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K. W. ROHLIN

2,097,602

RADIATOR

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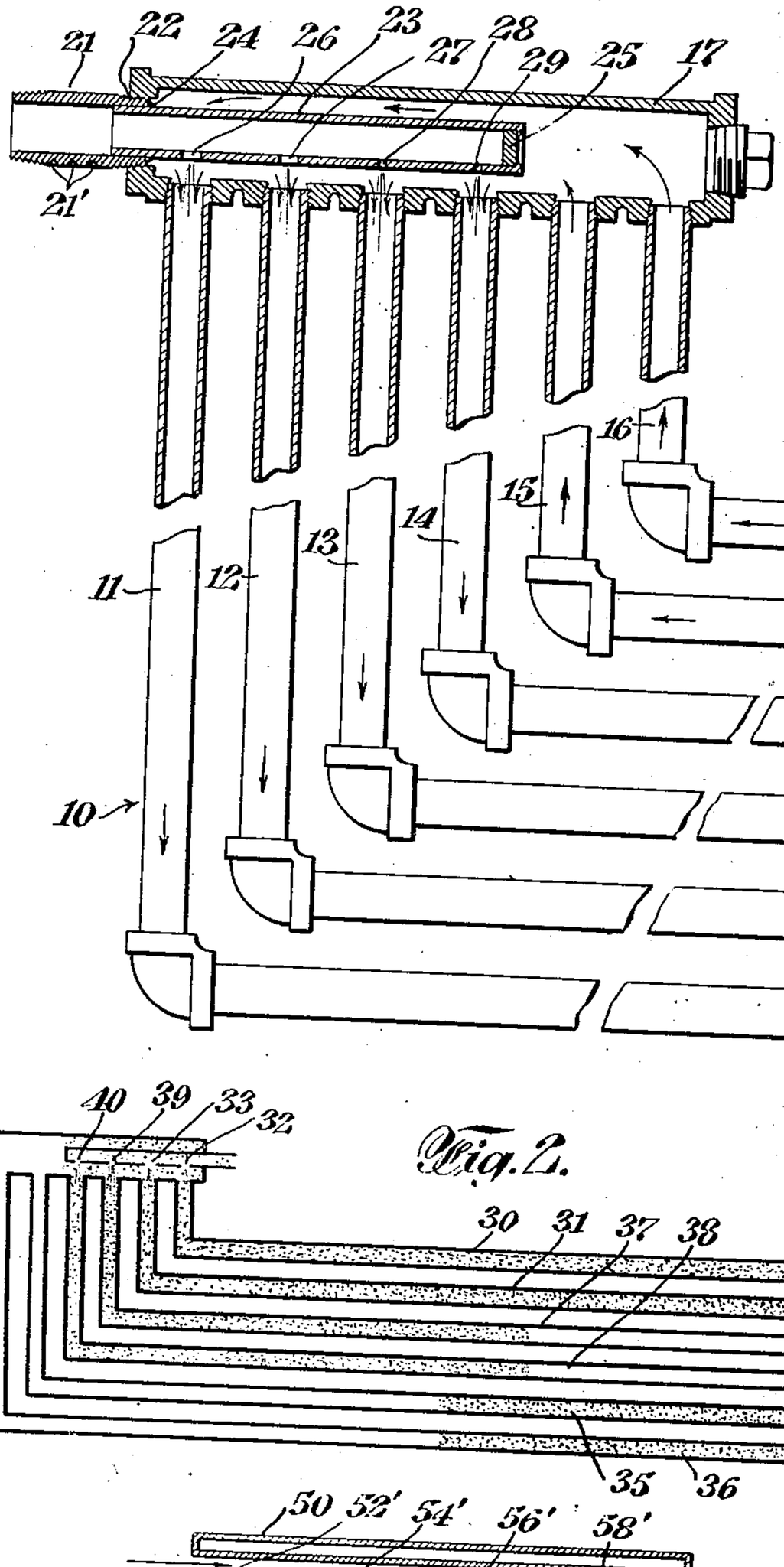

Fig. 1.

Fig. 2.

