Sept. 17, 1940. W. R. CLARKE 2,215,173

STEAM RADIATOR

Filed Oct. 31, 1939

Fig. 1

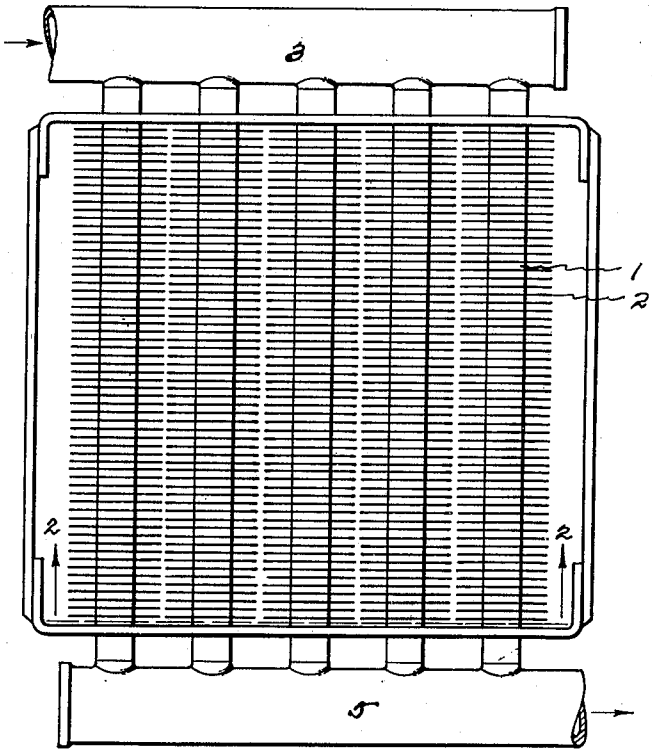


Fig. 3

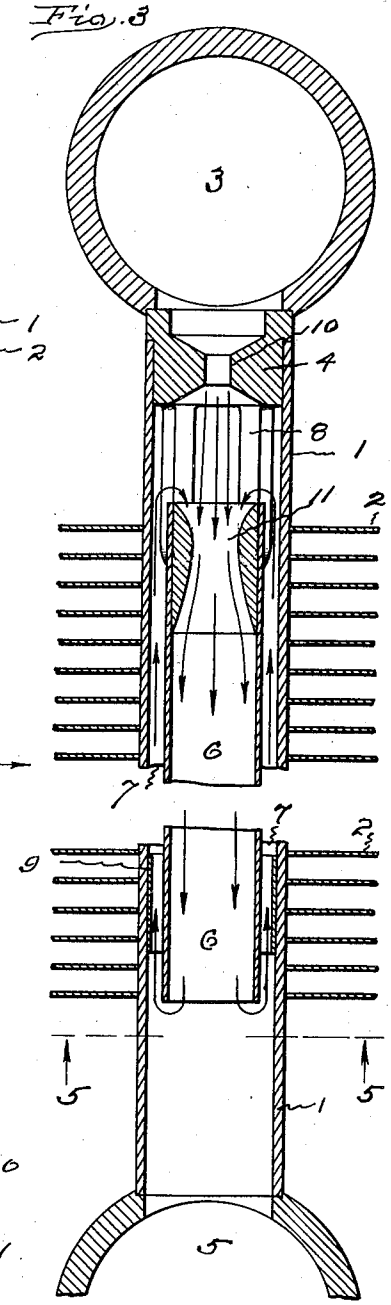


Fig. 2

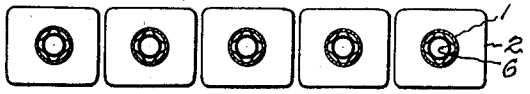


Fig. 4

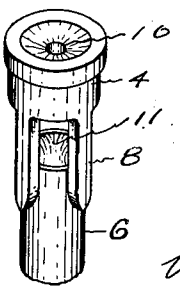


Fig. 6

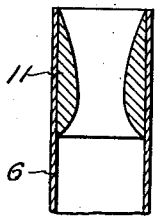
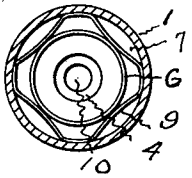


