United States Patent [19]

Hagdorn et al.

[11] **3,794,242**

[45] **Feb. 26, 1974**

[54] **TRAILER HEATING SYSTEM**

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[73] Assignee: **Aktiebolaget Electrolux**, Stockholm, Sweden

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[30] **Foreign Application Priority Data**

Aug. 20, 1971 Sweden 10578/71

[52] **U.S. Cl.** **237/59**, 237/66

[51] **Int. Cl.** **F24d 3/10**

[58] **Field of Search** ..... 237/8 A, 8 R, 66, 59

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Primary Examiner—William E. Wayner

Attorney, Agent, or Firm—Alfred E. Miller

[57] **ABSTRACT**

A central heating system for the enclosed space of a vehicle trailer, or motor home having circulating liquid medium which is heated in a boiler and heat transferred to radiators in an open system via an expansion vessel. The expansion vessel is situated at a high level and is so constructed that vapor in the riser conduit of the system is condensed and substantially only liquid descends in the downward conduit from the expansion vessel; the heating of the enclosed space is controlled by a thermostat operatively connected to the system.

15 Claims, 6 Drawing Figures

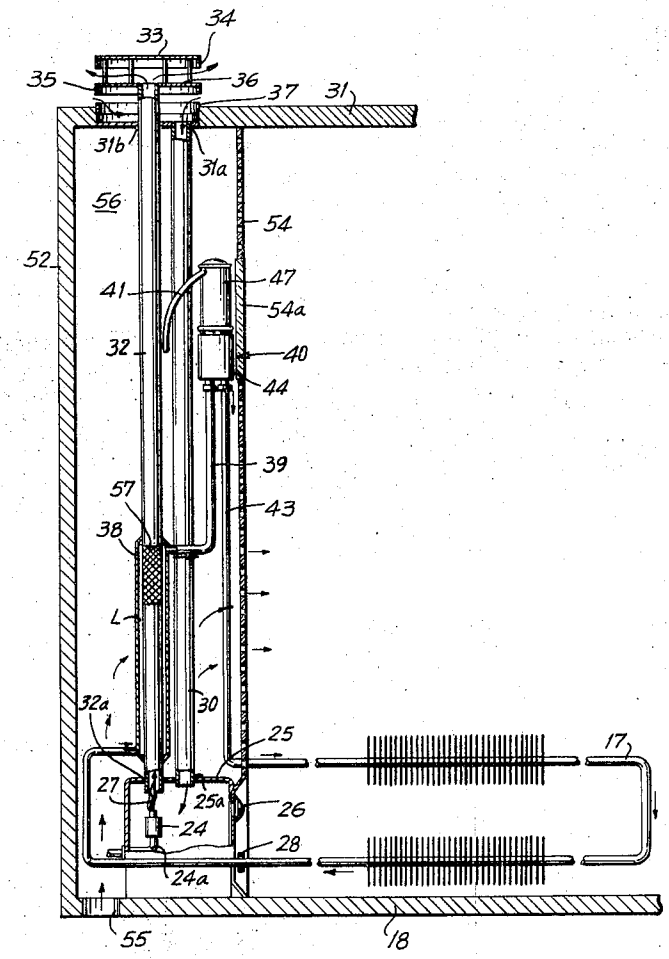

FIG. 1

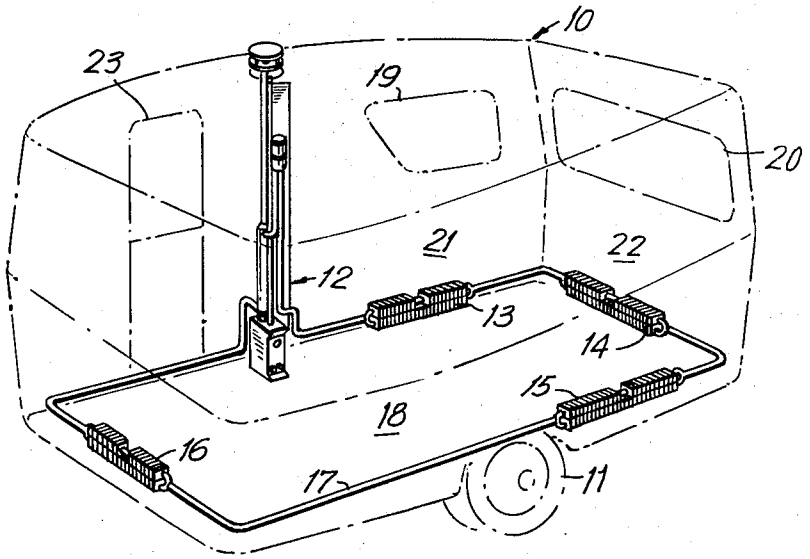
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FIG. 5

