

(No Model.)

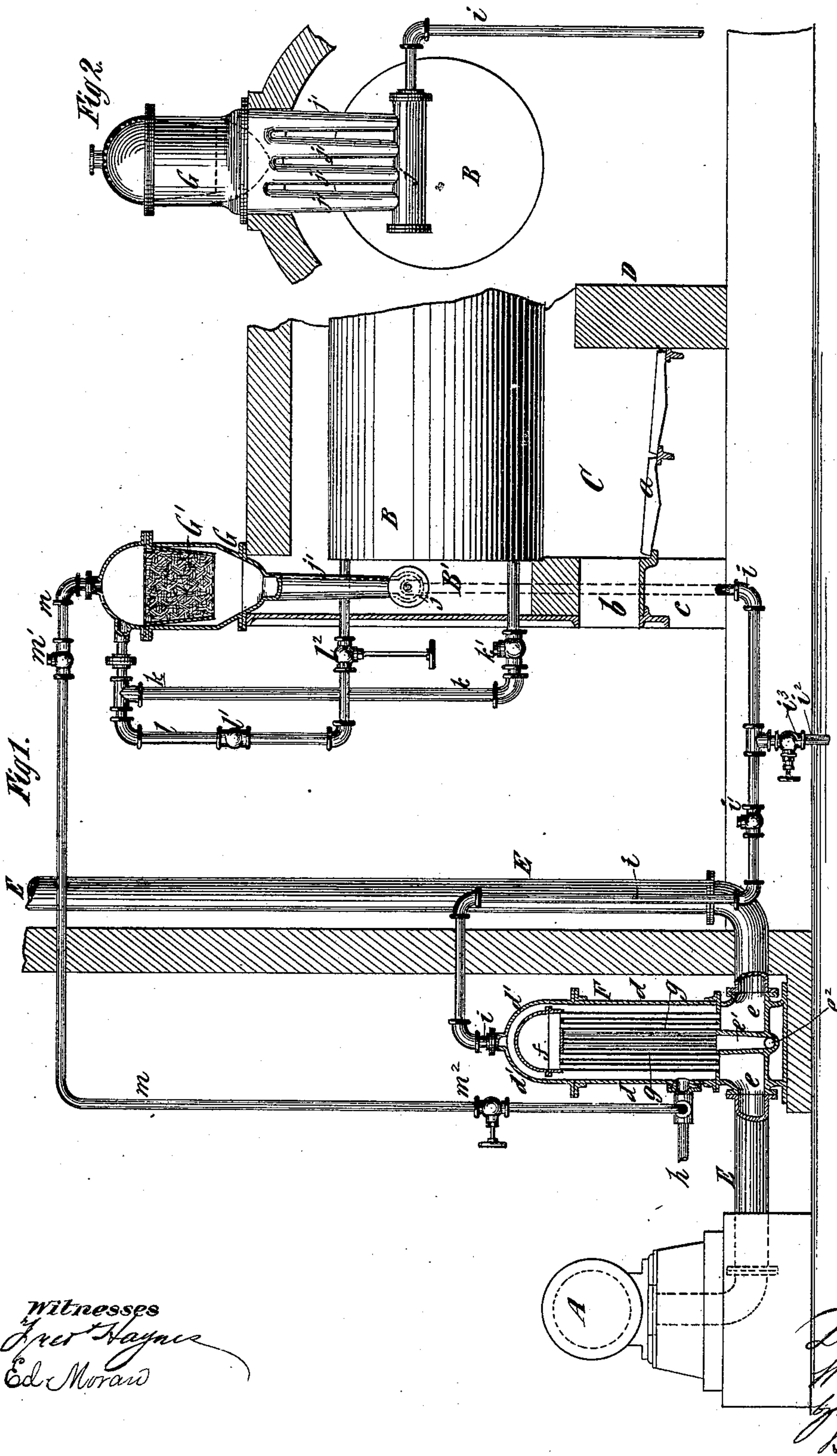
2 Sheets--Sheet 1.

D. KELLY & W. H. HOFFMAN.

FEED WATER HEATER AND PURIFIER FOR STEAM BOILERS.