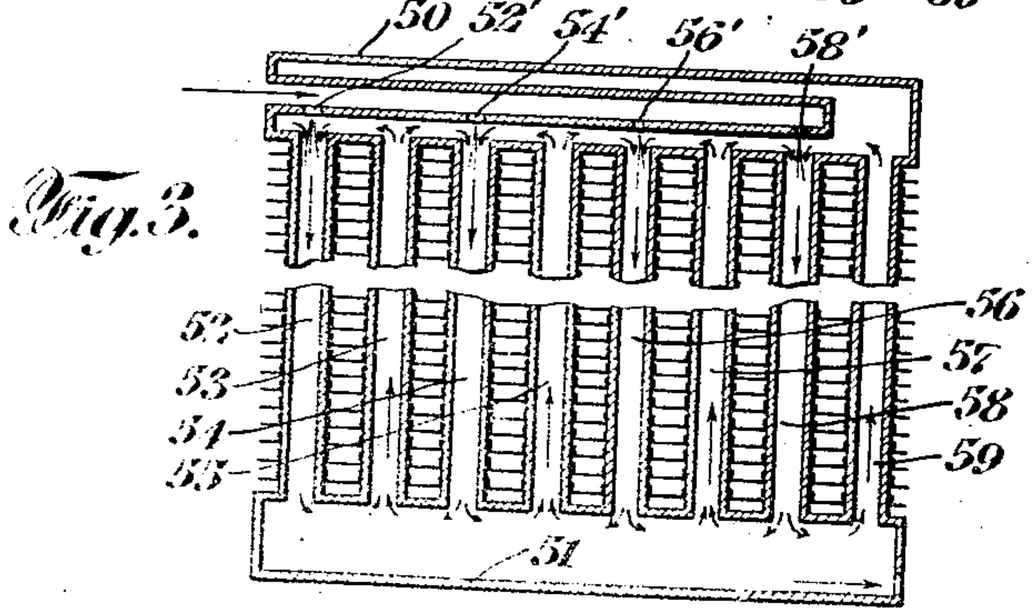

Fig. 3.

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RADIATOR

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5 Claims. (Cl. 237—74)

This invention relates to radiators for steam heating systems or the like heating units, and methods for introducing and distributing steam therein, whereby the steam is efficiently mixed with any air which may also be present in the radiator, and the mixture is circulated for more uniformly heating the radiating surfaces of the heating unit.

My invention is particularly adapted for providing more uniform heating of radiating units such as of the type known as "pipe coils", school classroom heating units or "ventilating" units, as well as the heating elements of so-called blast or centrifugal fan heating systems. With such "pipe coil" units as heretofore used, if the unit is of any considerable length, in moderate weather the end of the unit remote from the steam supply line is almost invariably substantially cold, and the heating effect is concentrated at that part of the unit at or near the steam supply line. Thus spaces adjacent the remote end of the unit are insufficiently heated and yet the spaces adjacent the supply line end of the unit are excessively heated, with highly unsatisfactory consequences. This difficulty is particularly pronounced with heating units installed for use with warm air ventilating units and with blast or fan systems with which part of the air admitted to rooms to be heated will be substantially cold, whereas other blasts of air will be excessively heated, in moderate weather or other times when the steam delivery to the "pipe coils" is reduced.

However, the features of my invention enable substantially uniform heating of the spaces adjacent all parts of radiating units of the above indicated character, even if the units are of unusual length or size.

Various further and more specific objects, features and advantages will clearly appear from the detailed description given below taken in connection with the accompanying drawing which forms a part of this specification and illustrates merely by way of example, certain preferred forms of the apparatus of the invention.

The invention consists in such novel features, arrangements and combinations of parts as may be shown and described in connection with the apparatus herein disclosed, and also such novel methods and combinations of method steps as are disclosed and described herein.

In the drawing, Fig. 1 is an elevational view partly in section illustrating a preferred form of my invention as applied to a typical "pipe coil" heating unit;

Fig. 2 schematically illustrates the manner in which steam is distributed in a "pipe coil" similar to that of Fig. 1, at a time when the steam supply is approximately one-half of that which would be supplied for normally heating the entire unit; and

Fig. 3 is a sectional view of an alternative embodiment of my invention.

