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E. F. SPANNER

2,218,898

STEAM GENERATOR OR WATER HEATER

Filed July 19, 1938

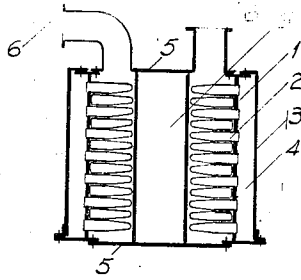


FIG. 1.

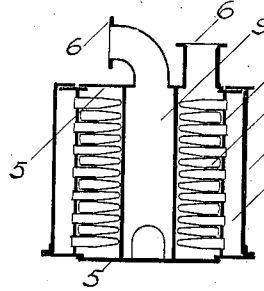


FIG. 2.

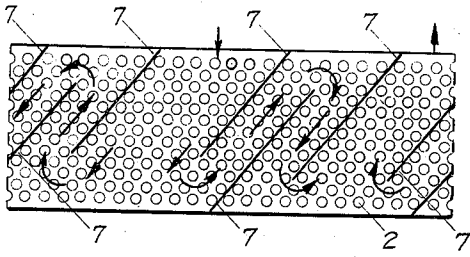


FIG. 3.

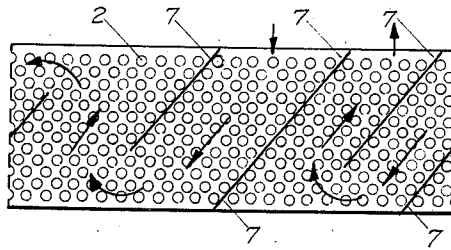


FIG. 4.

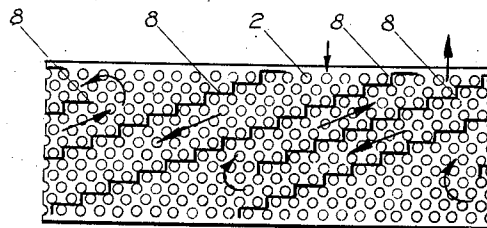


FIG. 5.

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STEAM GENERATOR OR WATER HEATER

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4 Claims. (Cl. 122-7)

This invention relates to improvements in steam generators and water heaters of thimble tube type, for waste heat recovery from Diesel engine exhaust gases, and has for its object the production of units convenient for installation and inspection, suitable and efficient for engines of different sizes delivering different volumes of gas, and very economical in first cost, dimensions and weight.

Waste heat boilers of thimble tube type for use with Diesel engine exhaust gases must have:

(1) Sufficient thimble tube heating surface to recover all the heat available.

(2) Sufficient area for the passage of the gas to avoid undue back pressure.

(3) Provision for reducing this area as the gas cools down.

(4) Provision for easy access to both the water and gas sides of the thimble tube heating surface.

This invention satisfies all these various requirements much better than they can be satisfied by units of known practice by arranging that the flow of the gas through the thimble tube nests shall be controlled by the disposition of a series of spiralled directional plates which can be altered in position in the same tube nest so that a single unit can be made effective for a range of engines having different rates of exhaust gas output.

In the drawing:

Figure 1 shows a section through a unit in accordance with this invention and having inlet and outlet at the top of the boiler on the same diameter, but off the centre.

Figure 2 shows a section through a unit having both inlet and outlet at the top but one of them central.

Both of these units could be used upside down.

Figure 3 shows an arrangement of removable spiralled directional plates suitable for Figure 1.

Figure 4 shows an arrangement of removable spiralled directional plates suitable for a unit generally similar to that shown in Figure 1 i. e. having inlet and outlet connections communicating with the annular space between the centre cylinder and the tube plate, but having these two connections communicating with gas channels adjacent to one another. Such an arrangement might be more convenient in layout than that shown in Figure 3.

Figure 5 shows an arrangement of removable stepped directional plates suitable for a unit generally similar to that shown in Figure 1, but having the inlet and outlet gas connections com-

municating with gas channels adjacent to one another.

Using the same tube nest, the invention enables either spiralled or stepped directional plates to be rearranged to suit engines of different horsepower or of different gas discharge characteristics.

