

July 7, 1970

A. HERZENBERG

3,518,973

STEAM BOILER

Filed July 9, 1968

7 Sheets-Sheet 1

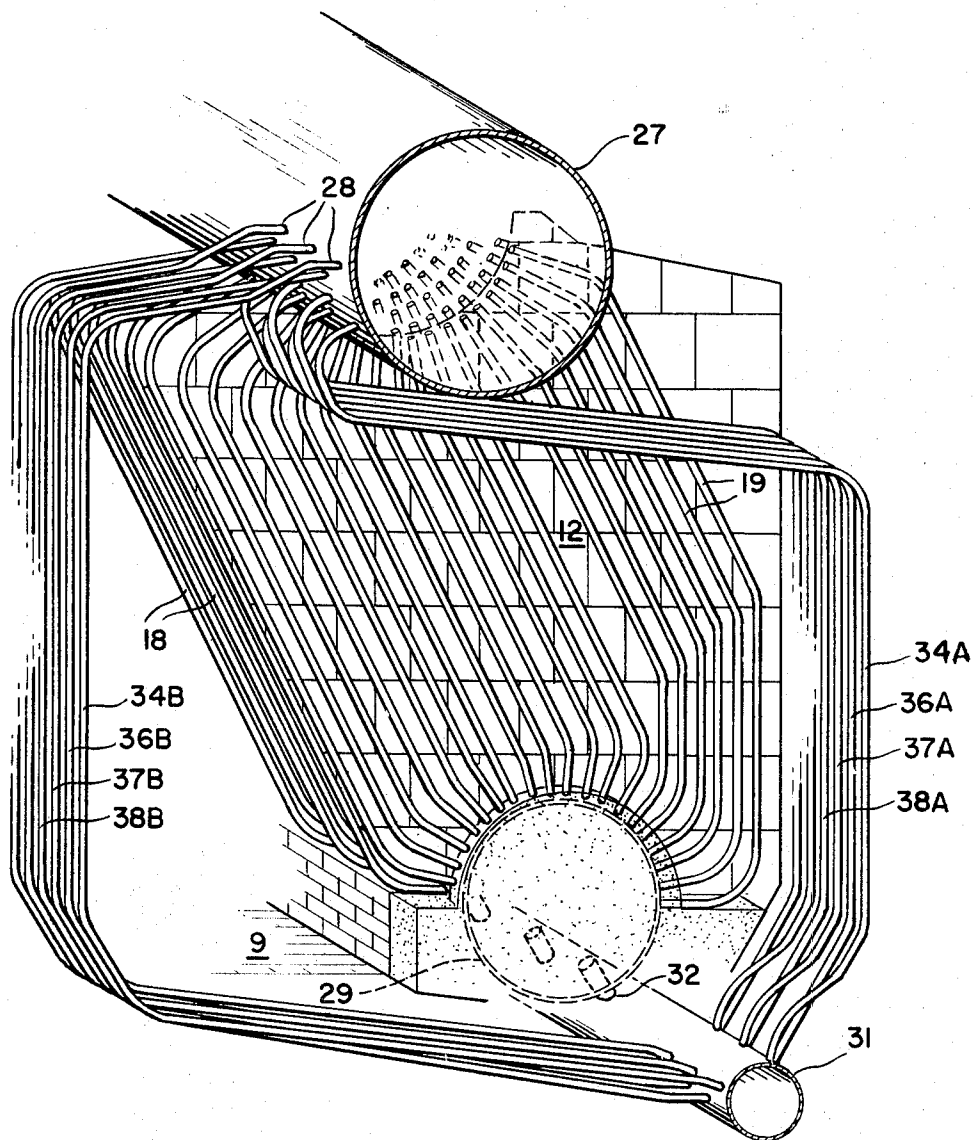


FIG. I

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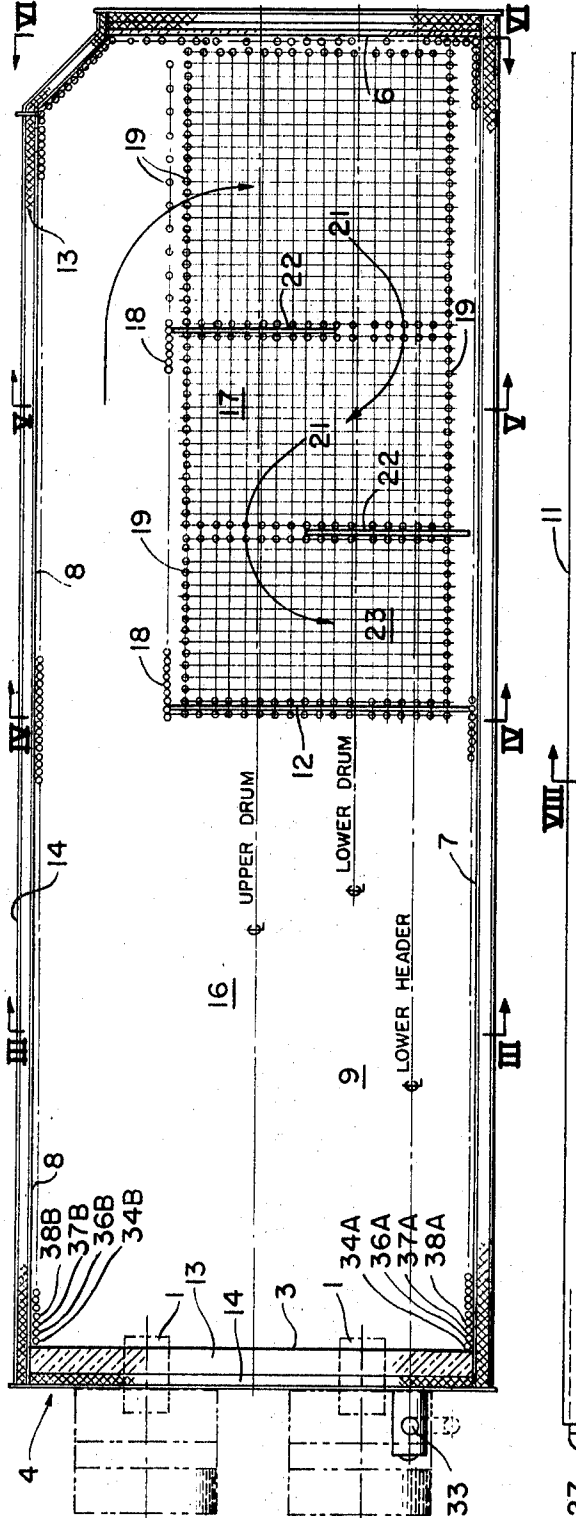


