(No Model.)

W. D. HOOKER.

STEAM GENERATOR.

No. 255,509 Patented Mar. 28, 1882.

Fig. 1.

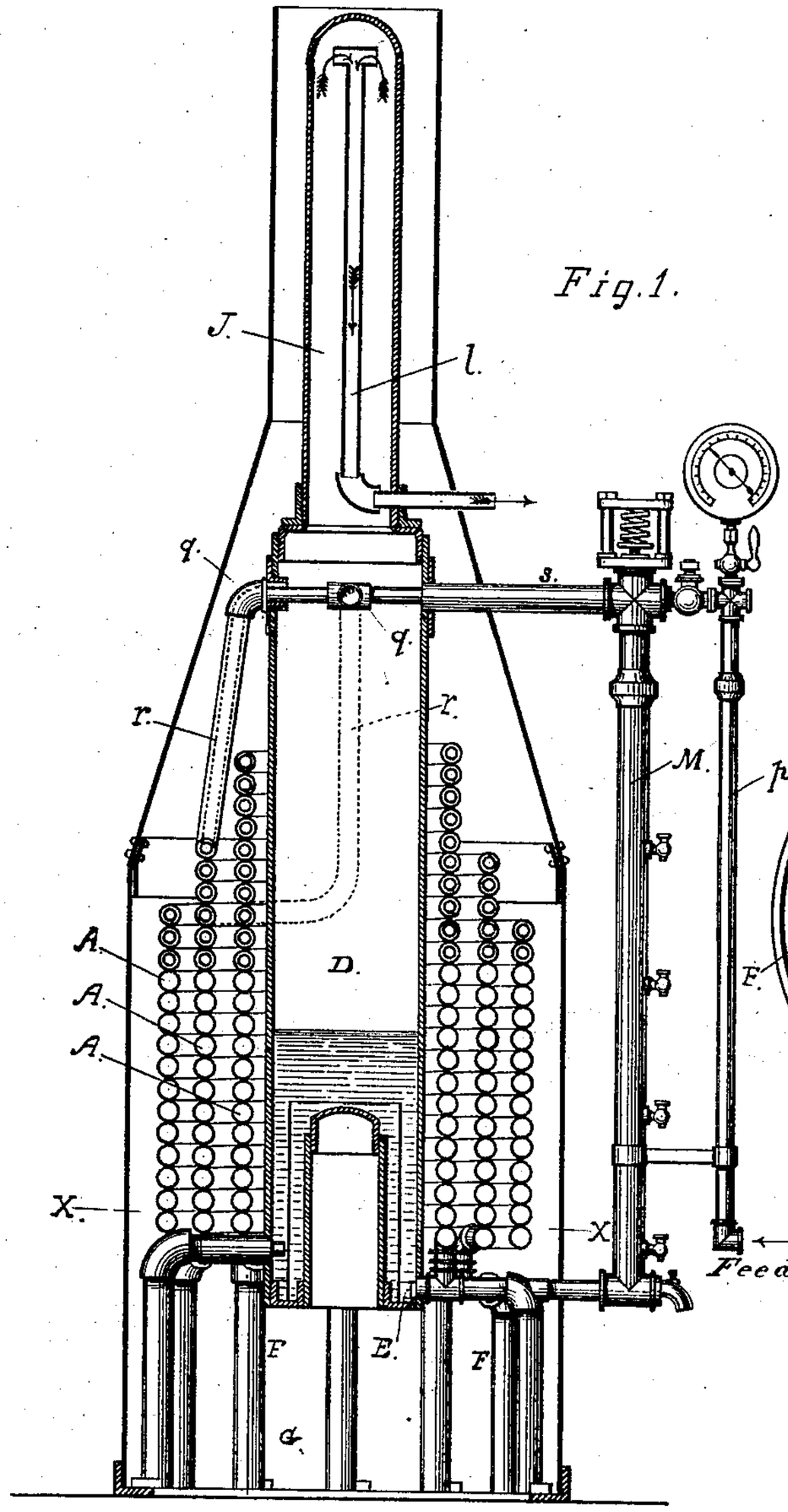


Fig. 2.

