(No Model.) 3 Sheets—Sheet 1.

J. L. HEALD.

STEAM BOILER.

No. 424,646. Patented Apr. 1, 1890.

Fig. 1.

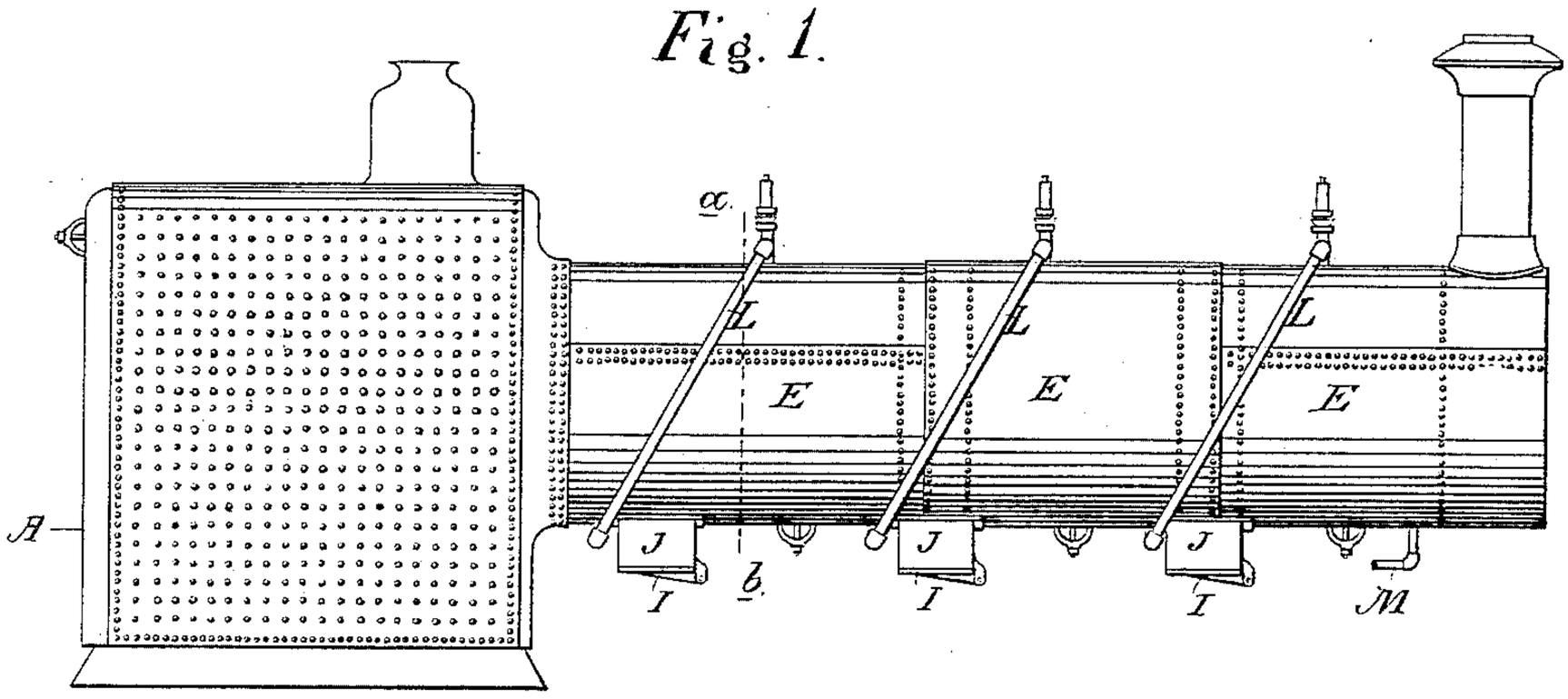


Fig. 2.

