May 10, 1955 R. R. ADAMS 2,707,942

FIRETUBE BOILER

Filed Sept. 14, 1951 3 Sheets-Sheet 1

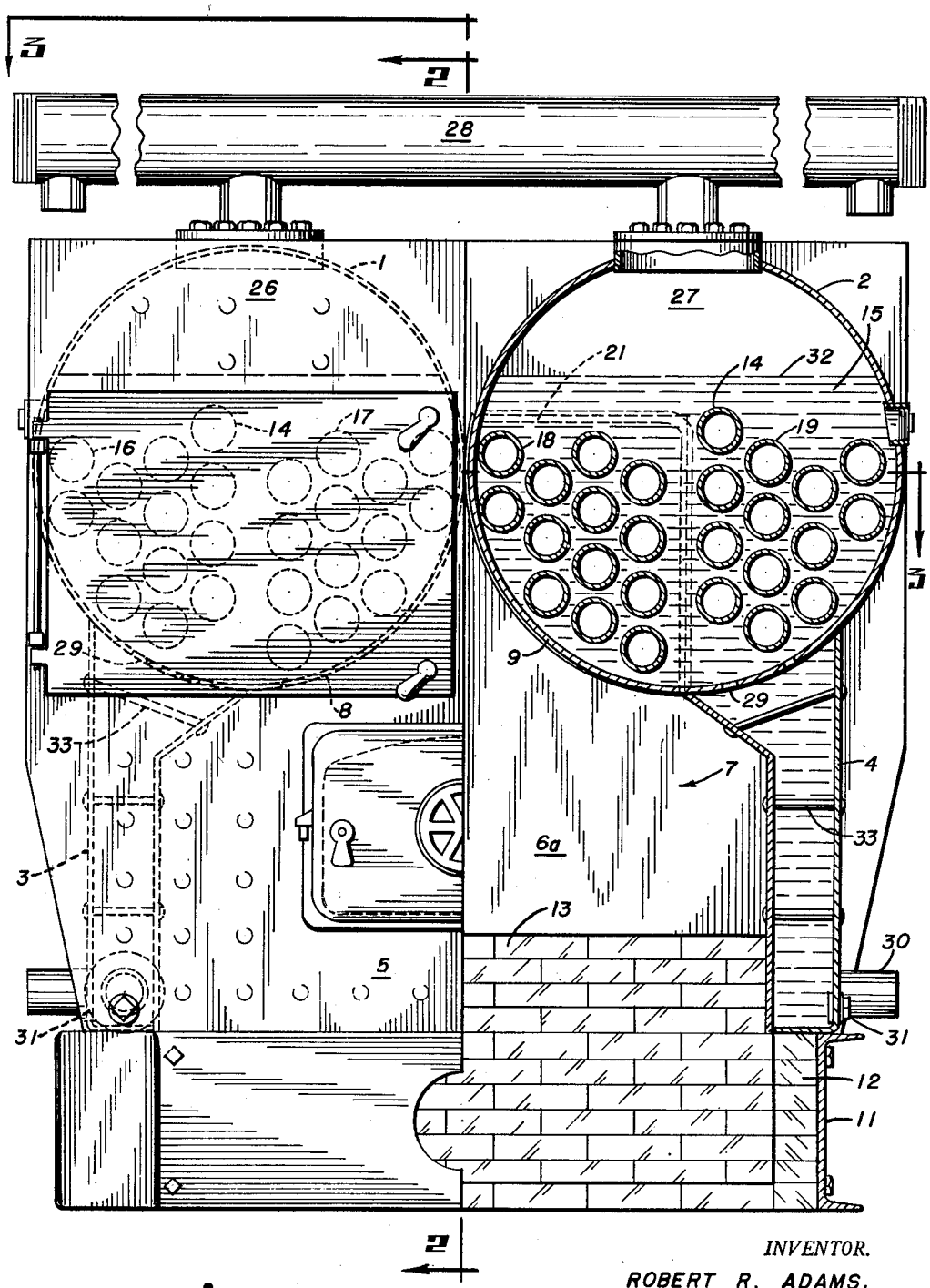

