United States Patent [19]

Armonies et al.

[11] 3,908,758

[45] Sept. 30, 1975

[54] HEATING OR COOLING RADIATOR

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[22] Filed: Dec. 1, 1972

[21] Appl. No.: 311,403

[30] Foreign Application Priority Data

Dec. 8, 1971 Germany 2160865
Aug. 26, 1972 Germany 2242159

[52] U.S. Cl. 165/174; 165/175
[51] Int. Cl.² F28F 9/02
[58] Field of Search 165/174, 175

[56] References Cited

UNITED STATES PATENTS

1,208,022	12/1912	Schlacks	165/173
2,001,663	5/1935	Carlson	165/174 X
3,153,447	10/1964	Yoder et al.	165/175 X
3,196,943	7/1965	Haerter	165/174
3,670,812	6/1972	Bemrose	165/175

FOREIGN PATENTS OR APPLICATIONS

217,557	2/1961	Austria	165/174
984,910	3/1965	United Kingdom	165/175
1,078,146	3/1960	Germany	165/174
1,042,098	10/1958	Germany	165/174
964,166	5/1957	Germany	336/57

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Assistant Examiner—Sheldon Richter
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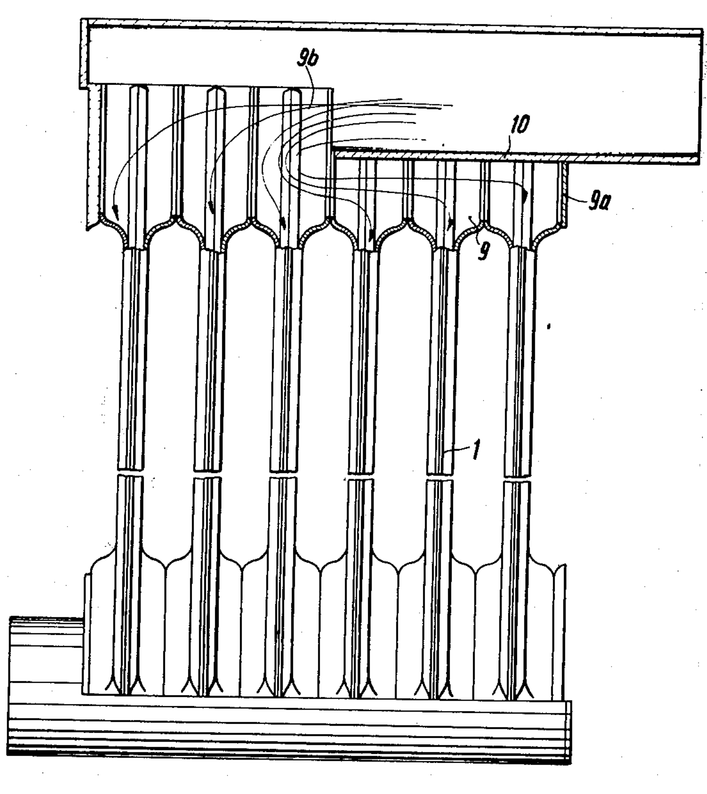
[57] ABSTRACT

A radiator with upper and lower manifolds and a series of radiator members extending therebetween, where at least the upper manifold chamber has in a first length portion an upper flow channel through which the incoming fluid initially bypasses a first group of radiator member throats and reaches the latter after reversal, via a lower flow channel.