Referring to Fig. 1, a common type of "pipe coil" is indicated at 10 having a plurality of tubes as at 11 to 16 inclusive, arranged in a generally parallel relationship and all interconnected at one end of the unit by a supply header 17. The ends of the tubes at the other end of the unit may be interconnected by a return header 18 of conventional form provided with a return trap 19 if desired, accompanied by a return main connection 20.

Radiating units embodying my invention may be used with satisfactory results with a wide variety of "two pipe" steam heating systems whether or not they are provided with vacuum or condensation pumps, boiler return traps or radiator traps.

A nipple 21 for connection to a source of steam supply may be secured in threaded engagement with the steam inlet opening at 22 of the supply header 17. A conduit 23, which may comprise a short length of brass tubing or the like may be telescoped within the nipple 21 and suitably secured and sealed therein as by welding at 24. The inner end of the conduit 23 may be provided with a plug 25 welded or otherwise sealed therein. The conduit 23 may be provided with a plurality of orifices, or other apertures for giving a nozzle effect, as at 26 to 29 inclusive. As here shown the orifices comprise circular apertures drilled through the side wall of the conduit member at points opposite each of the tubes 11 to 14 respectively. In the specific example illustrated, the orifices 26 and 27 may be of substantially the same size but relatively larger than the orifices 28 and 29 for purposes hereinafter explained.

The nipple 21 may be provided with a plurality of punch marks or other indicating means as at 21' in alignment with the orifices so that when the device is being assembled, one will be able to observe when the nipple with its conduit 23 is screwed in place at the proper angular and longitudinal position to have the orifices opposite the desired tubes.

When a source of steam is connected to the nipple 21 having a pressure in excess of the pressure in the return main or in excess of the pressure within the radiating unit, the orifices 26 to 29 will serve to provide jets of steam directed

respectively into the adjacent tubes, whereby some of the energy of the steam flow will be converted into kinetic energy as a result of the nozzle effect at each orifice. These jets of steam will extend for a substantial distance into the ends of the adjacent tubes and also cause air to be drawn into the tubes from the supply header **17**, the air being thereby also mixed with the steam. The kinetic energy of the mixture will insure its flow along a circuitous path through the unit, starting from the vicinity of the jets and running out toward the remote end of the radiator through the tubes **11** to **14** inclusive. The air or steam, or a mixture of the two, as thus started in circulation, will promptly travel to the return header **18** at the remote end of the radiator, and due to the withdrawal of air from the supply header **17**, a flow of the air or air-steam mixture will be promoted from the return header **18** back through tubes **15** and **16** to the supply header. Thus the possibility of any dead air spaces within the radiating unit will be substantially eliminated even though the unit may be of very great length and embody a large number of tubes. Furthermore, when the supply of steam is insufficient as in moderate weather to provide for full heating of the entire unit, at least some of the tubes, such for example as tubes **11** and **12** which are accompanied by relatively large steam jets, will be heated to a considerable degree throughout practically their entire length. Thus, even if the weather is quite moderate, at least some heat will be provided throughout or substantially throughout the length of the "pipe coil" and the air surrounding the entire unit will be substantially uniformly heated, even at the return end of the unit. Moreover, due to the prompt mixing of the relatively cooler air from the supply header **17** with the jets of steam, the heating effect of the steam will be widely distributed and no portion of the "pipe coil" will be excessively heated.

When the unit is initially heated, the steam delivered therein displaces air which is discharged through trap **19** (if such a trap is used) into the return piping and to some point of disposal. The air flows freely out of or into the unit through trap **19** and the connections thereto as required, by any increase or reduction in the volume of steam in the unit, until the unit is practically filled with steam, whereupon the trap will be heated and open only enough to discharge water of condensation from the unit. Thereafter any reduction in the volume of steam in the unit will result in opening the trap so that air can flow into the unit from the return piping.

