(No Model.) 4 Sheets—Sheet 1.

J. BUCKLEY.

TUBULAR STEAM GENERATOR.

No. 563,557. Patented July 7, 1896.

Fig. 1.

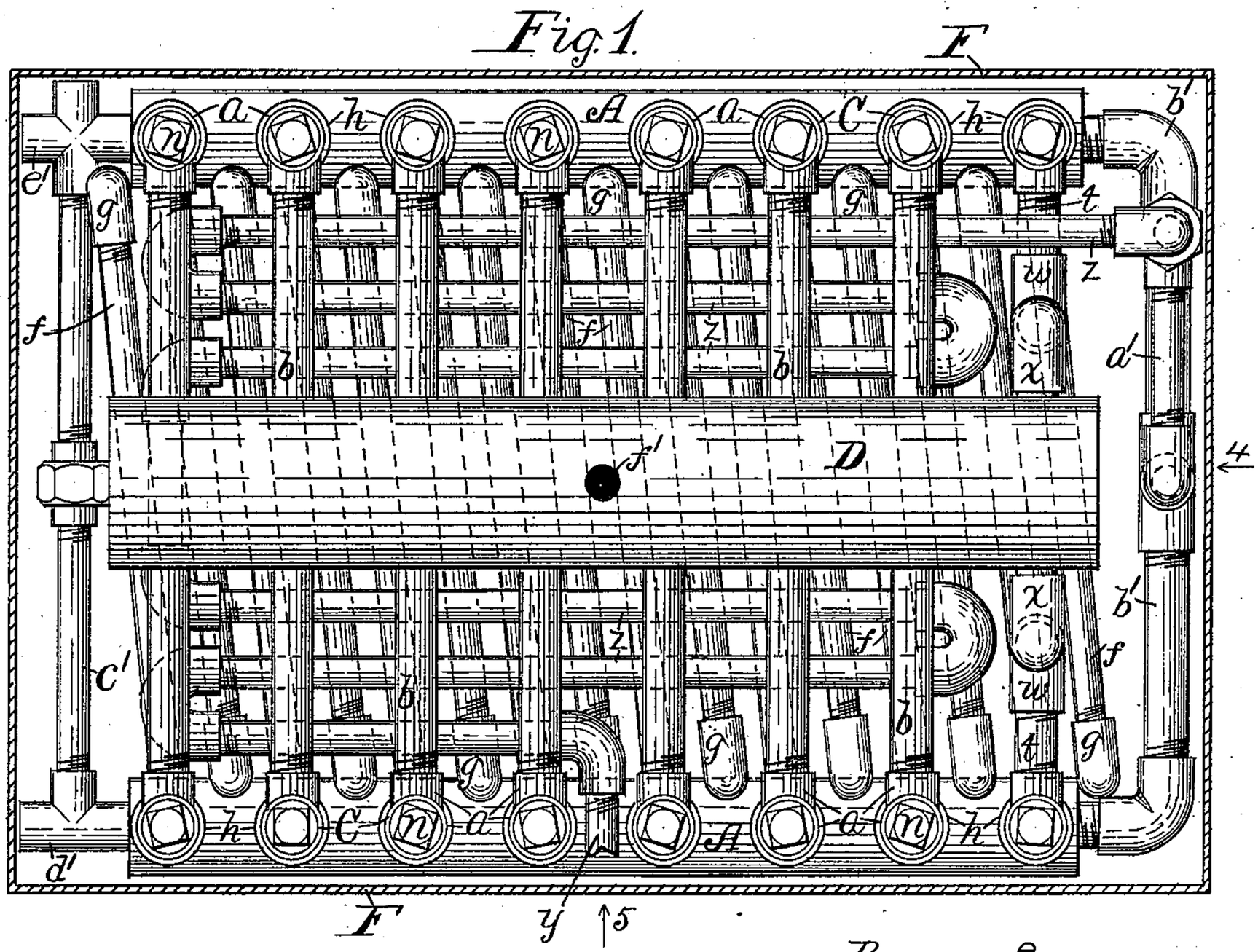
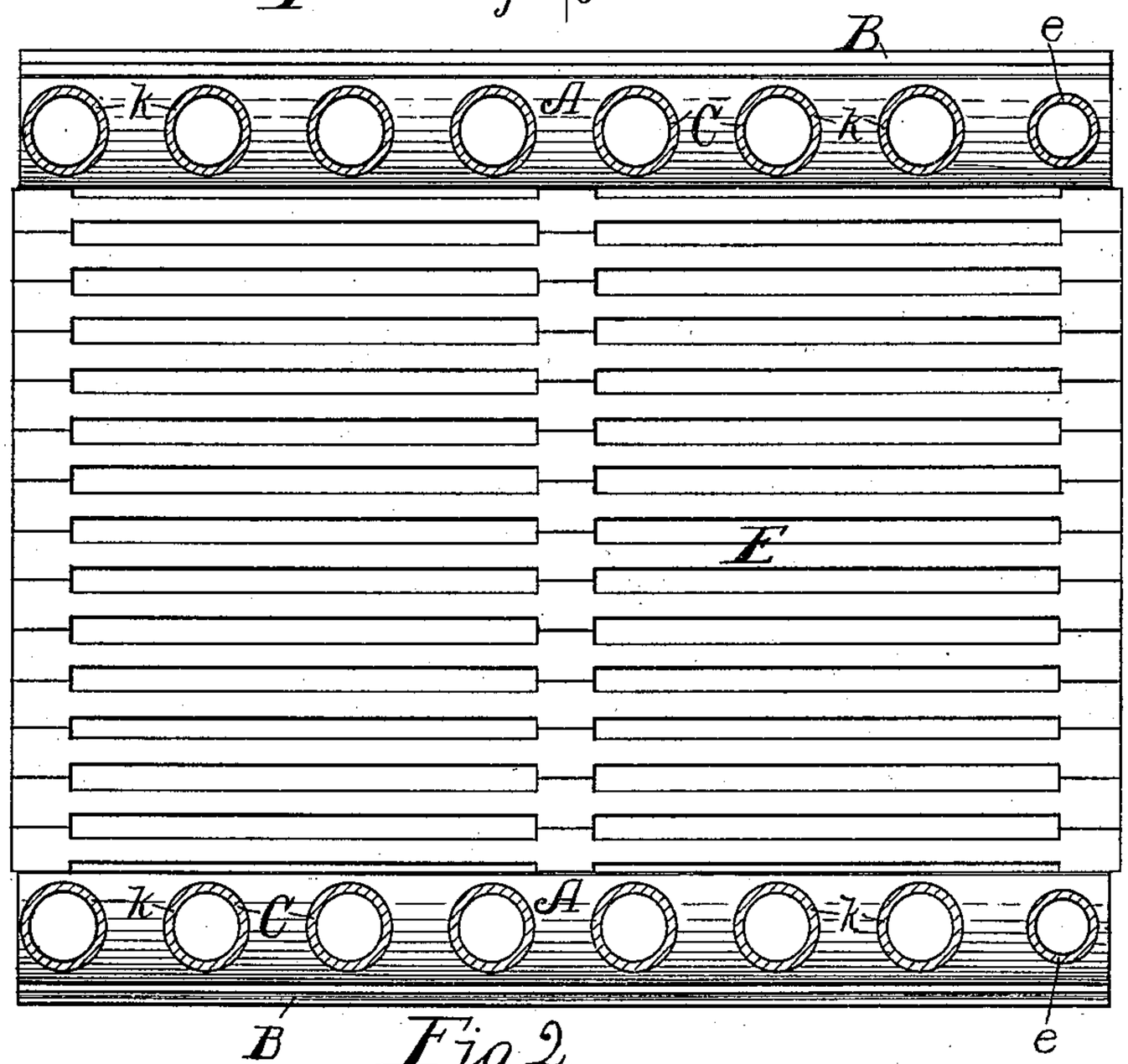


