

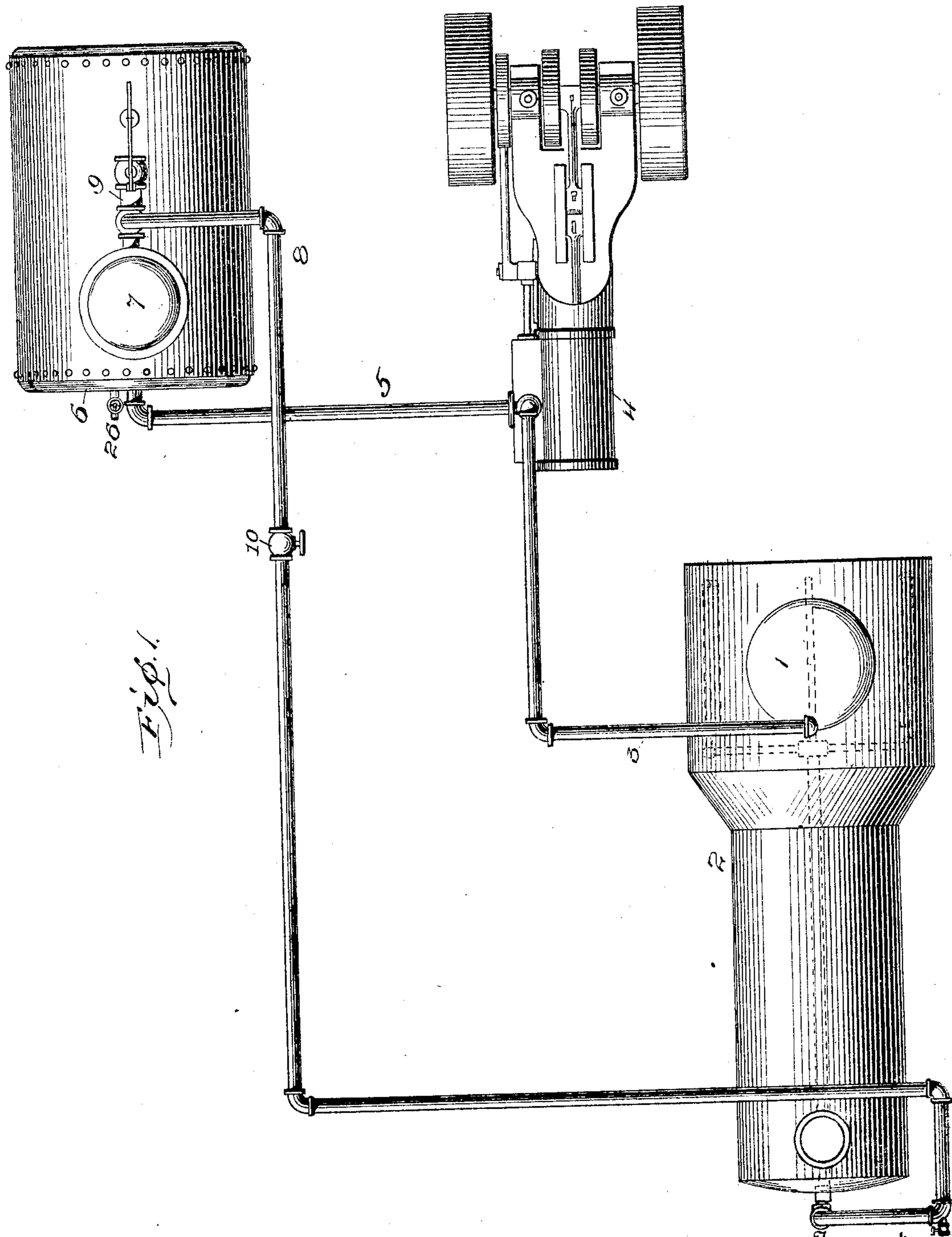
No. 804,098.

PATENTED NOV. 7, 1905.

L. P. BURROWS.  
METHOD OF UTILIZING EXHAUST STEAM.

APPLICATION FILED FEB. 15, 1902.