Fig 1

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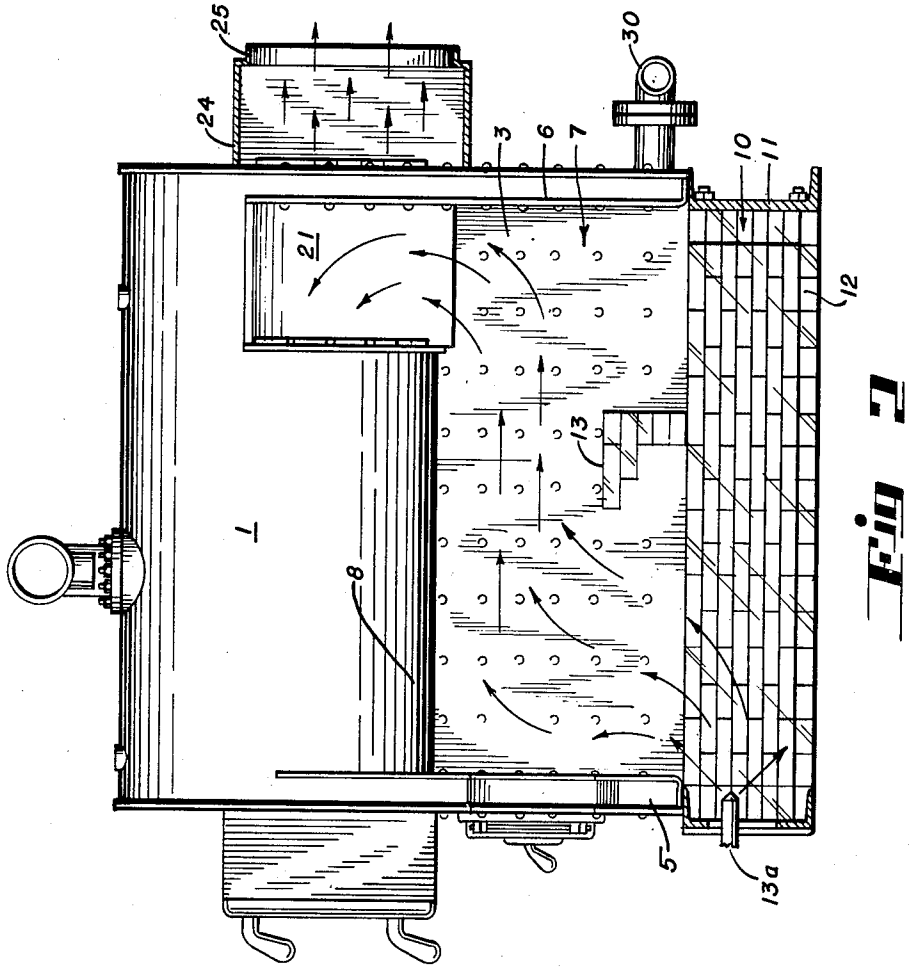