Fig. 2.



Attest:
M. L. Winston.
M. C. Hetzel.

Inventor
J. Buckley,
By E. B. Whitmore,
Atty.

(No Model.) 4 Sheets—Sheet 2.

J. BUCKLEY.

TUBULAR STEAM GENERATOR.

No. 563,557. Patented July 7, 1896.

Fig. 4.

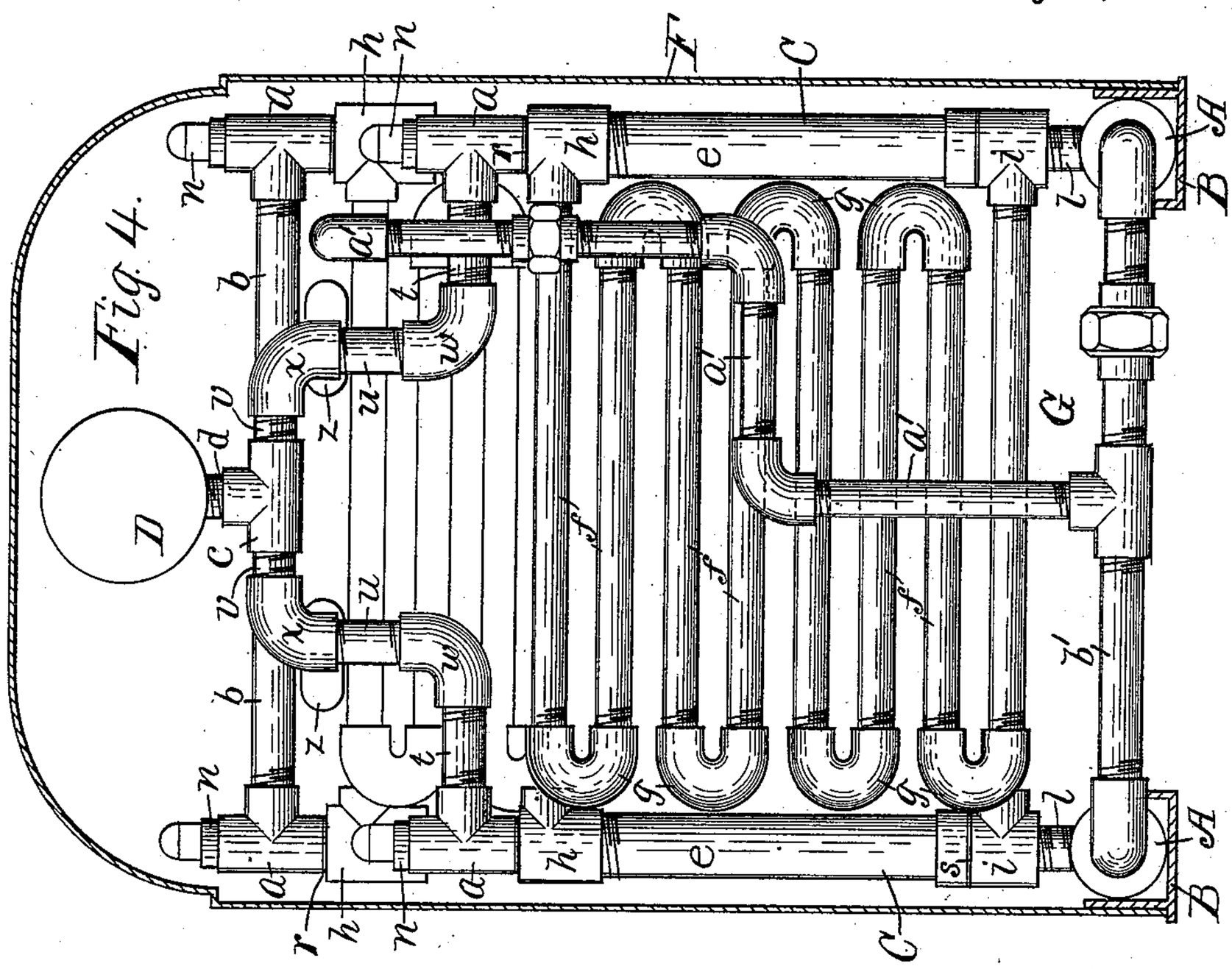
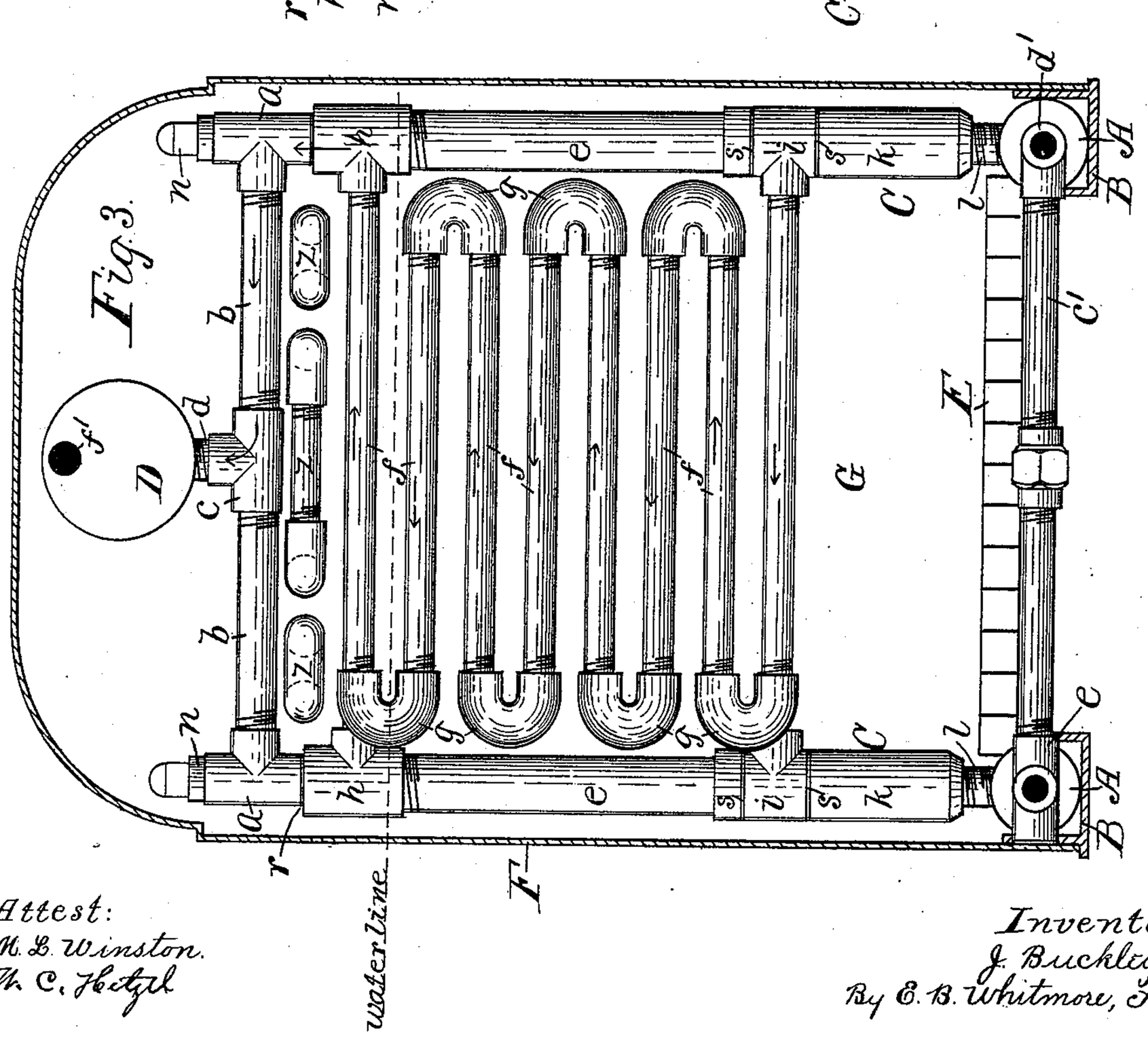


