

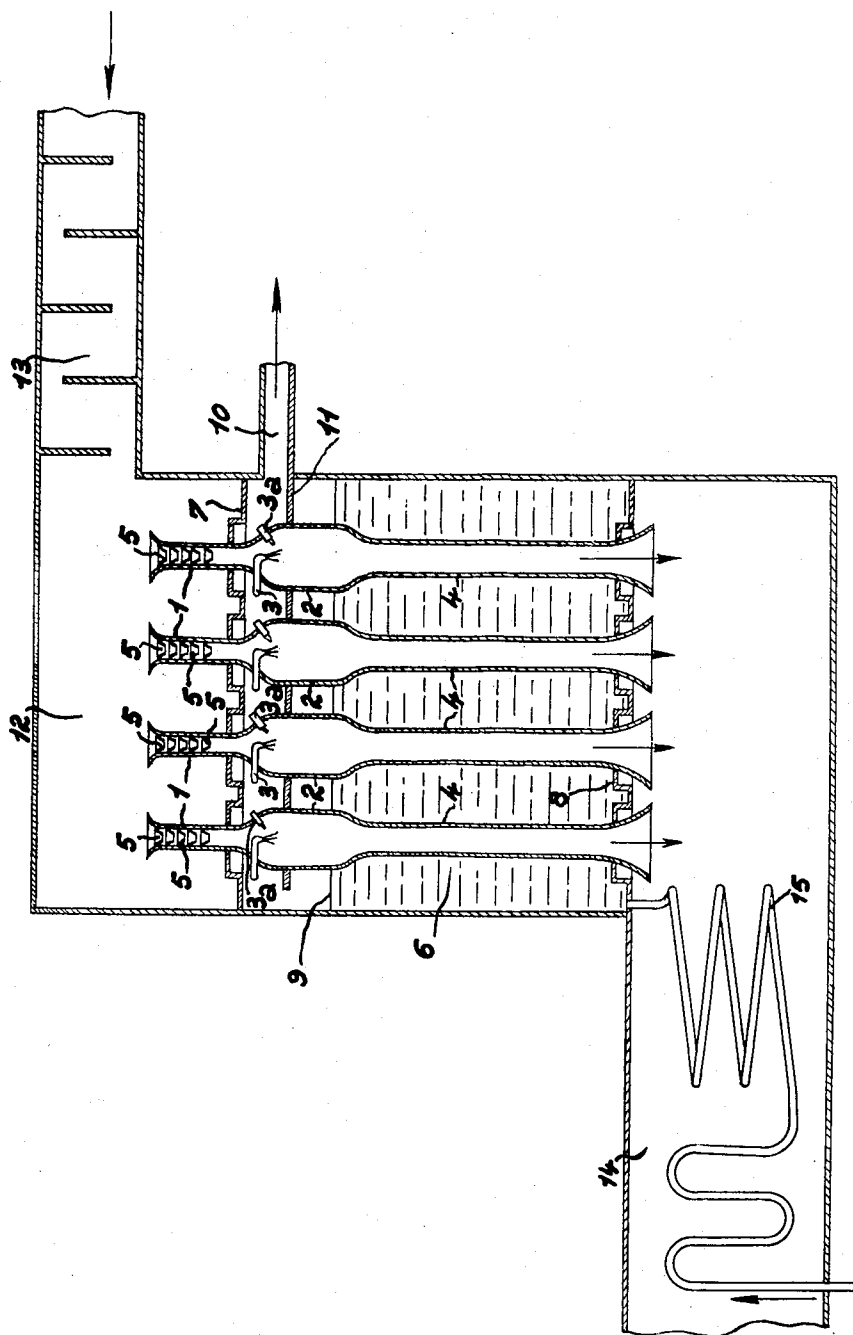
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BOILERS

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BOILERS

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The invention relates to intermittent combustion boilers, that is to say boilers provided with a combustion chamber supplied with liquid fuel and wherein combustion takes place in an intermittent way.

According to the invention, the intermittent combustion chamber used for heat generation is a resonant pulse-combustion duct. This latter term will be meant to indicate, in the following description and in the subjoined claims, a thermal duct such as that used in the so-called "pulse-jet" engines for reaction jet propulsion.

As known, pulse-jet engines include a simple duct or tube having a front air intake passage, an intermediate combustion zone into which a liquid fuel is continuously injected, and a rear reaction nozzle. In this duct, combustion does not take place in a continuous manner, but in a succession of explosions which naturally occur at the resonance frequency of the duct considered as a sound pipe, notwithstanding the continuous supply of fuel. The successive explosions cause hot gases to be exhausted rearward through the reaction nozzle and fresh atmospheric air to be sucked in through the front intake passage, the latter being provided with unidirectional flow means.

An object of the present invention is to adapt such resonant pulse-combustion ducts, not for jet propulsion purposes, but for heating purposes, in a boiler.

We have discovered that such an arrangement brings about particular unexpected results of very great interest due to the fact that, even when the ducts are supplied with air at atmospheric pressure, the important turbulence obtaining in the very hot gases therein leads both to a considerable combustion density (i. e. the amount of heat evolved per unit volume) and to a very high value of the heat transmission coefficient through the walls.