FIG. II

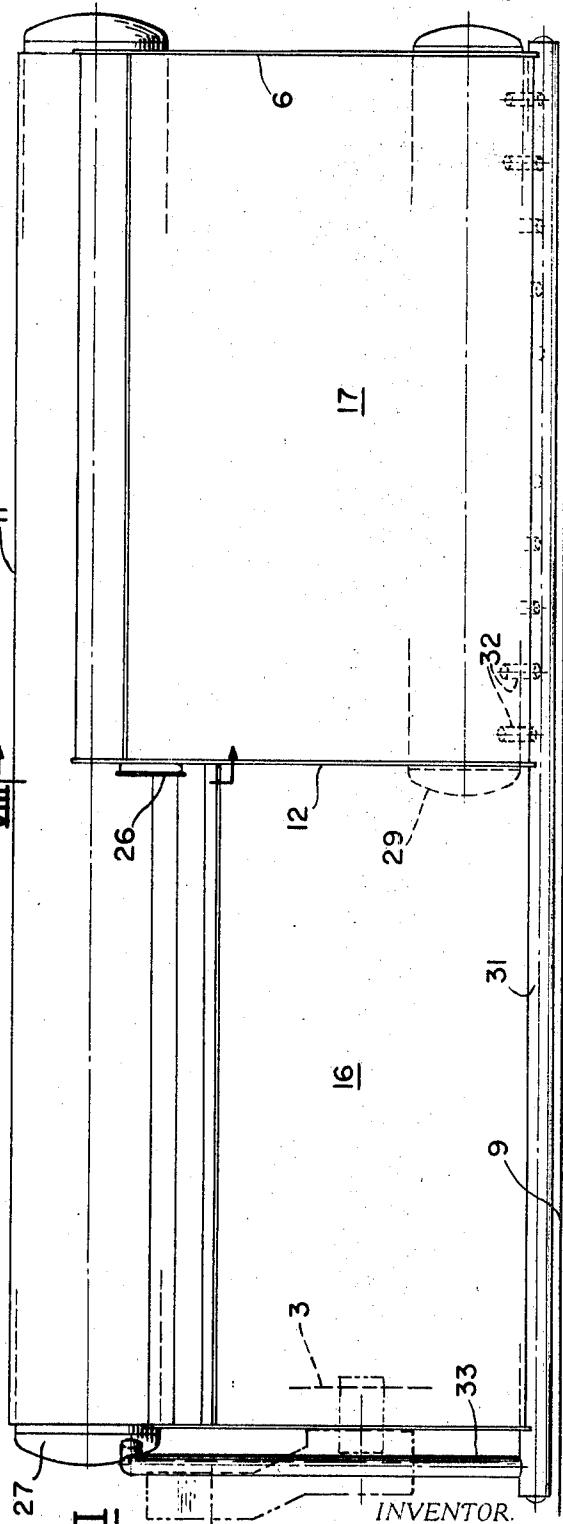


FIG. VII

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