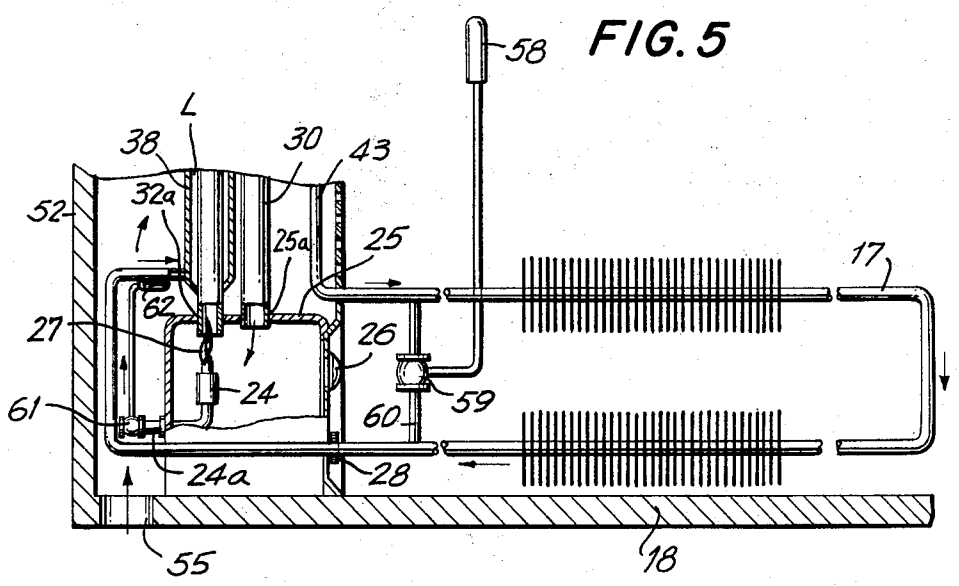
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FIG. 2

