July 25, 1939. A. E. DURAM 2,167,545

STEAM GENERATOR

Filed Dec. 11, 1935 4 Sheets-Sheet 1

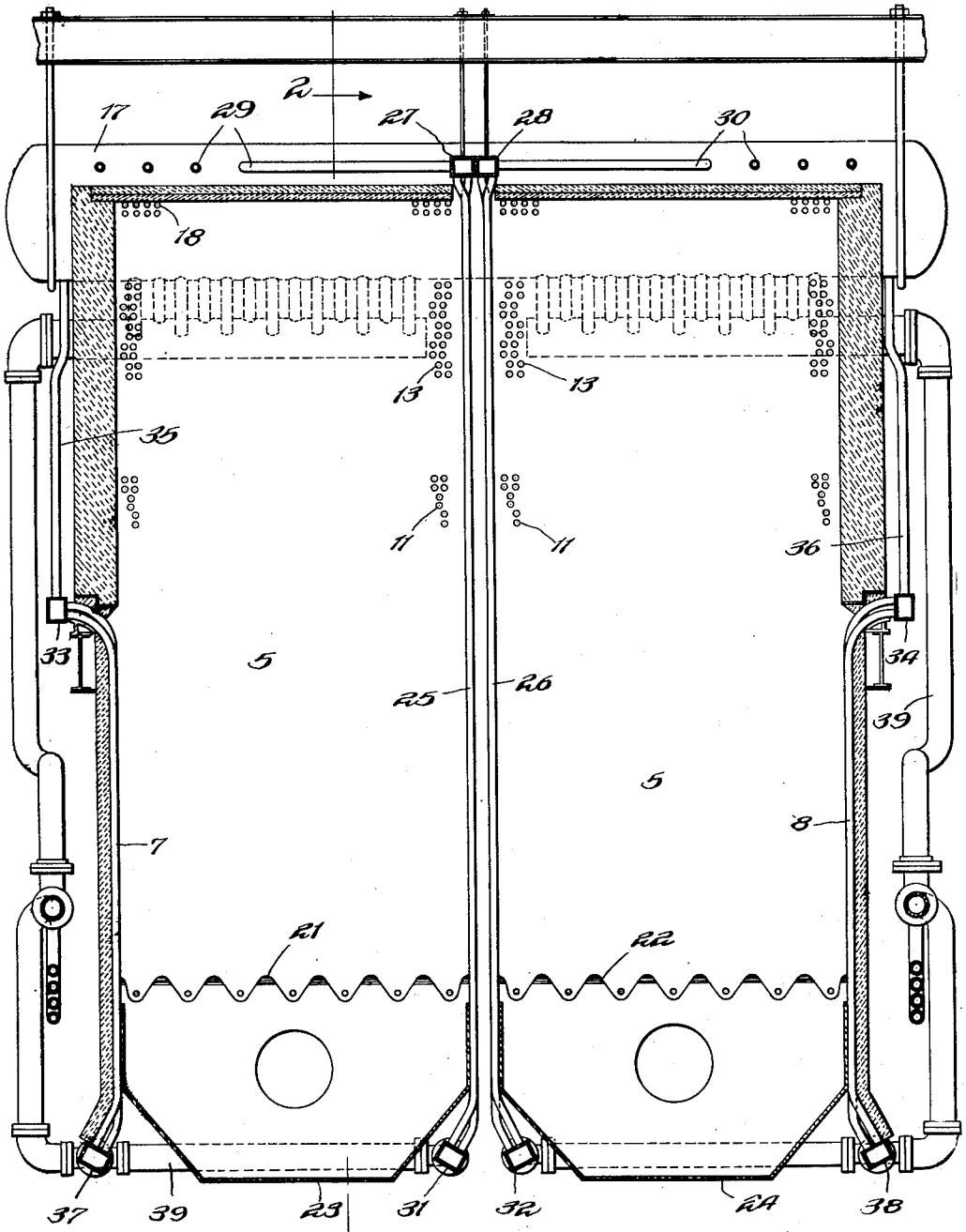

Fig. 1.