Fig. 3.



Attest:
M. L. Winston.
H. C. Hetzel

Inventor:
J. Buckley,
By E. B. Whitmore, Atty.

(No Model.)

4 Sheets—Sheet 3.

J. BUCKLEY.

TUBULAR STEAM GENERATOR.

No. 563,557. Patented July 7, 1896.

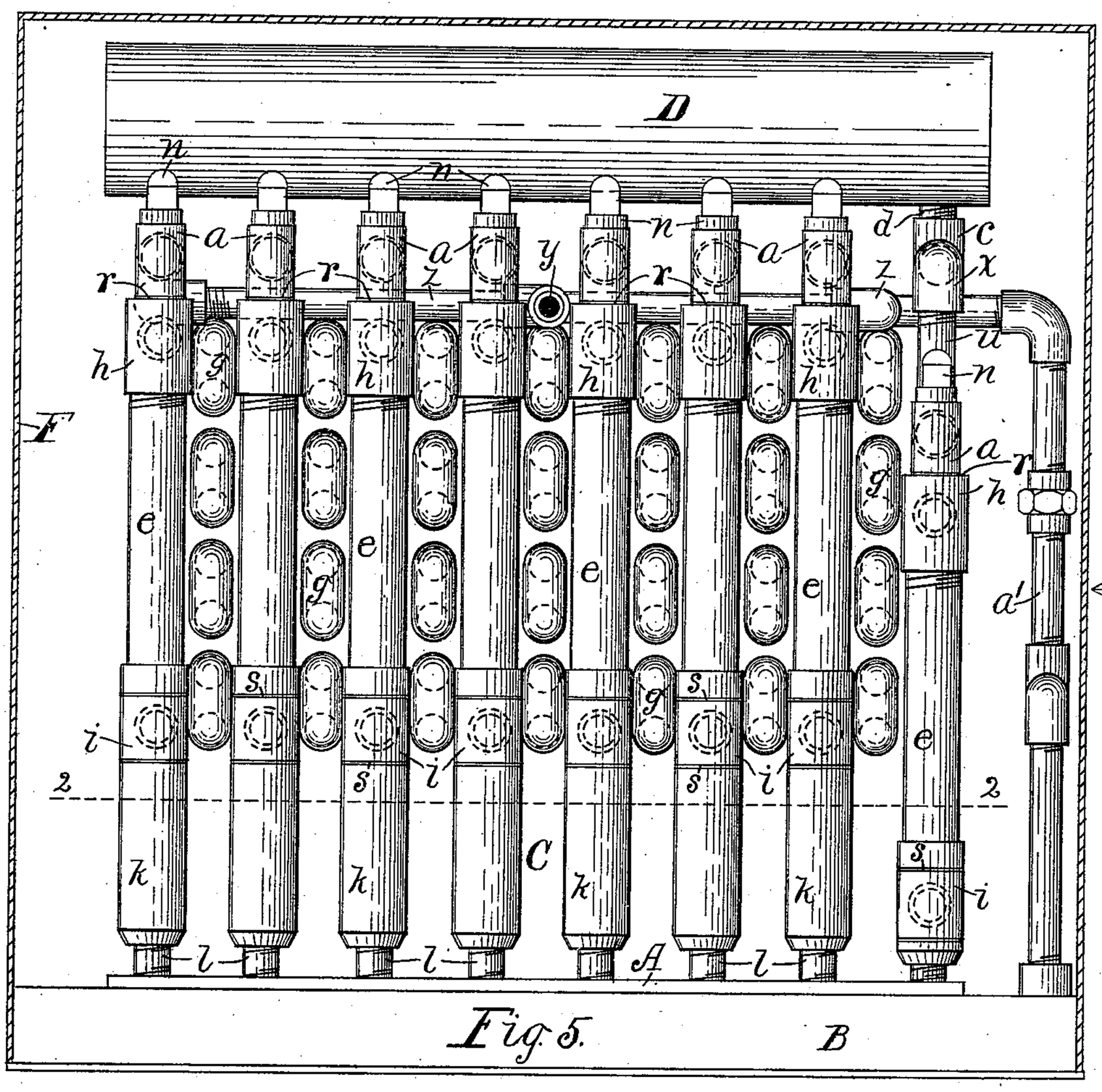


Fig. 5.