Fig. 2 illustrates by way of example the results obtained in the distribution of steam to various parts of a "pipe coil" of over 80 feet in length, during periods when the heating requirements were such that the steam supply was about one-half that required to heat the unit for maximum capacity (in the drawing the diameters of the pipes are exaggerated for clearness, as compared with the length of the unit). The results indicated in this figure and as hereinafter described, were obtained with an impulse or time interval type of control of the steam supply. In this figure the dotted areas indicate the extent to which the steam is conveyed within various parts of the tubes during each "on" period of steam flow. It will be noted that in tubes **30** and **31** which are provided with relatively large orifices **32** and **33**, the steam extends throughout their length, as well as into return header **34** and for approximately one-third of the way back along return tubes **35** and **36**. On the other hand, it will be noted that in tubes **37** and **38** which are provided with smaller orifices **39** and **40**, steam does not extend entirely to the return end of the unit. While Fig. 2 indicates the extent to which the steam flows in various tubes before being condensed under the conditions stated, it will be understood that the remaining parts of the tubes indicated as containing no steam, will be at least to some extent warmed due to the circulation of warm air therethrough. It will be apparent from this illustration that with the steam supply regulated to provide for but one-half of the maximum requirements, the steam will be fairly uniformly distributed as between the two ends of even a very long radiating unit. That is, the portions of the tubes which are provided with steam at each end of the unit are such that the general heating effect is substantially the same at both ends of the unit.

With a "pipe coil" such as above described in connection with Fig. 2, I have also found that when the steam supply is approximately one-quarter of that required for the maximum capacity of the unit, the distribution of the steam at the two ends of the unit will be almost equally satisfactory. That is, in such case the tubes **30** and **31** and the return header **34** will be provided with steam but the tubes **37** and **38** will be provided with steam only for a portion of their length depending upon the size of the orifices **39** and **40**, while the tubes **35** and **36** as well as the lefthand end of the supply header will be substantially free of steam. Also, when the steam supply is about three-quarters of the maximum demand, the distribution is quite satisfactory, for in that case steam will extend through the entire unit except for a small portion of tubes **35** and **36** nearest the supply header and the area in the supply header adjacent said tubes. This condition will give substantially equal radiation of heat at the two ends of the "pipe coil", since the incoming steam at the supply header will heat the portions of the unit adjacent the steam intake to a somewhat higher temperature than the return header, thereby compensating for cooler portions adjacent where the air is being returned into the supply header.

The invention is also of advantage when the unit is to be fully heated to meet its maximum requirements. That is, when the steam is initially turned on, the jets serve to promptly initiate circulation of the air and steam mixture throughout the unit, thereby very promptly bringing the whole unit substantially uniformly up to the required temperature.

To meet the requirements of different weather conditions, the steam supply may be varied by various control systems for throttling the steam flow, or controls for admitting the steam at timed periods. A highly desirable control system of such throttling type is disclosed in my Patent No. 1,880,213, granted October 4, 1932, and a control system utilizing predetermined timed periods of steam flow with the duration of the periods varied in accordance with outdoor temperature changes, is disclosed in the patent to Owens, Re. No. 19,507, of March 19, 1935, other improved systems of such class being disclosed in my co-pending application Ser. No. 19,397, filed May 2, 1935. Accordingly, such control systems need not here be described in further detail.

This invention is particularly advantageous in

connection with control systems wherein the steam is supplied in impulses of timed frequency, as with such systems even where the impulses are of relatively short duration as in moderate weather, the effect of the steam jets is such as to promptly distribute the steam of each impulse through even a long "pipe coil" to the extent necessary to heat the air adjacent both ends of the coil with substantial uniformity. On the other hand, with large "pipe coil" units as heretofore used, under some circumstances each individual impulse of steam would be substantially dissipated before any of the steam could arrive at the end of the unit remote from the supply header. With my invention successive impulses of steam will tend to heat the pipes further, heating also the return tubes in colder weather, until a balance is established between the heat of the steam entering the unit, and the heat leaving the unit by way of the radiating surfaces. Longer impulses of steam provided by the control in colder weather will deliver steam further through each of the circuitous paths, heating more of the radiating surfaces as well as heating such surfaces to a higher temperature. Air is discharged from the unit with each steam impulse and drawn back into the unit after each impulse through the trap **19** (if used) and/or the return connections.