5 Claims, 14 Drawing Figures



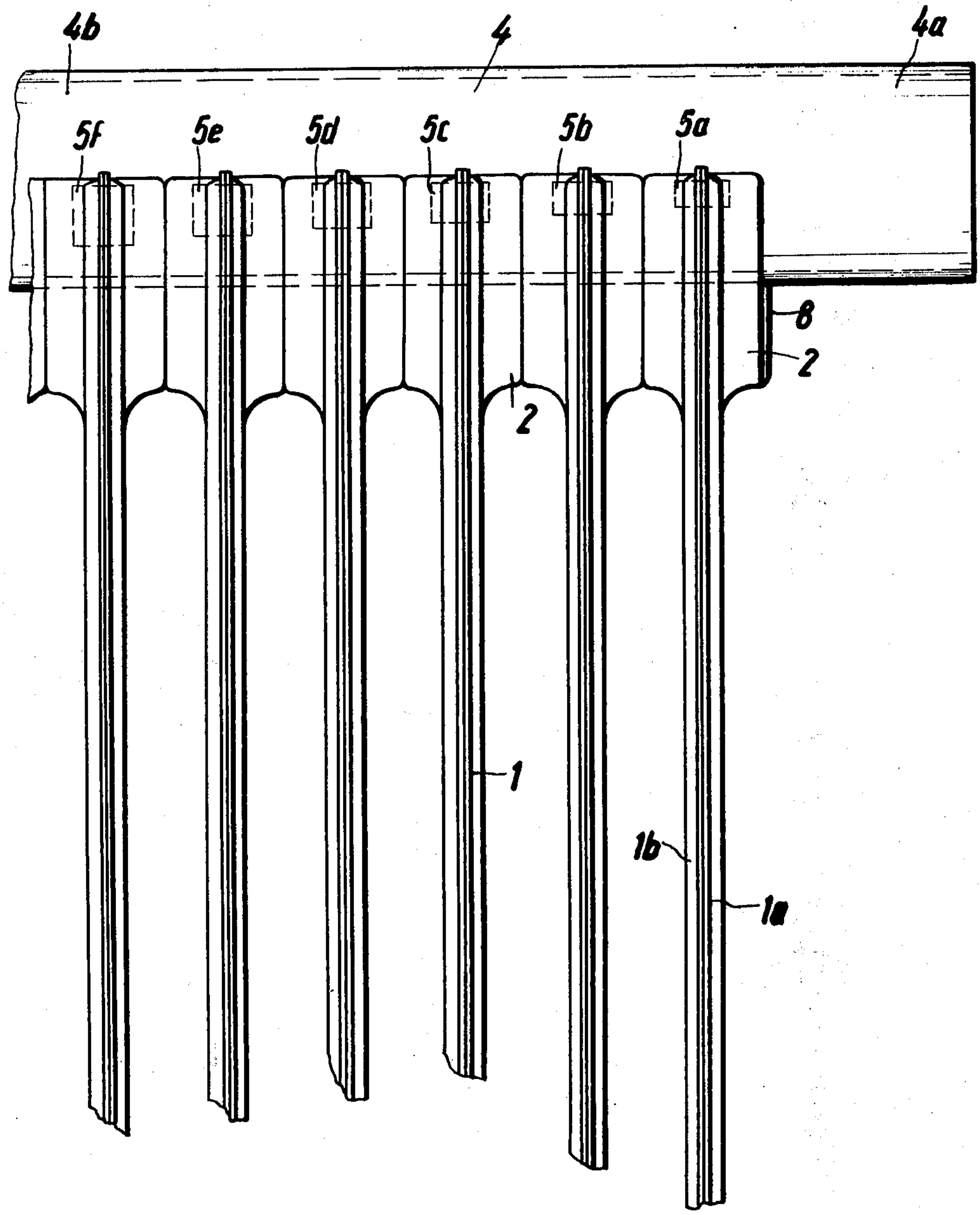


Fig.1

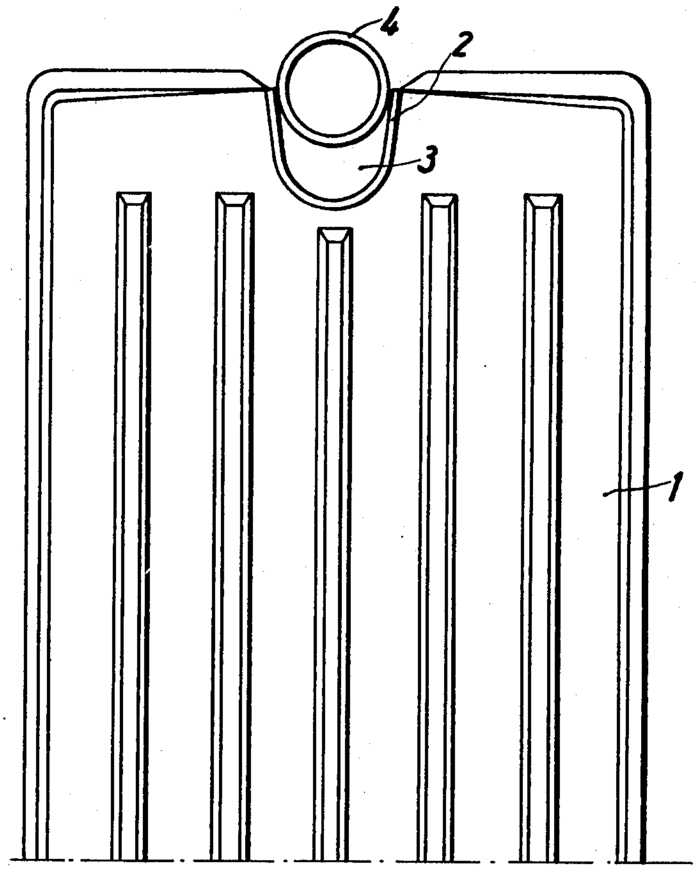


Fig. 2

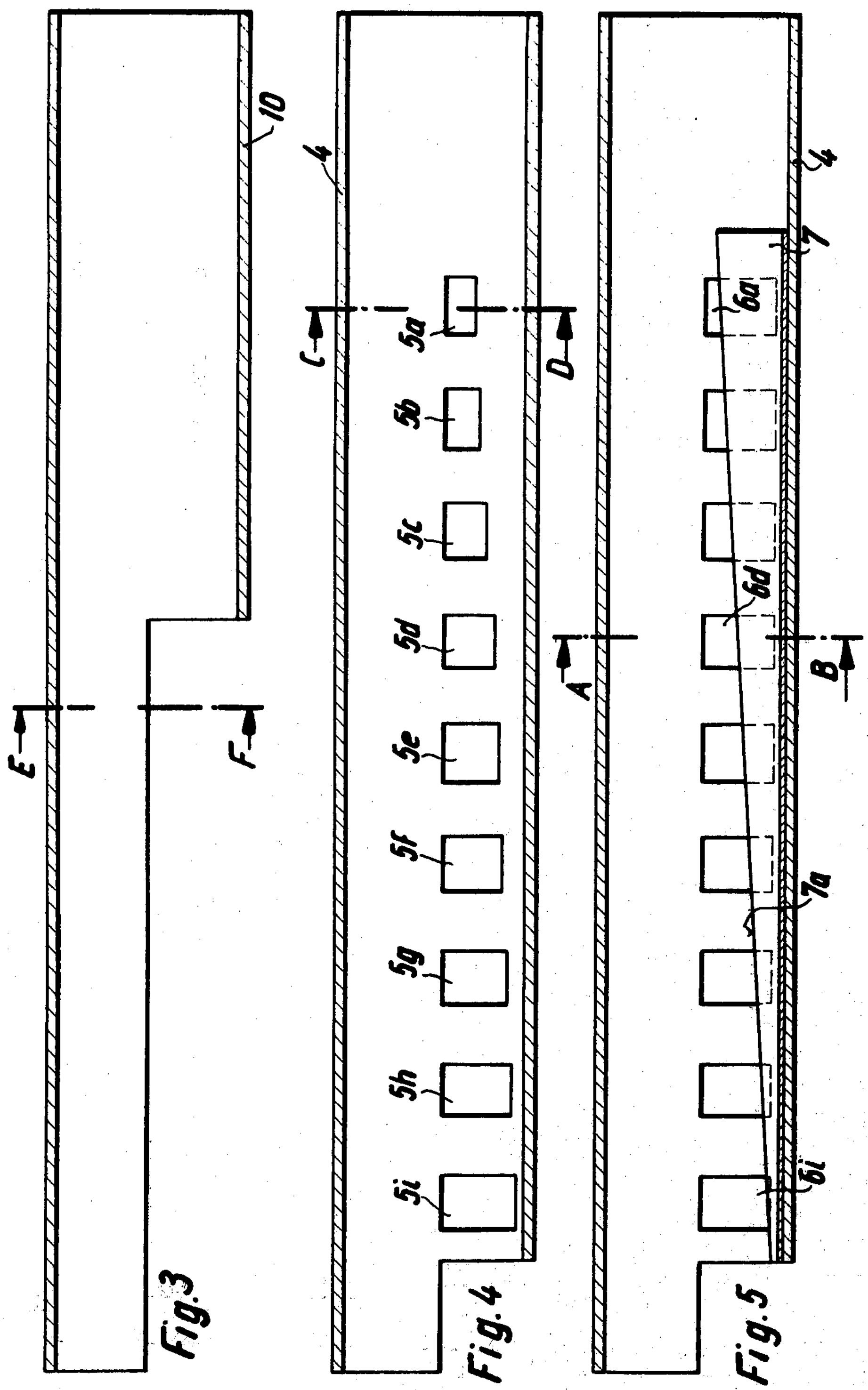

10
E
F
Fig.3
4
C
D