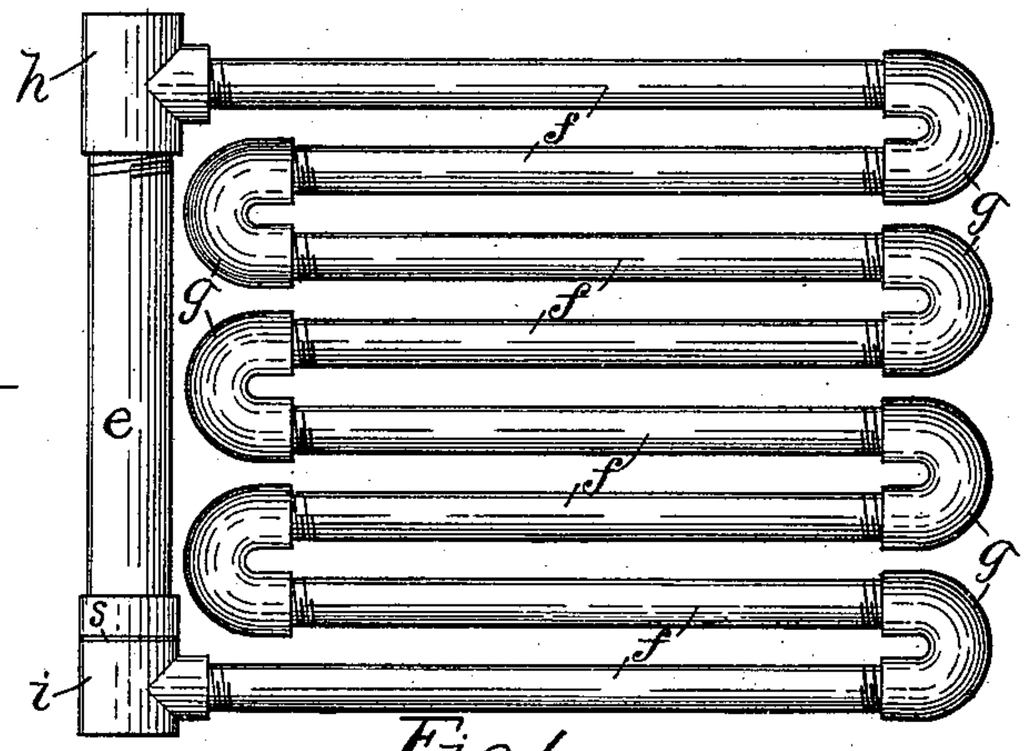


Fig. 6.

Attest:
M. L. Winston.
W. C. Hazel.

Inventor:
J. Buckley,
By E. B. Whitmore, Atty.

(No Model.) 4 Sheets—Sheet 4.

J. BUCKLEY.

TUBULAR STEAM GENERATOR.

No. 563,557. Patented July 7, 1896.

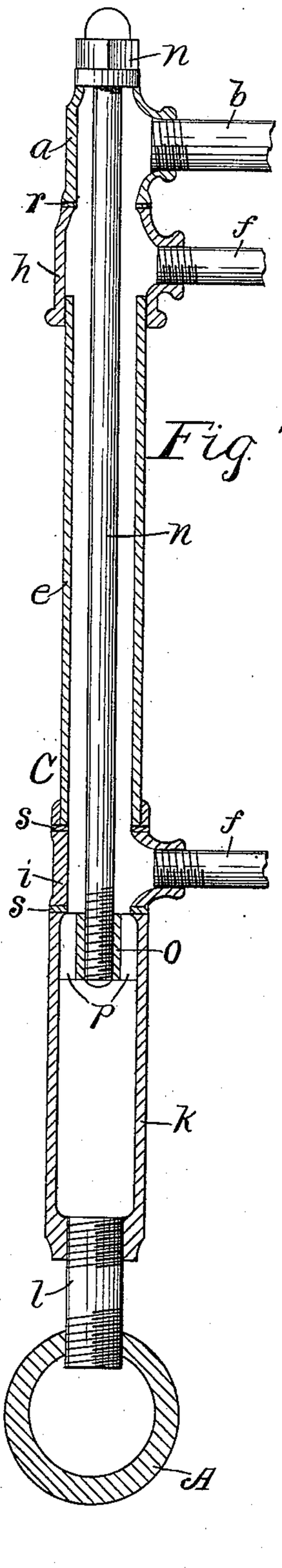


Fig. 7.