Fig. 5



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STEAM RADIATOR

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Application October 31, 1939, Serial No. 302,071

5 Claims. (Cl. 237—74)

This invention relates to the construction of tubular radiators of the plain coil or extended radiation surface type which are supplied with steam as the heating medium and which are used in localities or under conditions where the radiators are exposed to considerable variation of exterior temperature, as, for example, where outside air is blown across them.

These radiators are commonly used in heating systems which are controlled by thermostatic means and according to the temperatures desired at some periods a full volume of steam is required to meet the demand and at other periods a smaller volume of steam is sufficient.

The object of this invention is to so design the interior of such radiators that whether assembled for use as a single unit or in a battery of units the temperature of each unit from the steam supply end to the condensate return end will be uniform regardless of the volume or pressure of steam supplied and thus eliminate condensation at the return end where it would tend to obstruct free circulation of steam through the tubes when a small volume or low pressure of steam was adequate to maintain the desired temperature, and where such condensate would be liable to freeze and burst the tubes when subjected to draughts of air at below freezing temperatures.

In the accompanying drawing Fig. 1 shows a front view of a radiator which embodies the invention.

Fig. 2 is a section on the dotted line 2—2 on Fig. 1, looking upward.

Fig. 3 shows on larger scale a vertical section of a unit of the radiator.

Fig. 4 is a fragmentary view of the upper end of the inner element of the unit.

Fig. 5 is a section of the unit on dotted line 5—5 on Fig. 3.

Fig. 6 shows a modified shape of Venturi throat for the upper end of the inner element of the unit.

Each unit of the radiator illustrated has an outer element which preferably is in the form of a pipe or tube 1 that is seamless and has an extended or finned exterior radiating surface 2. The supply end of this element is designed to be connected to a steam supply pipe or header 3 by means of a nozzle 4, and the return end is designed to be connected to a return pipe or header 5. Each unit also has an inner element that may be in the form of a pipe or tube 6, of smaller cross section than the outer element, arranged within the outer so as to provide a space 7 between the two elements. This inner element is shown as secured at its supply end to legs 8 which project from the nozzle 4, and at its return end it is supported by a spider 9 so that the supply end will be centrally located below the orifice 10 through the nozzle and its return end be above the opening to the return header, and the space between the two elements will be uniform. The inner element is open at its supply end between the legs 8 of the nozzle 4 to the space between the two elements and it is open at its return end to the space between the elements above the opening to the return header. The supply end of the inner element has a Venturi throat 11 which may be of the shape shown in Fig. 3 or the reverse shape shown in Fig. 6, depending upon the result desired.

Steam emerging from the orifice 10 in the nozzle 4, whether of large or small volume, and passing through the Venturi throat 11 induces a suction above the throat and creates a draught which tends to draw vapor from the space between the elements into the supply end of the inner element and thus cause a continuous circulation of steam or vapor from the supply end to the return end through the inner element and from the return end to the supply end of the inner element through the space between the elements. This flow and circulation of steam or vapor causes the heating of the return end of the outer element before it heats the supply end of that element and therefore such condensation in the outer element as results from effect of the lower temperature of the exterior atmosphere to which the radiator may be subjected is uniform and the outer element heated evenly. The units may be used singly or may be assembled in a battery of units, a series of five being illustrated.

