4 Sheets—Sheet 1.

J. EVERDING.

Steam-Generator.

No. 220,712. Patented Oct. 21, 1879.

Fig: I

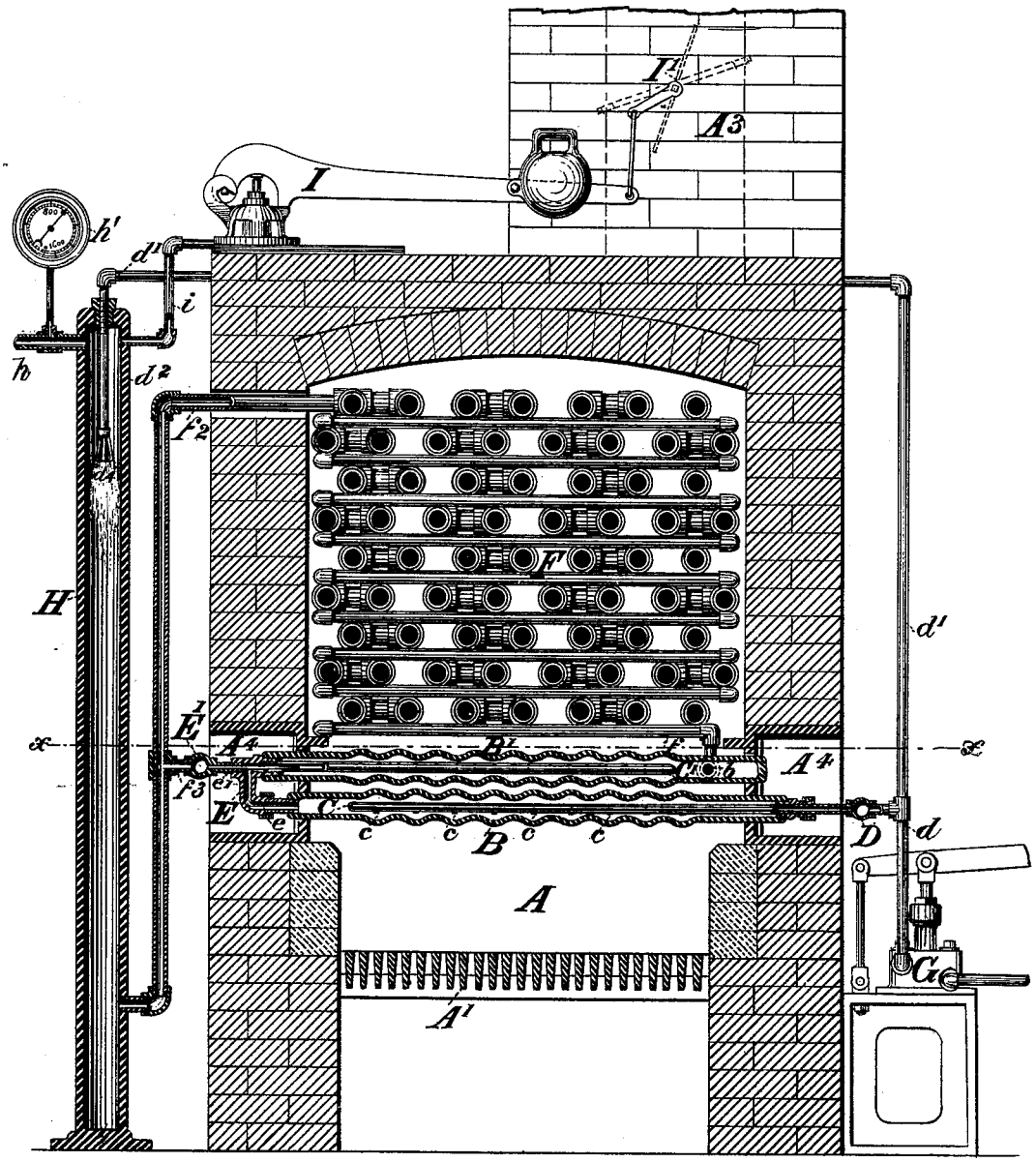

Fig: 9

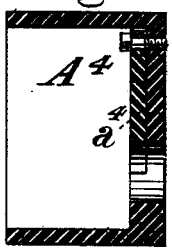

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Fig. 2

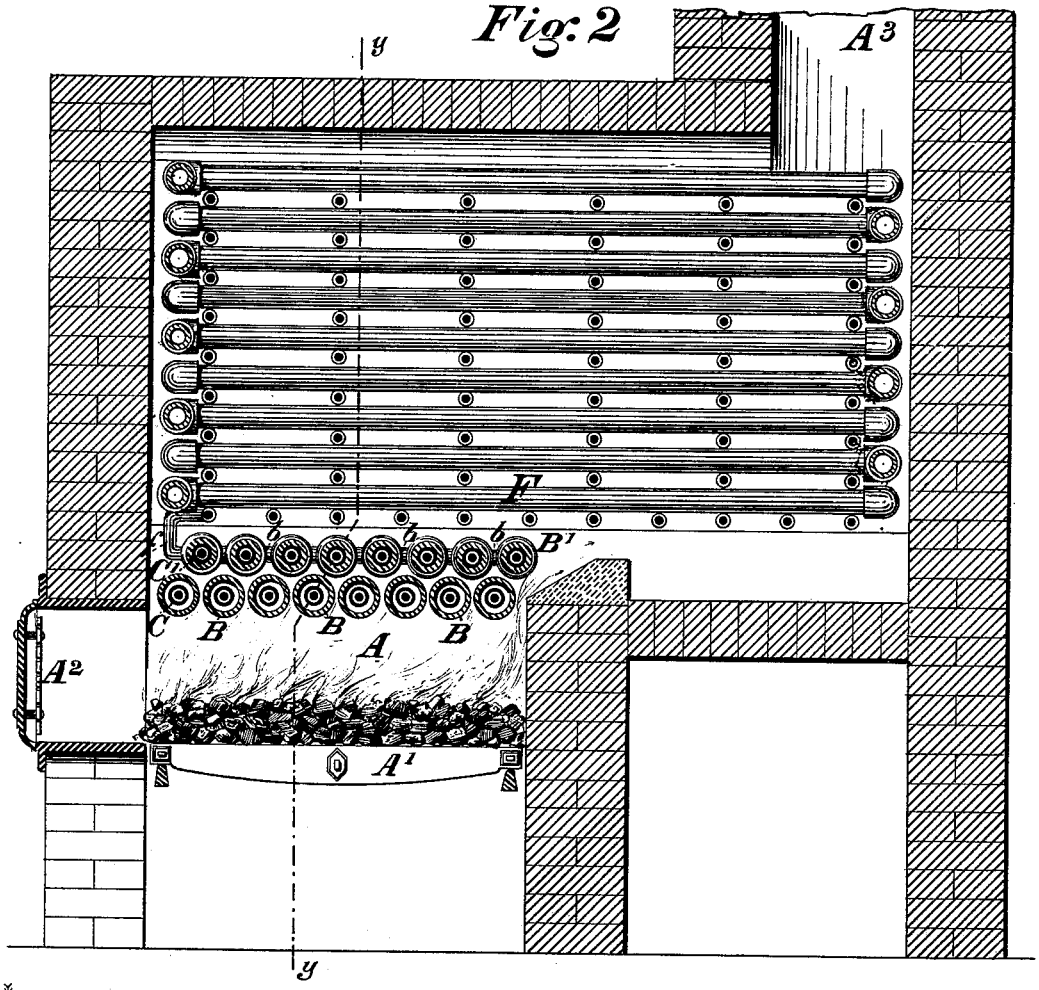

Fig. 3

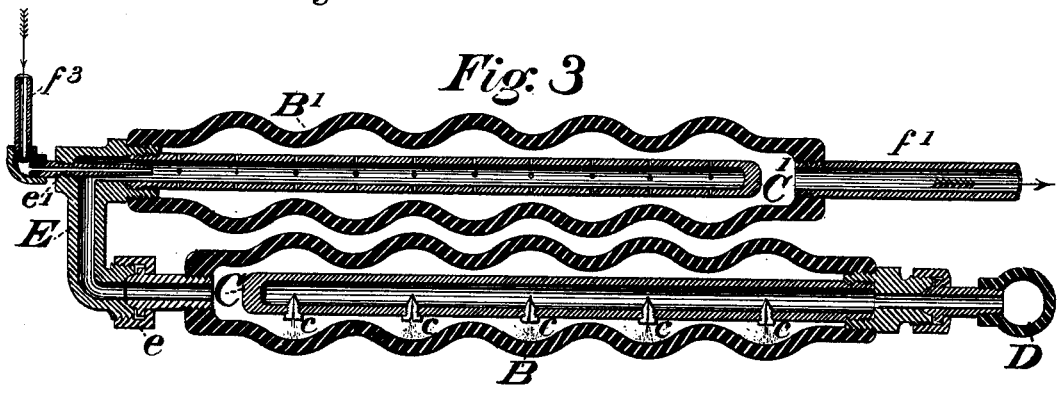

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Fig. 4

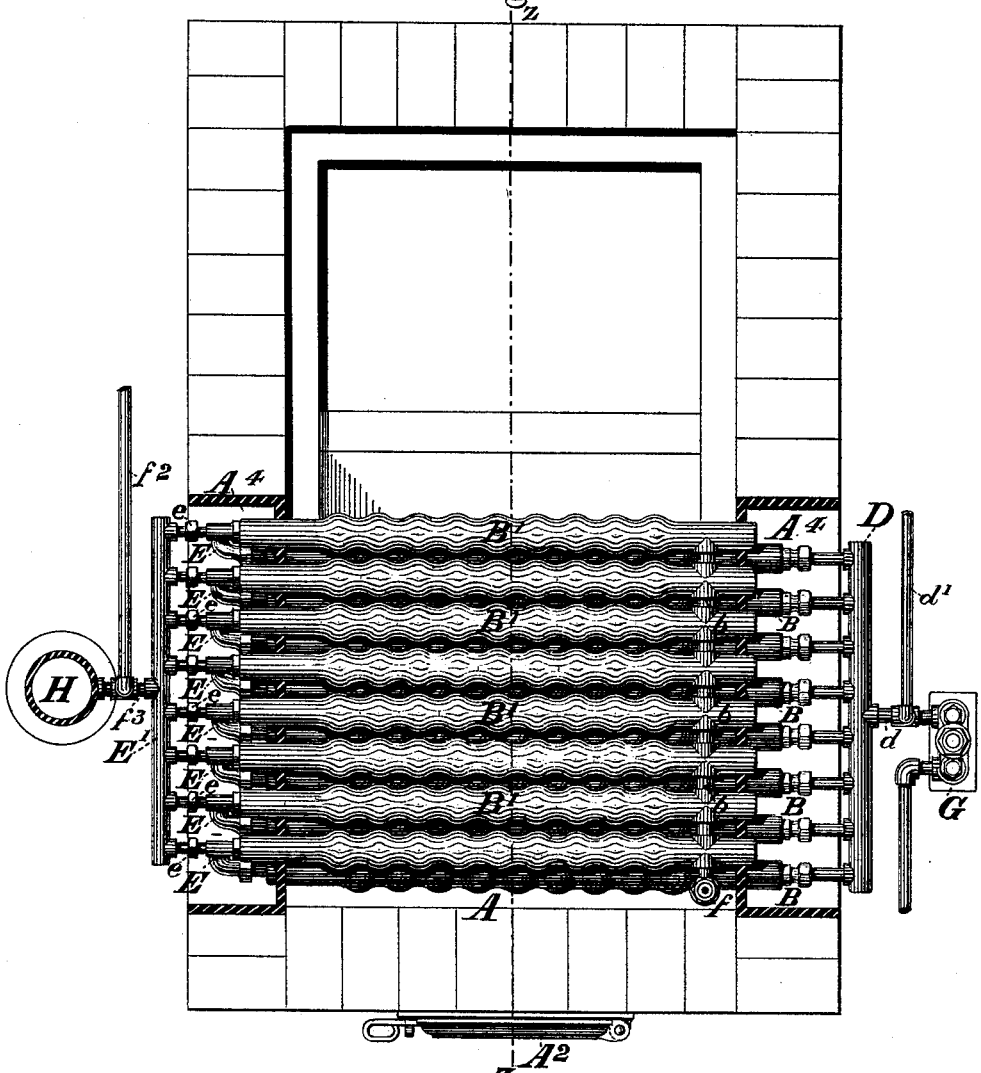

Fig. 5

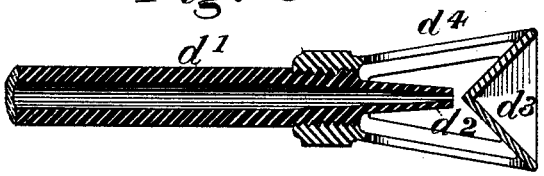

Fig. 6

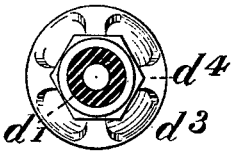

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Fig. 7

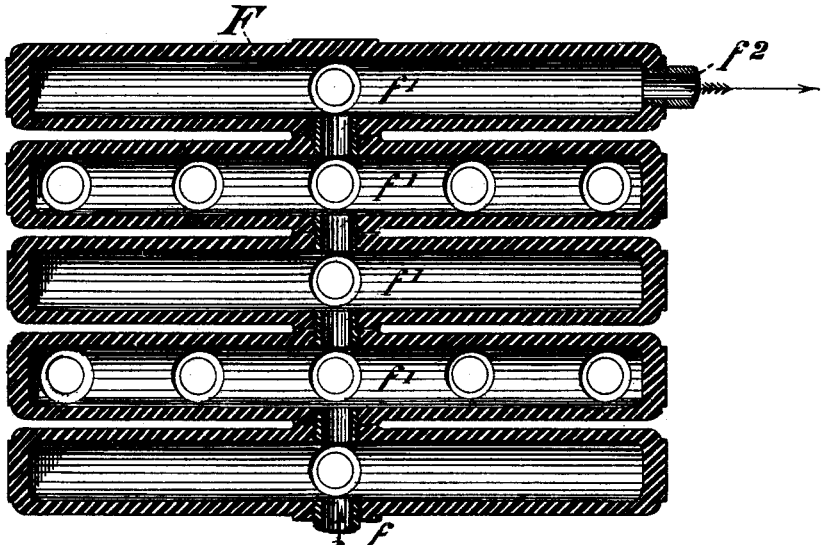
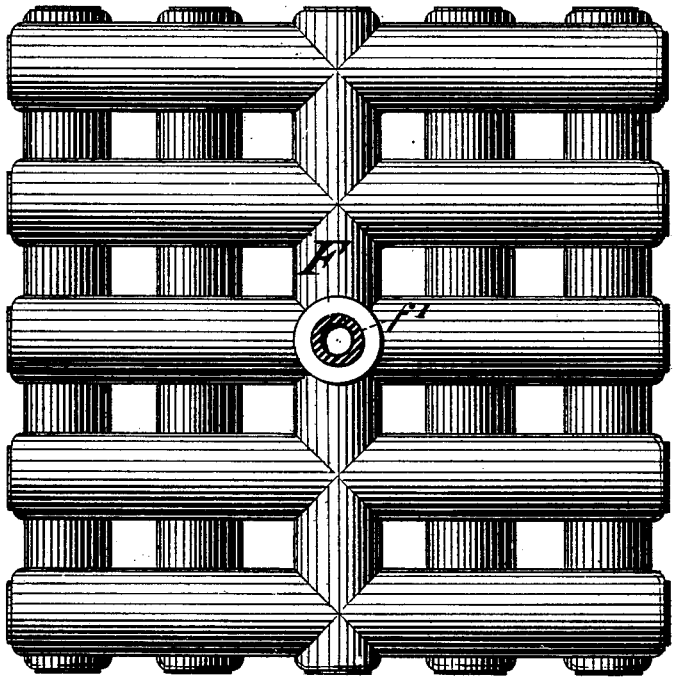


Fig. 8