5a
5b
5c
5d
5e
5f
5g
5h
5i
Fig.4
4
7
6a
6d
A
B
7a
6i
Fig.5

Fig. 6
("A-B")

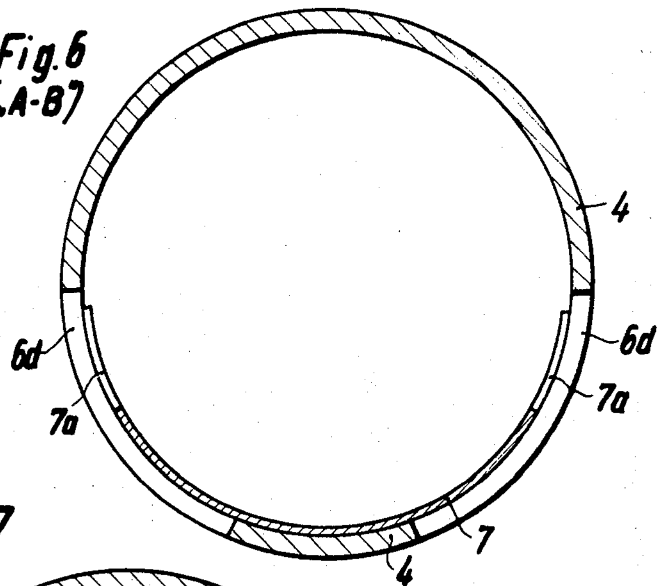


Fig. 7
("C-D")

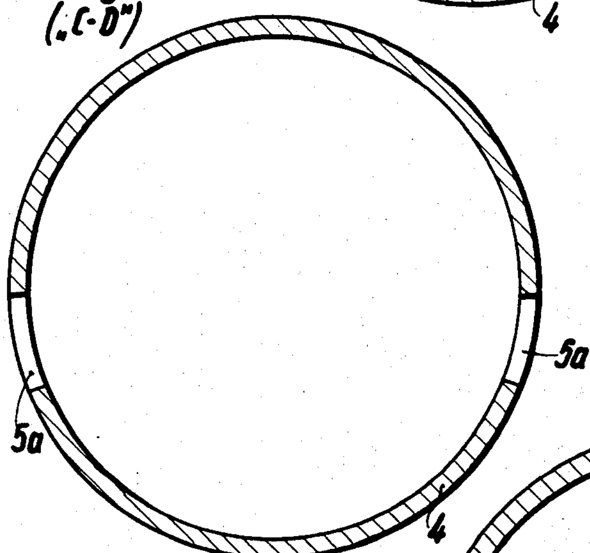


Fig. 8
("E-F")