FIG. III

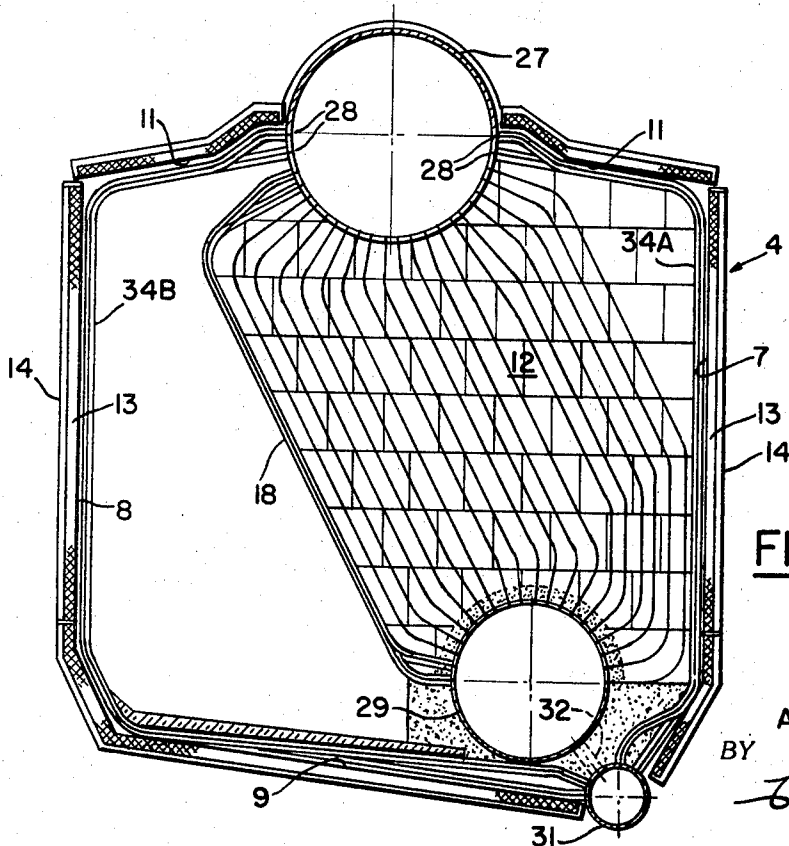
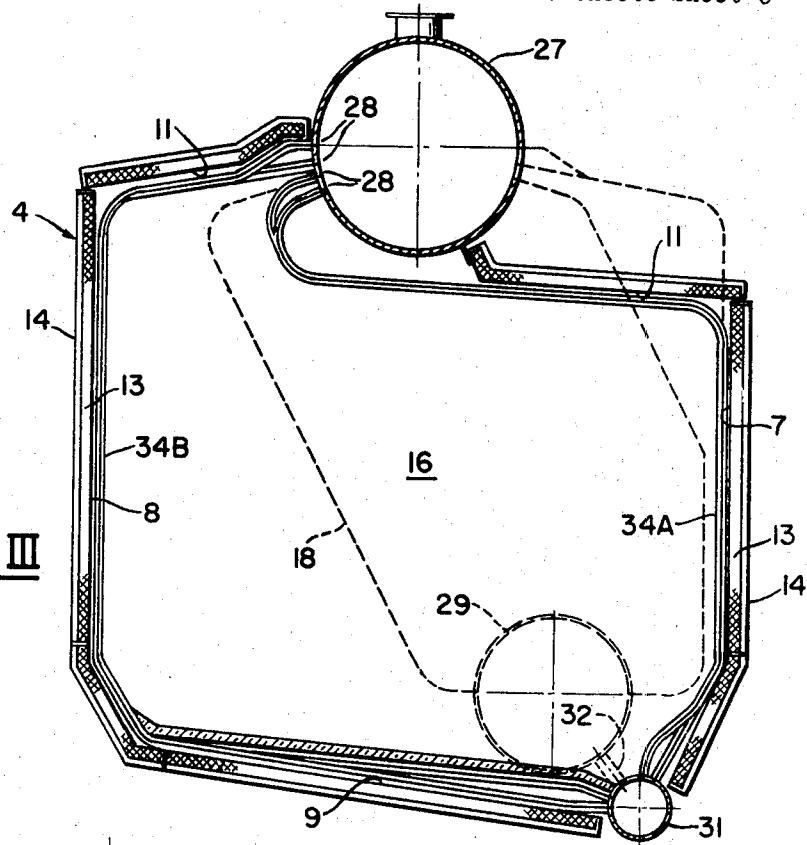