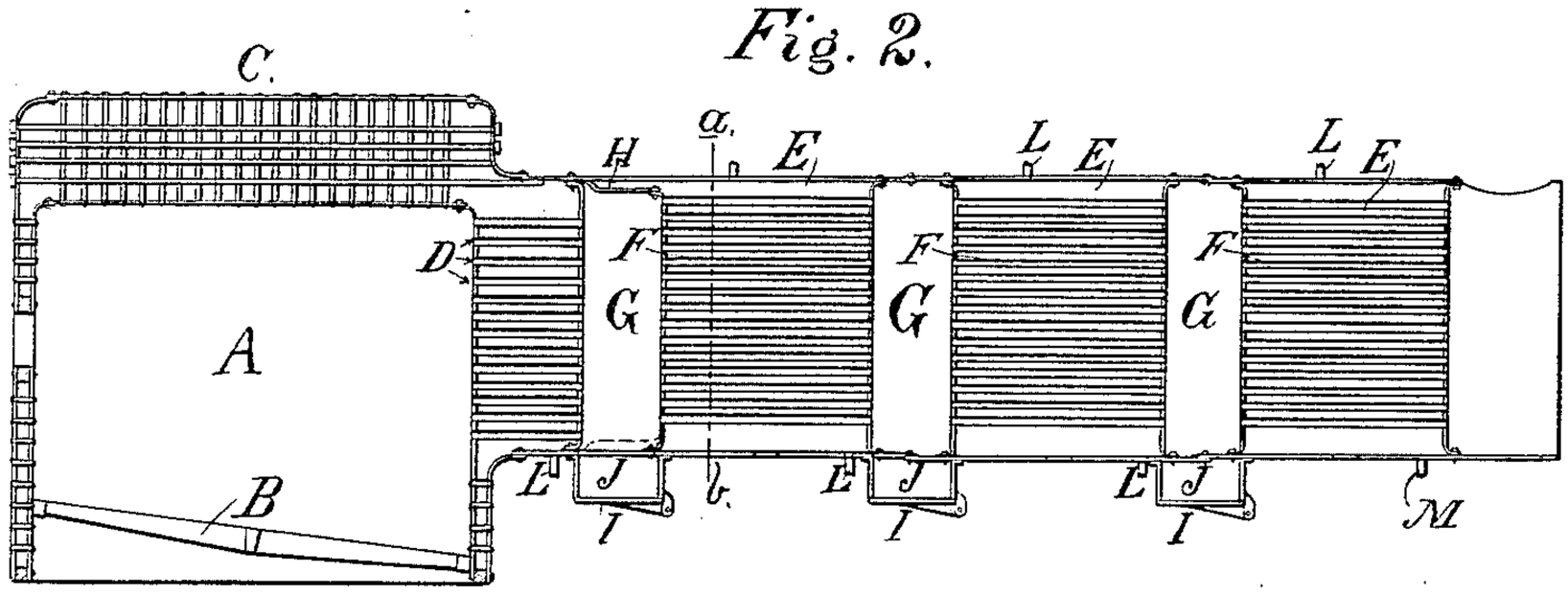


Fig. 3.

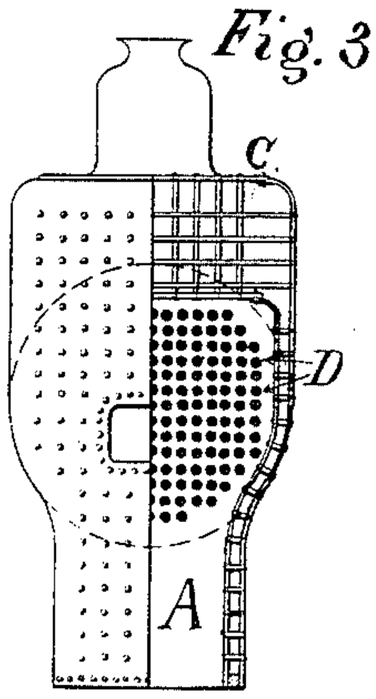
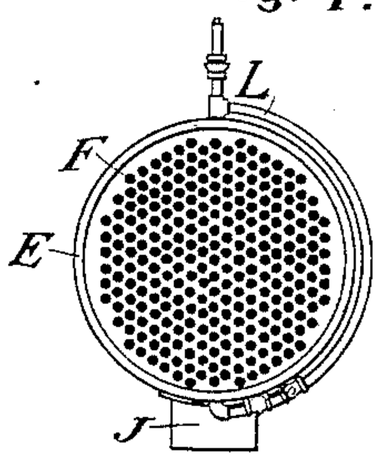


Fig. 4.