3 SHEETS—SHEET 1.



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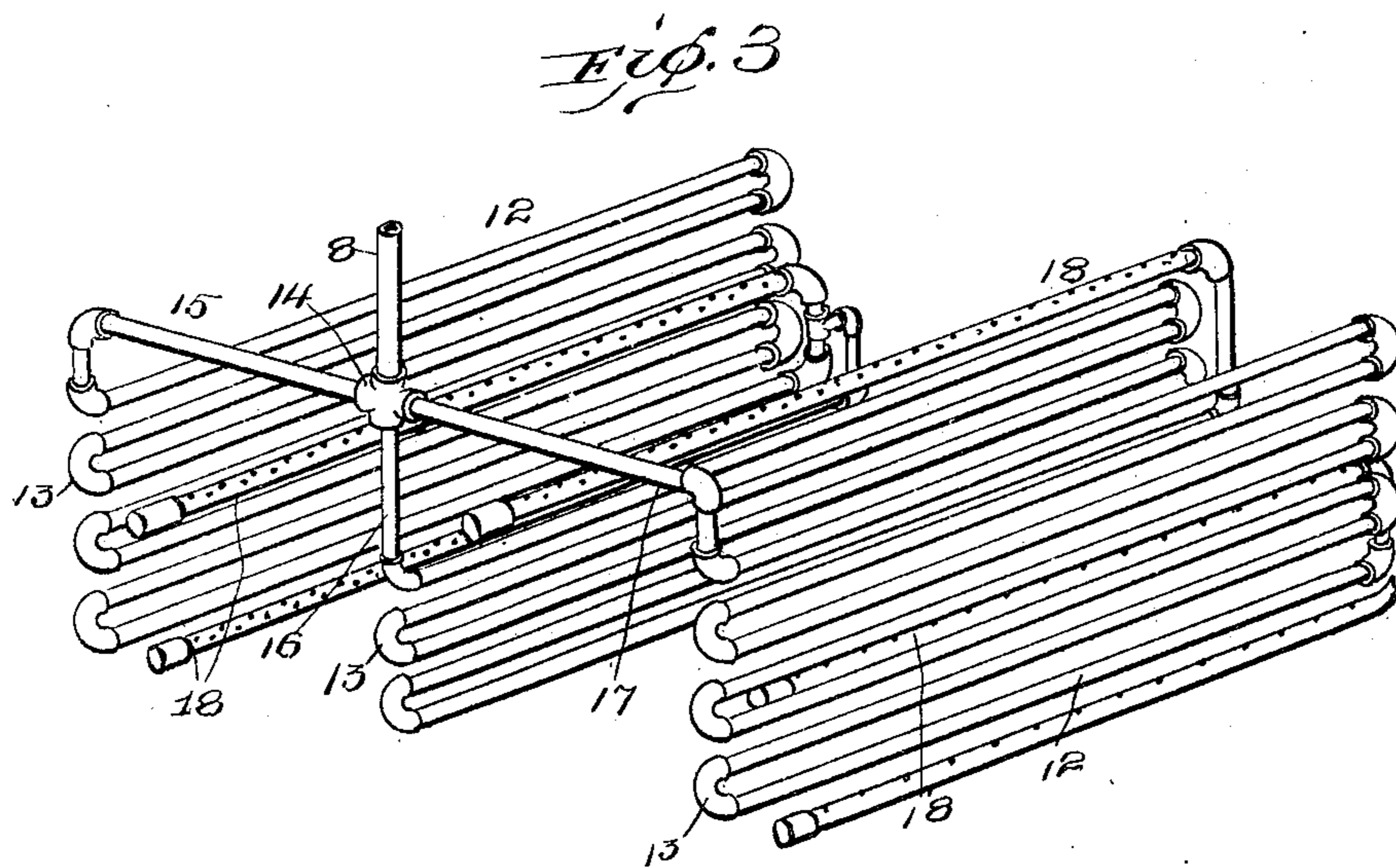