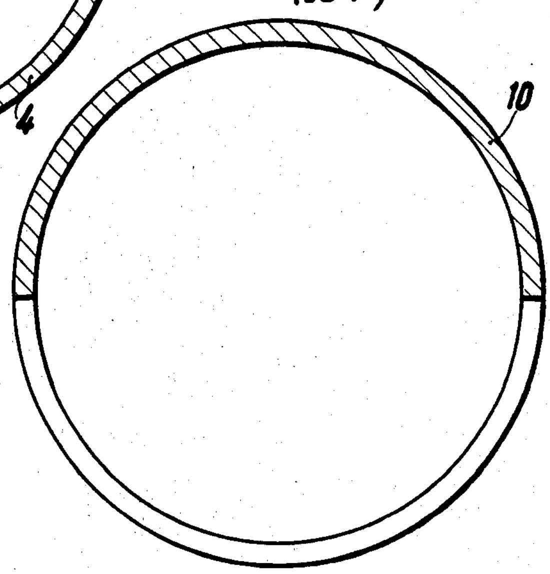


Fig. 9

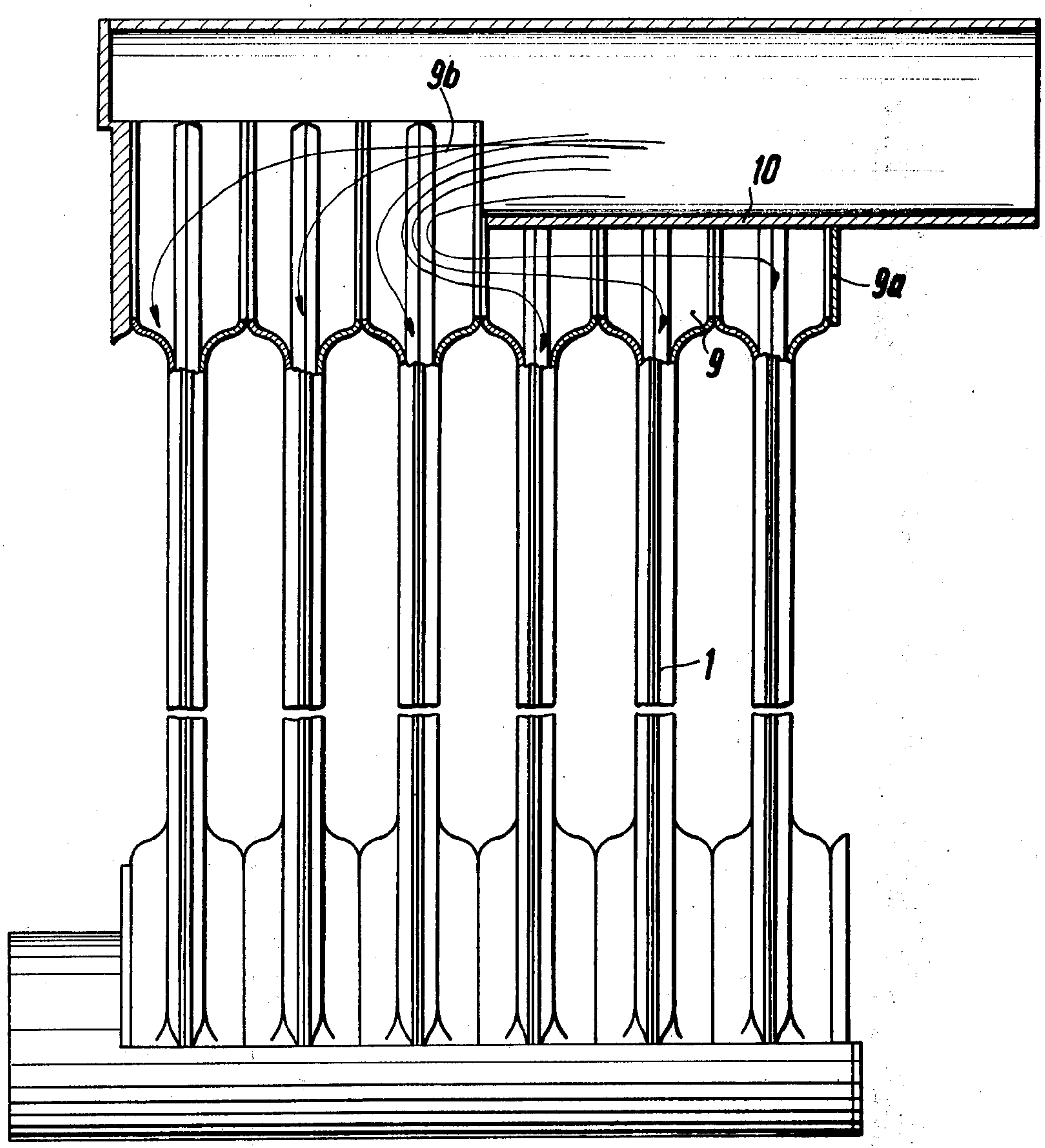
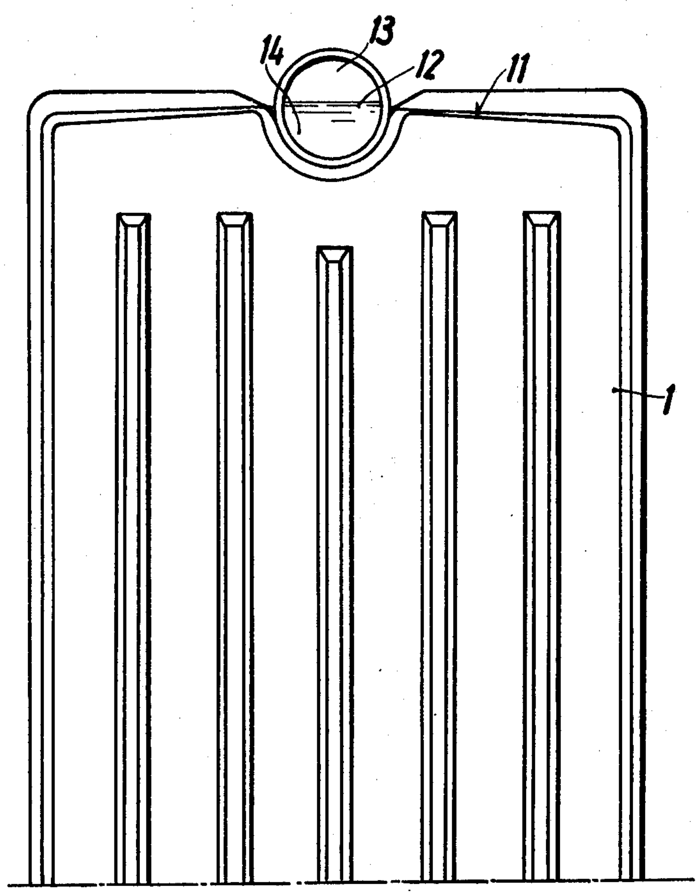


