No. 687,661. Patented Nov. 26, 1901.

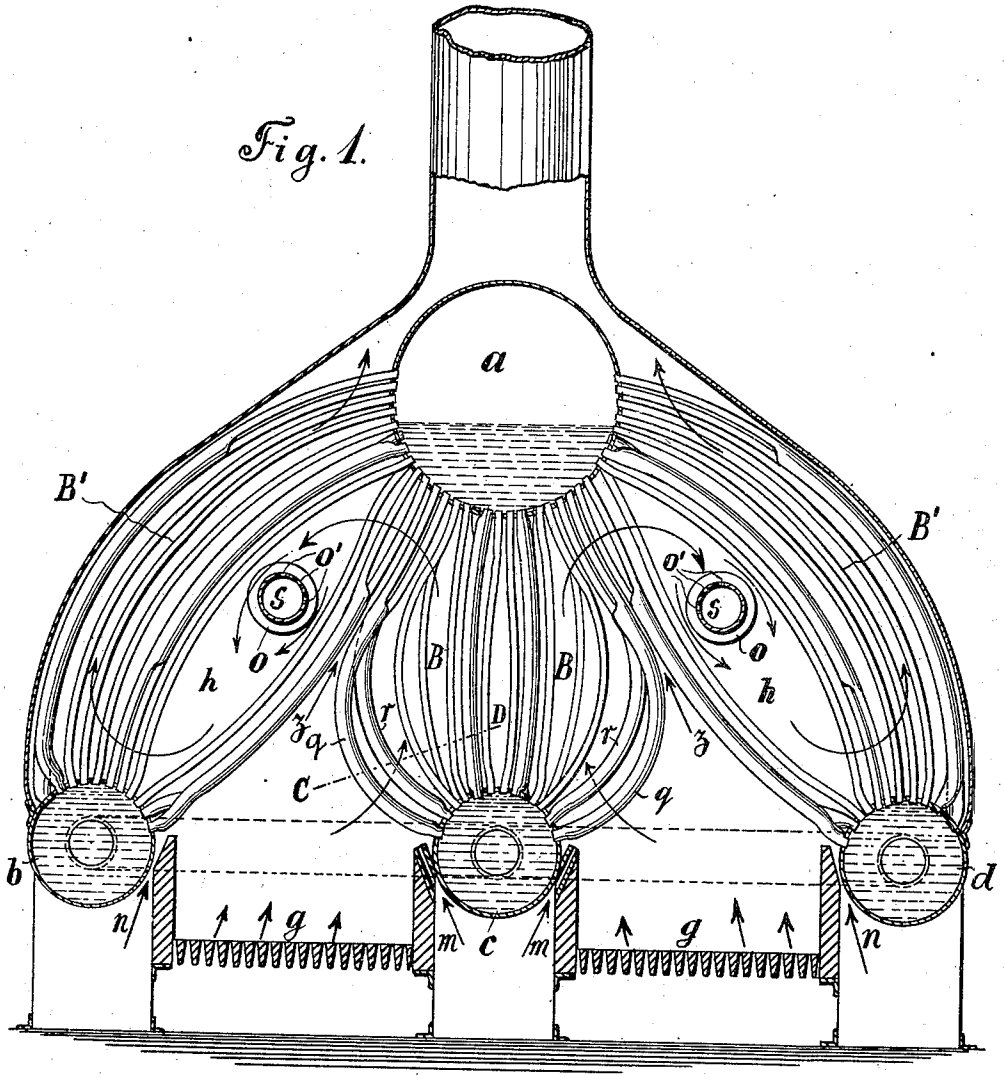
R. SCHULZ.

WATER TUBE BOILER.

(Application filed Jan. 8, 1901.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.




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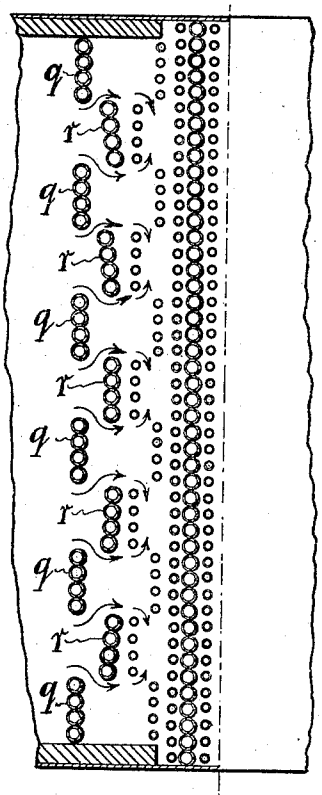
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(Application filed Jan. 8, 1901.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 2.