Witnesses,
Geo. H. Strong
J. B. Morse

Inventor,
John L. Heald
By Dewey & Co.
Attys

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 3 Sheets—Sheet 2.

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Fig. 5.

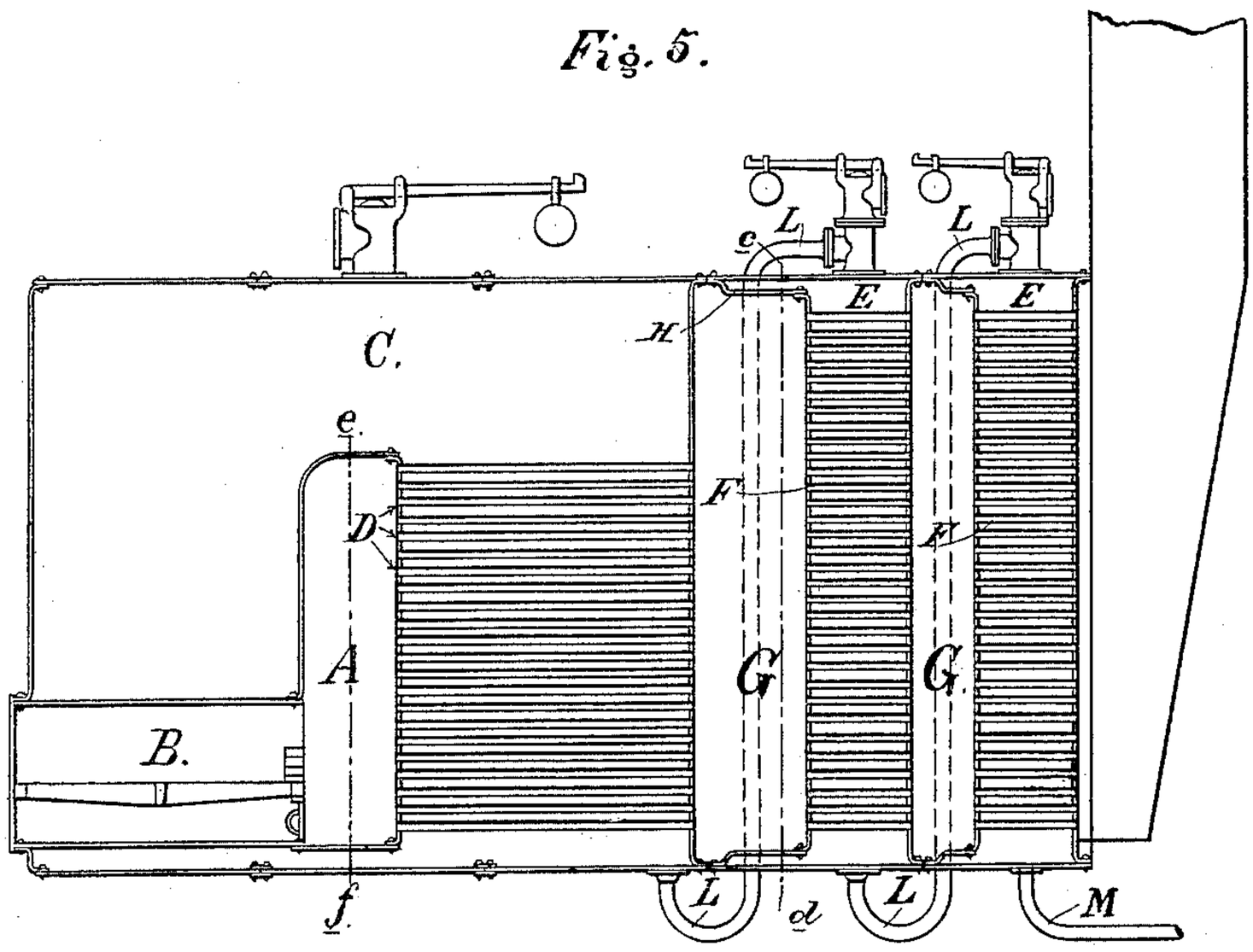


Fig. 6.