These ducts are further capable of ensuring their own supply of combustive air owing to the very operation of the pressure pulses therein, and therefore do not require any blasting, although, if desired, they can be supplied with air at a pressure above atmospheric pressure. Moreover they can operate with a great diversity of fuels such as for instance gasoline, kerosene, gas oil, domestic fuel and light fuel, and even powdery coal. Lastly the exhaust gases have sufficient pressure for ensuring adequate flow thereof through economisers and regenerators used in particular for heating feed water and whose tubenest, disposed in the path of the gases, can further damp pulse sonority.

The ducts will preferably be of the type which does not include check valves or any movable mechanical member for adjusting air intakes between successive explosions or combustions, the substantially unidirectional flow of air being achieved by means of aerodynamic valves examples of which have been described in our U. S. patent application Serial No. 56,582, filed October 26, 1948, now Patent No. 2,670,011.

Our invention may best be further described by reference to the accompanying drawing, which illustrates an

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embodiment thereof, and in which the single figure is a diagrammatic vertical section of a steam generator according to the invention.

Each of the resonant pulse combustion ducts illustrated in the drawing comprises an air inlet tube 1, a combustion chamber properly speaking 2 formed by an enlarged portion of tube 1 and a nozzle 4 for the expansion and exhaust of the gases. A fuel injector 3 opens out at 2. The inlet tube 1 is provided with an aerodynamic valve including check cups 5 of the type described in our above-mentioned patent application and designed for allowing admission of fresh air toward chamber 2 while hindering any back flow of gases during combustion, the cups 5 having for this purpose the shape of sharp-edged nozzles directed towards chamber 2. Obviously this valve arrangement is given merely as an example and other devices for adjusting the unidirectional flow of air and of the gases may be resorted to. Each of the injectors 3 is supplied with a convenient liquid fuel discharged in a continuous manner by a pump or a pressure tank. Starting can be effected by injecting gasoline and feeding compressed air from an auxiliary cylinder through the tubes 1, the first explosions being produced by ignition by means of a plug 3a connected to a magneto and adequately protected. The combustions or explosions are automatically adjusted to the frequency of the resonator or sound-pipe formed by each of the ducts 1—2—4, although the flow of liquid through the injectors 3 is continuous or practically so. As soon as starting is effected, gasoline can be replaced by another fuel and the plugs 3a disconnected, the successive combustions then occurring by self-ignition owing to the temperature reached and to the turbulence of the gases.

Several resonant pulse-combustion ducts thus arranged are fitted up in parallel relationship, in the same way as fire-tubes or flues, in the boiler 6 between the bottoms 7 and 8 thereof, the fluidtightness of these bottoms being obtained by welding or in any other way. The boiler 6 is filled with water up to a level 9 located in the connecting zone between the combustion chambers 2 and the expansion nozzles 4. The steam generated by heat transmitted through the wall of the ducts collects above the level 9 and is led through 10 to the steam engines. The walls of the chambers 2, being at a very high temperature, are useful for superheating the steam, convenient baffles such as 11 being provided for compelling the steam to flow along the walls of these chambers before being discharged. The vertical arrangement of the intermittent-combustion ducts is of interest in so far as it allows direct contact between steam and the hottest portion of the walls for the purpose of superheating. Moreover the fact that the walls 2 of the combustion chambers are not dipping into the liquid allows of keeping these walls at a quite high temperature, this being important when heavy liquid fuels are used. The air inlet tubes 1 open out into a common manifold 12 which can be fed with air at atmospheric pressure through a device with baffles 13 in staggered formation for damping sonorous pulses.

The gases issuing from the exhaust ducts 4 collect in a common flue or manifold 14 from which they are sent to the chimney. The residual heat energy contained in these gases can be conveniently used for heating recovery coils 15 through which feed-water for the boiler 6 flows. These coils form, in the path of the gases, sound damping obstacles.

What we claim is:

1. A boiler for generating and superheating steam comprising: an enclosure having a watertight bottom and a steam-tight top, said enclosure being designed for containing water up to a level located at a substantial distance from said top, a plurality of heating ducts of the

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pulsatory combustion type, adjacent to but spaced from each other, each of said ducts comprising a resonant-firing combustion chamber, the major portion of which extends between the top of said enclosure and the level of the water, and a gas exhaust pipe, the major portion of which is bathed by said water, said combustion chamber and gas exhaust pipe extending in succession and substantially vertically through said enclosure, said gas exhaust pipes extending through the bottom of said enclosure and discharging outside the same, an air intake device for each resonant-firing combustion chamber, extending through the top of said enclosure and having an inlet opening outside the same, said air intake devices being of the statical, aerodynamically operating type allowing substantially free flow of air towards the combustion chamber while hindering back-flow of combustion gas therefrom, a common air intake manifold above the top of said enclosure, in communication with the inlets of said air intake devices, a common gas exhaust manifold, below the bottom of said enclosure, in com-

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munication with said gas exhaust pipes, means adjacent the top of said enclosure for leading off superheated steam generated therein, and piping means leading into said enclosure for supplying water thereto.

2. Boiler as claimed in claim 1, wherein the air intake manifold opens to the atmosphere and comprises baffles designed for damping the sound of the inflowing air.

3. Boiler as claimed in claim 1, wherein the piping means extends within the gas exhaust manifold, in heat exchange relation therewith, and is in the form of a coil adapted to damp the sound of the outflowing gas.

References Cited in the file of this patent

UNITED STATES PATENTS

1,948,538	Noack	Feb. 27, 1934
1,948,939	Noack	Feb. 27, 1934
1,974,177	Doucha	Sept. 18, 1934
2,618,925	Wislicenus	Nov. 25, 1952
2,643,107	Kamm et al.	June 23, 1953