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UNITED STATES PATENT OFFICE.

JOHN EVERDING, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF OF HIS RIGHT TO ABRAHAM S. JENKS, OF SAME PLACE.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **220,712**, dated October 21, 1879; application filed March 21, 1879.

To all whom it may concern:

Be it known that I, JOHN EVERDING, of the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Steam-Generators, of which improvements the following is a specification.

My invention relates to "instantaneous" or "injection" steam-generators, certain improvements in which are described and claimed in Letters Patent of the United States No. 213,556, to myself and Abraham S. Jenks, (as my assignee,) dated March 25, 1879; and the object of the invention is to improve and perfect the generator set forth in said Letters Patent in the following particulars, to wit: To secure greater rapidity in the conversion of the water into steam, more thorough equalization of temperature in the different parts of the apparatus, simplification in construction, and prevention of injurious action by the high-pressure steam generated upon the pistons and valves of steam-engines.

To this end my improvements consist in the combination of a furnace, a series of generating-chambers placed therein above the level of the grate, each having a series of injection-nozzles fitted to a supply-pipe within it, and a series of secondary chambers or vessels located above the generating-chambers, each having an internal perforated pipe, through which steam from one of the generating-vessels passes to a reservoir or superheater, and an injection-nozzle, by which a jet of steam from the superheater is supplied to the internal perforated pipe.

My improvements further consist in the combination of a furnace, a series of generating-vessels therein, each having an internal water-injection nozzle or nozzles, and a steam reservoir or superheater, formed of a series of cast vessels of multitubular form, connected one to the other by threaded pipe-nipples or other analogous couplings.