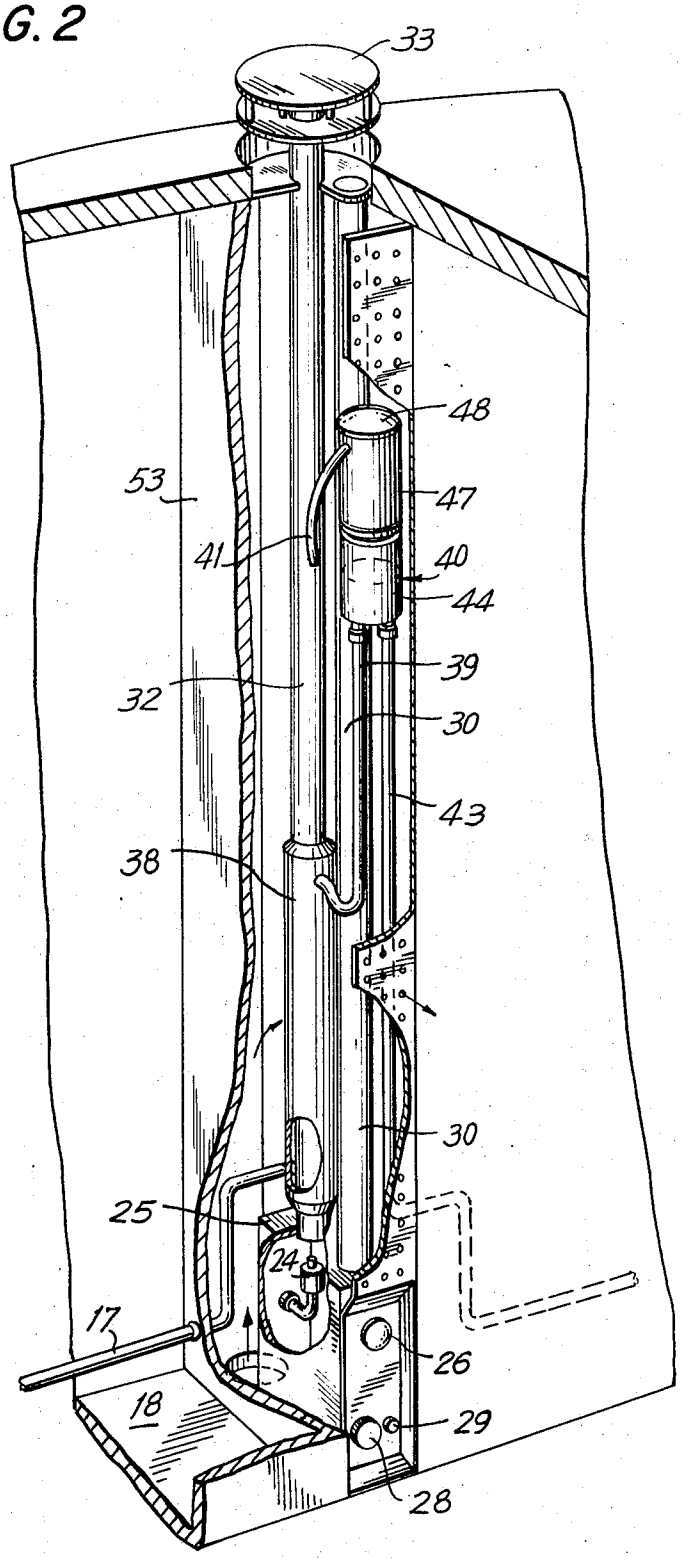

FIG. 3

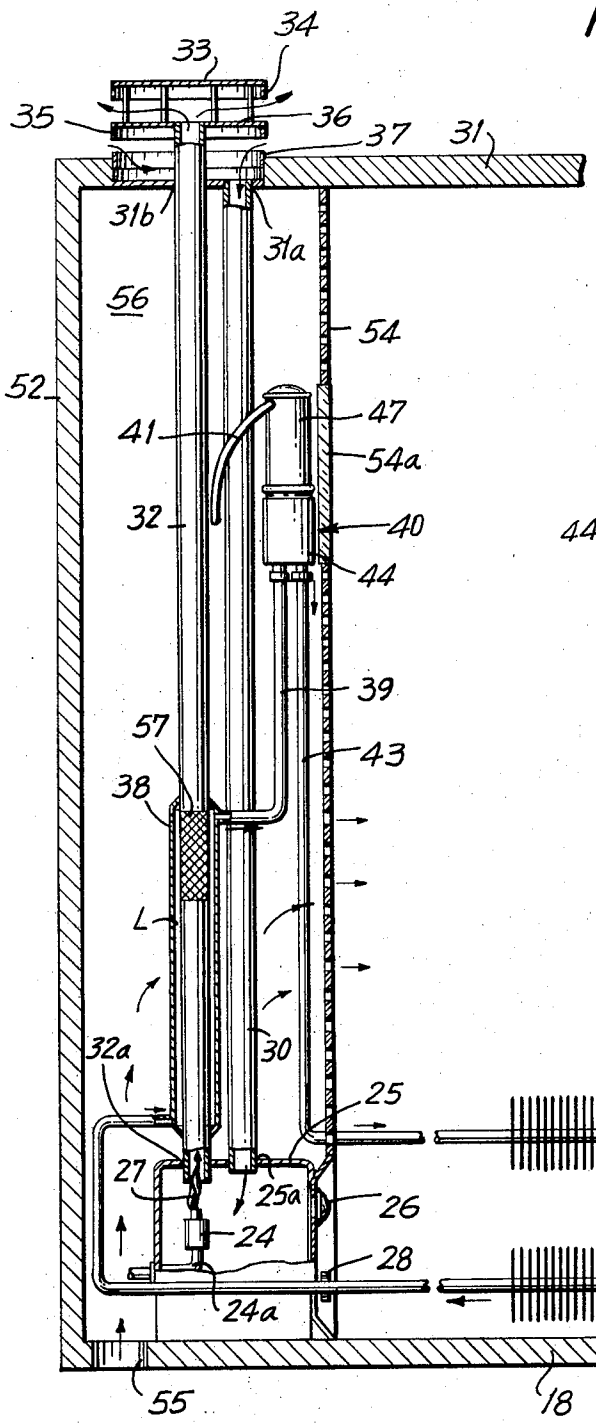
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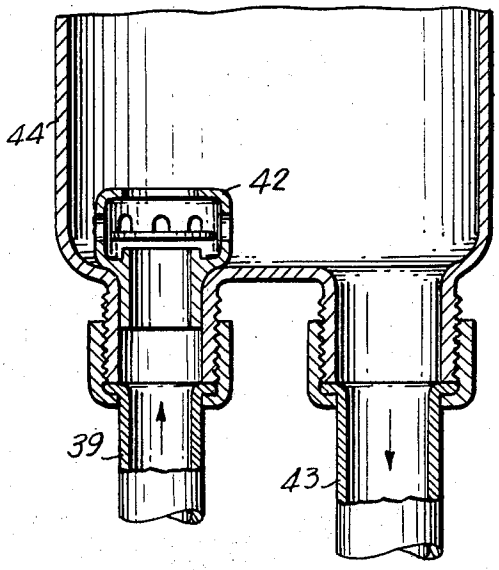
FIG. 6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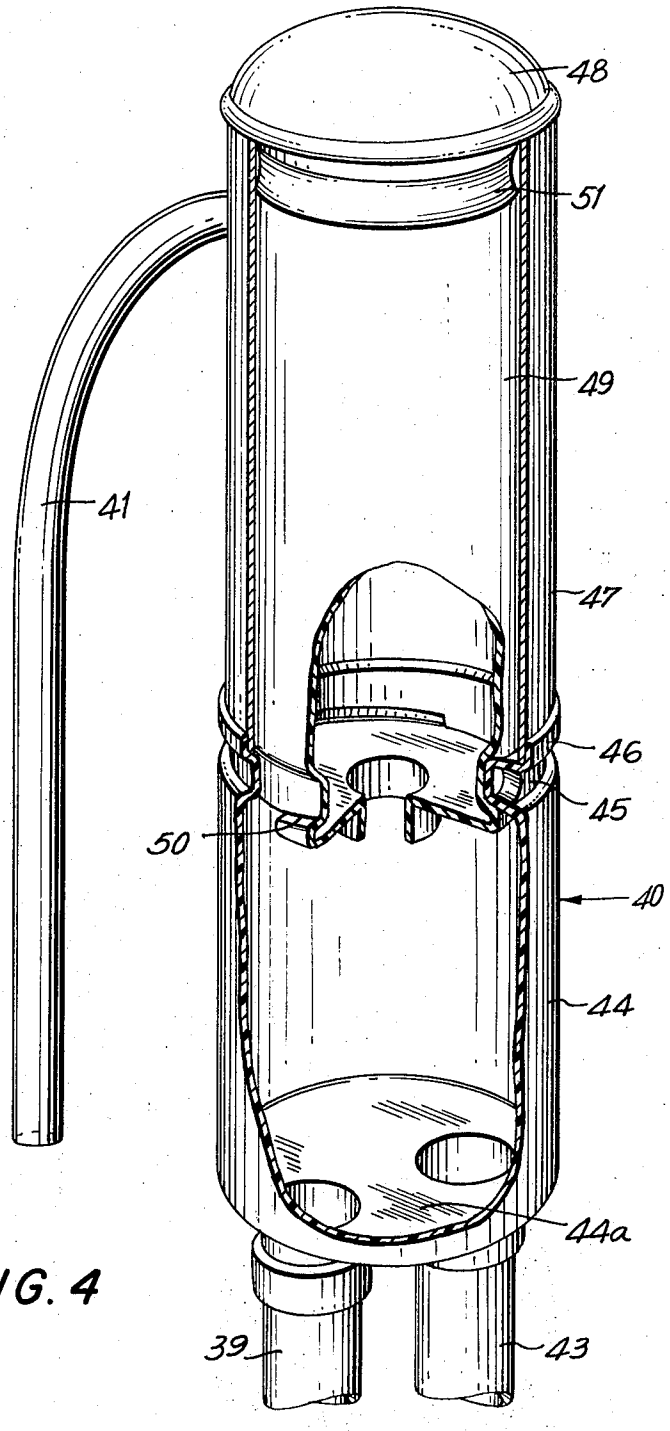

FIG. 4

TRAILER HEATING SYSTEM

BACKGROUND OF THE INVENTION

Heating systems for homes, or the like, are known that use circulating water as the medium. These systems, which are open, employ an expansion vessel located at a high level in the system. Thus, water is heated in a boiler forming hot water which flows from the heating place in the boiler upwardly to an expansion vessel, and the water in the vessel is circulated downwardly to be cooled by radiators. Since the upward flowing column is hot water and the downward flowing column is relatively colder water, there is a difference in density of the water columns sufficient to achieve continual circulation of the water in the system. However, in heating systems of this type, it is a desired objective to avoid the generation of vapor in the boiler since the generated vapor could not be used for heating purposes but would be cooled off in the expansion vessel that normally is located in an uninsulated attic. Nevertheless, vapor is essential in the ascending line of the system in order to maintain an effective circulation of the medium transferring heat from the boiler to the radiators.