If, in certain cases, the rearrangement of these plates to suit a different engine causes the final gas channel to lead in a downward instead of a preferred upward direction or vice versa, the invention provides that use can be made of the centre cylinder as a gas discharge pipe, as shown in Figure 2.

A unit using one or other of these two types of directional plates is a great improvement on a unit without spiral flow since much greater diameters of tube nest can be used at greatly decreased heights of boiler for the same total area of heating surface. The larger diameter ensures fewer rows of tubes, and better access for cleaning. Ability to remove both top and bottom plates is also very advantageous for cleaning.

In these figures a cylindrical tube plate 1, which has expanded into it inwardly projecting thimble tubes 2, is surrounded by an outer cylindrical shell 3, to which it is connected in a water or steam tight manner leaving an annular space 4, between the two shells.

The two ends of the cylinder formed by the tube plate are closed in a gas tight manner by end plates 5, to which are fitted flanges 6, for taking the inlet and outlet connections. Spiralled directional plates 7 or stepped directional plates 8 are fitted to force the gas to take an up and down spiralled flow, the inner edges of these plates being closely fitted to a removable centre cylinder 9.

I claim:

1. An improved steam generator and water heater for silencing and recovering waste heat from the exhaust gases from Diesel engines or gas engines, comprising a cylindrical tube plate into which are expanded inwardly projecting thimble tubes, an outer cylindrical shell providing an annular water or water and steam space between itself and the tube plate, gastight end plates closing the ends of the cylinder formed by the cylindrical tube plate, gas inlet and outlet connections to the thimble tube nest, water and steam connections to the outer shell, a centre cylinder, and adjustable directional plates so arranged between the thimble tubes as to cause the gas to pass spirally up and down through the

tube nest in a manner which provides a gradually reduced area for the passage of the gas, thus maintaining a consistently high velocity and turbulent flow.

- 5 2. An improved steam generator and water heater for silencing and recovering waste heat from the exhaust gases from Diesel engines or gas engines, comprising a cylindrical tube plate into which are expanded inwardly projecting
- 10 thimble tubes, an outer cylindrical shell providing an annular water or water and steam space between itself and the tube plate, gastight end plates closing the ends of the cylinder formed by the cylindrical tube plate, gas inlet and out-
- 15 let connections to the thimble tube nest, water and steam connections to the outer shell, a centre cylinder, and adjustable directional plates made in the form of steps and so arranged between the thimble tubes as to cause the gas to pass
- 20 spirally up and down through the tube nest in a manner which provides a gradually reduced area for the passage of the gas, thus maintaining a consistently high velocity and turbulent flow.
- 25 3. An improved steam generator and water heater for silencing and recovering waste heat from the exhaust gases from Diesel engines or gas engines, comprising a cylindrical tube plate into which are expanded inwardly projecting
- 30 thimble tubes, an outer cylindrical shell providing an annular water or water and steam space between itself and the tube plate, gastight end plates closing the ends of the cylinder formed by the cylindrical tube plate, gas inlet and outlet

connections to the thimble tube nest, water and steam connections to the outer shell, a centre cylinder, and adjustable spiralled directional plates so arranged between the thimble tubes as to cause the gas to pass spirally up and down 5 through the tube nest in a manner which provides a gradually reduced area for the passage of the gas, thus maintaining a consistently high velocity and turbulent flow.

4. An improved steam generator and water 10 heater for silencing and recovering waste heat from the exhaust gases from Diesel engines or gas engines, comprising a cylindrical tube plate into which are expanded inwardly projecting
- 15 thimble tubes, an outer cylindrical shell providing an annular water or water and steam space between itself and the tube plate, gastight end plates closing the ends of the cylinder formed by the cylindrical tube plate, gas inlet and outlet connections to the thimble tube nest, 20 water and steam connections to the outer shell, a centre cylinder, and adjustable stepped directional plates so arranged between the thimble tubes as to cause the gas to pass spirally up and down through the tube nest in a manner which 25 provides a gradually reduced area for the passage of the gas, thus maintaining a consistently high velocity and turbulent flow, the centre cylinder being arranged so that an opening is provided into it at the end adjacent to the end of the 30 last spiral passage so that the gas can pass into and through the cylinder, and so out of the boiler.

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