My improvements further consist in the combination, with the steam-reservoir of an instantaneous generator, of a stand-pipe or drum, connected by a pipe near its bottom with the steam-reservoir, and having a steam-outlet for the supply of an engine at its top and an internal water-injection nozzle below said steam-outlet.

The improvements claimed are hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a vertical transverse section on the line *y y* of Fig. 2 through a generator embodying my improvements; Fig. 2, a vertical longitudinal section on the line *z z* of Fig. 4; Fig. 3, an enlarged section, showing a generating and a secondary vessel; Fig. 4, a horizontal section through the generator on the line *x x* of Fig. 1; Figs. 5 and 6, longitudinal and transverse sections, respectively, on an enlarged scale, through the water-spray pipe of the steam-feed drum; Fig. 7, a vertical central section through a steam reservoir or superheater; Fig. 8, a plan view of the same, with a coupling in section; and Fig. 9, a vertical section, on an enlarged scale, through one of the wall-boxes.

The furnace A, which is shown as of brick, may be made of a cast-iron or wrought-iron case, lined with fire-brick, and is provided with a grate, A^1, fire-door A^2, and flue or chimney A^3. A series of generating-vessels, B, is arranged in a horizontal plane within the furnace, at a sufficient height above the grate to admit of the proper combustion of the fuel placed thereon. These generating-vessels are steel castings, and are, by preference, made in the form of hollow spherical chambers, connected by narrow necks. The dimensions of these vessels may be varied; but I prefer to make them of such diameter that a thickness of one-half an inch of metal will be sufficiently strong to admit of the vessel sustaining a bursting-pressure of at least four times the actual working-pressure, and I have found that it is not practicable or desirable to exceed one thousand pounds to the square inch as working-pressure.

Each of the generating-vessels B is provided with an internal water-supply pipe, C, closed at its inner end, and having an outlet in line with the center of each of the spherical chambers of which the vessels are composed. An injection-nozzle, *c*, is fitted to each of the outlets of the supply-pipes, the bore of which injection-nozzles should be such that in the ordinary working of the apparatus only such a

quantity of water is introduced through the several nozzles as will be immediately vaporized by contact with the surfaces of the heated chambers of the vessel B.

The water-supply pipes C are connected at their outer ends with a common pipe or manifold, D, to which water is forced by the pump G through the pipe *d*.

Immediately above the generating-vessels B and parallel therewith is placed one or more series of secondary vessels, B′, connected by communicating-pipes *b*. These vessels have substantially the same form as the vessels B, and are located above and between the latter in the furnace, so that they may, while receiving as far as practicable the direct action of the heat, have proper openings for the passage of the products of combustion.

The vessels B′ may be, as shown, separate castings, connected by the pipes *b*; but I prefer to make them in a single piece in all sizes of generators where such construction is practicable.

A pipe, C′, which is finely perforated throughout its length, is inserted in each of the vessel, B′, one of its ends being closed and the other screwed into a fitting, E, connected by a union, *e*, with one of the generating-vessels B, the construction and relation of the vessels B and B′, fitting E, and pipe C′ being such that communication between the vessels B and B′ can only be established through the perforations of the pipe C′; and, for the purpose of preventing corrosion, these perforations are preferably to be formed in small plugs of nickel or other material inserted in the pipes C′.

The generating-vessels B and auxiliary vessels B′ are supported in two wall-boxes, A^4, inserted in opposite sides of the furnace, and each having a removable plate, a^4, the wall-boxes and plates being provided with a series of sockets or recesses, in which the vessels rest and are held in position, so as to admit of the ready removal of the same when desired.

All the connections of the feed-manifold with the generating-vessels and of the generating with the secondary vessels being made from the outside, the joints can be easily broken without materially disturbing the structure, and are protected from the injurious effects of the direct action of heat.

The series of secondary vessels B′—or, if there be more than one series, then the last or uppermost of them—is connected with a steam receiver or reservoir, F, by a pipe, *f*.

The reservoir may be formed of coiled pipe or of return bends of pipe, as shown in Figs. 1 and 2, or of a series of steel castings, each composed of a central tubular stem and tubular side arms or branches, as shown in Figs. 7 and 8. In the latter case the several sections are placed alternately at right angles, so as to present the largest practicable amount of surface to the action of the heat without impeding the draft necessary for proper combustion in the furnace, and are connected by threaded pipe-nipples f^1, of steel or wrought iron.

An exit-pipe, f^2, leads from the top of the steam-reservoir F to a vertical stand-pipe or supply-drum, H, and is connected to the latter at or a short distance above its lower end.