FIG. IV

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FIG. V

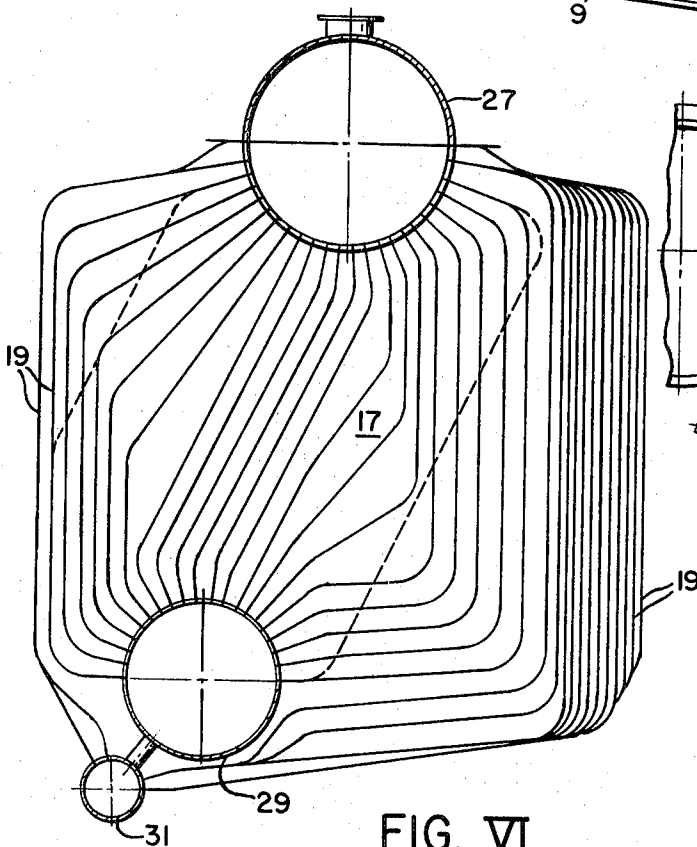
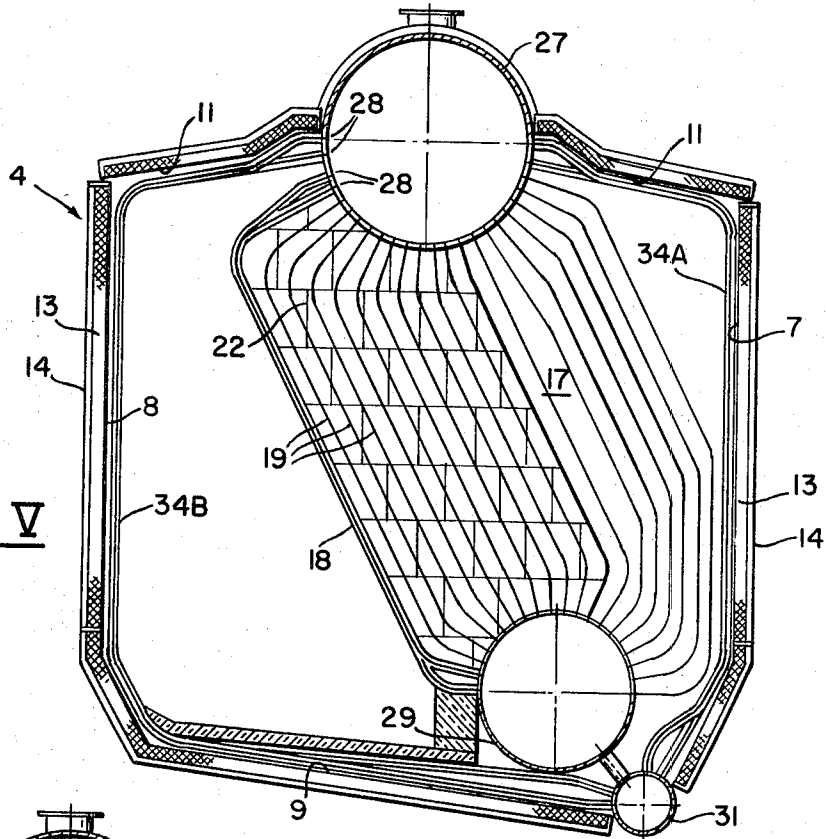