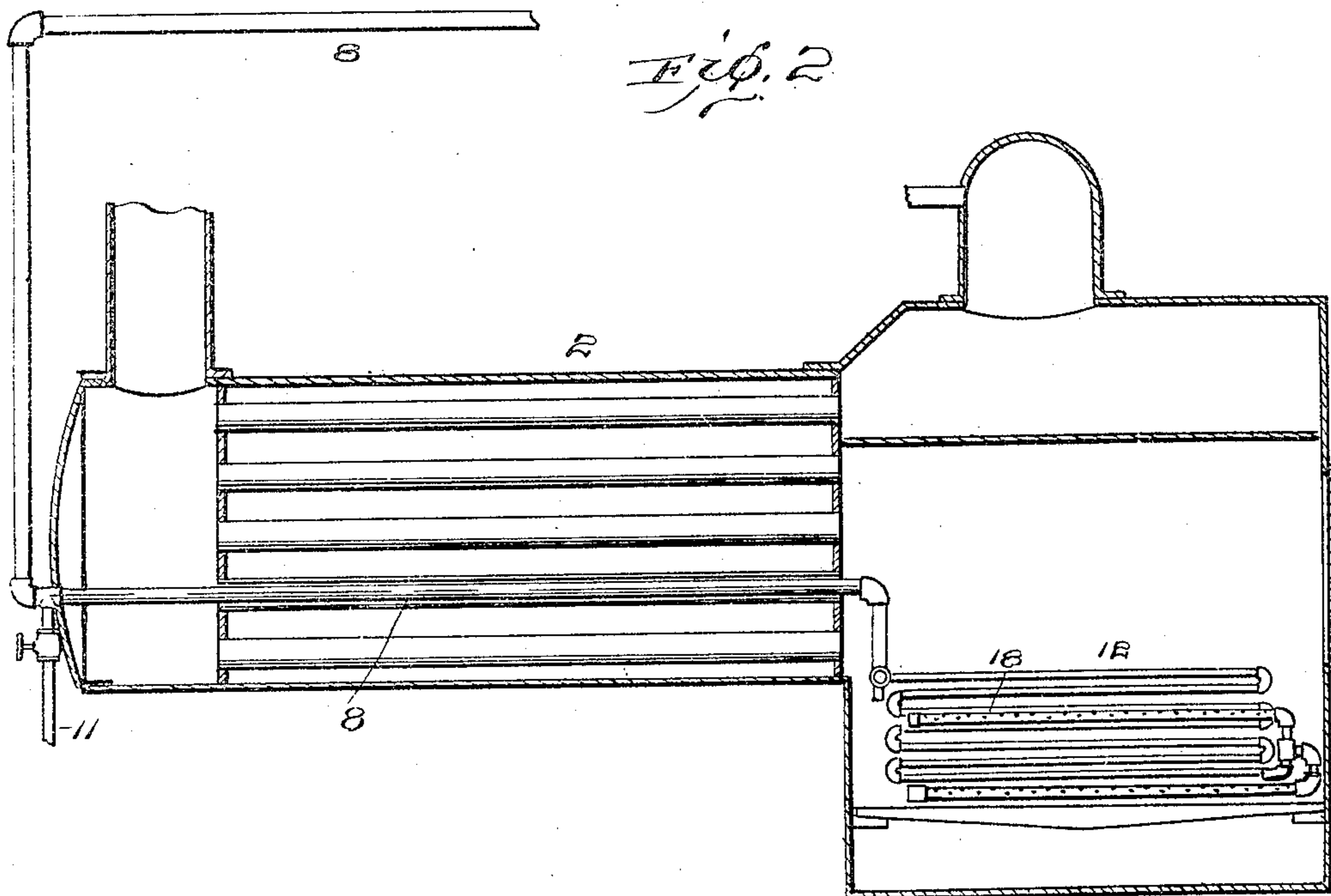
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3 SHEETS—SHEET 2.