Fig. 1

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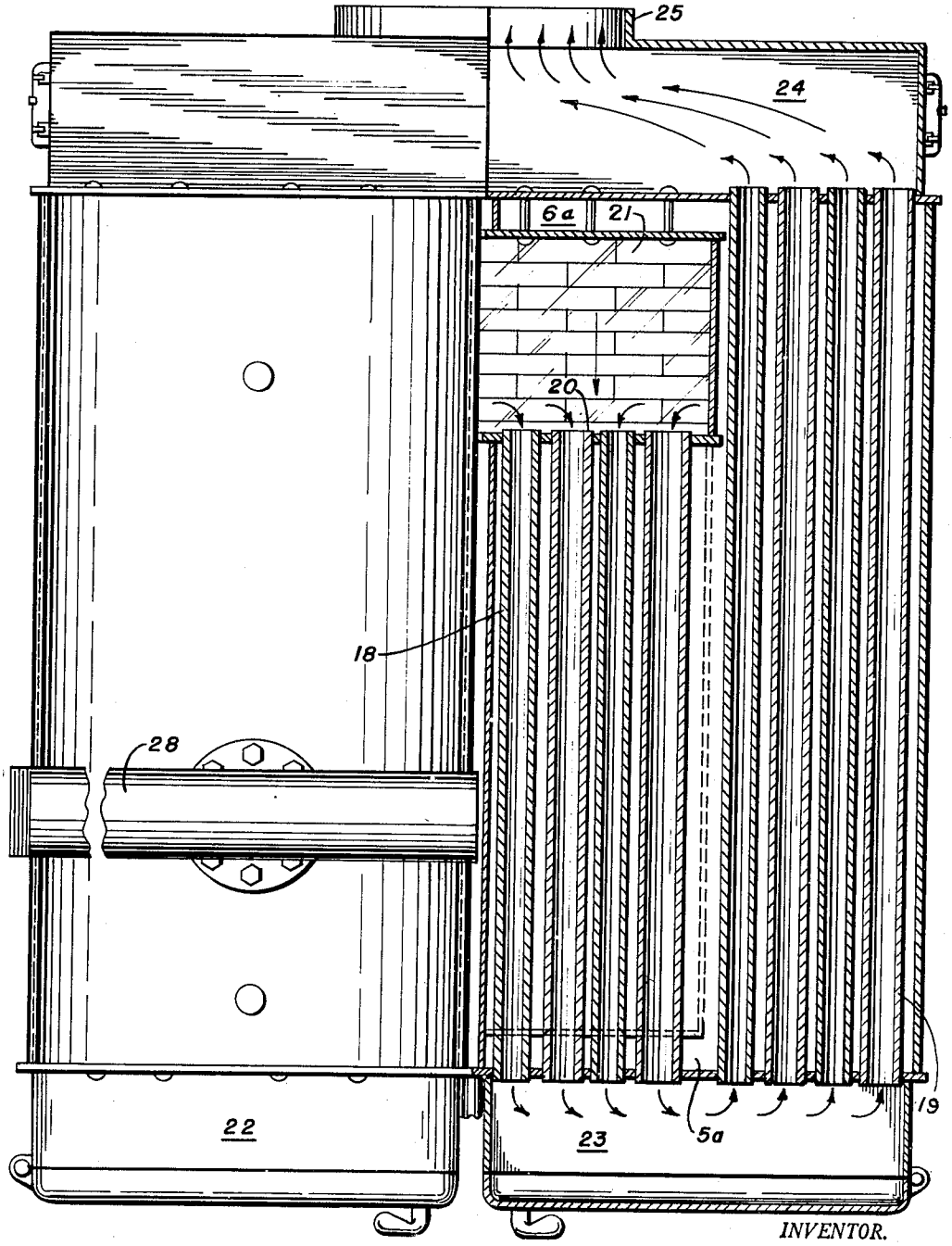

Fig 3

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FIRETUBE BOILER

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9 Claims. (Cl. 122—52)

The present invention relates to a stationary boiler installation for use in producing steam or hot water for small sized industrial establishments.

More particularly, the present invention relates to a firetube boiler which can be easily erected in the basement of an existing building and which is characterized by an unusually low water level while also being highly efficient and capable of producing substantially dry steam at outputs in excess of rated capacity.

Firetube boilers have been in use for a great many years, and often include a cylindrical shell in which the firetube passes are arranged one above the other so that the products of combustion from the firebox ascend successively through the banks of the tubes. Practically all of these currently used firetube boilers are characterized by a relatively high water level as well as by difficult installation problems. While it is true that this latter difficulty has been overcome in part by making boilers in sections which can be subsequently welded together at erection, this solution of the installation problem is expensive, is not looked upon with favor, and, in fact, is actually prohibited in certain States.

