion and perpendicular to the first fins; the ribs being substantially aligned with a major axis of the cross section; characterized in that the cross section has a dimension (D), measured along the major axis, smaller than or equal to approximately 45% of the depth (P) of the module, also measured along the major axis.
2. A radiator as claimed in Claim 1, characterized in that a root portion of each rib has no fins, and comprises a number of respective ridges connecting the rib both to the lateral wall of the tubular portion, and to a respective second fin carried by the rib and immediately adjacent to the tubular portion.
3. A radiator as claimed in claim 1 or 2, characterized in that said cross section of the tubular portion has a wall thickness (S) ranging between approximately 2.4 and approximately 4.5 mm.
4. A radiator as claimed in one of the foregoing Claims, characterized in that said cross section of the tubular portion has a dimension (L), measured along the minor axis, equal to or greater than approximately 15% of the dimension (D) of the same cross section measured along the major axis.
5. A radiator as claimed in any one of the foregoing Claims, characterized in that the dimensions (D) (L) measured along the major axis (X) and minor axis (X) of each cross section (4) may vary along the axial extension of the tubular portion (3), or may remain substantially constant along the whole axial extension of the tubular portion (3).
6. A radiator as claimed in any one of the foregoing Claims, characterized in that, at least along an axial portion of the tubular portion having said first fins, said cross section of the tubular portion is in the shape of a substantially rectangular ring with rounded corners and slightly outward-curving sides.
7. A radiator as claimed in any one of the foregoing Claims, characterized in that the depth (P) of the module, measured along the major axis of the cross section of the tubular portion, is over 80 mm.