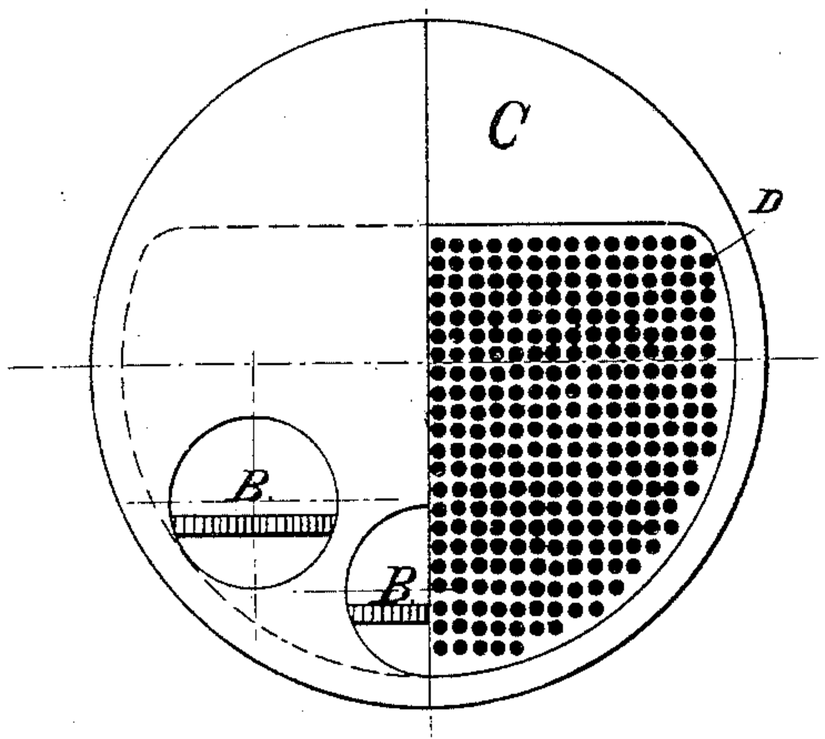
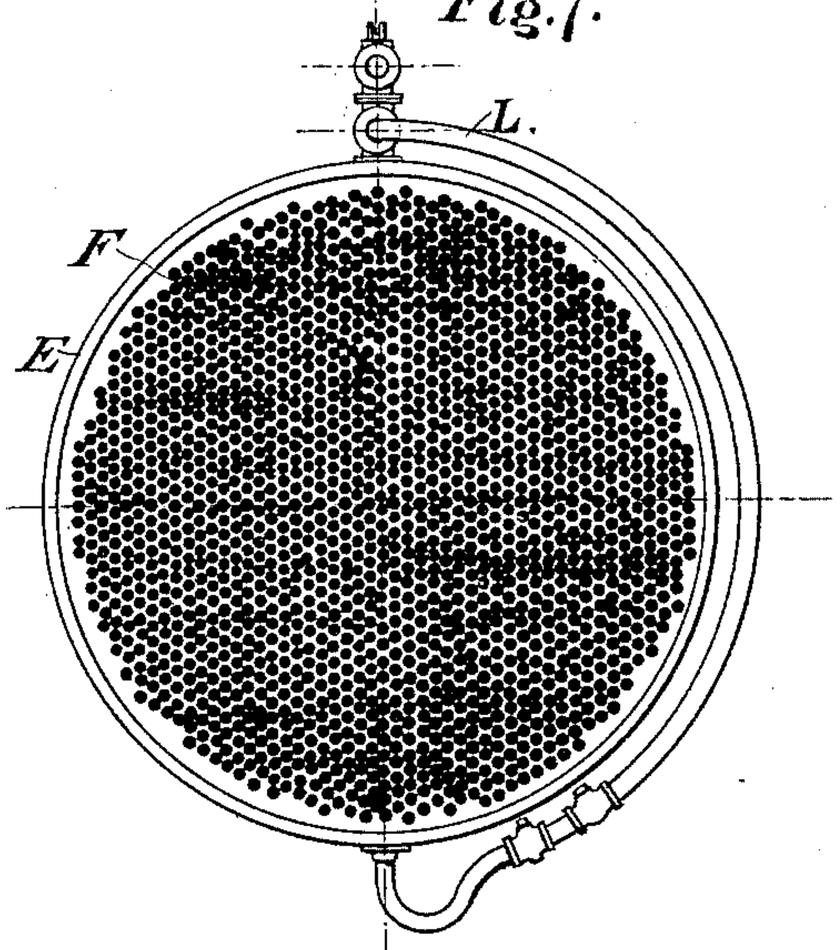


Fig. 7.