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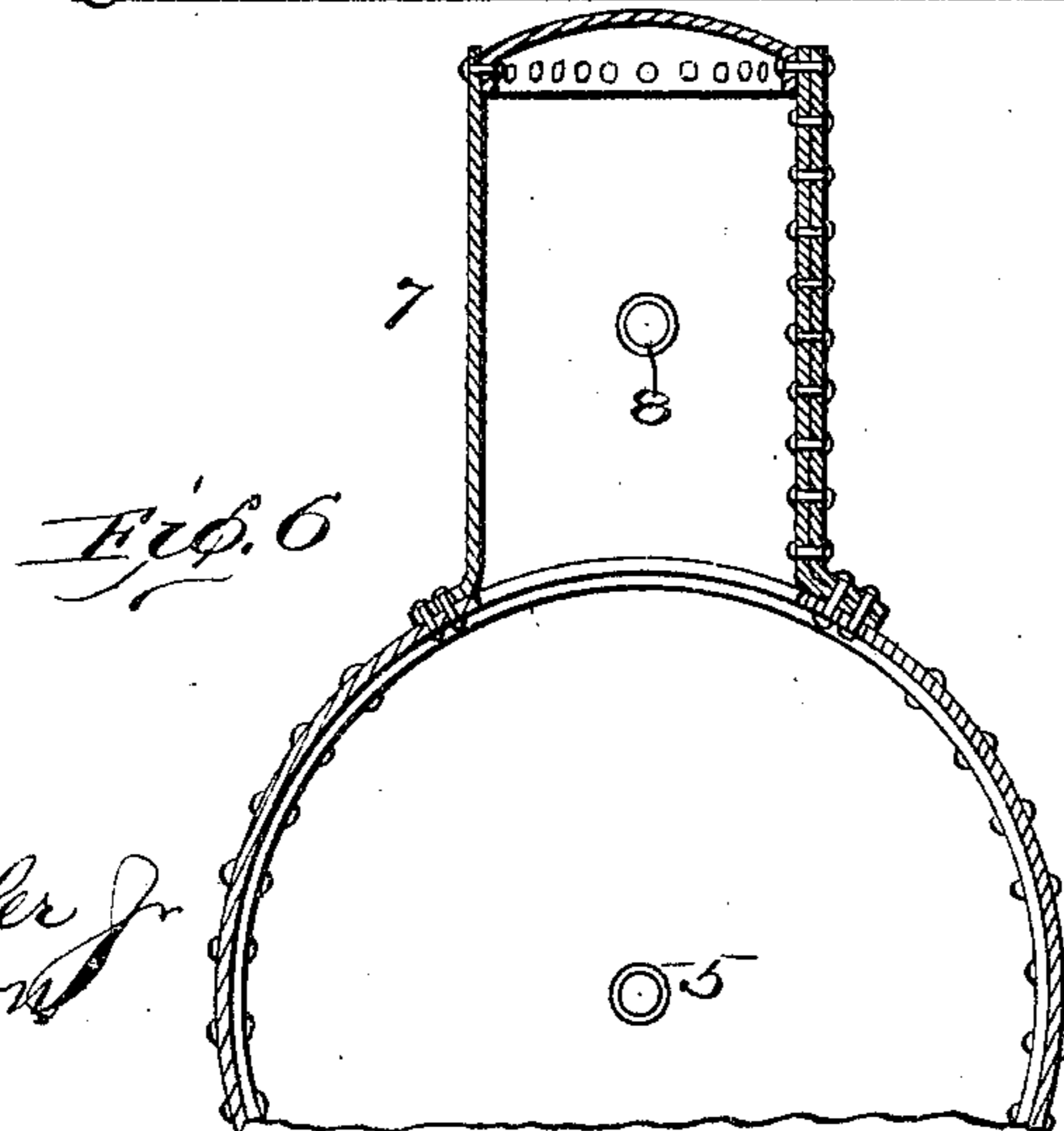
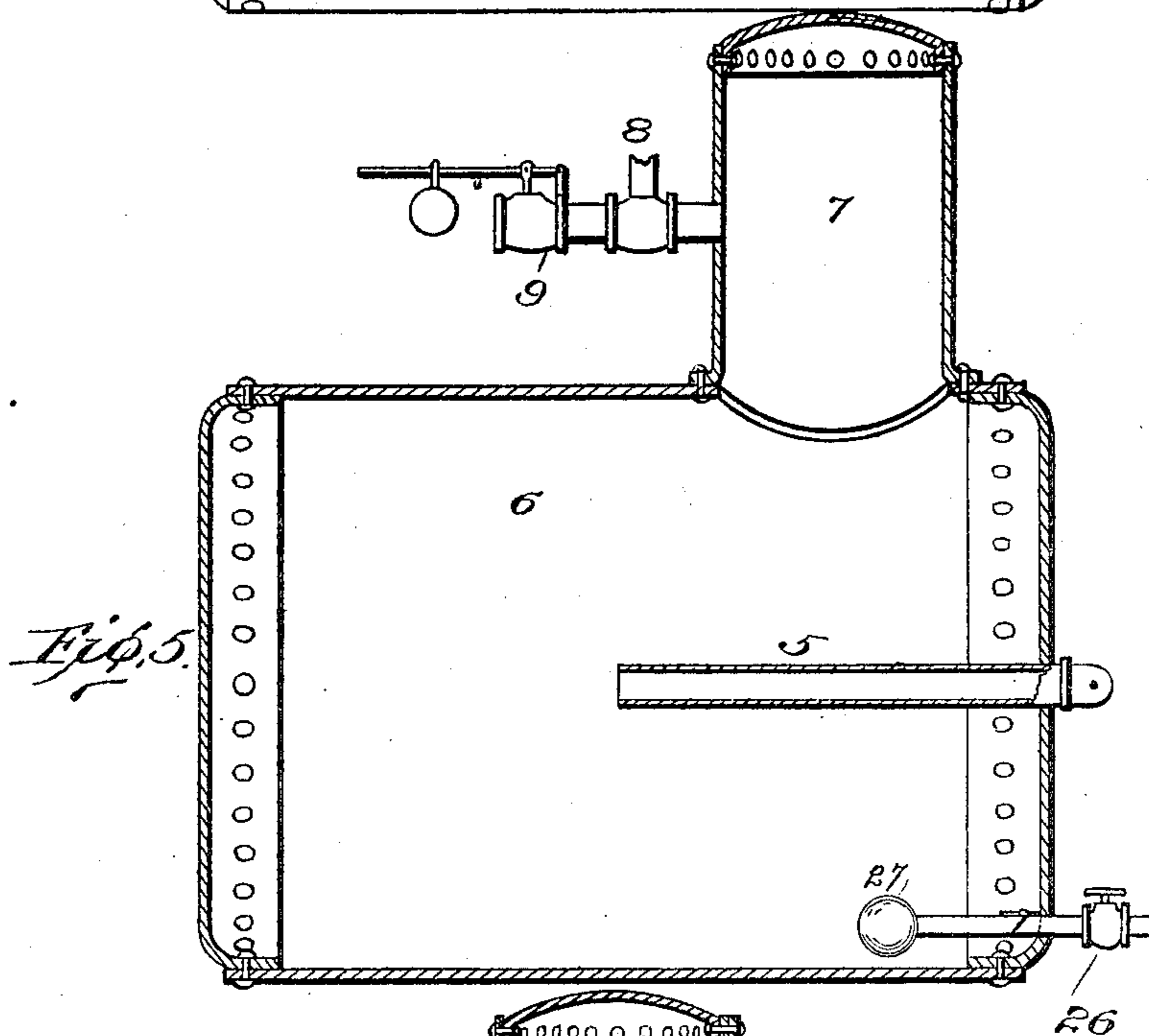