Fig.10



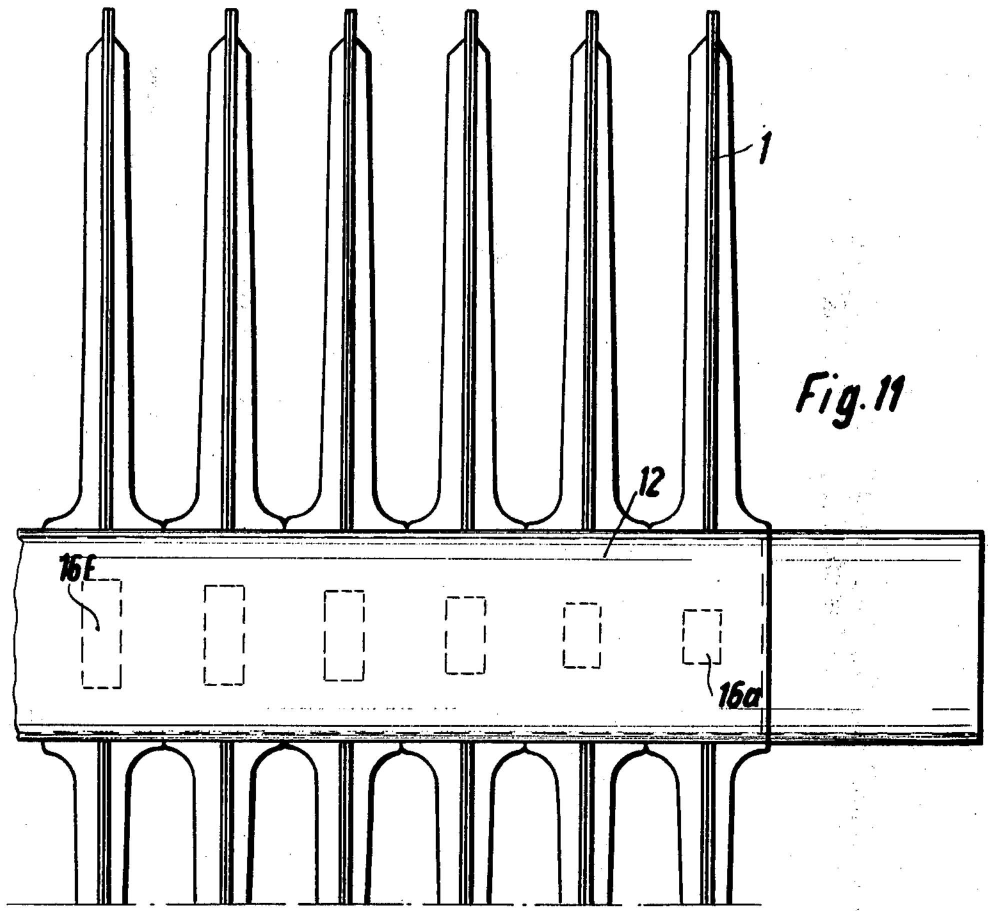


Fig. 11

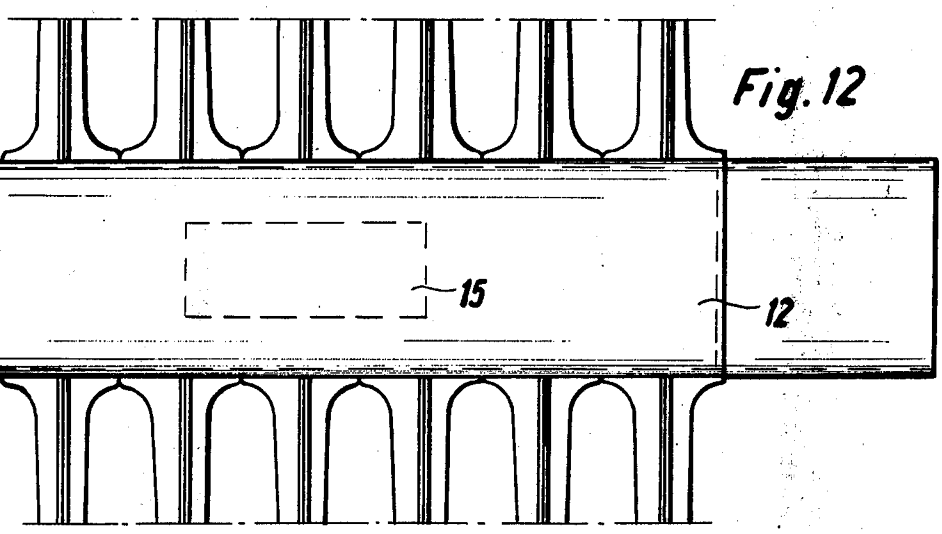
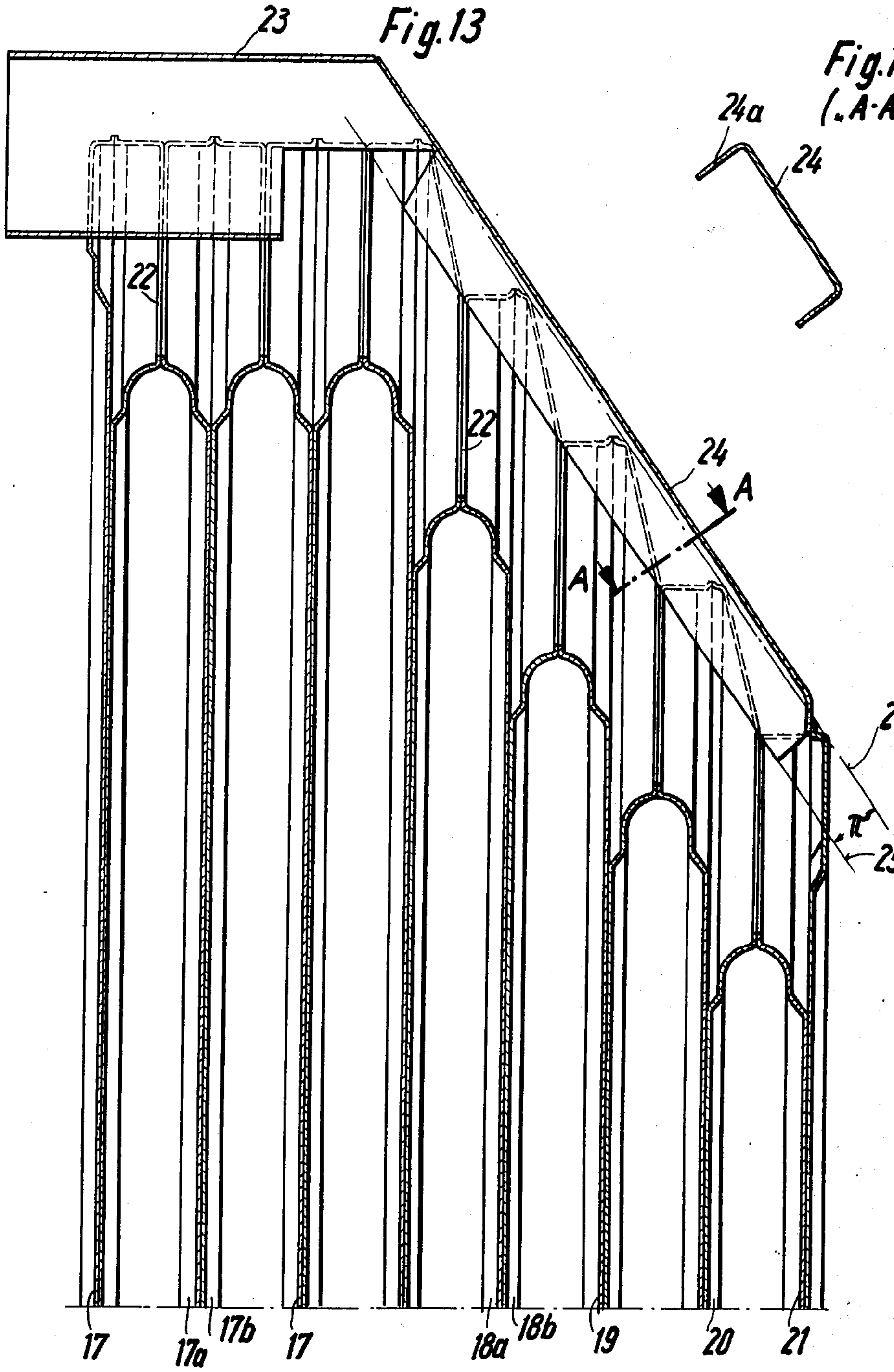


Fig. 12

Fig.13

Fig.14
(„A-A")



HEATING OR COOLING RADIATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention concerns a heating or cooling radiator, more particularly for cooling the oil of oil-cooled transformers.

2. Description of the Prior Art

Radiators of this type comprise a predetermined number of radiator members arranged in parallel and provided at their upper and lower ends with throat portions serving for the connection of the members to each other and to the radiator manifolds which lead to the transformer vessel and the main flow system. The compact manifold chambers thereby formed at the upper and lower ends of the radiator serve to distribute the heat transfer medium to the individual radiator members and to form a collecting outlet. The manifold chambers are provided in part by the half-shells forming the radiator member throat portions which are formed with a semi-circular recess at the top and bottom. After the half-shells and members are joined together to form a radiator, a continuous half-pipe is mounted on the resultant throat profile. The continuous half-pipe serves on the one hand for the closing of the radiator on the outside and, on the other hand, to provide mechanical strength.

A radiator for oil-filled transformer vessels is known wherein the throat portions are stamped and shaped from the body of the radiator half-shells as closed collars so that, when the half shells are joined together, they define closed members which are open only on the side where they adjoin other members. For producing the radiator in this case it is only necessary to weld the members together at their throat portions. It is not necessary to add a half-pipe.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a radiator having improved cooling or heat exchange properties, as well as greater strength, particularly in the throat junction area.