It will be understood that to meet varying conditions the arrangement of the orifices and the form and size of the orifices may be varied. For example, one-third of the tubes may be provided without jets and two-thirds with jets, or an equal number may be provided with and without jets, and jets of two or three different sizes may be provided, depending upon the conditions met by practice. As a further example, I have shown in Fig. 3 a radiating unit having a supply header **50**, a return header **51** and a plurality of vertical tubes as at **52** to **59** inclusive. In this case the alternate tubes of the group such as **52**, **54**, **56** and **58**, are provided respectively with orifices **52'**, **54'**, **56'** and **58'**, so that every other tube of the group is provided with a steam jet and the intervening tubes serve as return conduits. Furthermore, as illustrated in Fig. 3, the various tubes may be provided with radiating fins forming extended radiating surfaces between and around the tubes and for conducting heat from the warmer tubes to the remaining tubes. With such a unit a high degree of uniformity of heating is made possible throughout the unit, regardless of the proportion to which the unit is heated to its maximum capacity.

"Blast" units, "unit" heaters and "ventilating" units may be similarly equipped with my invention except that in case of units having more than one bank of tubes or coils around or through which the surrounding air to be heated passes in succession, the jets should be directed toward the upper third or half of the first bank of tubes, toward the lower half of the second or middle row of tubes, and the upper half of the third row or bank, and so on. In this way a higher degree of uniformity of distribution of the heat throughout the air streams is obtained.

While the invention has been described in detail with respect to particular preferred examples, it will be understood by those skilled in the art after understanding the invention, that various changes and further modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. A radiating unit comprising a plurality of tubes, a supply header interconnecting said tubes at one end of the unit, means within said header for directing jets of steam respectively into certain of said tubes, at least one of said jets being larger than the others, whereby when the steam supply is but a fraction of that required for heating the whole unit, the remote portions of tubes having larger jets will be supplied with more steam than tubes with smaller jets, means at the other end of the unit interconnecting each of the tubes having jets with at least one of the remaining tube or tubes, whereby said remaining tube or tubes provide return passages for permitting air or steam to circulate back toward or into said header.

2. A radiating unit comprising a plurality of tubes, a supply header interconnecting said tubes at one end of the unit, means within said header for directing jets of steam respectively into certain of said tubes, said means providing certain of said jets with greater quantities of steam than others, whereby when the steam supply is but a fraction of that required for heating the whole unit, the remote portions of tubes having said last named jets will be supplied with more steam than other tubes, means at the other end of the unit interconnecting each of the tubes having jets with at least one of the remaining tube or tubes, whereby said remaining tube or tubes provide return passages for permitting air or steam to circulate back toward or into said header.

3. A radiating unit comprising a plurality of tubes extending in substantially parallel relationship within a plane, a header at one end of the unit for interconnecting said tubes at one end, a second header for interconnecting the other ends of the tubes, a steam inlet opening in one end of said first header, a steam inlet pipe extending through said opening and sealed therein and extending partially through the cavity within said first header in spaced relationship to the interior walls of said first header, the inner end of said pipe being plugged, the side wall of the portion of said pipe within said first header being formed with a series of orifices respectively positioned at points opposite the ends of certain of said tubes for directing jets of steam into such tubes, the remaining tube or tubes together with said second header and the space exterior to said pipe within the first header providing return passages for permitting air and steam to recurrently circulate back to or toward said jets.

4. A radiating unit comprising a plurality of tubes extending in substantially parallel relationship within a plane, a header at one end of the unit for interconnecting said tubes at one end, a second header for interconnecting the other ends of the tubes, a steam inlet opening at one end of said first header, a steam inlet pipe projecting through said opening into said first header in spaced relationship to the walls thereof, the walls of said pipe within said first header being formed with a plurality of orifices opposite the ends of a part of said tubes for directing jets of steam respectively into such tubes, the remaining tubes together with said second header and the space within said first header outside said pipe forming return passages permitting air or steam to recurrently return to or toward said jets.

5. A radiating unit comprising a plurality of tubes extending in substantially parallel relationship within a plane, a header at one end of the unit for interconnecting said tubes at one end, a second header for interconnecting the other end of the tubes, a steam inlet opening at one end of said first header, a steam inlet pipe projecting through said opening into said first header in spaced relationship to the walls thereof, the walls of said pipe within said first header being formed with a plurality of orifices opposite the ends of a part of said tubes for directing jets of steam respectively into such tubes, the remaining tubes together with said second header and the space within said first header outside said pipe forming return passages permitting air or steam to recurrently return to or toward said jets, and means at said second header permitting condensate as formed to be drained from the unit.

KARL W. ROHLIN.