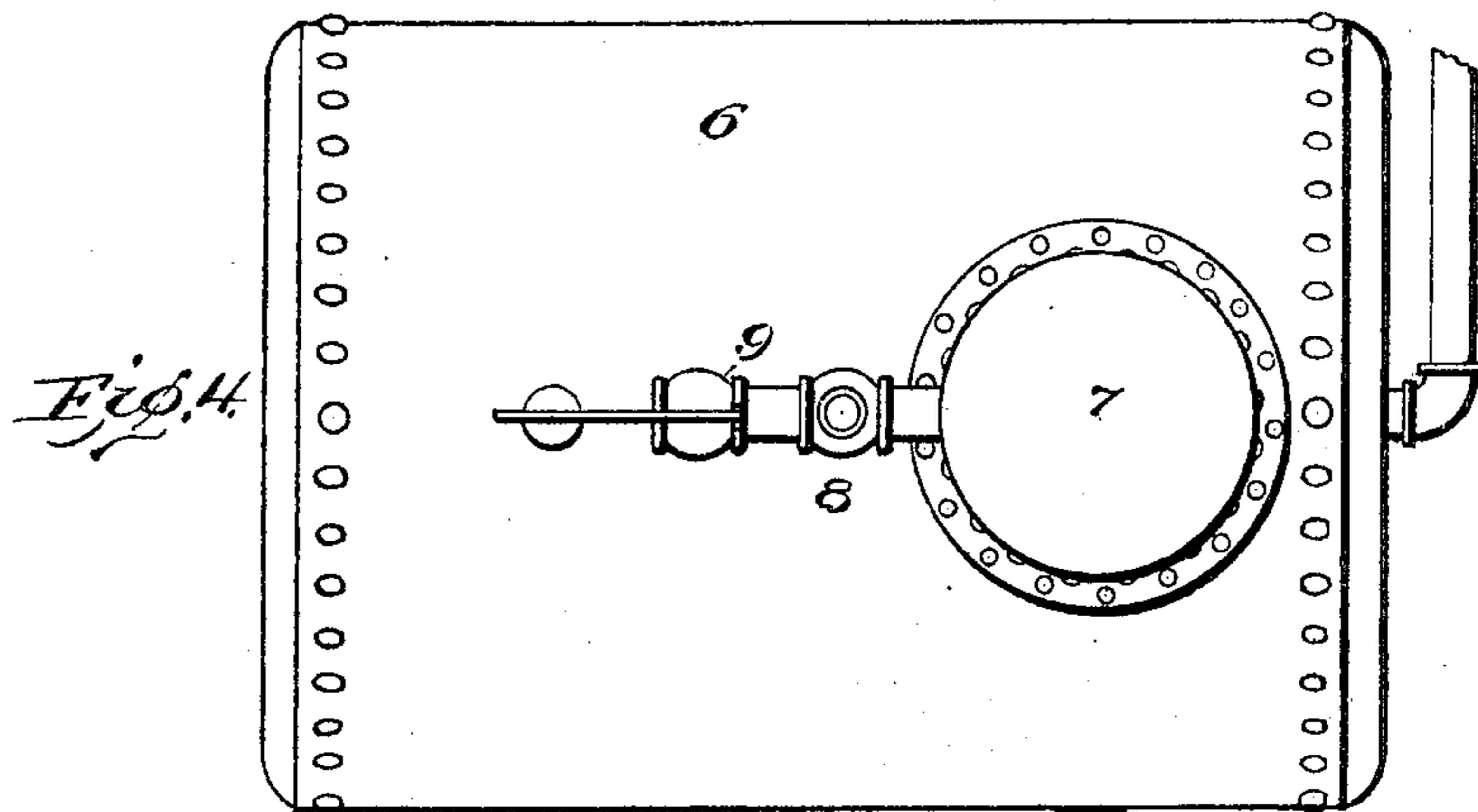
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3 SHEETS—SHEET 3.