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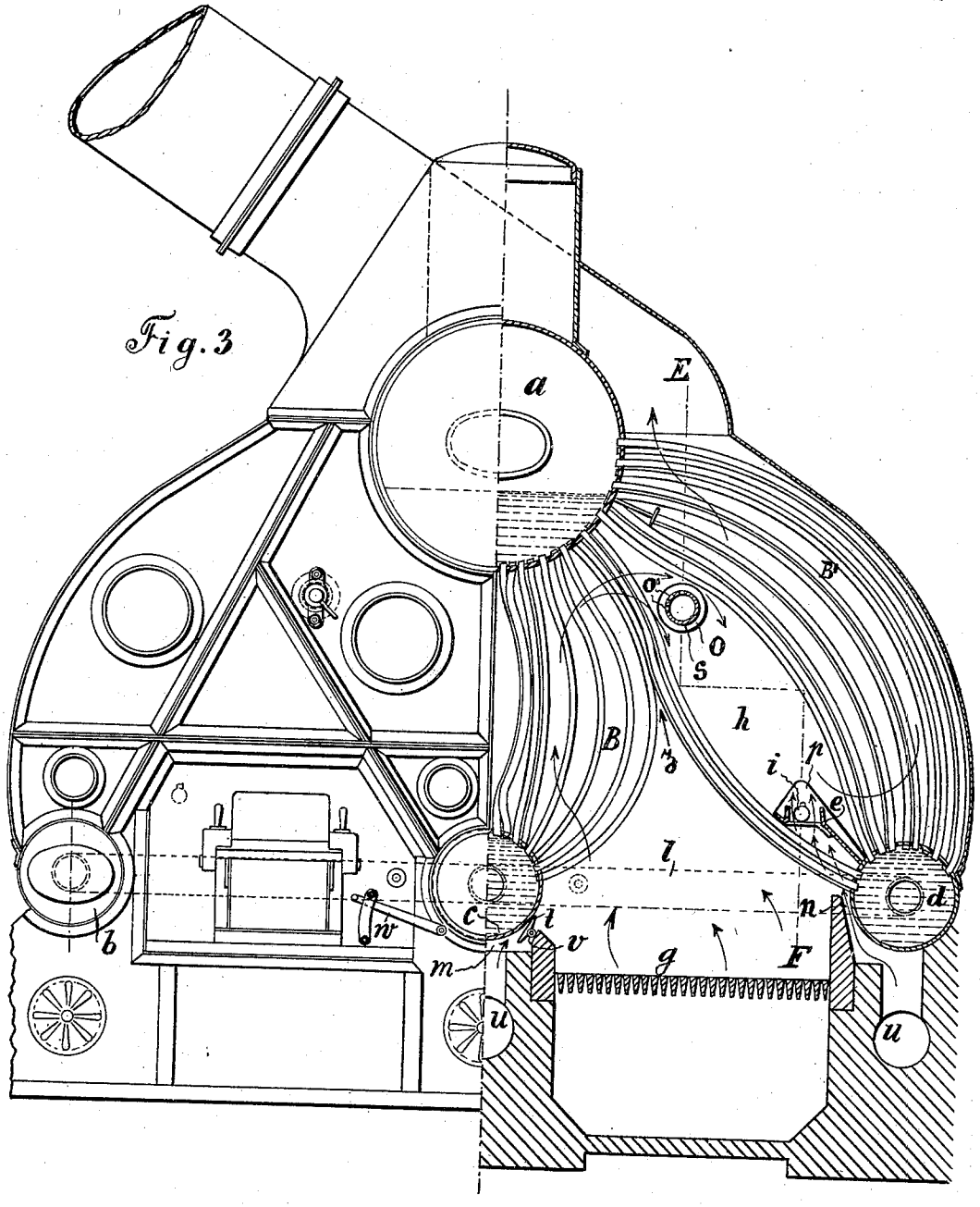
WATER TUBE BOILER.

(Application filed Jan. 8, 1901.)

(No Model.)

4 Sheets—Sheet 3.

Fig. 3




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No. 687,661. Patented Nov. 26, 1901.