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Fig. 2.

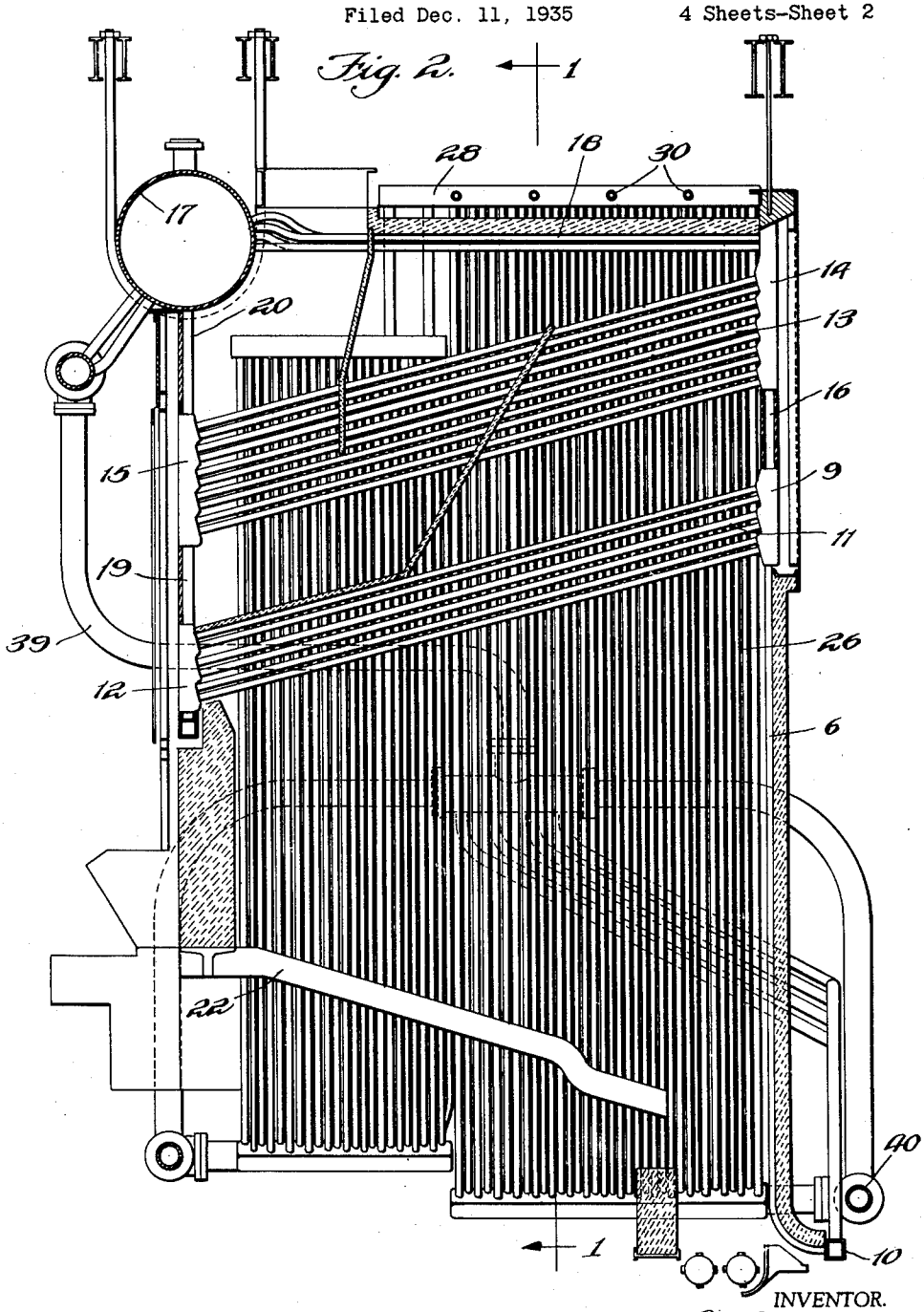

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Fig. 3.