Witnesses,
Geo. H. Strong
J. B. Hurse

Inventor,
John L. Heald
By Dewey & Co.
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 3 Sheets—Sheet 3.

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Fig. 8.

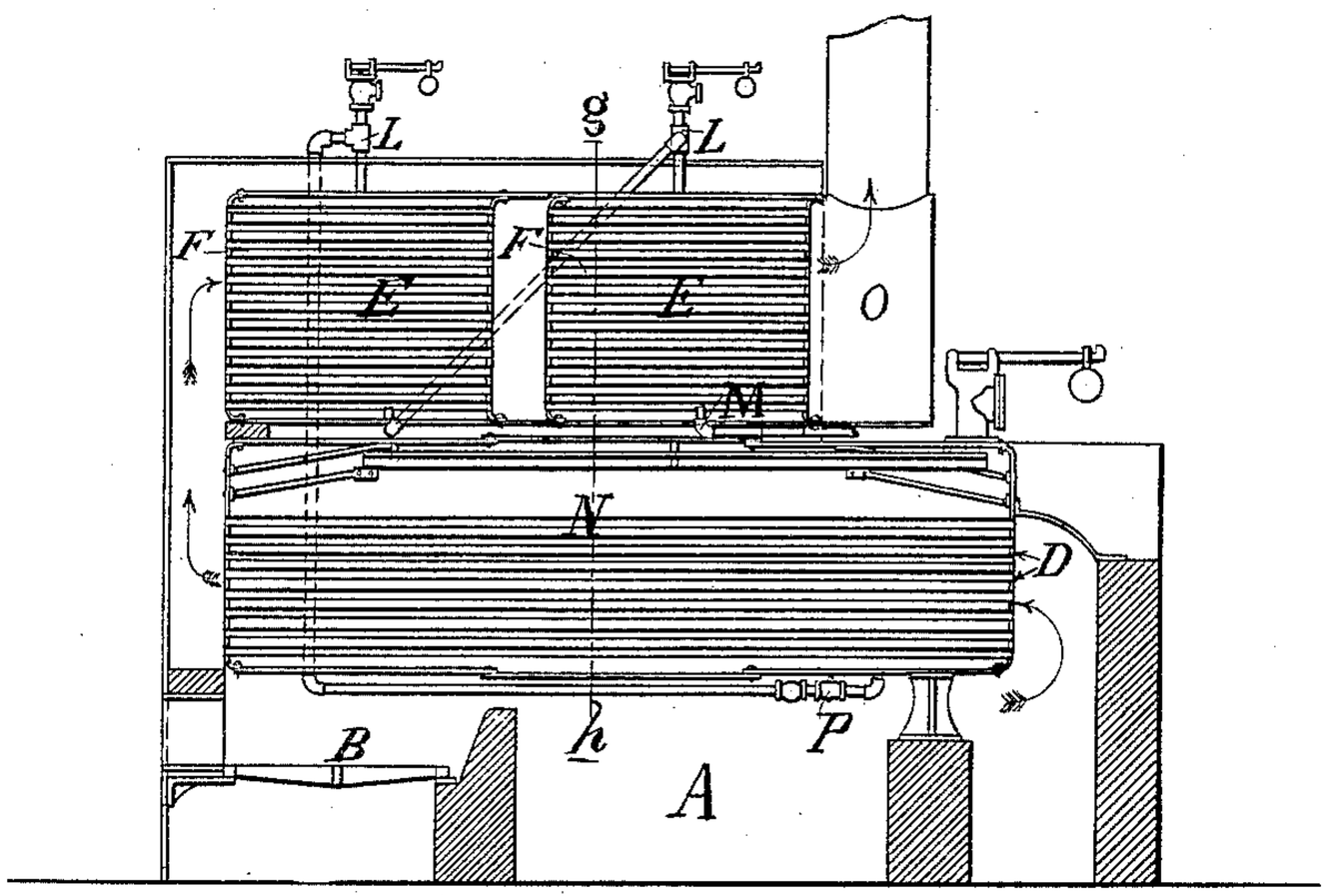
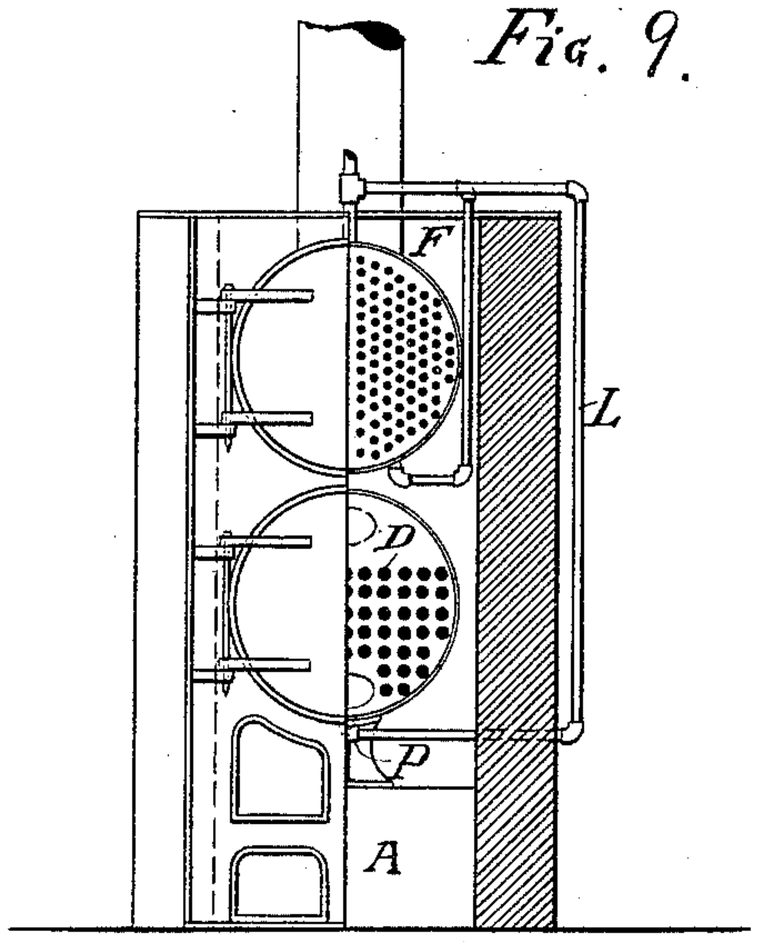