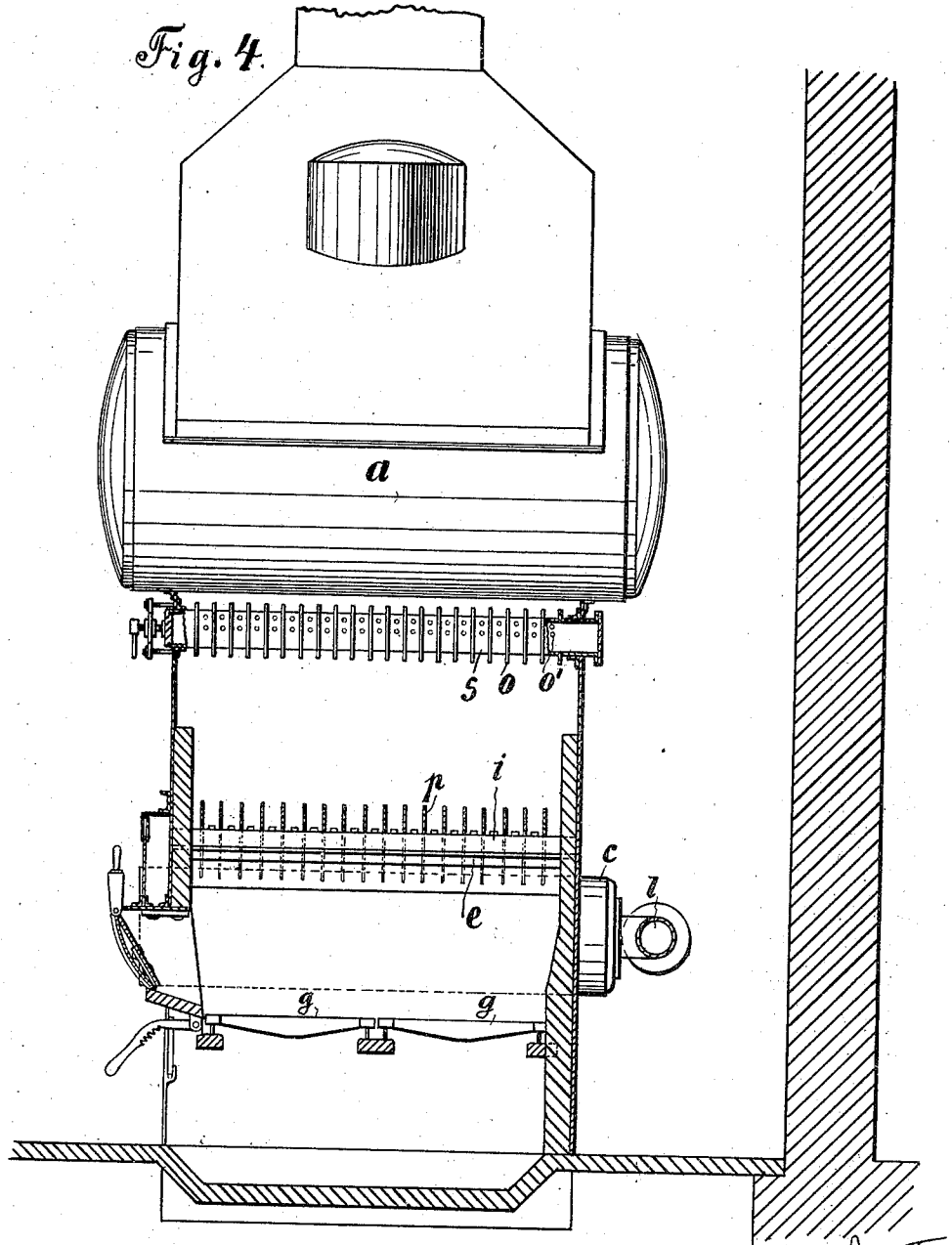
R. SCHULZ.

WATER TUBE BOILER.

(Application filed Jan. 8, 1901.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 4.




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# UNITED STATES PATENT OFFICE.

RICHARD SCHULZ, OF BERLIN, GERMANY.

## WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 687,661, dated November 26, 1901.

Application filed January 8, 1901. Serial No. 42,552. (No model.)

*To all whom it may concern:*

Be it known that I, RICHARD SCHULZ, a subject of the King of Prussia, Emperor of Germany, residing at Berlin, Germany, have invented certain new and useful Improvements in Water-Tube Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

This invention relates to water-tube boilers, and especially to that class of boilers which have an upper drum connected by water-tubes to one or more lower drums to form water-legs, and has for its object means for directing the current of gases through and between the tubes over as great a heating-surface as possible and at the same time promoting as complete combustion as possible.

In particular it has for its object means for mixing with the furnace-gases a promoter of combustion just before they enter between the tubes, an auxiliary combustion-chamber located within one or more of the water-legs, and means for directing gases or a promoter of combustion therein.

In order that the invention may be properly understood, reference will be made to the accompanying drawings, in which like parts are similarly designated, and in which—

Figure 1 is a cross-section of a boiler constructed in accordance with this invention. Fig. 2 is a section taken on the line C D of Fig. 1. Fig. 3 is a modified construction, partly in front elevation and partly in cross-section. Fig. 4 is a section taken on the line E F of Fig. 3.