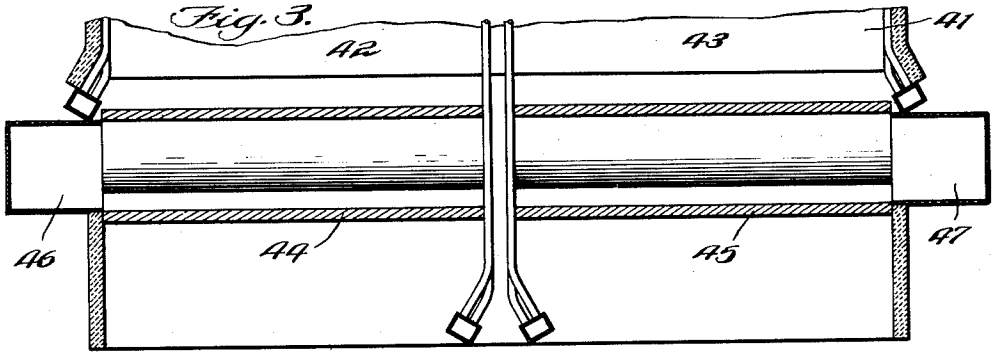

Fig. 4.

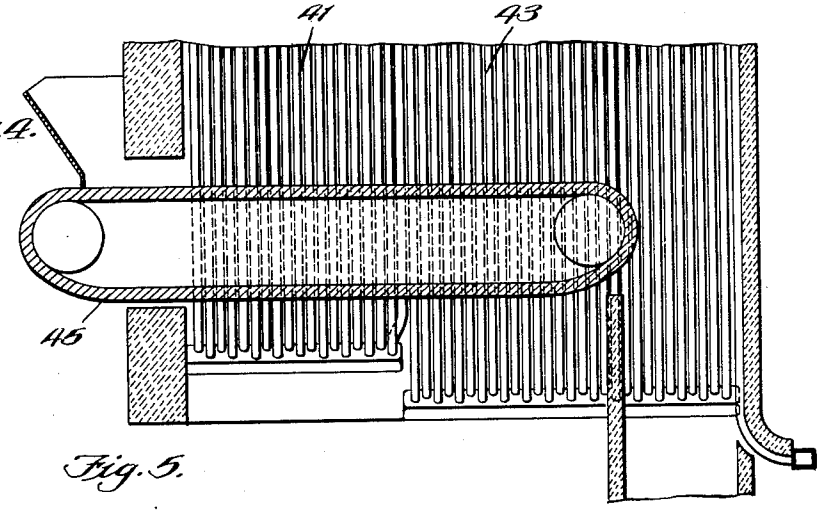

Fig. 5.