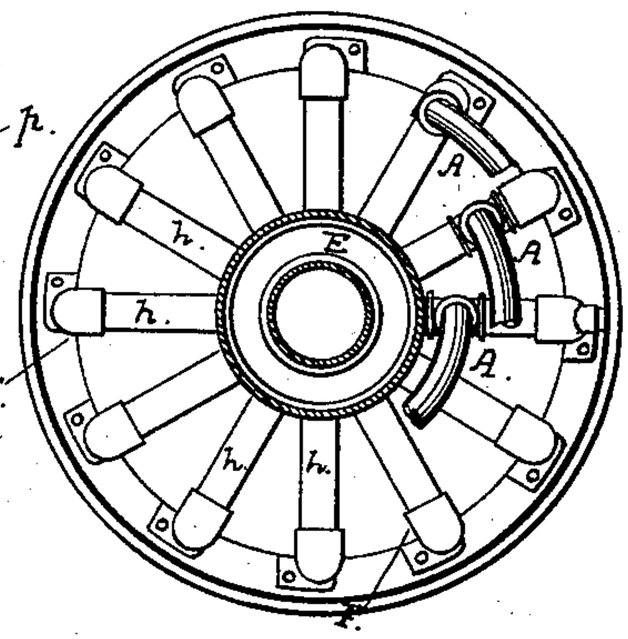
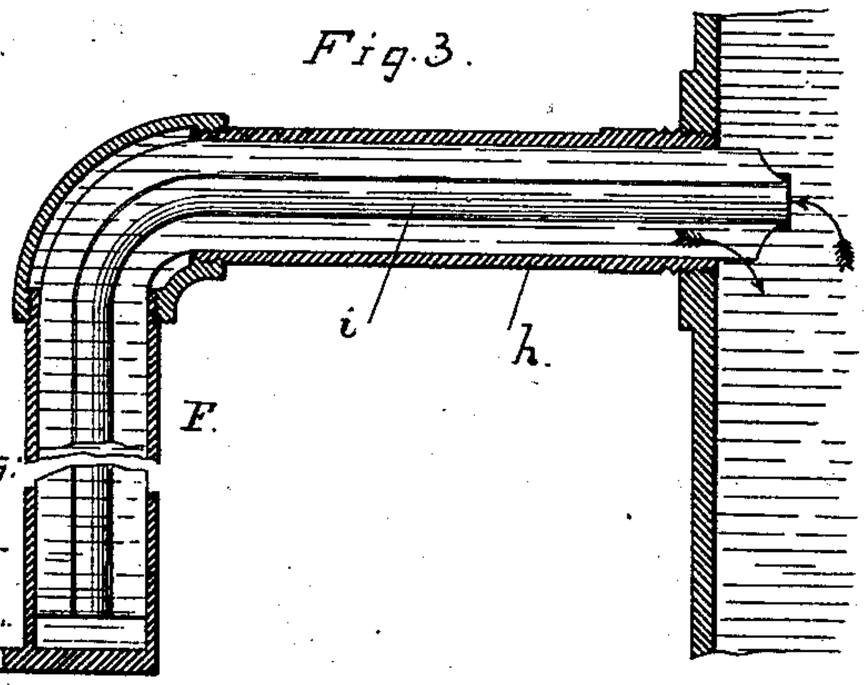


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM D. HOOKER, OF OAKLAND, CALIFORNIA.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 255,509, dated March 28, 1882.

Application filed June 16, 1881. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. HOOKER, of Oakland, Alameda county, State of California, have invented an Improved Steam-Generator; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings.

My invention has reference to that class of steam-generators in which the water to be converted into steam is contained in one or more coils of pipe, while the lower ends of the coil or coils extend into and are brought directly in contact with the fire. In this class of steam-boilers it has been found difficult to keep the water down in the lower coils, because, being subjected to the greatest heat, steam is generated below the water in the coils, which forces it upward, leaving the lower coils empty and liable to burn out.

The main part of my invention relates to a novel method and device for overcoming this difficulty; but in connection therewith I have made other improvements in the construction and arrangement of the boiler, by which its efficiency for generating steam quickly is greatly increased, all as hereinafter more fully described.

Referring to the accompanying drawings, Figure 1 is a vertical section of my improved steam-generator. Fig. 2 is a section through *x x*, Fig. 1. Fig. 3 is an enlarged sectional view with the water-leg F.

Let A A A represent any number of coils of pipe in which water is contained for the purpose of generating steam by introducing the coil into or surrounding it with fire or heat. In the present instance I have represented three coils; but a greater or less number can be used. Each of the three coils I connect with a central upright boiler, D, at top and bottom, so that the upper end of each coil connects with the upper end of the boiler and the lower end of each coil connects with the lower end of the boiler, while the coils themselves surround the boiler intermediate between their connections with it.

In the lower end of the boiler I make an inverted chamber, E, which extends a short distance up into the boiler, so as to form an annular space between it and the outside boiler, and with this annular space I connect the upper ends of tubular water-legs F F, upon which the boiler, with its surrounding coils, is supported above the fire-grates G G, so that the water-legs will pass down into and through the fire, while the heat-flames and products of combustion will strike the lower end of the boiler and pass up, through, around, and in contact with the exterior of the boiler and its surrounding coils. The water-legs are connected with the annular space in the boiler by elbows *h*, so that they stand vertical, and inside of each leg I place an inside or smaller tube or partition, *i*, which assists in producing a circulation of water from the annular space into and through the legs.