A jet of water is introduced into the drum H by a pipe, d^1, leading from the feed-pump, and terminating in a perforated plug or nozzel, d^2, within the drum, a short distance below its top.

The nozzle d^2 is formed of nickel or other material which will not readily corrode, and a conical spray-shield, d^3, is connected to the end of the pipe d^1 by arms d^4, its apex being adjacent to the opening of the nozzle.

The water entering the drum through the nozzle is, in the form of fine spray, brought into contact with the steam of high temperature, which passes into the drum by the pipe f^2, and is thereby converted into saturated steam, which is supplied to the engine with the steam from the reservoir F, and reduces the temperature of the latter, so as to prevent injurious action upon the parts to which it has access.

The pipe f^2, leading from the reservoir to the drum, is connected by a branch, f^3, with a common pipe or manifold, E′, from which a pipe, *e*′, having a contracted nozzle or opening, leads through the fitting E into the perforated pipe C′ of each of the secondary vessels B′, the object of this provision being to admit a jet of steam to each of the pipes C′, tending to produce a current from said pipe into the surrounding auxiliary vessel B′. A stop-valve may be placed in the branch pipe f^3 to regulate or shut off the supply of steam to the manifold E′, as desired.

A pressure-gage, *h*′, is connected with the steam-supply pipe *h*; and an automatic damper-regulator, I, may be connected with the drum H, to operate a damper, I′, in the flue A^3, and promote uniformity of pressure by regulating the draft of the furnace in conformity with variations thereof.

A steam-trap may be attached to the bottom of the drum H, to permit the escape of any unvaporized water; but I do not consider the same essential to the working of the apparatus, as the proper quantity of water to be injected can be readily determined and regulated.

In the operation of the apparatus, fire being made upon the grate the generating and secondary vessels become rapidly heated, when water is injected through the nozzles *c* by the hand-pump G until the pressure is sufficiently great to permit the use of steam upon the engine, after which a pump, receiving motion from the engine, will supply the quantity of water required regularly and automatically. The injected water is immediately vaporized within the generating-vessels B, from which the steam passes through the perforated tubes C′ into the secondary vessels B′, and is there brought in contact with the surfaces of the

heated chambers, by which any particles of unvaporized water that it may contain are converted into perfectly dry steam. The steam passes from the secondary vessels to the reservoir or superheater, which should have a capacity greater than, or at least equal to, that of the volume of the engine-cylinder, and from the reservoir it passes to the supply-drum, in which it is mixed with a small quantity of saturated steam derived from the injected jet of water, the result of such admixture of saturated steam being, as I have found in practice, to provide an efficient lubricator for the engine-cylinder, and prevent injurious effects upon the cylinder, piston, and valves from the use of steam of exceptionally high pressure and temperature. The injection of jets of steam into the perforated pipes C′ serves the purposes of equalizing both temperature and pressure, and of promoting the rapid conversion of saturated vapor into dry steam.

I claim as my invention and desire to secure by Letters Patent—

1. The combination, in an instantaneous steam-generator, of a flashing device, into which water is introduced in jets, and a secondary chamber or chambers, into which the steam generated in the primary chamber is injected through perforated pipes provided with injection-nozzles, receiving steam from the superheater, by means of which the injected steam is separated from the water, and any water carried over with it is vaporized, substantially as described.

2. The combination, in an instantaneous steam-generator, of a series of generating-chambers, each provided with a water-jet pipe, a secondary separating-vessel, into which steam is admitted in jets, and a steam reservoir or superheater composed of castings, having a central tubular stem and tubular side arms or branches, and united one to the other by screw-nipples, substantially as set forth and shown.

3. The combination, in an instantaneous steam-generator, of a series of generating-chambers, provided with pipes and water-injection nozzles, and a series of secondary chambers, each receiving steam independently from each section of the first series through perforated pipes, the secondary chambers being independently connected with the superheater by injection-nozzles, substantially as set forth.

4. The combination, in an instantaneous steam-generator, of a steam reservoir or superheater, a stand-pipe or supply-drum, communicating at or near its lower end with the steam-reservoir and at the upper end with a supply-pipe leading to the engine, and a water-injection pipe leading into the stand-pipe between the engine supply-pipe and the connection with the steam-reservoir, the pipe through which the steam-reservoir communicates with the supply-drum being also connected with and supplying steam to the secondary chambers, all arranged substantially as and for the purpose set forth.

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Witnesses:
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