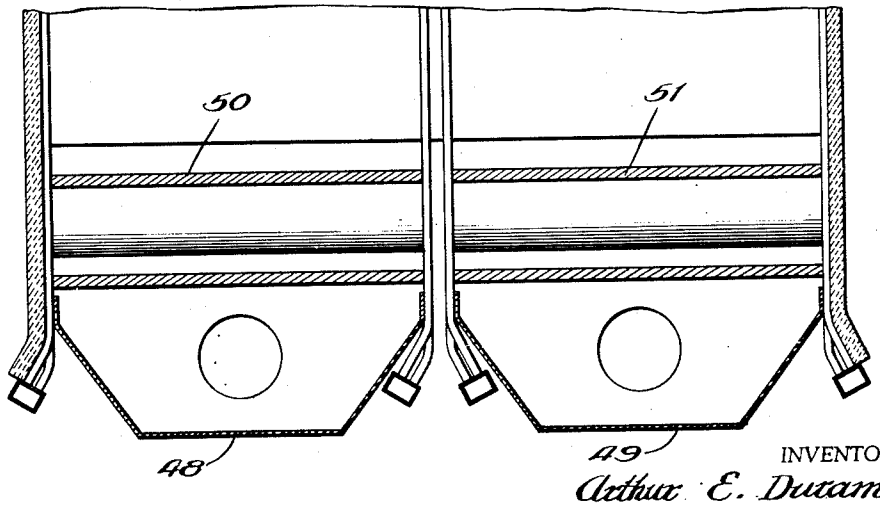

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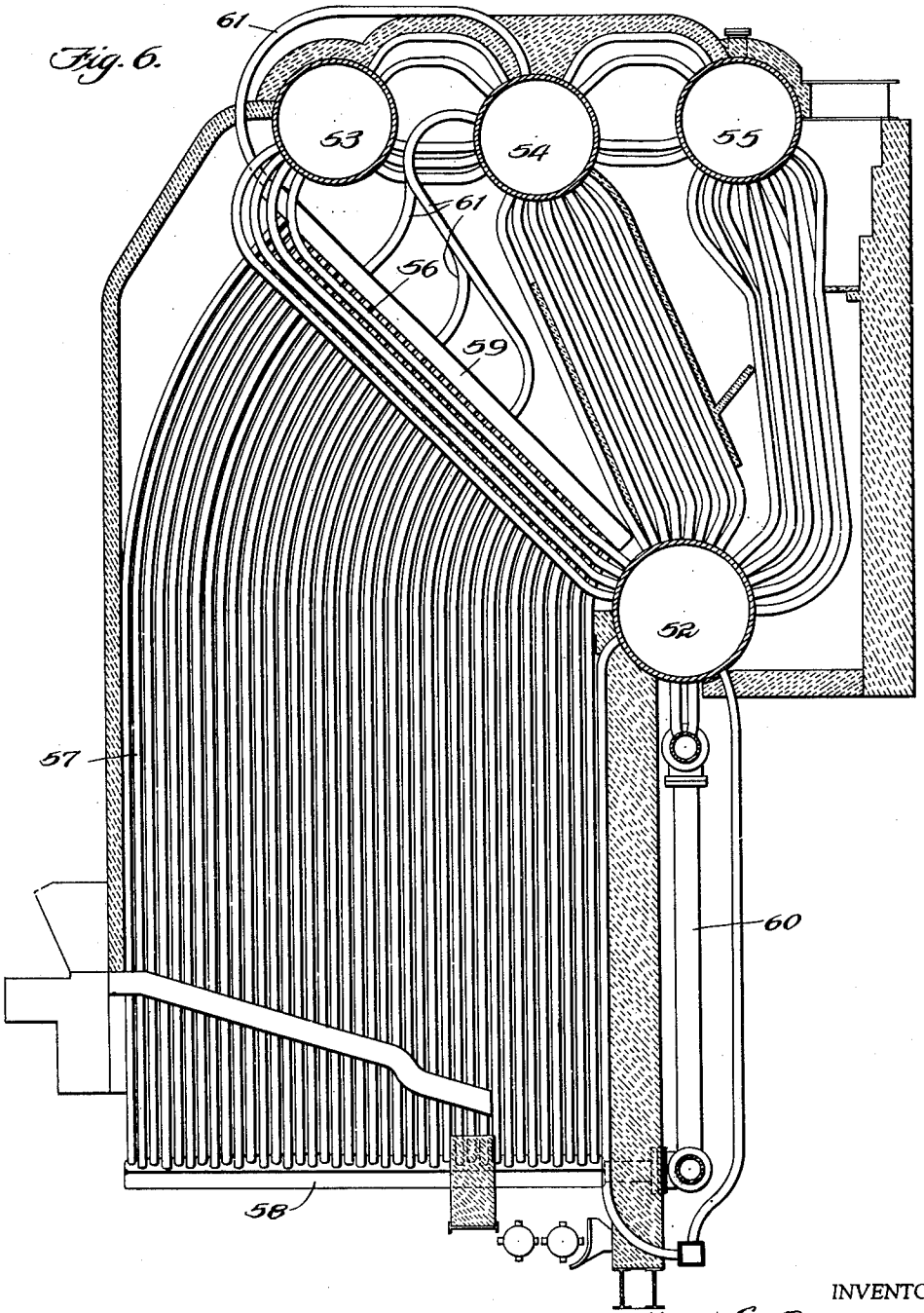
Fig. 6.