The boiler D has a smaller cylinder or extension, J, connected with its upper end and extending upward to near the top of the shell or casing K, which surrounds the boiler, thus forming a steam-dome and superheater, from which the steam is taken to the engine through the pipe *l*.

M is the gage-tube, which is connected with the boiler at top and bottom, and which serves to indicate the height of the water in the boiler and coils.

To supply the boiler with water I lead the feed-pipe *p* upward to a point opposite where the upper ends of the coils A enter the boiler, and then I carry it directly through and into the boiler. To the end of this feed-pipe in the center of the boiler, I secure a T-connection, *q*, which has as many openings as there are coils of pipe A, each opening being in line with one of the upper open ends of the coils. To each opening I secure one end of a small pipe or tube, *r*, which extends across the intervening space and enters the open end of the coil. Each pipe or tube *r* extends down into its coil to near the point at which it is desired to hold the water level in the coils and boiler, as shown. The object of these internal feed-pipes is to keep up a continual feed of water in a minute stream and to deliver it in the coils at or near the water-level. Now, when the boiler is making steam the heated water in the bottom of the coils will move upward through the coils, and will fall back into the boiler in a partially-vaporized condition from the upper ends of the coils by its gravity. At the same

time the minute stream of feed-water in the pipes *r* will be passing down into the coils, and being at a lower temperature than the upward circulating water, it will fall toward the bottom of the coils until it becomes heated to the same temperature as the water in the bottom of the coils. I thus produce a double circulation in the coils, the heated water passing up around the pipes *r* and the feed-water passing down through them toward the bottom of the boiler. The feed-water, being delivered, as before stated, at or near the water-level, will prevent a too rapid generation of steam in the bottom of the coils, so that it will hold the water down solid in the bottom of the coils and boiler, and it will be impossible for the boiler to prime.

It is impossible to determine absolutely the exact point where the feed-tubes *r* should terminate in the coils, because this point will vary in different boilers. The way in which I have managed to secure the desired result is to test the boiler several times and to keep lengthening the tubes until the circulation in the bottom of the boiler is balanced, leaving the heat which surrounds the coils above the water-level to keep up the upward circulation through the coils. This arrangement prevents priming, and at the same time does not materially interfere with the circulating and steam-generating capacity of the boiler, whereas if the feed-water were injected into the upper ends of the coils, as has heretofore been done, the circulation of the water in the coils would be prevented, while the water in the boiler would prime, because the feed-water would only affect the water in the coils, and would become sufficiently heated before it reached the bottoms of the coils to generate steam, and its only relief would be through the boiler. This I consider an important discovery, as it remedies one of the defects heretofore encountered in coil-boilers.

I prefer to introduce the feed-pipe *p* into the boiler by passing it through the upper horizontal connecting-pipe, *s*, of the gage-tube, as I thereby avoid making another hole in the boiler, and the heat in the tube assists in heating the feed-water. As the mingled water and steam from the upper ends of the coils fall into the boiler the steam is separated and rises into the dome or extension J, where it is dried and superheated by the heat which surrounds the dome. The pipe *l* takes the steam from the upper end of the dome, so that the steam that goes to the engine is superheated and at a high tension.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The upright boiler or cylinder D, surrounded by one or more coils of pipe, A, and having the introverted heat and flame chamber E formed in its lower end and extending up into the body of water, said boiler being supported on water-legs F F, which extend down into the fire, substantially as described.

2. The upright boiler or cylinder D, with its superposed dome or extension J, said boiler having an annular water-space formed in its lower end around an introverted flame and heat chamber, and having one or more coils, A A, surrounding it, said coils being connected at their lower ends with the annular water-space at the lower end of the boilers and at their upper ends with the top of the boiler, in combination with the feed-water pipe *p*, with its radial feed-tubes *r*, arranged to deliver the water through the upper ends of the coils, substantially as described.

3. The method of feeding water to circulating coil-boilers, consisting in conducting the feed-water in a solid stream into the coils through internal imperforate pipes or tubes coiled around the exterior of the boiler, and delivering it at or near the water-level, whereby a circulation is established up through the boiler, while the incoming solid stream forms a counter-current downward in the lower part of the coil, substantially as above described.

In witness whereof I have hereunto set my hand and seal.

WILLIAM DAVIS HOOKER. [L. S.]

Attest:

WM. F. CLARK,

JNO. L. BOONE.