For the heating of a room or other enclosure it is desirable to place the radiators as close to the floor of the room as possible. On the other hand, the circulating heating system requires two vertical liquid columns. Thus, in the proposed heating system, there would be a vertical liquid column heated by the boiler, a horizontal liquid flow and another vertical descending liquid column. This latter liquid column would not be cooled since the radiators would be positioned in a horizontal plane. Consequently, the two vertical liquid columns would be approximately the same temperature and the circulation of the heating medium would be negligible. In order to cool the second vertical column in this system, radiators have to be placed at a selected height above the lower horizontal connecting part of the system. This system causes difficulty with the efficient arrangement of the radiators in the space to be heated, and therefore a central heating system with motor-driven pumps that ensure an efficient circulation of liquid in the system has been substituted for the first described system.

Currently there is an increasing need for central heating systems for rooms or enclosures that eliminate the necessity for driven pumps and thereby reduce the need for their maintenance and service. This is especially true for trailers, small boats and cabins where there is little or no electricity available, and it is desired to heat up the enclosure fast and adjust or control the heat transfer in the enclosure depending upon the heat requirements. In the past, a system has been utilized which eliminates the driving means for circulating liquid. This system is the impulse pump arrangement that is driven by the heat supply only. Since the pumping is dependent upon vapor generation, the liquid level periodically moves up and down in a boiler. Therefore, the pump operates with a pulsating rhythm which corresponds to the movements of the liquid level in the boiler. A serious disadvantage of this system is the considerable throbbing noise created by the pulsating operation of the pump.

SUMMARY OF THE INVENTION

Our invention relates to a central heating system for an enclosure such as a trailer, having horizontally disposed radiators positioned close to the floor. The system is an open heating system having circulating liquid heated by a heat source located in a boiler, and utilizes an expansion vessel of a special construction so that both liquid and vapor are in the riser side of the system and essentially only liquid is in the downward side of the system.

It is an object of the present invention to provide a trailer heating system located between the floor and ceiling of a room that has an effective circulation of the water medium, and a heat transfer to the radiators situated close to the floor of the trailer.

It is another object of the present invention to provide a novel construction resulting in a fast and smooth start up of a cold system.

Another object of the present invention is to provide a thermostatically controlled valve for adjusting the heating of the trailer.

A further object of the present invention is to provide a central heating system which does not require electrical power, and is provided with a burner which can operate on gaseous or liquid fuel.

Another object of the present invention is to provide an expansion vessel which is so constructed that substantially only liquid appears on the downwards side of the heating system.

An object of the present invention is to provide a relative compact heating system that has an effective air intake arrangement.

The invention will now be more fully described with reference to the accompanying drawings wherein:

FIG. 1 is a perspective view of the central heating system mounted in a trailer and embodying the principles of our invention.

FIG. 2 is a perspective view of the central unit of our novel heating system drawn on a larger scale and with parts of the trailer and screen wall cut away for purposes of clarity.

FIG. 3 is a vertical sectional view taken through the trailer and through part of the central unit of the heating system.

FIG. 4 is a perspective view on a larger scale of the expansion vessel with condenser having parts thereof cut away for purposes of clarity.

FIG. 5 is a side elevational view of certain details of construction of a thermostatically controlled valve arrangement of our present invention, and

FIG. 6 is a fragmentary view of parts like those shown in FIGS. 2, 3, and 4, illustrating another embodiment of the invention.