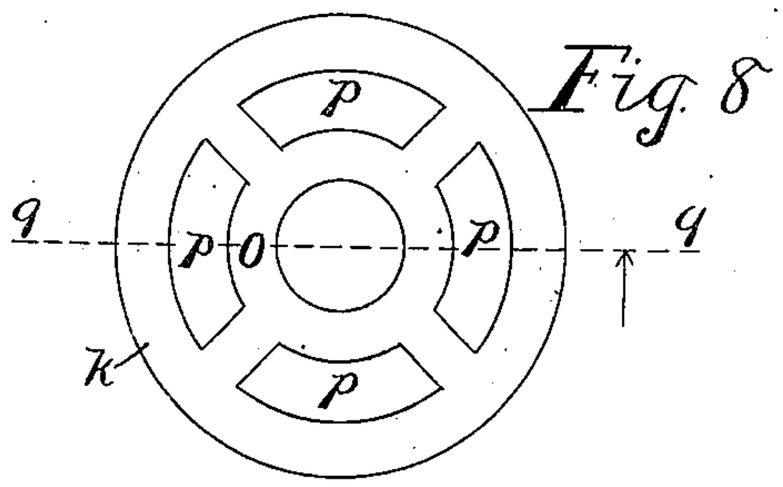


Fig. 8

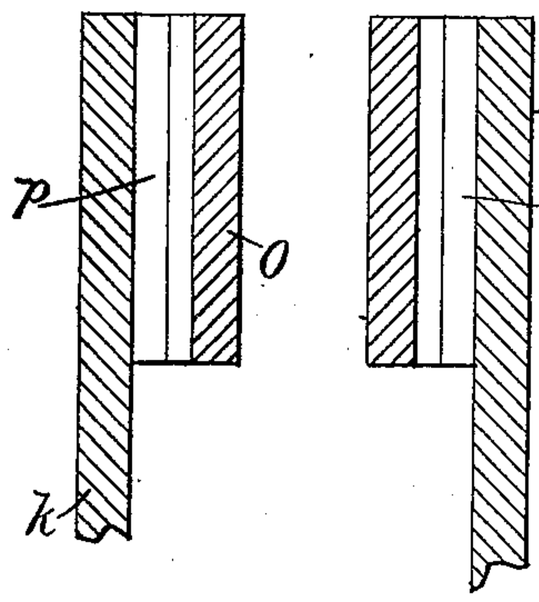


Fig. 9.

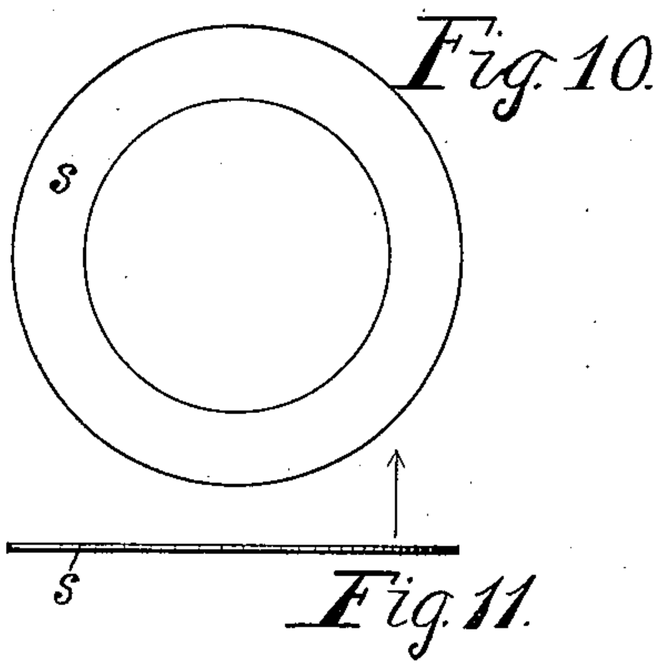


Fig. 10.

Fig. 11.

Attest:
M. L. Winston
W. C. Hazel

Inventor:
J. Buckley,
By E. B. Whitmore, Atty.

UNITED STATES PATENT OFFICE.

JOHN BUCKLEY, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE ROCHESTER MACHINE TOOL WORKS, OF SAME PLACE.

TUBULAR STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 563,557, dated July 7, 1896.

Application filed December 9, 1895. Serial No. 571,514. (No model.)

To all whom it may concern:

Be it known that I, JOHN BUCKLEY, of Rochester, in the county of Monroe and State of New York, have invented a new and useful Improvement in Tubular Steam-Generators, which improvement is fully set forth in the following specification and shown in the accompanying drawings.

The object of my invention is to produce an improved tubular steam-generator which shall contain no large, solid, or unbroken bodies of water and which shall be of convenient construction, and a generator in which, on account of its peculiar construction, all of its interior parts, including those exposed to the direct action of the heat from the furnace and liable to give out, are readily accessible for examination and repairs.

A further object of the invention is to produce a steam-generator in which the different relative expansions and contractions of the various parts from variations or differences in the action of the heat are provided for to the end that the joints shall remain tight and perfect.

The object of the invention is, further, to produce a steam-generator having large evaporating-surface within a relatively small space and consequently be a quick steamer, and one that shall be comparatively proof against foaming, and will furnish dry steam at the top.

The invention comprises, in addition to mud-drums, two parallel series of stand-pipes made up in part of steam-generating sections each having a series of horizontal evaporating tubes or pipes of peculiar construction, each of which sections, with its retinue of tubes or pipes and return-bends, being adapted to be readily removed from the stand-pipe for the purpose of examination and repairs.

The invention consists in other novel features and advantageous combinations of parts, all hereinafter fully described and more particularly pointed out.