In contrast, boilers made according to the present invention can be easily installed in a very limited space without welding of any sort. Furthermore, the components of the boiler pass easily through existing building openings. In addition, these boilers, because of their low water line height, facilitate drainage of condensate and can readily accommodate existing piping in most buildings.

Briefly stated, the boiler installation of the present invention comprises a pair of juxtaposed, horizontally arranged, cylindrical shells to which are attached in depending relationship front, rear, and side water legs which define a fire box beneath the contiguous portions of the boiler shells. Each of the side water legs subtends the lowermost portion of its associated boiler shell so that sludge and other accumulations from the boiler automatically settle within the water legs, thus making the boiler shells practically self-cleaning.

The boiler shells are recessed at their rear ends and with the rear water legs define an uptake from the fire box through which the hot gases pass to a group of firetubes in each of the adjacent boiler shells. Each boiler shell contains two horizontally spaced groups of firetubes, the inner group in each shell extending between the uptake and a smoke box at the forward end of the boiler installation. Each outer group of tubes extends between a smoke box at the front end of the boiler and a smoke box and breeching at the rear of the boiler shells. It is to be noted that the groups of boiler tubes constitute gas passes in laterally spaced relationship rather than in conventional vertically spaced disposition. Through this arrangement of boiler tubes and the overall boiler design, the water level within the boiler shells can be kept very low for an installation of relatively high rating.

According to the present invention, a front and a rear

water leg are formed integrally with each of the boiler shells. Thus, the entire boiler installation is split in half, each half including a cylindrical shell side water leg, and a front and rear water leg. These halves can be easily passed through the average building opening and erected within the basement of most existing structures. Even if a new structure be involved, the possibility of so erecting the boiler is of great importance, since the cost is considerable for each additional foot of foundation and excavation.

In view of the foregoing, it is an object of the present invention to provide a firetube boiler installation which has a very low normal operating water line height.

A further object of the present invention is to provide a boiler installation in which the portions of the boiler shells facing the fire box, or in other words the crown sheets, are self-cleaning, sludge and other accumulations tending to settle in water legs secured to the boiler shells.

It is also an object of the present invention to provide a boiler installation including a horizontally disposed cylindrical shell to which a vertically disposed water leg is secured, the water leg subtending the lowermost portion of the shell.

An important object of the present invention is the provision of a boiler having the greatest fire box height at the center of the installation.

Another very important objective is the provision in a boiler installation of a large steam liberating area at the water line whereby substantially dry steam is produced despite the fact that the boiler is operated considerably in excess of its rated capacity.

A still further object of the present invention is to provide a boiler installation comprising a pair of horizontally arranged, parallel cylindrical shells each shell incorporating horizontally spaced groups of firetubes through which the gases pass in succession from an uptake which is centrally located at the rear of the fire box and is in communication with one group of firetubes within each boiler shell.

Still another object of the present invention is to provide a boiler made in sections which can be readily moved through an average sized building opening and subsequently erected without welding.

The novel features that are considered characteristic of the present invention are set forth in the appended claims; the invention itself, however, both as to its organization and use, together with additional objects and advantages thereof will best be understood from the following description of a preferred embodiment when read in conjunction with the accompanying drawings, in which:

Figure 1 is a front elevational view of the complete boiler installation, one-half of the boiler being shown in cross section to illustrate the interior construction thereof;

Figure 2 is a vertical longitudinal sectional view of the boiler installation taken on plane 2—2 of Figure 1; and

Figure 3 is a horizontal longitudinal-sectional view taken on plane 3—3 of Figure 1 showing the horizontally spaced disposition of the groups of boiler tubes within one of the boiler shells.