PREFERRED EMBODIMENT OF THE INVENTION

FIG. 1 of the drawings shows a trailer **10** drawn schematically and supported by wheels **11** mounted on a single axle. For purposes of clarity, all of the usual fixtures of the trailer have been omitted in order to illustrate our novel central heating system. The heating system comprises a heat supply and liquid circulating unit referred to generally by the numeral **12** and a conduit **17** which circulates the liquid heating medium through a circuit close to the trailer floor **18** and at the periphery thereof adjacent to the trailer walls **21** and **22** having windows **19** and **20** and a door **23.** It should be un-

derstood that the other side and front wall of the trailer **10** have been omitted for purposes of this illustration. As seen in FIG. **1**, a series of radiators **13, 14, 15,** and **16** are appropriately spaced and close to respective walls of the trailer **10.**

Referring now to FIGS. **2** and **3**, the heating system embodying our invention is provided with a burner **24** located close to the floor **18** of the trailer **10** and which uses a fuel such as LP gas or a liquid fuel, for example kerosene or oil. The burner **24** shown in FIGS. **2** and **3** is housed in an enclosure **25** which also houses means, such as control devices, and other fittings for the burner **24.** The aforesaid means constitutes a knob **28** which controls the gas supply and opens a by-pass valve (not shown) in the gas conduit **24***a* when it is desired to light the burner. In connection with the latter, the burner **24** can be lit by means of a push button **29** for a piezoelectric lighter (not shown). The enclosure **25** is also provided with a sight window **26** for observing the operation of the flame **27** of the burner **24.** As seen in FIG. **3**, the enclosure **25** is provided with the opening **25***a* to which is connected the vertical air intake conduit **30** that extends through an opening **31***a* in the trailer roof **31.** The hot gases generated by the burner **24** are conducted through a flue **32** upwards and through the roof **31** of the trailer **10** and exit through a generally circular top plate **33** which extends in a plane substantially perpendicular to the longitudinal axis of the flue **32.** It will be noted that the flue **32** is connected to an opening **32***a* in the enclosure **25** and passes through an opening **31***b* in the roof **31.** Thus, the hot gases from the burner **24** travel upwards in the flue **32** and laterally under circular plate **33** and out to the atmosphere. The plate **33** has a downwardly projecting annular rim **34** that functions as a protection against rain being swept into the flue **32.** The conduit **30** is also provided with a lower, generally circular plate **36** having a downwardly projecting annular rim **35** that forms a protective roof for the air intake of the conduit **30.** In addition, an upwardly projecting annular flange **37** is located in the top surface of the roof **31** which functions to prevent water on the roof surface from flowing into the air intake conduit **30.**

The lower part of the flue **32** is surrounded by a jacket **38** that is filled with a liquid L. This construction forms the boiler for the heating system. A riser pipe **39** is connected to the upper part of the jacket **38** and has the other end thereof connected to an expansion vessel referred to generally by the numeral **40.** Referring now to FIG. **4**, it will be seen that the expansion vessel **40** has a hose **41** located at the upper part thereof to ventilate the system and to permit vapor to escape to the atmosphere in the event of an over-pressure in the system. However, the vapor will immediately condense and therefore the hose is connected to the exterior of the trailer **10** by means of a hose extension (not shown) passing through the floor **18** of the trailer **10.**

As clearly seen in FIGS. **1** and **3**, a down pipe **43** is connected to the conduit **17** through which the liquid in the system is circulated together with the radiators **13, 14, 15,** and **16,** and which is connected at its other end to the lower part of the jacket **38.** At this point, the liquid cooled in the radiators **13, 14, 15,** and **16** and in the conduit **17** makes a re-entry into the jacket **38.**

Referring to FIG. **4**, the expansion vessel **40** is shown on a larger scale in which the details of construction are clearly shown. In this connection, the expansion vessel **40** includes a lower liquid container **44.** Connected into the bottom **44a** of container **44** are the riser pipe **39** and the down pipe **43.** It is preferable that the liquid container **44** be constructed of a suitable durable transparent plastic material so that the liquid level in the container **44** can be observed. The upper part of the liquid container **44** is provided with an interior bayonet mount **45** and at the top thereof has a catch **46** for the upper metal sleeve **47,** which is fabricated preferably of aluminum. The metal sleeve **47** is retained by a cover **48** having an inner part **49** which in its lower portion has parts **50** fitting into the bayonet mount **45** of the liquid container **44.** The inner part **49** and the cover **48** are resiliently connected together by means of a yieldable annular member **51.**