KNOWN ART

Fig. 1

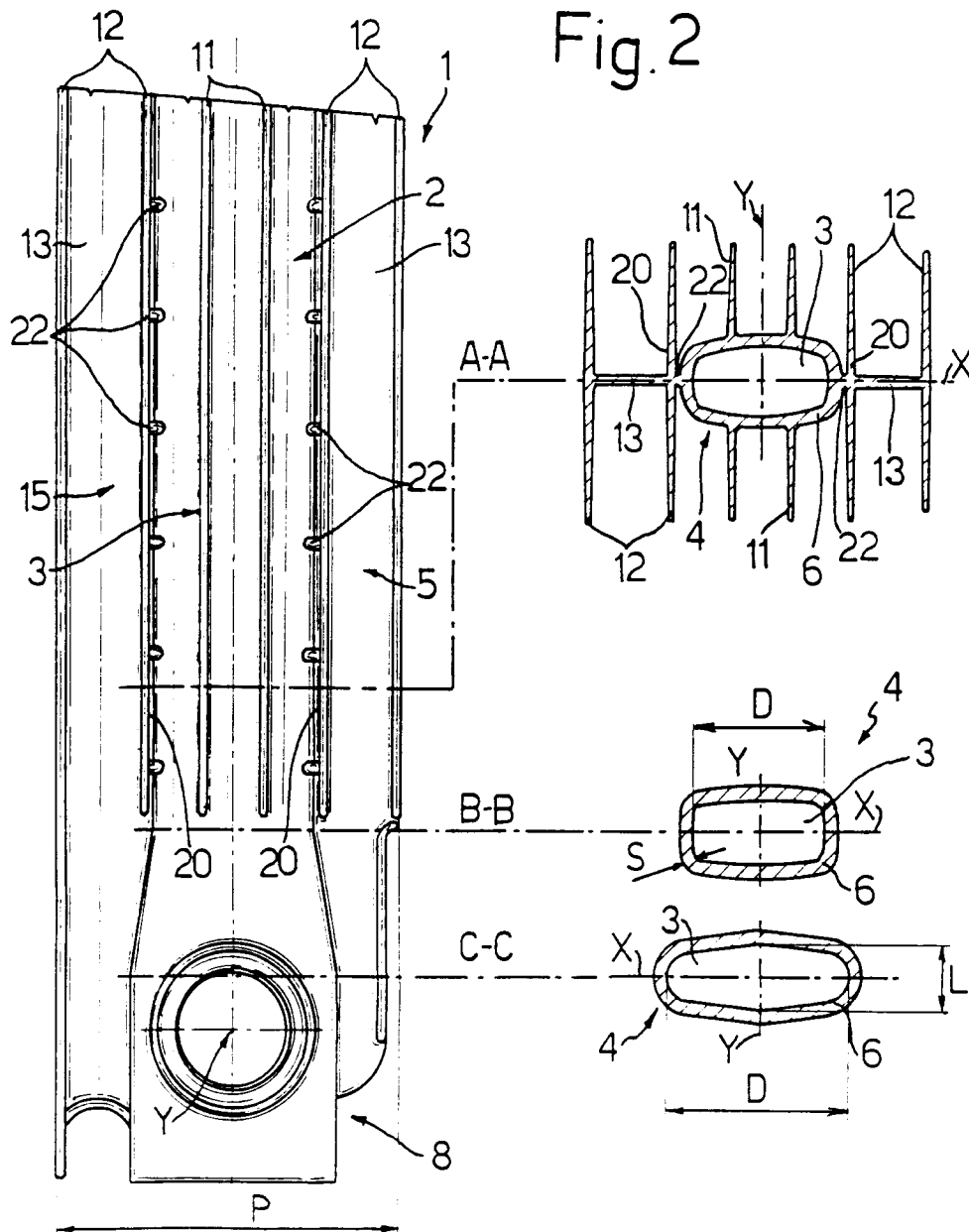


Fig. 2

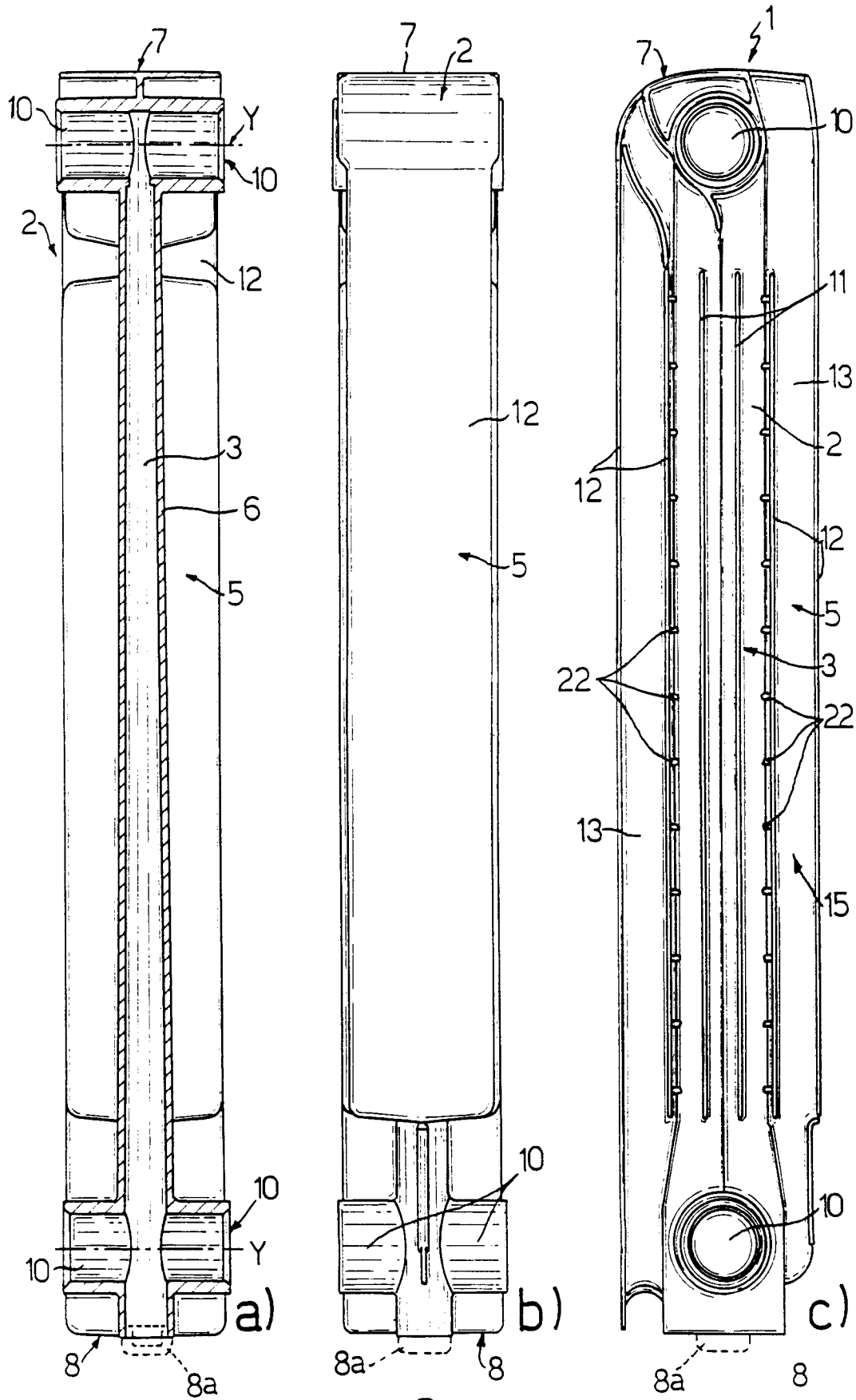


Fig. 3