FIG. VI

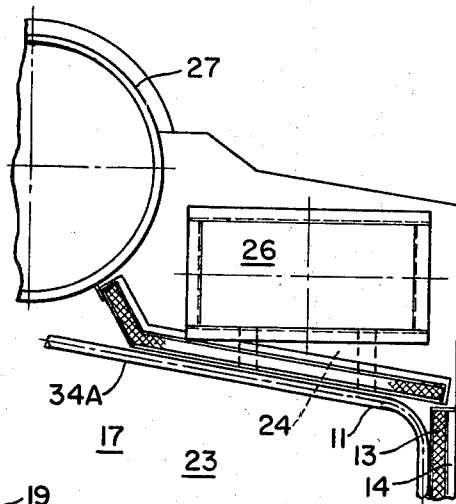


FIG. VIII

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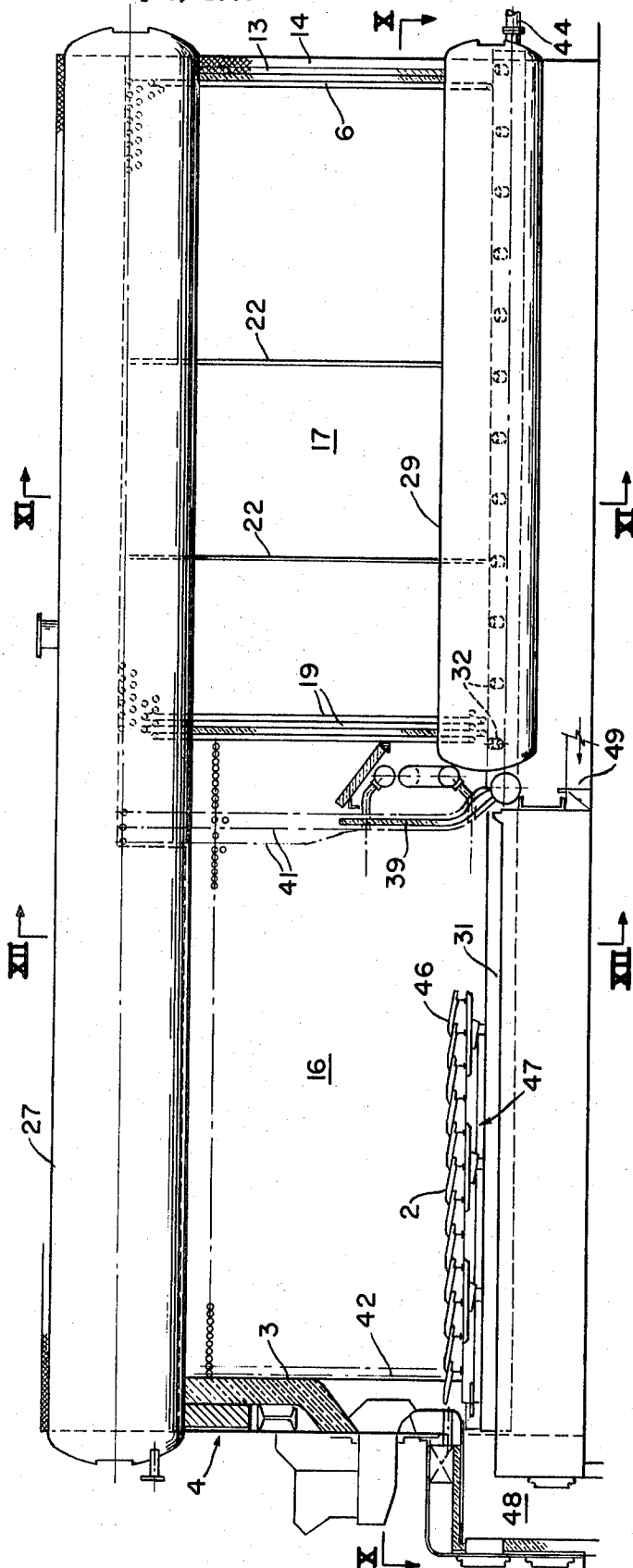


FIG. IX

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BY

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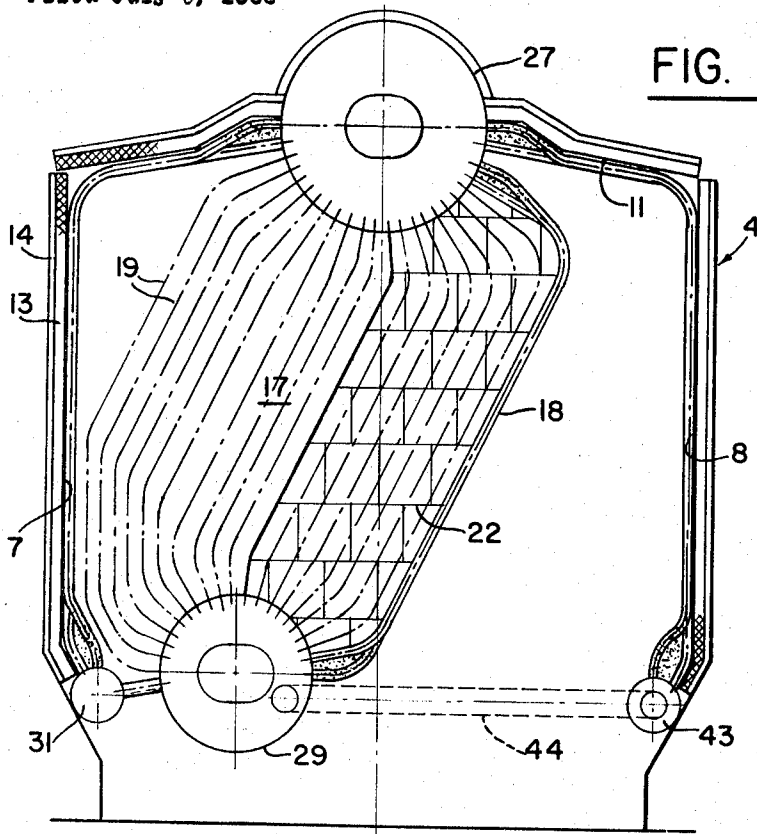