The heating system of our present invention is so constructed and arranged that there is an effective liquid circulation inasmuch as the liquid column in riser pipe **39** which comprises the jacket **38** and the riser pipe **39** is hot and contains some vapor. On the other hand, the down pipe **43** contains substantially only hot liquid. Moreover, the conduit **17** through which the liquid medium is circulated extends substantially horizontally close to the floor of the trailer and does not have any significant level differences. Thus, conduit **17** does not influence the flow of the liquid medium therein other than the usual flow resistance of a pipe. This resistance is overcome by the driving force exerted on the liquid medium produced as a result of the density difference between the two liquid columns in the heat supply and liquid circulating unit **12.** It should be apparent that our present construction achieves the desirable operating condition in which the vapor formed in the jacket **38** is condensed partly in the liquid in the expansion vessel **40.**

In order to overcome the drawback of previous constructions in which the heat is lost because the vapor in the system passes through an expansion vessel in an uninsulated location, the heat supply and liquid circulating unit **12** is mounted in a space between the floor **18** and the roof **31** of the trailer **10.** As seen in FIG. **3**, the rear of the space is provided with a heat insulated wall **52** and the sides by either heat insulated walls **53** (FIG. **2**) or by heat conducting walls such as sheet metal, which are complete or partial, and which conduct some heat to the contiguous rooms of a trailer. This latter construction is of value if, for example, the contiguous room is used for drying clothes.

Located in the front of the heat supply and liquid circulating unit **12** is a screen **54.** An opening **55** is provided in the floor **18** of the trailer through which cool ambient air flows into the space **56** around unit **12** (FIG. **3**). The air is heated by the jacket **38** and the flue **32** and to some extent by the metal sleeve **47** of the expansion vessel **40.** This air thus heated flows through the screen wall **54** and into the interior of the trailer **10.**

It is within the scope of our present invention to make the screen wall **54** removable so that the space **56** and the apparatus therein can be accessible. In addition, it is desirable to make the expansion vessel **40** visible from the interior of the trailer **10** and this is accomplished by the insertion of a window **54a** in the screen wall **54** directly in front of the vessel **40.** The window **54a** permits the liquid level in the transparent expansion vessel to be observed often and maintained at the desired level without removing the screen wall **54.**

Although our described construction produces an effective circulation of the heat transferring liquid through conduit **17** and radiators **13, 14, 15,** and **16,** the trailer additionally is further heated by what would normally be the heat losses from the unit **12.** Thus, an effective heating is achieved by both the liquid in the radiators and heat thrown off from the unit **12** which makes the heat losses from our heating system insignificant.

At the start of the heating season, a condition may occur in the present heating system in which the circulation of the liquid medium in the system is delayed in spite of the fact that large amounts of vapor are generated in the boiler. In this condition, the liquid level in the expansion vessel will rise. In order to overcome this condition, a certain part of the exterior surface of the flue **32** is roughened, as shown at **57.** This roughened surface can be produced by sand blasting, metal coating, or the like, and when vapor is generated along the exterior walls of the flue **32** within the jacket **38** small vapor bubbles are caused to leave these walls, especially at the peaks of the roughened surface, which may be also prepared by knurling.

It is desired to point out that the lower part of flue **32** in the jacket **38** acts as a preheater for the liquid in the jacket **38** and the upper part **57** of the flue **32** within the jacket **38** functions as a vapor generator. In order to have the heat of the gases emitted in suitable proportions to the two boiler parts, within the jacket **38,** it is desirable to use a flue baffle (not shown) which ensures that the main heat quantity is emitted to the vapor generating part **57** of the flue **32.** This result can be achieved by means of a pipe suspended in the flue **32** and having a flattened lower end (not shown).

FIG. **5** shows a thermostatically controlled valve arrangement for our unit **12** in which a temperature sensitive bulb **58** is placed in a suitable location in the interior of the trailer **10.** The bulb **58** is connected to a thermostatically controlled valve **59** mounted in a by-pass pipe **60** between portions of the conduit **17** which short circuits the radiators **13, 14, 15,** and **16.** Thus, when the interior space in the trailer **10** is too hot as sensed by bulb **58,** the valve **59** is opened and most of the liquid in conduit **17** will flow through by-pass pipe **60** and back to the boiler since the portion of conduit **17** provided with the radiators has a large flow resistance and consequently the radiators **13, 14, 15,** and **16** will be short-circuited. In addition, a valve **61** in the gas conduit **24***a* is also thermostatically controlled by means of a temperature sensitive bulb **62** located in the conduit **17** close to its connection to the bottom of jacket **38.** The bulb **62** measures the return liquid temperature and is operatively connected to the valve **61** in order to adjust the gas supply to the burner **24,** it being desirable to maintain the liquid temperature at about 75°–80° centigrade. The foregoing thermostatically controlled valve arrangement has the desirable result of being able to adjust the heat output from the system in accordance with the desired heating requirements.