The radiator of the present invention is characterized by the feature that the upper and/or lower manifold chamber is provided with flow bypass means for the heating or cooling medium and is constructed and arranged to operate so as to distribute the medium to the radiator members in such a way that the temperature at the throats of the radiator members is the same or at least approximately the same over the entire length of the intake manifold. It was unexpectedly discovered that the arrangement of the present invention, with which a predetermined positive control of the flow is effected, brings with it a very considerable improvement in the efficiency of cooling, the latter rising more than proportionally with an increasing number of members, as compared with conventional radiators. Tests seem to confirm that this result is attributable to the more even distribution of the coolant and, hence, to a more even distribution of the heat load over the surface of the entire radiator.

In a preferred embodiment of the present invention the manifold may be formed by a series of upper member openings of elongated oval throat shape, which openings are closed to the outside by means of a pipe having a diameter corresponding to the opening width of the throats, the pipe communicating with the manifold chamber in the region of the outer members remote from the manifold inlet through a longitudinal cut-away.

As a result of this construction of the radiator, the entering coolant arrives in a compact flow in the center area of the radiator manifold, from where, under the suction exerted by the transformer vessel, it flows in reverse into the elongated oval space and, due to the deflection by the upper manifold pipe, is distributed substantially uncooled to the individual members of the radiator. Thus, a particularly uniform head temperature is achieved at the inlet into the radiator members which results in a more even surface heat load. In this manner, an improvement of the cooling efficiency of more than **10** percent, as compared with conventional radiators, is obtained. The same effect is obtained with a radiator inside whose manifold chamber is a continuous intake pipe having an opening into the chamber in the center of the manifold length.