Referring to the drawings, Figure 1 is a plan of the steam-generator with the jacket horizontally sectioned. Fig. 2 is a plan of parts at the base of the device, parts being horizontally sectioned as on the dotted line 2 2 in Fig. 5. Fig. 3 is a front end view seen as indicated by arrow 3 in Figs. 1 and 5, the jacket and shoes or sills being vertically sectioned. Fig. 4 is a rear end view seen as indicated by arrows 4 in Figs. 1 and 5, the jacket and sills being vertically sectioned. Fig. 5 is a side elevation seen as indicated by arrow 5 in Fig. 1, the jacket being vertically sectioned. Fig. 6 is a side elevation of an evaporating-section detached. Fig. 7 is a central longitudinal section of a stand-pipe, the plane cutting the mud-drum transversely. Fig. 8 is a plan of the end of the barrel of a stand-pipe. Fig. 9 is an axial section of the upper part of the barrel, taken on the dotted line 9 9 in Fig. 8. Figs. 10 and 11 show, respectively, a plan and an edge view of a packing-ring. Figs. 7 to 11, inclusive, are drawn to scales larger than that of the other figures.

Referring to the parts shown, A A are two parallel horizontal mud-drums, preferably cylindrical in form, usually placed in horizontal metallic shoes or sills B B, as of gutter-iron. From these mud-drums rise two series of stand-pipes C C, as shown, the number and the height of the stand-pipes depending upon the size or steaming capacity of the generator to be produced in any given case. These stand-pipes are composed in part of vertical T connections or "T's" *a a* at their upper ends, which T's are connected in pairs by horizontal cross-pipes *b*. Over the whole is a longitudinal steam-drum D, connected with each of the cross-pipes *b* by a T connection *c* and a nipple *d*, which form continuous connections between the stand-pipes and the steam-drums. Between the two rows or series of stand-pipes is the furnace-space G, Sheet 2, and a floor E of ordinary grate-bars, Figs. 2 and 3. A sheet-metal jacket F, substantially of common construction, is placed in position to cover and inclose the whole generator, openings being formed therethrough for furnace-doors, inlet and exit pipes, smoke-pipe, steam and water gages, &c. The stand-pipes are further composed in part of independent sections *e*, Fig. 6, each provided with a series of horizontal evaporating tubes or pipes *f* with return-bends *g*. Each section *e* is provided with an upper and a lower T connection *h i*, respectively, at which two points the series

of evaporating-tubes communicate with the stand-pipe, these being the only communications between the evaporating-tubes and the stand-pipe. In making up the generator these sections are alternated, as shown in Figs. 1 and 5, the evaporating-tubes *f* lapping upon each other and extending wholly across the furnace-space over the grate-bars.

Below the sections *e* the stand-pipes consist of cylindrical parts or barrels *k*, joined to the mud-drums by nipples *l*, as clearly shown in Fig. 7. To hold the various parts of the stand-pipes together, axial longitudinal bolts *n* are employed, headed above the T connections *a* and threaded into parts *o*, Sheet 4, in the upper ends of the barrels *k*. The threaded parts *o* are connected with the outer shells of the barrels *k*, as shown in Figs. 8 and 9, in a manner to leave vertical openings *p*, which admit of a free communication for the water and steam between the mud-drums and all parts above them, including the steam-drum D.

The adjacent ends of the T connections *a* and *h*, Fig. 7, are made plain and flat, between which are placed flat packing-rings *r*, preferably of copper. Likewise the ends of the T connections *i* and the ends of the adjacent parts *e* and *k* are made plain and flat, there being employed between them flat copper rings *s*. (Shown in Figs. 10 and 11.) Now, on account of the plain surfaces or joints between the parts *a* and *h* and *i* and *k*, and from the construction of the parts generally of the generating-sections, as above described, it will be understood that by withdrawing a bolt *n* at any time upward out of the stand-pipe any steam-generating section may be withdrawn or slipped out horizontally from a stand-pipe in the direction indicated by the arrow in Fig. 6 without in any way disturbing any other part of the generator. Thus the parts of any section may be readily examined and repaired and the section be replaced with very little loss of time.

The evaporating-sections are purposely made with continuous tubing *f* and return-bends, having only two connections with the vertical part or stand-pipe, that is to say, at the bottom at *i* and at the top at *h*. Thus a continuous uninterrupted passage for the water and steam is provided between the two points *i* and *h* through said tubing. On account of this construction of the section there is little shifting of the water in the vertical part between the points *i* and *h*, the upward flow between those points being mainly through the tubes *f*. Through these tubes the flow of water and steam is rapid, the water being kept more constantly in the furnace-space directly over the fire, resulting in a much more rapid evaporation than if the flow was a considerable part of the time by way of the vertical part of the section; or, to further explain, the tubes *f* take water from the stand-pipes at *i* and deliver it, largely converted into steam, back into the stand-pipes at *h*, from which points the steam quickly passes into the drum D. This is a matter of great importance in the plan and construction of the generator, for, on account of it, the comparatively cool water drawn from the lower part of a stand-pipe is caused to pass many times backward and forward through the furnace-space without becoming again mingled with the cooler water in the stand-pipe. As a consequence the water in the sections becomes most wholly converted into steam before it is reintroduced into the stand-pipe on its way to the steam-drum.