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# UNITED STATES PATENT OFFICE.

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TO BURROWS DEVELOPMENT COMPANY, OF WASHINGTON, DISTRICT  
OF COLUMBIA, A CORPORATION OF MAINE.

## METHOD OF UTILIZING EXHAUST-STEAM.

No. 804,028.

Specification of Letters Patent.

Patented Nov. 7, 1905.

Application filed February 15, 1902. Serial No. 94,226.

*To all whom it may concern:*

Be it known that I, LINUS P. BURROWS, a citizen of the United States, residing at Washington, District of Columbia, have invented new and useful Improvements in Methods of Utilizing Exhaust-Steam, of which the following is a specification.

According to this invention exhaust-steam from an engine is subjected to sudden expansion and passed through a gas-generating device situated in the fire-box of the steam-boiler and is thereby converted into a gaseous product which is ejected into the fire-box and burned in conjunction with any solid, liquid, or gaseous fuel, thereby promoting combustion and reducing the consumption of said fuel.

While the apparatus required for carrying out this process necessarily includes a steam-expansion chamber and gas-generator, the precise construction is capable of wide modification. For the purpose of illustration I have shown in the accompanying drawings an apparatus which is in actual working operation and drawn to scale.

Referring to the drawings, Figure 1 is a plan view of the apparatus. Fig. 2 is a longitudinal vertical section of the boiler, with gas generators and burners. Fig. 3 is a perspective view of the gas generators and burners removed from the fire-box, and Figs. 4, 5, 6 are detail views of the expansion and precipitation chamber.