As illustrated particularly well in Figure 1, the present invention comprises a pair of parallel, juxtaposed, horizontally arranged cylindrical boiler shells **1** and **2**, each of which has an integrally secured side water leg **3** and **4**, respectively. The boiler shells **1** and **2** are also connected to front water legs **5** and **5***a* and rear water legs **6** and **6***a*, respectively. These water legs define a fire box, generally designated **7**, the upper extremities of which are defined by the contiguous crown sheets **8** and **9** of boiler shells **1** and **2**, respectively.

With reference to Figure 2, the boiler installation can be erected on a setting, generally designated **10**, which

may include a structural steel framework **11** lined with refractory brick **12**. A transverse bridgewall **13** may be provided across the fire box as is conventional in firetube boilers to deflect the hot gases and products of combustion upwardly against the crown sheets of the boiler shells.

Boilers of the type to which the present invention relates may be fired by any conventional method for burning coal, oil, or gas. For purposes of illustration, a burner nozzle **13***a* has been illustrated at the front of the boiler installation for injecting oil into the fire box the combustion of which produces hot gases which pass underneath the boiler shells and through a plurality of firetubes **14** in order to heat water **15** within the boiler shells and water legs.

The firetubes within both boiler shells are divided into horizontally spaced groups. With reference to boiler shell **1**, it will be noted that two groups of boiler tubes **16** and **17** are provided whereas in boiler shell **2** groups **18** and **19** are provided. The adjacent groups of firetubes **17** and **18** are relatively short compared to groups **16** and **19**, as best illustrated in Figure 3, which shows the ends **20** of the short firetubes **18** projecting rearwardly into an uptake **21** defined by the rear ends of the boiler shells and the rear water legs **6** and **6***a*.

The uptake is substantially as wide as fire box **7**. In this way, there is free passage for the hot gases, formed within the fire box, which first flow upwardly and rearwardly past substantially the entire area of the crown sheets **8** and **9**, and then into the uptake **21** from which the gases flow forwardly through the groups of firetubes **17** and **18**.

With reference to Figure 3, it will be noted that the gases pass from the firetube groups **17** and **18** to smoke boxes **22** and **23**, respectively. In these smoke boxes the gases reverse their direction of flow and enter the other groups of tubes of the associated boiler shells. For instance, with respect to boiler shell **1** the gases enter smoke box **22** from firetubes **17**, reverse their direction and flow rearwardly through firetubes **16**. Similarly, gases enter smoke box **23** from the group of firetubes **18**, reverse their direction of flow and enter firetubes **19**. The gases pass from the firetubes **16** and **19** into a common rear smoke box **24** where the gases merge and pass through a breeching **25** to a common smoke stack (not shown).

As will be readily appreciated by those skilled in the art, the passage of hot gases underneath the boiler shells and through the firetubes imparts a large amount of heat to the water. Heat is also transferred directly from the fire box into the water legs, thereby reducing the temperature of the furnace volume to a practical level and increasing the capacity of the boiler installation. As the water increases in temperature, steam is generated which collects in steam spaces **26** and **27** which are interconnected by a common manifold **28** used to convey the steam to a piping system (not shown) for use in heating buildings or for other desirable purposes.

There is free water circulation throughout each boiler shell and its associated water legs which are secured, as by welding, to the shell. In particular, it is to be noted in Figure 1 that holes **29** are provided in the lower portion of each boiler shell subtended by the side water legs. A common pipe line **30** introduces water to both sides of the boiler installation with the result that there is complete equalization of the water level within the two sections.

Although the present invention has been described primarily with reference to a steam generating installation, it should be appreciated that it may also be used to produce hot water for a hot water heating system with equal facility.