The final discharge of the mingled steam and water from the upper pipes *f* of the sections into the stand-pipes is above the water-line, as appears in Fig. 3, and as the contents of the small pipes *f* are discharged into the stand-pipes of large relative diameters the velocity of the flow is instantly checked, which results in an easy separation of the water from the steam. The water readily drops down onto the water at the water-line while the steam passes onward to the drum.

So far as the matter of generating steam itself is concerned the upper pipe *f* of the section, Fig. 3, instead of reëntering the stand-pipe at *h*, might make a return-bend at that point and lead thence directly into the steam-drum; but such a construction would tie the section to place in the structure and render its removal inconvenient. Furthermore, by causing said upper pipe *f* to lead back into the upper end of the stand-pipe and thence through a different pipe to the steam-drum much drier steam for the drum is insured, as will be hereinafter fully explained. Now, regarding said Fig. 3, it will be observed that the right-hand T connection *a*, for instance, and the contiguous pipe *b*, with the T connection *c* and nipple *d*, secured to the drum, together constitute a rigid self-sustaining arm, so that if the evaporator-section *e* be removed said arm will maintain its place and be in position to receive the section again when replaced. Thus a free removal and replacing of the section is facilitated.

The horizontal steam-pipes *b*, extending between the opposing T connections *a* of opposite stand-pipes, are made larger in diameter than that of the pipes or tubes *f*, so as to further provide for a flow of dry steam to the drum D. These pipes *b*, being of large diameter, cause the flow of steam through them to be less rapid and violent than it is through the smaller pipes *f*, on account of which any water that might at any time be carried into said pipes *b* by the onflowing steam easily becomes separated from the latter by gravitation and drops back into the still larger stand-pipes through the T's *a*, the dry steam only flowing into the drum D; and it will be observed that the steam-passages all the way from the upper pipes *f* of the sections to the drum are large in cross-section compared with that of the pipes *f*, on account of which the water becomes thoroughly separated from the steam before the latter enters the drum.

Steam is taken from the drum D in the ordinary manner from an opening f', Figs. 1 and 3, as may be convenient.

In case it should be wished to have the evaporating-tubes extend downward to form a back for the furnace-space the two rear stand-pipes are shortened by omitting the barrels k, as shown in Fig. 4, the nipples l connecting directly with the T connections i. In this construction of the two rear sections the depressed T connections a are connected with the T connections c under the steam-drum by means of nipples $t\,u\,v$ and elbows $w\,x$. These parts together make communication complete between the mud-drums and the steam-drum and intermediate parts.

The water supply for the generator enters through a pipe y, Figs. 1 and 5, and passing through a series of horizontal pipes z, above the sections and beneath the steam-pipes b, finally passes down through a pipe a', Figs. 1 and 4, thence through a pipe b' into the mud-drums A. The pipes z, collectively, constitute a heater for the feed-water. I also prefer to connect the opposite ends of the mud-drums, Figs. 1 and 3, with a pipe c', provided with T's d' and e', for the convenience of attaching blow-off pipes for clearing said mud-drums, and for other purposes.

What I claim as my invention is—

1. A steam-generator consisting of a steam-drum and mud-drums, and two series of stand-pipes, each stand-pipe comprising a barrel, a generator-section and a T connection, with means for connecting the barrels with the mud-drums, said generator-sections being formed of laterally-extending steam-generating pipes and return-bends, and pipes, b, above the generator-sections connecting said T's and the steam-drum, said pipes b being larger in diameter than the generating-pipes of the sections, substantially as set forth.

2. A steam-generator consisting of a steam-drum and mud-drums, and two series of stand-pipes, each stand-pipe comprising a barrel, a generator-section and a T connection, with means for connecting the barrels with the mud-drums, said generator-sections being formed of laterally-extending steam-generating pipes and return-bends, and pipes b connecting said T's and the steam-drum above the generator-sections, and a series of horizontal pipes between the sections and said pipes b, connected with the mud-drums, substantially as shown.

3. A steam-generator comprising mud-drums and a steam-drum, and series of parallel stand-pipes supported by the mud-drums, each stand-pipe comprising a steam-generating section removable from the stand-pipe, the parts of said sections and the other parts of the stand-pipes adjacent to the sections being made plain so the sections may be readily slipped out of or withdrawn from the stand-pipes, substantially as shown.

4. A tubular steam-generator comprising mud-drums and a steam drum or space, and series of stand-pipes comprising a series of steam-generating sections above the mud-drums, and pipes connecting the stand-pipes with the steam-space, and longitudinal pipes over the steam-generating sections and below the steam-drum, connected with the mud-drums, and furnace-space beneath the steam-generating sections, with grate-bars, and a jacket or a casing inclosing the whole, substantially as and for the purpose specified.

In witness whereof I have hereunto set my hand this 2d day of December, 1895, in the presence of two subscribing witnesses.

JOHN BUCKLEY.

Witnesses:

ENOS B. WHITMORE,

M. L. WINSTON.