In the case of mobile transformers utilizing the radiator of the present invention, and more particularly in the case of railway transformers in which the outer radiator members are stepped externally for adaptation to tunnel, bridge, and viaduct outlines, the stepped members of the radiator are provided with elongate oval throats for forming the manifold chamber, and the resultant stepped manifold chamber is closed by means of a flat, arched, or ridged U-shaped profile, the side legs of the profile having a length approximately equal to the vertical distance between the edge line of the radiator throats and the top line of the members.

A stepped radiator designed in this manner has a much smaller lateral overhang, while retaining the necessary full flow cross-section for the coolant in the upper manifold, compared with conventional stepped radiators, so that the stepped portion of the radiator can begin further away, while obtaining an equivalent cooling surface. The resultant improvement in the cooling efficiency makes it possible to construct smaller units or to choose a higher transformer power output with the same size vessel, a feature which, particularly in the case of series installations on railroad equipment, results in a considerable reduction in the number of required units for such a series installation for the same total power.

In another embodiment, the upper or lower manifold chamber may be formed by a single pipe, or such a continuous manifold pipe may be provided inside an enlarged manifold chamber, said pipe connecting the radiator to the cooling vessel or heating system and having one or more openings in the region of each radiator member throat, the opening cross-section increasing progressively from the inlet end to the closed end of the manifold. In this case, the openings are preferably formed on both sides of the inner manifold pipe, thus facilitating the transfer of any air bubbles from the radiator to the manifold pipe and the discharge thereof. To simplify the manufacture, the openings in the pipe may all have an identical cross-section, and a longitudinal sector of tubing with a slanting edge may be inserted in the pipe, whereby the desired progression in the cross-section of the openings can be produced with only a few standardized parts. For adjusting the desired cross-sectional progression, it is then only necessary to insert the standardized pipe section to a greater or lesser depth into the manifold pipe and to cut it, if necessary, in the correct position. In this way, the necessary changes in cross-sectional progression may be readily adapted to change in the number of radiator members from radiator to radiator.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a side view of a radiator embodying the invention;

FIG. 2 is an end elevation of the radiator of FIG. 1 or FIG. 9, as seen from the right-hand end;

FIG. 3 is a longitudinal section through a manifold pipe for a radiator of the invention;

FIGS. 4 and 5 are similar longitudinal sections through two modified manifold pipes;

FIGS. 6, 7 and 8 are sections taken along the lines A – B, C – D, and E – F, of FIGS. 5, 4, and 3, respectively;

FIG. 9 is a side view of a radiator of the invention, utilizing a manifold pipe like the one shown in FIG. 3;

FIG. 10 is a side view of another radiator embodying the invention;

FIGS. 11 and 12 are plan views of two modifications of the radiator manifold shown in FIG. 10;

FIG. 13 is a partial longitudinal section through a stepped radiator; and

FIG. 14 is a cross section taken along line A — A of FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIGS. 1 and 2 of the drawings, the individual radiator members are formed by joining together radiator half-shells **1***a* and **1***b*. The half shells and consequently the radiator members each have throat portions **2** formed at their ends with, in the case of the embodiment shown, an elongated oval cut-out **3** (FIG. 2) which defines the cross-sectional outline of the manifold chamber to the extent that the latter is defined by the radiator members. The manifold chamber is closed externally by the upper portion of the pipe **4**. The free end **4***a* of the manifold pipe is welded to the connecting pipe socket of the main supply system, i.e., in the case of a heating radiator, to the heating medium supply line, or, in the case of a cooling radiator for a transformer vessel, to the vessel connecting sockets. The manifold chamber serving to distribute the heating medium or coolant to the radiator members is defined between the member throats **3** and the half-pipe **4**. Positive flow guides are provided in the upper part of the manifold chamber for directing the heating or cooling medium to the radiator members in such a manner that the radiator temperature is the same or at least approximately the same over the entire length of the radiator manifold.

In the case of the embodiment shown in FIGS. 1 and 2, a continuous manifold pipe is provided in the upper portion of the manifold chamber **3**, the latter being enlarged for an elongated oval cross-section so that the pipe **4** can be a continuous pipe, serving as the external chamber limitation. Facing each radiator member **1**, the manifold pipe **4** may have openings **5***a* through **5***i* (see FIG. 4) which openings increase in cross-section from the inlet end **4***a* to the opposite end **4***b*. Two openings **5***a* are preferably provided in each member plane, as shown in FIG. 7, for example, so as to enable the pipe to communicate with the radiator throat chamber directly below the horizontal junction line with the external manifold closure, so as to allow rising air bubbles in the radiator to readily pass into the manifold pipe and to be discharged.

In the embodiment shown in FIG. 4, the openings are stamped out in the manifold pipe in the proposed progression of sizes. However, the openings may also be formed in the manner shown in FIGS. 5 and 6, so that the pipe **4** itself is provided with openings **6***a*, **6***d* . . . **6***i*, of identical cross-section, but the openings are partially covered by the insertion of a baffle **7** of arcuate cross-section with slanting edges **7***a* to form openings of progressively increasing cross-section. In this manner the manifold pipes may be standardized for radiators of various types and may have any number of members, and the graduation of the openings may be obtained by inserting a tube sector which is preferably stamped and shaped in one standardized size, sliding it into place and cutting-off projecting portions. The manufacture of the novel radiators is greatly simplified in this manner. Due to the downward extension of the manifold chamber, which is longitudinally closed by a closure plate **8** (FIG. 1), the member throats are also communicating with each other. However, the members may also be closed-off from each other, as in the case of an embodiment where the radiator does not have a downwardly extended manifold chamber, in which case the member throats communicate with each other only through the openings in the manifold pipe and possibly through the lower manifold chamber.