Steam at the usual working pressure—say from eighty to one hundred pounds per square inch—is taken from the dome 1 of the steam-boiler 2 and carried through pipe 3 to the cylinder 4 of the engine. The exhaust-steam from the engine, which it is the purpose of this invention to utilize, is carried through pipe 5 into a large expansion radiation and precipitation chamber 6. This chamber is shown as a cylindrical drum of thin boiler-iron arranged horizontally in proximity to the engine and having water-outlet pipe 26. The exhaust-steam pipe 5 preferably enters the chamber through the middle of one of its ends and extends axially to a point indicated. On the top of this chamber is a dome 7, from which the expanded and dried steam passes into a delivery-pipe 8. A weighted pop-valve 9 leads from pipe 8 near dome 7 into the atmosphere and serves to maintain a substan-

tially uniform pressure in pipe 8. Pipe 8 also contains a control-valve 10 and extends from chamber 6 to the steam boiler and passes through the front wall of the smoke-chamber and thence through one of the fire-tubes to the superheater or gas-generators. A drip-pipe 11, with cock, leads downwardly from pipe 8 just before it enters the smoke-chamber.

The superheaters or gas-generators are here shown as three in number, though the number may be increased or diminished, according to the volume of steam to be gasified. Each generator consists of a set of pipe-sections 12, preferably arranged in vertical series, the sections of each series being alternately connected at opposite ends by couplings 13 to provide a zigzag passage. The expanded and dry steam is delivered from pipe 8 through the coupling 14 and branch pipes 15, 16, and 17 into the top section of each gas-generator and thence passes down the several convolutions to the bottom section. Connected to the lowermost section of each generator is a gas burner or burners 18. Each burner consists of a section of pipe closed at the extreme end and having throughout its length a series of gas-passages. The burners of the outer gas-generators are shown as arranged in superposed pairs just inside of the generators. The burner of the middle generator is shown as arranged directly above this generator. The outer gas-generators are preferably so arranged within the fire-box as to be subjected not only to the direct heat of any fuel burned in the fire-box, but also to the heat radiated by the adjacent side walls of the fire-chamber. The position of these gas generators and burners can be varied as found desirable.

While the fire-box of the boiler is here shown with a grate for solid fuel, it may be heated by any other suitable means—for example, a gas or oil burner.

In the operation of this apparatus the exhaust-steam from the engine when discharged from pipe 5 into the central part of chamber 6 is subjected to sudden expansion, with diminution of pressure under such conditions of temperature as to prevent any material condensation and to allow the watery particles that are held in suspension in the steam to separate from the steam by gravity or otherwise and become deposited at the bot-

tom of the chamber. The water of precipitation is removed by a suitable valved outlet 26 at the bottom, this valve being preferably controlled by a ball-float 27, which causes the  
5 water to flow off as soon as it rises to any considerable height in the bottom of the chamber. The steam thus deprived of its watery constituents now passes from the dome 7 of the expansion-chamber into pipe 8. As the  
10 steam passes through that portion of pipe 8 which lies within the smoke-chamber and one of the fire-tubes of the boiler it is superheated and thence delivered to the gas-generators. These gas-generators being arranged within  
15 the fire-box in position to be heated to a high temperature serve to convert the steam passing through them into a nascent gaseous product that materially promotes combustion. This mode of utilizing exhaust-steam can ob-  
20 viously be applied with equal advantage to any steam-boiler and engine plant, whether stationary, marine, or locomotive.

Having described my invention, what I desire to claim as new and useful is—

25 1. The method of utilizing exhaust-steam, which consists in taking the steam from the exhaust-port of an engine, suddenly expand-

ing the steam to a larger volume, separating the steam, without material condensation, from any water held in suspension, heating 30 the steam to a high temperature, injecting the product into the fire-box of a steam-boiler and there burning it in conjunction with carbonaceous fuel.

2. The method of utilizing exhaust-steam to 35 assist in combustion, consisting in taking the steam from the exhaust-port of an engine, immediately expanding the steam, thereby reducing its pressure before it has had an opportunity to absorb the water of condensation 40 from the exhaust-port, separating from the steam the watery vapor therein without material condensation of the steam, immediately superheating the steam to a high temperature, and finally introducing the resultant products 45 thereof into the fire-box of a steam-boiler and there burning it in conjunction with carbonaceous fuel.

In testimony whereof I affix my signature in presence of two witnesses.

LINUS P. BURROWS.

Witnesses:

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EUGENE A. BYRNES.