The particular construction of the boiler which I have shown is designed to provide a tortuous path for the gases around and between the water-tubes, having interposed in such path an auxiliary combustion-chamber and means therein for feeding a combustible or a promoter of combustion to said chamber and at the same time directing at one or more other points in said path auxiliary streams of a promoter of combustion, so as to obtain as high a temperature as possible within the furnace and cause all the carbon to be burned.

Referring to Figs. 1 and 2, I have shown the boiler or main drum *a*, which contains the steam-space, as connected to a central water-leg B, located between two side legs B′, each leg terminating in a water-drum *c b d*. In each of the side legs is formed by properly bending the water-tubes an auxiliary combustion-chamber *h*. The water-leg rests upon a suitable foundation 1, into which are built, between the side water-legs and the central water-leg, fire-spaces *g g*. The tubes are so placed relatively to one another that those in the central water-leg are bent outwardly and laid close together to form a wall at their central portions and openings between them or sets of them at the lower portions. The outer tubes *q* of the central water-leg enable gases from the grates *g g* to pass between them near their juncture with the lower drum *c* into the spaces between and around the inner tubes *r* in said leg and at the same time carry with them air, compressed air, or steam injected at or near their point of juncture with the central drum *c*. This air, compressed air, or steam is a promoter of combustion and enters through suitable openings provided at the sides of the fire-space and near the point of entrance of the furnace-gases into the water-legs. They may be perforations, slots, or other devices *m* feeding from the common flue (not shown) in the foundation. Each of the side legs rests on foundation 1, which are likewise provided with means *n* for directing air or other promoters of combustion into the furnace and with the gases into the lower end of the side water-legs B′, thereby passing across and between the lower ends of the water-tubes or groups of tubes that form the inner wall of each of the furnace-chambers proper.

The auxiliary combustion-chambers *h* in each of the side legs is provided with a tube *s*, carrying radiating ribs *o* and perforations *o′*, through which latter furnace-gases, air, compressed air, or steam can be directed at substantially right angles to the main current of furnace-gases coming from the upper part of the central water-leg into the side leg.

It will be observed that the sets of water-tubes *q* and *r* of the central water-leg form the inner walls of the main combustion-chambers and that these sets of tubes, as well as the sets of tubes forming the outer walls of

the combustion-chambers and at the same time the inner part of the side water-legs, do not meet at the top, but are sufficiently distanced from one another or staggered in sets so as to allow furnace-gases to flow directly from the grate between them up into the water-legs. The walls of each main fire-space do not meet to form a roof near main boiler *a*, but are sufficiently distanced from one another to form flues or divides *z*, which direct furnace-gases from the fireplaces at approximately right angles to that current of furnace-gases passing from the central water-leg into the side water-legs, thus adding to and moving with them into the auxiliary combustion-chambers *h* in each side of the water-legs.

Referring to Figs. 3 and 4, I have shown a similar construction in which the main drum and steam-space *a* is connected with the auxiliary drums *c b d* by water-tubes to form central and side water-legs B and B', respectively, and in which the tubes of each leg combine to form the walls and roof for the fire-space, and between these walls is left at the top of the fire-space sufficient distance to form flues *z*, directing furnace-gases against that current of gases passing from the central to the side water-legs.

Under each of the drums and at the lower end of each of the water-legs I have shown ducts *u*, which carry a combustible or a promoter of combustion designed to be fed through slots extending from the end of each drum, the central drum *c* having a slot *m* on each side thereof and between it and the masonry foundation.

Dampers *t*, hinged at *v*, operated by hand-levers *w*, control these openings. The side water-legs, having slots between the lower drums *b d* and the masonry near the grates *g*, are fed from the ducts *u*. These slots are designed to feed air up between the staggered lower ends of the inner tubes that form a side and part of the top of the fire-space near where they enter the lower water-drums.

The auxiliary combustion-chamber has arranged in its upper part auxiliary means for feeding either furnace-gases or a promoter of combustion, or both, and consists of a tube *s*, provided with ribs *o*, if desired. Perforations in said tube between the ribs are arranged to direct streams of gas or a promoter of combustion at approximately right angles to the main current of gases.

In the lower part of the auxiliary combustion-chambers I arrange a species of fire-bridge *e*, composed of plates or ribs *p*, between and around which furnace-gases coming up from the furnace below circulate, and in this fire-bridge is arranged a tube *i*, having perforations through which air or fresh furnace-gases meet the upwardly-flowing gases that pass on one or both sides of said tube.