As will be understood by those skilled in the art, the hottest portions of the fire box are the crown sheets **8** and **9**. There is a tendency for sludge and other accumulations of foreign matter to settle on the crown sheets of many conventional firetube boilers. In the present invention, however, the inclination of the crown sheets **8** and **9** in combination with their being adjacent and in full communication with the water legs **3** and **4**, respectively, induces a movement of the sludge through openings **29** into the water legs **3** and **4** where it settles to the bottom and can easily be flushed out periodically through clean out holes **31** at the sides of the water legs.

This self-cleaning feature of the subject invention is very important, since it assures that at all times the interior surfaces of the crown sheets will be free and clear of sludge and other deleterious deposits which would otherwise act as an insulating layer and impede heat transfer through the boiler shells.

It is also noteworthy that the fire box is highest at the center where the crown sheets are contiguous. This is highly beneficial and favors complete combustion of the fuel within the fire box and also tends to minimize soot deposits on any of the heat transfer surfaces of the boiler installation.

By arranging the groups of firetubes in spaced horizontal relationship, the gas passes are maintained at a minimum elevation. In this way, the water level, indicated at **32**, is kept at an absolute minimum which favors the use of the present boiler in relatively shallow basements and makes use of the boiler desirable in new structures since a minimum excavation is required to accommodate the installation. Furthermore, the boiler favors drainage from existing pipe lines within buildings in which it is installed, since its water level is so low as to be beneath that of most condensate return lines ordinarily encountered.

Another important feature of the present invention is the construction of the boiler installation in sections. The boiler is split vertically, each section including a boiler shell, a side water leg, and a front and rear water leg. This is of considerable importance since the sections of the boiler can be readily passed through existing building openings even though somewhat under-sized, and the boiler can be erected easily in a relatively confined space. It is important to note that no welding is necessary for installing the two sections.

Another advantage of the present invention is the fact that no reinforcing stays are necessary in the boiler shells because of their cylindrical formation and relatively small diameter. Stays **33** are provided in the water legs for reinforcement purposes. These stays are easily provided because of the flat sides of the water legs, and the relatively small thickness involved. Thus, the boiler disclosed can be readily fabricated with ordinary boiler making equipment, and no expensive and intricate staying problems are encountered.

Another feature of importance in the present invention is the large steam liberating area inherently present at the water line **32**. By virtue of this large area, steam can be generated within the boiler shells with a minimum of moisture entrapment with the result that steam of ninety-eight per cent quality can be produced at an operating load of over two hundred per cent rated capacity.

In view of the foregoing description, it will be appreciated by those well versed in the art that the present invention provides a boiler installation which is not only highly desirable from the viewpoint of fabrication and erection, but which also favors the economical and rapid production of substantially dry steam. It will also be appreciated that the boiler installation is highly desirable from the viewpoint of having a high fire box defined by self-cleaning crown sheets and surrounding water legs which can be readily reinforced by short stays. The integral construction of the water legs with the boiler shells and the absence of any welding at the time of erection favors greatly the production of a leak-free installation.

Having described a preferred embodiment of my invention, I claim:

1. A sectional boiler installation comprising adjacent halves each comprising a horizontal, cylindrical boiler

shell and front, rear and side water legs secured to said shell, the halves of the boiler installation being located with the boiler shells in contiguous disposition with the water legs defining a fire box beneath said boiler shells, the highest region of the fire box being defined by the contiguous surfaces of said shells; a plurality of firetubes passing through each of said shells, the firetubes within each shell comprising two horizontally spaced groups; said boiler shells and rear water legs defining an uptake for directing hot gases from the fire box into the inner group of fire tubes in each boiler shell; and means at the end of the boiler shells remote from the uptake for directing the gases from each inner group of firetubes to the outer group of firetubes in the associated shell.

2. Apparatus as defined in claim 1 in which said inner group of firetubes is shorter than said outer group of firetubes, the inner group terminating in the uptake in communication with the fire box.