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Patented July 25, 1939 2,167,545

UNITED STATES PATENT OFFICE

2,167,545

STEAM GENERATOR

Arthur E. Duram, Springfield, Ill., assignor to Springfield Boiler Company, Springfield, Ill., a corporation of Illinois

Application December 11, 1935, Serial No. 53,880

5 Claims. (Cl. 122—240)

This application is a continuation in part of my former application Serial No. 747,764, filed October 10, 1934, for Steam generating apparatus issued May 24, 1936, No. 2,034,717, insofar as certain common subject matter is concerned.

This invention relates particularly to steam generators or furnaces of relatively large size and high rating. It has been found that in furnaces of this kind it is necessary or essential to keep the furnace temperatures below the fusing point of the slag or impurities in the fuel in order to prevent undue slagging or coating of the boiler tubes. It has been found that this may be accomplished to a certain degree by the use of water walls but where the combustion chamber becomes too large the cooling effect of such walls is not sufficient to reduce the temperature of the flame in the central portions of the furnace. In order to overcome such objections and to further provide for cooling of the gases of combustion I divide the furnace into two or more compartments or sections by means of double water walls so as to provide sufficient water cooling for each section to maintain a furnace temperature below the fusing temperature of the ash in the coal. Each of such compartments is provided with a stoker and in this manner large furnaces may be built without undue increase in the size of the stoker mechanism, or excessive variation in the temperature of the gases.

As an example it may be noted that in a furnace of approximately twenty-five feet in width and provided with the usual side water walls, the lack of radiant absorption to the side walls would permit the flame in the center of the furnace to become hotter than the fusing point of the impurities of the coal. Consequently I have found it advisable to divide a furnace of this size into two sections or zones by means of a suitable central wall or partition formed of two rows of tubing which will increase the radiant absorption sufficiently so that the temperature is reduced below the softening or fusing point of the impurities in the coal. A partition formed by a single water wall would not be practical inasmuch as such a wall with stokers on each side would be subjected to excessive radiant heat and cause such a high rate of evaporation in the tubes that they would not stand up. This is particularly true when considered in connection with large units or boilers such as have a capacity of approximately one hundred thousand pounds of steam per hour, or more.

The objects of the present invention as above indicated are to provide an improved steam generator in which the furnace will have sufficient water walls to prevent slagging; to provide an improved steam generator of relatively large capacity in which the furnace is divided into a plurality of zones or compartments with double water walls between the same, each zone being provided with a stoker or suitable fuel feeding mechanism; to provide an improved water wall adapted to serve as a partition in a furnace, the arrangement being such that the tubes in one row will serve to shield or protect the tubes in the other row from the radiant heat of the opposite zone; and to provide such other improved features in construction and operation as will appear more fully from the following description.

In the accompanying drawings illustrating this invention,

Figure 1 is a vertical sectional view taken substantially on line 1—1 of Figure 2, parts being shown diagrammatically and well known structural features being omitted for convenience in illustration;

Figure 2 is a sectional view taken approximately on the line 2—2 of Figure 1 and showing a furnace provided with one type of stoker mechanism which is shown conventionally;

Figure 3 is a sectional detail similar to Figure 1 but showing a different form of stoker;

Figure 4 is a sectional view of the apparatus shown in Figure 3 taken at right angles to the view shown in Figure 3;

Figure 5 is a sectional view similar to Figure 3 showing a further modification; and

Figure 6 is a sectional view similar to Figure 2 but showing the invention applied to a multiple drum boiler.