FIG. XI

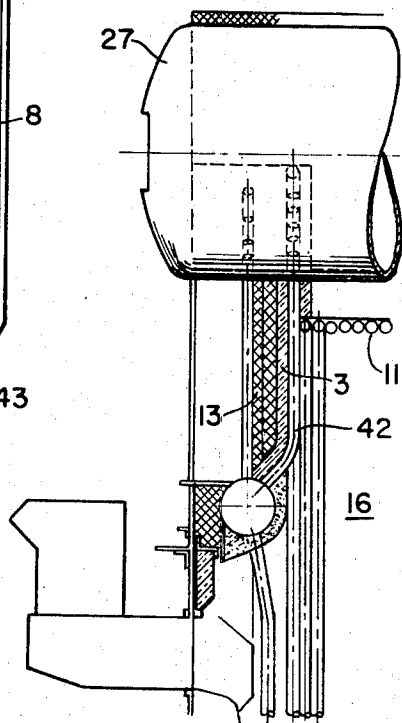


FIG. XIII

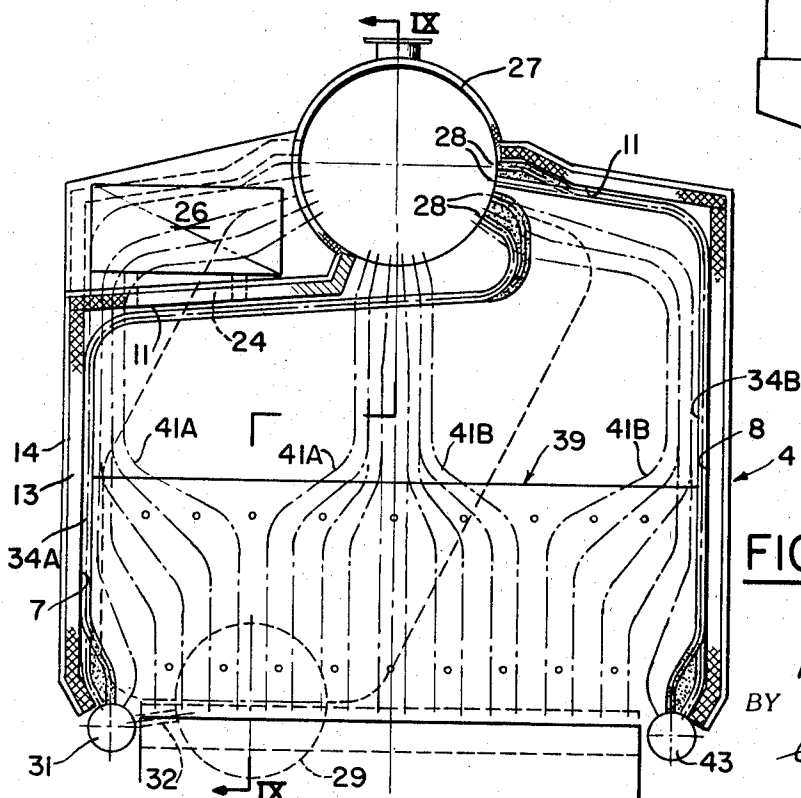


FIG. XII

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STEAM BOILER

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Int. Cl. F22b 21/00

U.S. Cl. 122—235

7 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure teaches a natural-circulation steam boiler especially suited to shop fabrication and which can accommodate more stringent transportation clearances and/or installed space requirements than other boilers of its kind. In its radiant section a lower header is positioned laterally and parallel to a longitudinal upper drum and pairs of equal-length, transverse tubes are connected therebetween. One tube of each pair courses a route up the wall away from the lower header while the other tube courses up the near wall then under the upper drum. By this expedient a more compact, natural-circulation steam boiler is achieved and the upper drum is shielded from hot combustion gases.

BACKGROUND

Manufacture in shops of natural-circulation steam boilers (packaged boilers) offers ease, economy, manufacturing quality and rapid assembly. But in many instances, transportation clearances limit and frustrate this approach to boiler manufacturing. At the core of the clearance problem is design of natural-circulation radiant sections, because adequate radiant transfer is essential to overall efficiency. Radiant surface must be made available, without flame impingement onto tubes and allowing adequate radiant section volume, whereby tube life is prolonged and fuels are enabled to release their heat. An additional aspect of the clearance problem is pairing of radiant tubes between the lower header and the upper drum so as not to disrupt natural-circulation of steam to the latter.

SUMMARY

Mr. Herzenberg has solved the foregoing clearance problem in a particularly novel and facile way. He positions the lower header laterally relative a longitudinally-oriented, medial upper drum and provides transverse pairs of equal length tubes connected therebetween. One tube of each pair courses a route up the wall away from the lower header and the other tube courses up the near wall then under the upper drum.