Fig. 9.



Witnesses,
Geo. H. Strong
[illegible]

Inventor,
John L. Heald
by Dewey & Co.
attys

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

JOHN L. HEALD, OF CROCKETT, CALIFORNIA, ASSIGNOR TO THE HEALD MANUFACTURING COMPANY, OF CALIFORNIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 424,646, dated April 1, 1890.

Application filed March 9, 1889. Serial No. 302,656. (No model.)

To all whom it may concern:

Be it known that I, JOHN L. HEALD, of Crockett, Contra Costa county, State of California, have invented an Improvement in Steam-Boilers; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to steam-boilers and steam-generating apparatus generally and a new method of dealing with the gases of combustion; also, the disposition of the water in such apparatus and methods of supplying and conveying the same.

It consists in the arrangement of steam-generating apparatus in sections, so as to more effectually utilize and apply the heat of fuel, in avoiding the danger of destructive explosion, and in securing an increased area of heating-surface within a given amount of enveloping-shell.

Referring to the accompanying drawings, showing the application of my invention to several kinds of steam-boilers, Figure 1 is a side elevation of a multitubular locomotive-boiler with an interior furnace, the boiler consisting of four sections arranged in accordance with my improved method. Fig. 2 is a longitudinal vertical section of the same. Fig. 3 is an end view, partially in section, of Fig. 1, showing the arrangement of the flues in the furnace-section. Fig. 4 is a transverse section on line *a b* of Figs. 1 and 2, showing the arrangement of flues in supplemental sections, also the pipes for conveying the feed-water from one section to another. Fig. 5 is a vertical longitudinal section through a marine boiler arranged in accordance with my improved methods. Fig. 6 is an end view of Fig. 5, partially in section on line *e f* of Fig. 5, showing the first series of flues, the position and relation of the furnaces, and also in dotted lines the first chamber behind the furnaces. Fig. 7 is a cross-section on line *c d* through Fig. 5, showing the arrangement of flues in the second and third sections. Fig. 8 is a vertical longitudinal section through a horizontal tubular boiler set in masonry having two supplementary sections; and Fig. 9 is an end view partially in section, showing the arrangement of the flues in the first and supplemental sections.

Similar letters of reference on the different figures indicate corresponding parts.

The object of my improvements in steam-boilers is to provide for a gradual reduction and absorption of the hot gases of combustion by opposing to them surfaces of varying temperature, so that the transmission of heat will continue as long as the temperature of the gases is high enough to produce useful effect.

In steam-boilers as commonly arranged there is nearly uniform temperature throughout all portions exposed to the heat, and as soon as the temperature of the boiler and that of the gases approximate each other, or when the gases of combustion have fallen to the maximum temperature of the boiler, the transfer of heat ceases and it is lost, the gases escaping at a high temperature and without having completed the useful effect of which they are still capable. The power of heat absorption being as the difference of temperature in the two cases, the transmission of heat is directly as this difference, and by allowing the temperature of the boiler to diminish with that of the gases (which is possible only by arranging a boiler in separate sections) the difference of temperature is maintained until the gases escape and all useful heat is absorbed.

In the present case I have shown my invention applied to three different types of steam-boilers. In Figs. 1 and 2 there is shown a horizontal tubular boiler of the locomotive type consisting of four sections. The first or main section contains a furnace A, the fire-grates B, and a steam-space at C. This steam-space is raised above the main shell of the boiler to permit a greater number of flues D in the first series leading out of the furnace A, and thus increasing the amount of heating-surface at this point, providing also more surface space for rising steam and to prevent foaming. This arrangement of the steam-space is not, however, essential in the application of my invention to boilers already constructed, no change being required in such cases except the addition of supplemental sections with their proper connections.

E E E are supplemental sections filled with water alone, and as no steam-space is

provided in these sections they are entirely filled with flues F, as shown in Fig. 4. The area available for flues is in this way greatly increased, and as large passages are not required between the flues for rising steam, and no incrustation to be guarded against, their number can be all the flue-sheets will contain, providing a greatly-increased amount of heating-surface in these sections, and at the same time reducing the velocity of the hot gases and intensifying their action on the heating-surfaces by reason of prolonged contact.

Between the several sections E E E are chambers G G G, the purpose of which is to baffle and redistribute the hot gases at each chamber by change of course, a change of area in the flues and ducts, altering their velocity, and by the gases impinging against the flue-sheets. These chambers are in the present example formed by a continuation of the outer shell, as shown; but in case the temperature demands these chambers can be surrounded with an annular water-space, as shown at H, between the two first sections. The connection between the sections may be formed by a continuation of the main shell in the case of a traction or locomotive boiler, as shown in Figs. 1 and 2, or may be temporary and detachable for stationary boilers, so as to permit access to the flue-sheets or other internal parts. For stationary boilers these sections need not be placed with their ends opposite and in a horizontal position, as shown in the drawings, but may be superimposed one above another to form a vertical boiler, or placed side by side, the gases of combustion being conveyed by suitable conductors from one to the other.

In Figs. 1 and 2 the chambers G G G are made large enough to permit access through the hinged doors I I I for inspection or repairing the flues or flue-sheets. The chambers J J J are arranged to catch and contain cinders, ashes, or other unburned matter passing through the flues, the doors I I I permitting the removal of such collected material whenever necessary.

The different sections are connected by the pipes L L L, extending from the top of the last section to the bottom of the next, and so on in the same manner until the first or main section is reached, so that the feed-water forced in at the pipe M in the last section will pass from one to the other, its temperature rising in each until the first or furnace section is reached and there be expanded into steam, either by the superior heat of this section or by latent heat absorbed in its passage through the supplemental sections E E E. The pipes L L L are connected from top to bottom of the several sections in the manner shown to accommodate the tendency of the water to rise as its temperature increases. These water-connections may, however, be arranged in any manner that will permit the overflow to pass out at the top and thus keep the supplemental sections E E E filled with water.