A preferred embodiment is shown in FIGS. 3, 8, and 9, which embodiment has its manifold chamber **9** (FIG. 9) partially defined by downwardly enlarged throats and the remaining upper manifold chamber portion is closed by means of a half-sectioned pipe **10** having a diameter corresponding to the transverse width of the member throats. This design of the radiator throat junctions and of the manifold pipe, while not complicating the manufacture of the radiator, affords a considerable reinforcement of the radiator structure. In addition, it produces a more even distribution of the heat to be transferred to the cooling surface of the radiator, because the cooling or heating medium fed into the manifold chamber portion **9***b* reaches the radiator members approximately in the manner indicated by the arrows in FIG. 1, under the action of the suction exerted by the transformer vessel, in a flow which is guided by the manifold inlet pipe for an even distribution.

The same effect is achieved with the embodiment of the radiator shown in FIGS. 10 and 12, wherein, on the basis of downwardly extended or unextended (as shown) manifold chamber approximately at the level of the upper edge **11** of the radiator, a continuous baffle plate **12** is provided approximately in the center area of a comparatively large inlet opening **15** — see FIG. 12, which plate divides the manifold chamber into an upper closed cooling medium inlet channel **13** and the lower chamber **14** connecting the individual radiator members together but closed on the outside. In this embodiment, in the case of radiators having a round, i.e. not enlarged, throat portion, an effect corresponding to the embodiment shown in FIG. 9 is also obtained, whilst an effect corresponding to the embodiment shown in FIG. 1, with otherwise the same structure, may be obtained, if the baffle plate **12** (FIG. 11) is provided in the region of each radiator member with openings **16***a* through **16***f*, the openings having a progressively increasing cross-section from the inlet end of the radiator, at **16***a* to the closed end of the radiator at **16***f*.

In the case of a stepped radiator as shown in FIGS. **13** and **14**, the step-free members are indicated by reference numeral **17** and the regularly stepped members by reference numeral **21**. The radiator members are assembled from half shells *a* and *b* and are provided at the upper and lower ends with throat recesses **22** open at the top and arranged opposite each other. The throat recesses are formed by cut-outs at the top having an elongate oval form and are closed in the region of the step-free members by means of a manifold pipe **23** having a cut-away at its downstream end with a diameter corresponding to the throat width. In the region of the stepped members **18** – **21**, the manifold chamber is closed by means of a U-shaped profile **24** (see FIG. **2**), the side legs **24***a* of which have a length approximately equal to the inner spacing π between the top line **25** of the throat edges and the top line **26** of the members.

In this manner, a minimum overhang of the radiator members is achieved whilst retaining a sufficiently large flow cross-section of the radiator in the stepped section and the maximum overhang does not exceed the overhang of the radiator members themselves. The space gain corresponds approximately to the width of one radiator member so that, relative to conventional stepped radiators, the beginning of the stepping can be shifted outwardly by that one radiator member with a corresponding considerable gain in effective cooling surface area.

We claim:

1. A radiator assembly for the circulation therethrough of a heat transfer fluid such as the cooling oil of a transformer, for example, the assembly comprising:

a generally horizontally oriented inlet manifold having a closed end on one side and an inlet opening on its opposite side connectable to a fluid circulating system;

a generally similarly oriented outlet manifold spaced a distance below the inlet manifold and having likewise a closed end on one side and an outlet opening on the opposite side connectable to said fluid circulating system;

a plurality of hollow radiator members extending generally vertically and at regular intervals between the two manifolds, each radiator member including upper and lower openings for communication with both manifolds; and wherein

at least the inlet manifold has its length subdivided into first and second length portions, the latter encompassing corresponding first and second groups of upper radiator member openings, respectively;

the first manifold length portion has its flow section longitudinally subdivided into an upper flow channel leading from the inlet opening of the manifold directly to its second length portion, and a lower flow channel leading from the second manifold length portion to said first group of radiator member openings, thereby forcing the entire incoming fluid flow to initially bypass the first group of radiator member openings, the latter being reachable only through reversal of a portion of said flow, via the lower flow channel; and

at least said inlet manifold is constituted in its upper portion by a manifold pipe and in its lower portion by adjoining enlarged throat portions at the upper ends of the radiator members.

2. A radiator assembly as defined in claim **1**, wherein:

said manifold pipe has a full circumference in said first length portion of the manifold, thereby defining said upper flow channel, but has at least a major portion of the lower half of its circumference missing in said second manifold length portion;

the throat portions of the radiator members having adjoining collars, upwardly curved in a cradle-shaped profile and connected to the manifold pipe at both ends of the cradle profile; and

said axially adjoining collars define the lower flow channel in said first length portion of the manifold in cooperation with the lower half of the manifold pipe.

3. A radiator assembly as defined in claim **2**, wherein:

the manifold pipe is a round pipe, said missing lower circumferential portion being the lower half of the pipe; and

the width of said cradle profile defined by the radiator member throat portions is substantially equal to the diameter of the manifold pipe.

4. A radiator assembly as defined in claim **2**, wherein:

the intake manifold has an angled longitudinal axis, its first length portion near its inlet opening being oriented substantially horizontally and its second length portion being slanting downwardly away from said first length portion; and

the radiator members of said first group are of uniform length and the radiator members of said second group are progressively shorter so as to present a stepped line of collar joints with the slanting manifold length portion.

5. A radiator assembly as defined in claim **1**, wherein

said first and second length portions of the manifold have substantially the same length; and

the first and second groups of radiator members are substantially equal in numbers.

* * * * *