One object of this invention is to provide a shop-assembled, natural-circulation steam boiler which (for given limitations on transportation clearances) can accommodate a larger capacity than steam boilers of prior designs.

Another object is to furnish a steam boiler in which heat absorbing surfaces are arranged to shield the upper drum from direct impingement of hot combustion gases.

Another object is to maintain definite and positive water circulation by reason of a natural, siphon-effect circulating of relatively cooler water to a lower drum and exhausting steam via the upper drum.

Another object is to keep the water line relatively low and steady at all ratings.

Another object consists of a steam boiler wherein the radiant tubes, a water cooled target wall and a refractory-lined or water-cooled front wall embrace the radiant section.

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Another object resides in a steam boiler having the foregoing features which may have incorporated therein an economizer or a superheater or both without substantial changes in construction or rearrangement of other parts.

Another object is to fashion a steam boiler of such design as to preclude accumulation of material amounts of soot, and which retards the adhesion of fused particles of ash.

Another object is to provide a convenient outlet arrangement for venting flue gases to a stack.

Another object is to accommodate changing over from burners to automatic stoking equipment.

DRAWINGS

The foregoing and other objectives will appear more fully from the accompanying drawings wherein:

FIG. I is a somewhat idealized perspective view indicating the general association of tubing according to the present invention.

FIG. II is a fragmented sectional plan view of the steam boiler.

FIG. III is a sectional elevation view taken along line III—III of FIG. II and depicting the radiant section.

FIG. IV is a sectional elevational view taken along line IV—IV of FIG. II and showing the target wall.

FIG. V is a sectional elevation view taken along line V—V of FIG. II and illustrating the convection section.

FIG. VI is a sectional elevation view taken along line VI—VI of FIG. II and illustrates the tube configuration at the back wall with the casing removed.

FIG. VII is an idealized side elevation view showing the upper and lower drum along with the lower header.

FIG. VIII is a fragmented sectional detail view taken along line VIII—VIII of FIG. VII and showing the gas duct.

FIG. IX is a sectional side view taken along line IX—IX of FIG. XII showing an alternate embodiment wherein the basic design of this boiler is adapted to accommodate automatic stoker firing.

FIG. X is a sectional plan view taken along line X—X of FIG. IX.

FIG. XI is a sectional elevation view taken along line XI—XI of FIG. IX and showing the configuration of a convection section in the stoker fired embodiment.

FIG. XII is a somewhat idealized vertical elevation taken along line XII—XII of FIG. IX and showing a water-cooled bridge wall useful in the stoker fired embodiment.

FIG. XIII is a fragmented detail showing a water-cooled front wall which is useful in either the burner or stoker fired embodiment but which is especially suited to stoker firing.

PREFERRED EMBODIMENTS

FIGS. I through VII show a version of the steam boiler according to this invention with burners 1 which can fire gaseous, liquid or pulverent fuels. FIGS. IX through XII show a modified version by which this boiler can be converted for firing by automatic stokers 2. A water-cooled front end wall 3 shown in FIG. XIII could be used in either burner or stoker fired applications but it is necessary for the stoker fired version as is the cooled bridge wall shown in FIG. XII.

As best seen in FIGS. II and X, a setting generally designated 4 includes front end wall 3, back end wall 6, first side wall 7, second side wall 8, floor 9, roof arch 11 and target wall 12. Insulation 13 and casing 14 are of conventional design and are sometimes omitted throughout the drawings. Also for clarity and simplicity, tubes are

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sometimes omitted or indicated by single lines. As best seen in FIG. II, setting 4 is generally divided into radiant section 16 (wherein heat is transferred by radiation) and convection section 17 (wherein heat is transferred by convection).

Hot combustion gases may be supplied from a source extrinsic to this boiler, but it is more usual to generate these hot combustion gases in radiant section 16 by combustion of a conventional fuel. The fuel liberates its heat in radiant section 16 and hot combustion gases formed therefrom are channeled by tangent tubes 18 (best seen in FIG. II) to pass adjacent second side wall 8 about convection tubes 19 in serpentine passage 21 which is defined by baffles 22 and 23 to reach a location 23 back of target wall 12 from which the gases exit via port 24 to gas duct 26 (as best seen in FIG. VIII). Gas duct 26 runs along first side wall 7 and allows convenient gas exit to a stack.

At the core of this invention is a natural-circulation boiler wherein upper drum 27 is shielded from hot combustion gases in radiant section 16. By this achievement the present boiler may be operated at substantially higher pressures than was possible with prior designs. Even operating at these higher pressures the present design eliminates danger to upper drum 27 as well as to the connections of tubes 28 situated thereat. In the burner fired embodiment of FIGS. I through VII, upper drum 27 is mounted approximately midway between and above side walls 7 and 8. Lower drum 29 is positioned parallel to upper drum 27 toward first side wall 7 and behind target wall 12. Lower header 31 is likewise positioned toward first side wall 7 and it runs the length of the boiler. Lower header 31 is connected via conduits 32 to lower drum 29 and via downcomer 33 to upper drum 27 whereby lower header 31 is supplied with relatively cool water.