Referring now to Figs. 5, 6, and 7, these show a marine boiler arranged in sections and operating on the same principle as the one already described.

The letters of reference indicate corresponding parts.

Fig. 5 is a vertical longitudinal section showing the internal construction and arrangement of a marine boiler consisting of three sections. The furnaces B are cylindrical in section, and the combustion-chamber A separate, as shown. The flues shown in Fig. 7 can be of any suitable size and fill the whole available space, thus increasing the area of heating-surface to nearly double what is attainable if the sections E required a steam-space at the top, as in the first section.

The course of the feed-water and other details corresponding to the boiler previously described, no further description is necessary.

In Figs. 8 and 9 the boiler shown is of the plain horizontal tubular kind set in masonry and arranged with two supplementary sections E E superimposed on the main or first section N. The gases of combustion pass to the rear under N, returning in the flues D, and then upward and through E E, as indicated by the arrows in Fig. 8, passing into the chimney at O. The feed-water is forced in at M and follows the connecting-pipes from section to section, and is delivered to the first or main one at P. The arrangement can of course be varied to conform to various kinds of horizontal boilers. The sections E E can be placed vertically or in any position with reference to the main section, so that the hot gases will pass through them.

Referring to the various drawings of boilers and descriptions of the same that have preceded, it will be apparent that an increased effect is obtained by the chambers G breaking up and redistributing the flames and hot gases of combustion. This is performed by the change of area in the flues and ducts and consequent velocity of the gases, by their impinging against the flue-sheets, by a change of alignment in the flues, or by the introduction of extra baffling-plates, any or all of these agencies being employed, as may be required in different cases, so that every portion of the hot gases will come in contact with the heating-surfaces.

In straight or continuous flues only an outer film of the hot gases comes in contact with the flue-surfaces, the central part remaining a neutral core, passing from the furnace to the chimney without coming in contact with the heating-surfaces or giving up its heat. In this way can be explained the superior effect of flame when it is broken up by impinging against surfaces at a right angle to its course, and one object of my invention is to provide in the walls of the chamber G a large amount of such surface.

By arranging steam-boilers according to my invention—in separate sections—the temperature rising in each as the furnace is ap-

proached, there is an adaptation of the increasing temperature of the water to a like increasing temperature of the gases, maintaining at each stage a difference between the two and permitting a transfer of heat not possible in a common boiler having a uniform or nearly uniform temperature throughout. The conditions permitting heat absorption are totally different in the two cases.

Another object attained by my invention is the precipitation in the supplemental sections E E of mineral matter held in solution in the feed-water by the system of progressive heating in these sections. The precipitation of such matter takes place at from 200° to 300° of temperature, and consequently is all deposited in the supplementary sections under a modified temperature in the form of silt of soft material before it reaches the higher temperature of the first or furnace section, which is in this way completely protected from incrustation.

No free steam being made in the supplemental sections E, they being filled with water only and not subject to elastic pressure, there is no danger of destructive explosion in these sections, and, if desired, they can be made of thinner material than is required for sustaining an equal elastic steam pressure, thus saving in the cost of construction and facilitating the passage of heat by reason of the thinner plates and flues.

The arrangement of steam-boilers and the method of their operation embodied in my improvements and shown in examples hereinbefore described is not confined to particular types of boilers and steam-generating apparatus, but is applicable to any case where a division into sections is possible, whether the water is contained in or surrounds the tubes or whether a boiler contains a furnace or be set in masonry, such modifications being apparent and understood without further description here.

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

In a steam-boiler, a section containing a furnace, flues, and a steam-space, supplemental sections having flues passing through them, intermediate baffling-chambers between the sections through which the products of combustion pass, a feed-pipe delivering water into the bottom of the section farthest from the furnace-section, and exterior pipes through which water is forced from the top of each section into the bottom of the next adjacent section toward the furnace-section, substantially as described.

In witness whereof I have hereunto set my hand.

JOHN L. HEALD.

Witnesses:
S. H. NOURSE,
H. C. LEE.