This invention is particularly adapted for so-called blast heaters, that is, those heaters through which steam is circulated for warming air blown or drawn across its exterior surfaces by means of a fan. When the heater is full of steam it is immaterial how cold the exterior air is, there is no danger of freezing the condensate as the units are heated the same at all points. However if the temperature of the air to which the heater is subjected is below freezing and the steam supply is reduced below its normal maximum volume the heater, without the circulation provided by the present invention, would be only partially full of steam, all of which would be at the supply end and this would be condensed as rapidly as it flowed in and the condensate would drip down

through the cold lower portion of the heater with the liability of becoming frozen before it reached the return header and causing fracture. Even if the condensate did not freeze the temperature of the supply end of the heater would be high and the temperature of the return end of the heater would not be raised at all. With such a condition there would be a stratification of heat eminating from the heater, and the temperature could not be satisfactorily controlled by thermostatic means located in the return which is a common arrangement.

The present invention overcomes the liabilities mentioned by producing a continuous circulation of steam at all pressures and volumes throughout the entire length of the inner and outer elements through the means of the suction action resulting from the jet that enters through the small nozzle orifice and passes through the Venturi throat in the inner element and causes the steam or vapor to flow back from the return header between the two elements and into the inner tube element and commingle with the entering steam which keeps the temperature of the condensate above freezing temperature.

The invention claimed is:

1. A steam radiator comprising a tubular supply header, a tubular return header, a plurality of heat radiating tubes each connected at one end to the supply header and at the other end to the return header, imperforate tubes of less diameter than the interior diameter of said radiating tubes extending longitudinally a substantial distance within and spaced from said radiating tubes, said imperforate inner tubes being open at both ends to the space within the radiating tubes and having Venturi throats in the ends adjacent the supply header, means with restricted openings from the supply header positioned to project steam from the supply header into said throats and cause steam to flow in one direction through the interior of the inner tubes and in the opposite direction about the exterior of the inner tubes, and radiating fins extending from said radiating tubes.

2. A steam radiator comprising a tubular supply header, a tubular return header, a plurality of heat radiating tubes each connected at one end to the supply header and at the other end to the return header, imperforate tubes of less diameter than the interior diameter of said radiating tubes extending longitudinally a substantial distance within and spaced from said radiating tubes, said imperforate inner tubes being open at both ends to the space within the radiating tubes and means with restricted openings from the supply header positioned to project steam from the supply header into said inner tubes and cause steam to flow in one direction through the interior of the inner tubes and in the opposite direction about the exterior of the inner tubes, and radiating fins extending from said radiating tubes.

3. A steam radiator comprising a tubular supply header, a tubular return header, a plurality of heat radiating tubes each connected at one end to the supply header and at the other end to the return header, imperforate tubes of less diameter than the interior diameter of said radiating tubes extending longitudinally a substantial distance within and spaced from said radiating tubes, said imperforate inner tubes being open at both ends to the space within the radiating tubes and having Venturi throats in the ends adjacent openings from the supply header whereby steam is caused to flow in one direction through the interior of the inner tubes and in the opposite direction about the exterior of the inner tubes, and radiating fins extending from said radiating tubes.

4. A steam radiator comprising a tubular supply header, a tubular return header, a plurality of heat radiating tubes each connected at one end to the supply header and at the other end to the return header, imperforate tubes of less diameter than the interior diameter of said radiating tubes extending longitudinally a substantial distance within and spaced from said radiating tubes, said imperforate inner tubes being open at both ends to the space within said radiating tubes, means with openings from the supply header positioned to project steam from the supply header into said inner tubes and cause steam to flow in one direction through the interior of the inner tubes and in the opposite direction about the exterior of the inner tubes, and radiating fins extending from said radiating tubes.

5. A steam radiator comprising a tubular supply header, a tubular return header, a plurality of heat radiating tubes each connected at one end to the supply header and at the other end to the return header, imperforate tubes of less diameter than the interior diameter of said radiating tubes extending longitudinally a substantial distance within and spaced from said radiating tubes, said imperforate inner tubes being open at both ends to the space within said radiating tubes, and means for causing steam to flow in one direction through the interior of the inner tubes and in the opposite direction about the exterior of the inner tubes, and radiating fins extending from said radiating tubes.

WALTER R. CLARKE.