In order to maintain natural siphoning, tubes in radiant section 16 are organized in pairs to course from lower header 31 to upper drum 27. One pair of tubes 34A and 34B as shown in FIGS. I through V will serve as illustrative of other pairs of tubes in radiant section 16, such as 36A and 36B, 37A and 37B as well as 38A and 38B. Tubes 34A and 34B are approximately equal in length so they have about the same head loss vis a vis. Tube 34A courses from lower header 31 up first side wall 7 under upper drum 27 and connects thereto. Radiant tube 34B courses across floor 9, up second side wall 8 and connects to upper drum 27. Tube 34A shields upper drum 27 from hot combustion gases in radiant section 16. If it is desired to have a cooled bridge wall 39 such as is shown in FIG. XII and/or a cooled front end wall such as is shown in FIG. XIII, tubes 41 and/or 42 of each would also be paired in like manner as indicated by tubes 41A and 41B in FIG. XII.

It may be desirable to convert this basic design from burner firing to stoker firing. Conversion is best understood from viewing FIGS. X and XI. Cooled bridge wall 39 and cooled front end wall 3 are necessary for this conversion. As shown in FIG. XI an additional lower header 43 is also provided. Conduits 44 similar to conduits 32 are connected between lower drum 29 and the additional lower header 43 to supply relatively cool water thereto. An additional external downcomer from upper drum 27 to the lower header 43 at the front end of the boiler may also be employed and would be desirable. Stokers 2 may be of conventional design with rotors to throw the coal toward the rear 46 of vibrating grates 47 which gradually move the burning coal forward toward ash pit 48. Air is supplied through duct 49.

It will be apparent to those skilled in the design of boilers that wide deviations may be made from the preferred embodiments without departing from the main theme of invention set forth in the following claims.

What is claimed is:

1. In a steam boiler,

a setting which includes a front end wall and a first side wall and a second side wall and a target wall

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as well as a floor and a roof arch all embracing a radiant section therebetween,
means for providing hot combustion gases to the radiant section,

an upper drum mounted approximately midway between and above the side walls,
a lower header parallel to and laterally positioned relative the upper drum toward the first side wall,
means for supplying the lower header with relatively cool water,

at least one pair of radiant tubes including a first radiant tube and a second radiant tube each approximately the same length and each connected between the lower header and the upper drum,

the first radiant tube coursing from the lower header up the first side wall and under the upper drum projecting laterally thereof toward the second side wall and connecting to the upper drum,

the second radiant tube coursing across the floor and up the second side wall and connecting to the upper drum.

2. The combination of claim 1 with a lower water drum connected to the lower header to supply the lower header with the relatively cool water.

3. The combination of claim 2 with a downcomer connected between the upper drum and the lower header.

4. The combination of claim 3 with the downcomer outside the setting and in the vicinity of the front end wall.

5. A steam boiler comprising:

an elongated setting including a front end wall and a back end wall with a target wall substantially parallel thereto and spaced therebetween as well as side walls and a floor and a roof arch,

the front end wall and the target wall as well as the floor and the roof arch embracing a radiant section therebetween,

means for providing hot combustion gases to the radiant section,

an upper drum mounted approximately midway between and above the side walls,

a lower drum behind the target wall parallel to and laterally positioned relative the upper drum and in the vicinity of the first side wall,

means for supplying the lower drum with relatively cool water,

a lower header connected to the lower drum so that it receives relatively cool water therefrom and arranged parallel to and laterally positioned relative the upper drum and extending into the radiant section forward of the target wall,

at least one pair of radiant tubes each of approximately the same length and including a first and a second radiant tube,

the first radiant tube of the pair coursing from the lower header up the first side wall under the upper drum and connected thereto,

the second radiant tube of the pair coursing across the floor and up the second side wall and connecting to the upper drum,

the target wall and back wall as well as the side walls floor and roof arch all embracing a convection section,

the target wall spaced from the second side wall to define a passage communicating the radiant section in flow series with the convection section to deliver combustion gases thereto,

a plurality of convection tubes mounted in the convection section for heat recovery from the combustion gases,

the roof arch provided with a port for exhausting combustion gases from the convection section.

6. The steam boiler of claim 5 with tangent tubes arranged in the convection section to channel the flow of gases therethrough.

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7. The steam boiler of claim 6 with:

the flow of gases organized rearward along the second side wall and then forward in a generally serpentine path toward the back side of the target wall, the setting provided with a gas duct positioned above the radiant section and along the first side wall as well as a port at the rear of the target wall to conduct gases from the convection section thereto.

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U.S. Cl. X.R.

122-347

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