If the number of steam bubbles generated increases, the difference in specific weight of the upwardly directed riser pipe having liquid plus steam and the downwardly flowing column of liquid becomes greater so that the circulation in the system is speeded up.

At low heat input to the boiler it may occur that the liquid circulation is not continuous. To prevent this, a non-return valve **42** may be provided in the circulation system. Any known kind of a valve suitable for the purpose may be used and be disposed anywhere in the system. Preferably, however, the valve is placed as shown in FIG. **6,** i.e., at the end of the riser pipe **39** inside the container **44.**

What we claim is:

1. A central heating arrangement of at least one room of a forming space having a limited height difference between floor and ceiling in an open system having a circulating liquid and radiator means, comprising:

a. a boiler for the liquid,
b. means for heating the boiler,
c. an expansion vessel,
d. a riser pipe connecting the boiler to the expansion vessel,
e. a down pipe connecting the expansion vessel to the radiator means,
f. the expansion vessel being so constructed and arranged that the vapor ascending together with the liquid in the riser pipe is condensed and passes through the down pipe with its heat content being supplied to the radiator means, with the liquid, and
g. said boiler, radiators, and expansion vessel all being located within the space and
h. means providing heat communication over the expansion vessel and boiler by air flow thereover to the room.

2. The arrangement in accordance with claim **1** wherein the expansion vessel has part thereof in the form of a vapor separator and another part thereof in the form of a condenser.

3. The arrangement in accordance with claim **1** further comprising a flue for the heating means, a jacket surrounding a portion of the flue and forming the boiler and additionally constituting part of the riser pipe.

4. The arrangement in accordance with claim **3** wherein the height of the boiler forming part of the riser pipe is approximately the same height as the remainder of the riser pipe.

5. The arrangement in accordance with claim **3** further comprising a housing for the burner, the flue being connected at the intake end to the housing, and an air intake conduit opening at one end to the exterior of the enclosed space and connected at the other end to the housing for supplying combustion air to the burner.

6. The arrangement in accordance with claim **3** wherein the riser pipe is supplied with heat over at least half its height.

7. The arrangement in accordance with claim **3** wherein the portion of the flue surrounded by the jacket has an upper part provided with an exterior surface which is roughened thereby causing vapor bubbles to be emitted from the upper part of the flue portion within the jacket.

8. The arrangement in accordance with claim **7** wherein the roughened surface is knurled.

9. The arrangement in accordance with claim **3** wherein an opening is provided in the floor of the enclosed space through which cool ambient air passes and flows over the boiler, flue, and the expansion vessel and thus becomes heated.

10. The arrangement in accordance with claim **1** wherein a non-return valve is arranged in the liquid circulation system.

11. The arrangement in accordance with claim 10 wherein the non-return valve is mounted inside the liquid container in connection to the riser pipe.

12. A central heating arrangement located between the floor and the ceiling of a space having a liquid heated in a boiler operated by a burner and circulated in radiator means in an open system comprising:

a. an expansion vessel,

b. a riser pipe connecting the boiler to the expansion vessel,

c. a down pipe connecting the expansion vessel to the radiator means,

d. the expansion vessel having one part which is a vapor separator and liquid container and another part which is an air cooled condenser whereby vapor ascending together with the liquid in the riser pipe is condensed and its heat content supplied to the radiator means after passing through the down pipe,

e. the radiator means being positioned at or above the level of the burner, and

f. means providing heat communication over the expansion vessel and boiler by air flow thereover to the room.

13. The arrangement in accordance with claim 12 wherein the radiators are located at a lower level than the boiler.

14. The arrangement in accordance with claim 12 wherein the air cooled condenser is a metal sleeve having an inner part and being provided with a cover.

15. The arrangement in accordance with claim 14 further comprising a yieldable element connecting the inner part and the cover.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,794,242 Dated February 26, 1974

Inventor(s) MANFRED OTTO HAGDORN, TORSTEN BIRGER PALMETH et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 9, cancel "forming".
Column 6, line 24, cancel ",".
Column 6, line 25, change "said" to --the--;
Column 6, line 25, change "radiators" to --radiator means--.
Column 8, line 9, change "radiators are" to --radiator means is--.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.