The furnace or combustion chamber 5 has a rear water wall 6 and side water walls 7 and 8 and may be provided with a front water wall (not shown). The tubes of the rear water wall are connected at the top to the header 9 and at the bottom to the header 10, the header 9 being one of the headers of the main lower bank 11 of tubes of the boiler. The opposite ends of the tubes of the lower bank 11 are connected with a header 12. The tubes of the upper bank 13 are connected with headers 14 and 15 and the upper and lower banks are preferably separated in the usual manner as shown in Figure 2. The high end headers 9 and 14 are connected by tubes 16 and the header 14 is connected with the drum 17 by tubes 18. The lower end headers 12 and 15 are connected by tubes 19 and the header 15 is connected with the drum 17 by means of the tube 20. Any suitable return pip-

ing may be provided for the various headers and banks of tubes, such as indicated, in order to provide proper circulation in any well known manner.

The furnace is divided into two compartments or sections by my improved center or partition wall, although of course any number of such walls may be used to divide the furnace into as many sections as desired. As shown in Figures 1 and 2, the sections are provided respectively with underfeed stokers 21 and 22 and with the usual air or wind boxes 23 and 24 which may be supplied with air from any suitable source of supply (not shown).

The center or partition wall includes two sets or banks of tubes 25 and 26, the tubes of each set being of sufficient size and suitably spaced to reduce the temperature of the adjacent portions of the furnace to the desired degree and to serve in a similar manner as the other water walls. The respective tubes of these two banks or walls 25 and 26 are arranged sufficiently close to make substantially two water walls adapted to divide the furnace into the two separate chambers as above suggested. The tubes of the banks or walls 25 and 26 extend upwardly through the lower and upper banks 11 and 13 of the main tubes of the boiler, sufficient space being provided through these banks for the same, and are connected at the top with suitable headers 27 and 28 respectively as best shown in Figure 1. The header 27 is connected with the drum 17 by means of one or more tubes 29 and the header 28 is similarly connected with the drum by means of tubes 30. On account of having the headers 27 and 28 arranged at the top of the boiler they are readily accessible and in the arrangement shown may be placed close together but if desired a single header may be used in place of the two headers shown. The lower ends of the tubes 25 are connected with a header 31, and the lower ends of the tubes 26 with a header 32, the tubes being bent adjacent to such headers in order to provide sufficient separation or opening between the headers to provide access thereto. The upper ends of the tubes 7 and 8 are connected respectively with headers 33 and 34 which are in turn connected with the drum 17 by means of tubes 35 and 36. The lower ends of the tubes 7 and 8 of the side water walls are connected respectively with headers 37 and 38. The lower sets of headers 31, 32, 37 and 38 may be connected with the drum by any suitable piping system such as indicated generally at 39, the intake for supplying water to the system being shown at 40, and the steam may be withdrawn through any suitable outlet in the usual manner. It will be understood that the connecting piping which provides suitable circuits for the various water walls may be varied in accordance with the requirements for various boilers and any well known or suitable arrangement may be provided for this purpose.

Figures 3 and 4 show an arrangement which may be utilized in connection with endless belt or chain grate stokers. In this arrangement the furnace or combustion chamber 41 is provided by a double center water wall into two compartments 42 and 43 which are provided respectively with stokers 44 and 45. In this arrangement air is supplied through wind boxes 46 and 47 arranged on either side of the furnace and which are adapted to receive air from any suitable source of supply (not shown) and deliver the same to the combustion chambers through the stokers.

Figure 5 shows an arrangement similar to that shown in Figures 3 and 4 but in this instance the wind boxes 48 and 49 are arranged below the chain grate stokers 50 and 51 but other features are substantially the same as shown in the above described forms.