All of the ducts and pipes located either below or within the fire-spaces are provided with dampers or other means to control the admission of air or other fluid, and the delivery-orifices are arranged to direct the currents of air at substantially right angles to the main current of gases.

Fire is made on the grates *g*, and the general tendency of furnace-gases is first up between the lower staggered ends of the tubes in the central water-leg. At the same time a promoter of combustion from the slots *m* is projected at approximately right angles to their path and is carried with them up between the tubes in the central water-leg, and at the upper end between the interspaced tube ends or staggered sets of tubes, crossing from this water-leg to the side water-legs and the auxiliary combustion-chamber *h*, furnace-gases passing through the flue *z* meeting this current of gases at substantially right angles and are carried with them over into the auxiliary combustion-chambers in side water-leg. Here these gases are augmented by a fresh supply of either furnace-gas, air, (or both,) or steam, likewise directed at substantially right angles to their direction of flow, burned within the auxiliary combustion-chamber, pass downward through the combustion-chamber to fresh furnace-gas, mixed with a fresh supply of air flowing around the fire-bridge *e*, located within the lower part of these auxiliary chambers, where the combined current of gases is reverted and flows between the tubes of the side water-legs along the length of the outer portion thereof into the stack.

Although I have shown two modes of constructing such a furnace, I do not limit myself to the particular arrangement and form shown in the drawings.

What I claim, and desire to secure by Letters Patent, is—

1. In a water-tube boiler, a main drum and an auxiliary drum, series of water-tubes connecting said drums, and auxiliary combustion-chamber within the series of tubes, auxiliary means therein for supplying a combustible to said chamber and a fire-bridge arranged to direct furnace-gases to and within said auxiliary combustion-chamber, substantially as described.

2. In a water-tube boiler, a main drum and an auxiliary drum, water-tubes connecting said drums, said tubes arranged to form the roof of the fire-space, passages between said tubes near the drums for the circulation of gases, and an auxiliary combustion-chamber within the series of tubes, and means for directing an auxiliary supply of combustible at substantially right angles to the flow of gases between two series of said tubes, substantially as described.

3. In a water-tube boiler, a main drum and an auxiliary drum, a series of water-tubes connecting said drums the outer tubes of said series arranged to form a substantially solid wall, spaces between said outer tubes near said drums for the passage and circulation of gases and an auxiliary combustion-chamber

within said series of tubes, means for supplying a combustible located at one end of said auxiliary combustion-chamber and a fire-bridge located at the other end thereof, substantially as described.

4. In a water-tube boiler, a central water-leg and a pair of side water-legs, the outer tubes of each water-leg arranged to form the sides and roof of the fire-space, a flue between the pair of water-legs, an auxiliary combustion-chamber in each side water-leg, means for injecting air at substantially right angles to the flow of furnace-gases at the auxiliary drums and means for the supply of air in the auxiliary combustion-chamber, substantially as described.

5. In a water-tube boiler, a main drum and three auxiliary drums, tubes connecting the main and auxiliary drums to form water-legs said tubes staggered at their upper and lower portions, and the outer tubes forming a solid wall at their central portions, flues between adjacent water-legs, means for injecting a gas on either side of the fireplace adjacent each drum, an auxiliary combustion-chamber in each of the side water-legs, means for feeding a promoter of combustion at one end, a fire-bridge and means for feeding gas at the other end thereof, substantially as described.

6. In a water-tube boiler, a main drum and three auxiliary water-drums, water-tubes connecting each with the main drum to form a central and lateral water-legs, an auxiliary combustion-chamber in each lateral water-leg and passages between the heater-legs at their upper ends, means in the upper parts of auxiliary combustion-chambers to supply a promoter of combustion and at the other to supply a fuel, substantially as described.

7. In a water-leg of a water-tube boiler, a chamber formed within the series of tubes of said water-leg to form a combustion-chamber, means in one end of said chamber to supply a promoter of combustion and a device in the other end of said chamber to supply a fuel, substantially as described.

8. In a water-leg of a water-tube boiler, a chamber formed within the series of tubes that form said water-leg, means in one end of said chamber to supply air to and direct it against the incoming gases and means in the other end of said chamber to supply a fuel to said gases before leaving the chamber, substantially as described.

9. In a water-leg of a water-tube boiler, a chamber formed within the series of tubes that form said water-leg, means in one end of said chamber to supply a promoter of combustion to the entering gases and a fire-bridge in the other end organized to supply a fuel to said gases before leaving the chamber, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

RICHARD SCHULZ.

Witnesses:
JOHANNES HEIN,
HENRY HASPER.