3. In combination, a sectional boiler installation comprising vertically split halves each of which includes a horizontal, cylindrical boiler shell and front, rear, and side water legs, the water legs and shells defining a fire box, the side water legs subtending the lowermost portions of the associated boiler shells, the boiler shells defining openings in their lower walls permitting free circulation between said side water legs and boiler shells respectively, a plurality of firetubes passing longitudinally through each of said shells, the firetubes within each shell comprising two horizontally spaced groups, said boiler shells and rear water legs defining an uptake for directing hot gases from the fire box to the inner groups of firetubes in each boiler shell and means remote from the uptake interconnecting the groups of associated firetubes in each boiler shell.

4. In combination, a sectional boiler installation comprising vertically split halves each of which includes a horizontal, cylindrical boiler shell and front, rear, and side water legs, said water legs and shells defining a fire box; said side water legs subtending the lowermost portions of the associated boiler shells, each boiler shell being in free communication with its side water leg; a plurality of firetubes passing longitudinally through each of said shells, said firetubes within each shell comprising two horizontally spaced groups; said boiler shells and rear water legs defining an uptake for directing hot gases from the fire box to the inner groups of firetubes in each boiler shell; and means remote from the uptake interconnecting the groups of associated firetubes in each boiler shell.

5. In combination, a sectional boiler installation comprising split halves each of which includes a horizontal, cylindrical boiler shell and front, rear and side water legs, said water legs and shells defining a fire box; said side water legs subtending the lowermost portions of the associated boiler shells and being in free communication therewith; a plurality of firetubes extending longitudinally through said shells, said firetubes of each shell being arranged in two horizontally spaced groups; the inner adjacent groups of firetubes in said boiler shells being shorter than the other groups of firetubes and being in communication with an uptake defined in part by said boiler shells and water legs, the uptake being in communication with the firebox; and means at the ends of said boiler shells remote from the uptake interconnecting said groups of firetubes of each boiler shell.

6. In combination, a sectional boiler installation comprising vertically split halves each of which includes a horizontal, cylindrical boiler shell and a side water leg, said water legs and shells defining a fire box; said side water legs subtending the lowermost portions of the associated boiler shells and being in free communication therewith– a plurality of fire tubes passing longitudinally through each of said shells, said firetubes within each shell comprising two horizontally arranged groups; an uptake defined in part by said shells for directing hot gases from the fire box to the inner group of firetubes in each boiler shell; and means remote from said uptake interconnecting the groups of associated firetubes in each boiler shell.

7. In combination, a boiler installation comprising a pair of horizontal, cylindrical, contiguous boiler shells; side and rear water legs connected to each shell; said shells and water legs defining a fire box; said side water legs subtending the lowermost portions of the associated boiler shells and being in free communication therewith; a plurality of firetubes extending longitudinally through said shells, said firetubes of each shell comprising two horizontally arranged groups; the inner adjacent groups of fire tubes in said boiler shells being shorter than the other groups of fire tubes; said rear water legs and shells at the ends of said shorter firetubes defining a central uptake communicating with the fire box and delivering hot gases to the inner group of firetubes in each boiler shell; and means remote from the uptake interconnecting the groups of firetubes in each shell.

8. A sectional boiler installation comprising adjacent halves each comprising a horizontal, cylindrical boiler shell and water legs secured to said shell, the halves of the boiler installation being located with said boiler shells in contiguous disposition with the water legs defining a fire box beneath said boiler shells, the highest region of the fire box being defined by the contiguous surfaces of said shells; a plurality of firetubes passing through each of said shells, the firetubes within each shell comprising two horizontally spaced groups; said boiler shells and water legs defining a central uptake for directing hot gases from the fire box into the inner group of firetubes in each boiler shell; and means at the end of the boiler shells remote from the uptake for directing the hot gases from each inner group of firetubes to the outer group of firetubes in the associated shell.

9. Apparatus as defined in claim 8 in which said inner group of firetubes is shorter than said outer group of firetubes, the inner group terminating in the uptake in communication with the fire box.

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