Figure 6 illustrates the application of the invention to a multiple drum or bent tube boiler, of any well known form. In the one shown, there is a lower drum 52 and upper drums 53, 54 and 55 which are connected by suitable banks of tubes. In order to provide space for my improved center water wall some of the tubes may be left out of the lower or front bank 56. In this arrangement the tubes 57 of the center or partition wall are connected at the bottom with a header 58 and are curved at the top to pass between the tubes 56 and engage with a top header 59. The headers 58 and 59 may be connected with the main boiler system in any well known manner in order to provide for suitable circulation. As illustrated, the lower header is connected with an intake pipe or system of pipes 60 leading from the lower drum 52 and the header 59 is connected by means of outlet pipes 61 with one of the upper drums.

From this description it will be seen that I provide an improved steam generating apparatus or furnace of large size wherein the operating elements such as the stokers may be made of convenient size for favorable operation instead of being too large and unwieldy as might be the case in which a single stoker is utilized for supplying the entire combustion chamber. Furthermore, by dividing the combustion chamber into two or more compartments by means of the central or intermediate water wall, the furnace is arranged so that suitable temperatures may be maintained in the respective chambers and the gases will be cooled sufficiently to prevent undue slagging. The provision of the center water walls and extension of the tubes up to the top of the boiler permits the convenient installation as well as removal or repair of these tubes and simplifies the general structure of the boiler. The operation will be readily understood as being that common to all tubulous boilers of either single drum or multiple drum type, in which the fuel is supplied by means of any suitable form of stoker as will be readily apparent to those familiar with such apparatus.

While I have shown a preferred form of my invention such as applicable for actual installation, it is apparent that changes may be made in order to adapt the same for different conditions without departing from the scope thereof and therefore I do not wish to limit the invention to the particular construction shown and described except as specified in the following claims, in which I claim:

1. A furnace under a single unit boiler comprising a combustion chamber having tubular water walls and divided into a plurality of sections by partitions, each partition comprising two adjacent water walls, the tubes of each wall being of sufficient size and suitably spaced to shield the tubes of the adjacent wall from the heat of the adjacent section and each of said sections being adapted to be heated by separate fuel supply means.

2. A relatively large furnace under a single boiler having side water walls and divided longitudinally into a plurality of combustion zones by means of tubular water walls arranged adjacent to each other, the tubes of each wall being spaced closely together and of sufficient size to shield the tubes of the other wall from the heat of the oppo-

site zone and to reduce the temperature of the adjacent portion of the furnace below a predetermined degree for the purposes described.

3. In combination with a single boiler of the horizontal inclined tube type, a furnace having side water walls and having separating water walls in parallel with said side walls, each separating wall comprising two sets of vertically arranged tubes immediately adjacent to each other and sufficiently removed from the side walls to provide independent combustion zones with water cooled walls on each side thereof whereby the temperature of the furnace may be regulated for the purposes set forth and the tubes of each set will be shielded from the heat of the next adjacent zone.

4. The combination with a boiler of the inclined horizontal tubulous type having a bank of tubes and having a drum connected with said tubes, of a furnace, means for dividing the furnace into zones, comprising two series of tubes arranged adjacent to each other, the tubes in one series serving to shield the tubes of the adjacent series from the heat of the opposite zone, headers for the lower ends of each of the series, headers for the upper ends of each of the series located above the main bank of tubes of the boiler, and pipes leading from said last named headers to the drum.

5. A unitary steam generator construction for a single boiler of the tubulous type, including a furnace chamber having outer furnace walls, said chamber being divided into two compartments by a partition wall formed of two banks of tubes **25** and **26** arranged adjacent to each other, the tubes of each bank being of sufficient size and suitably spaced to reduce the temperature of the adjacent portions of the furnace to the desired degree and being sufficiently close to each other so that the tubes in one bank will protect the tubes in the other bank from the heat of the adjacent compartment, the tubes of both banks being incorporated as a part of the boiler, and means for supplying heat to each compartment.

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