No. 251,243.

Patented Dec. 20, 1881.



Witnesses
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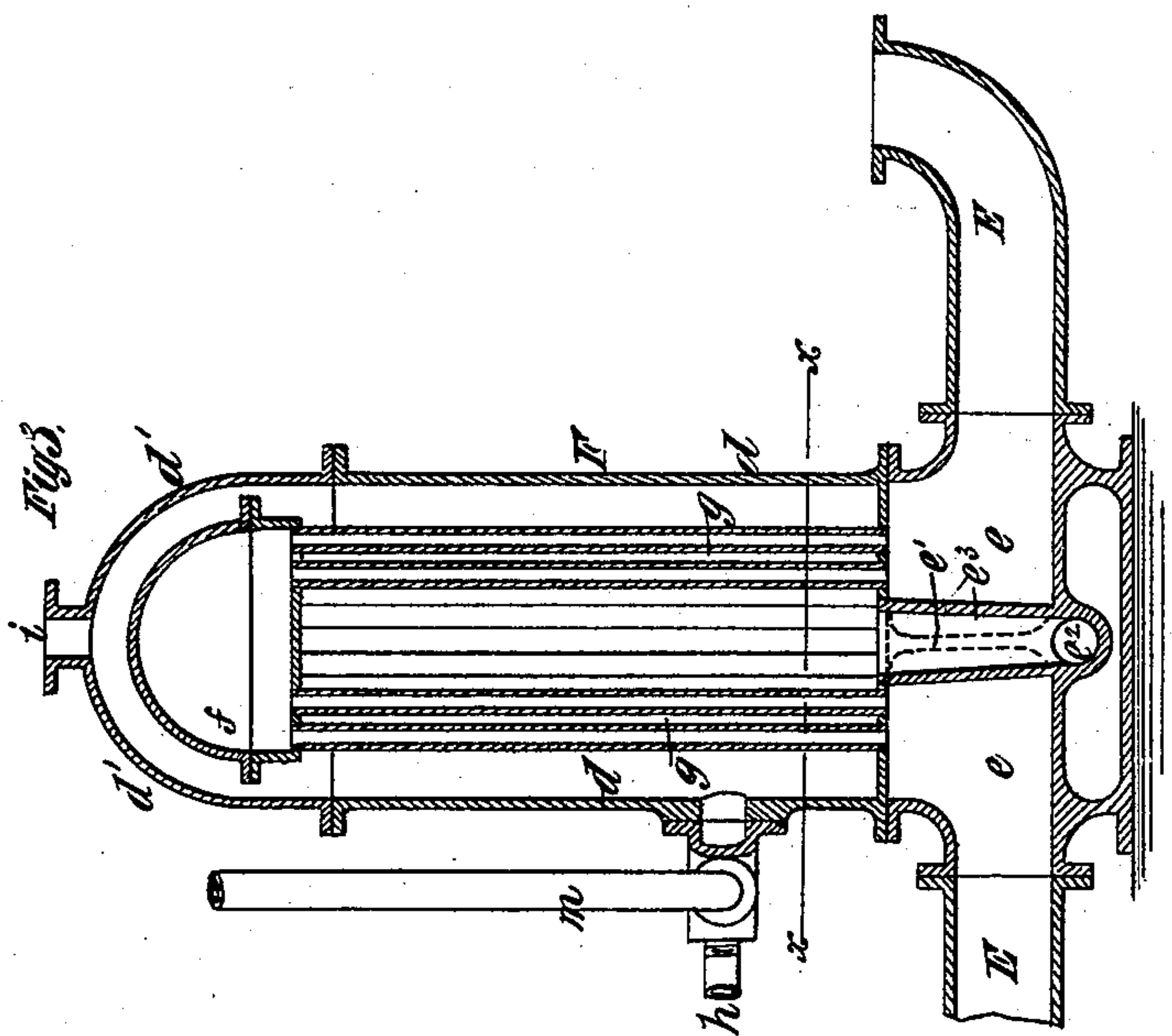
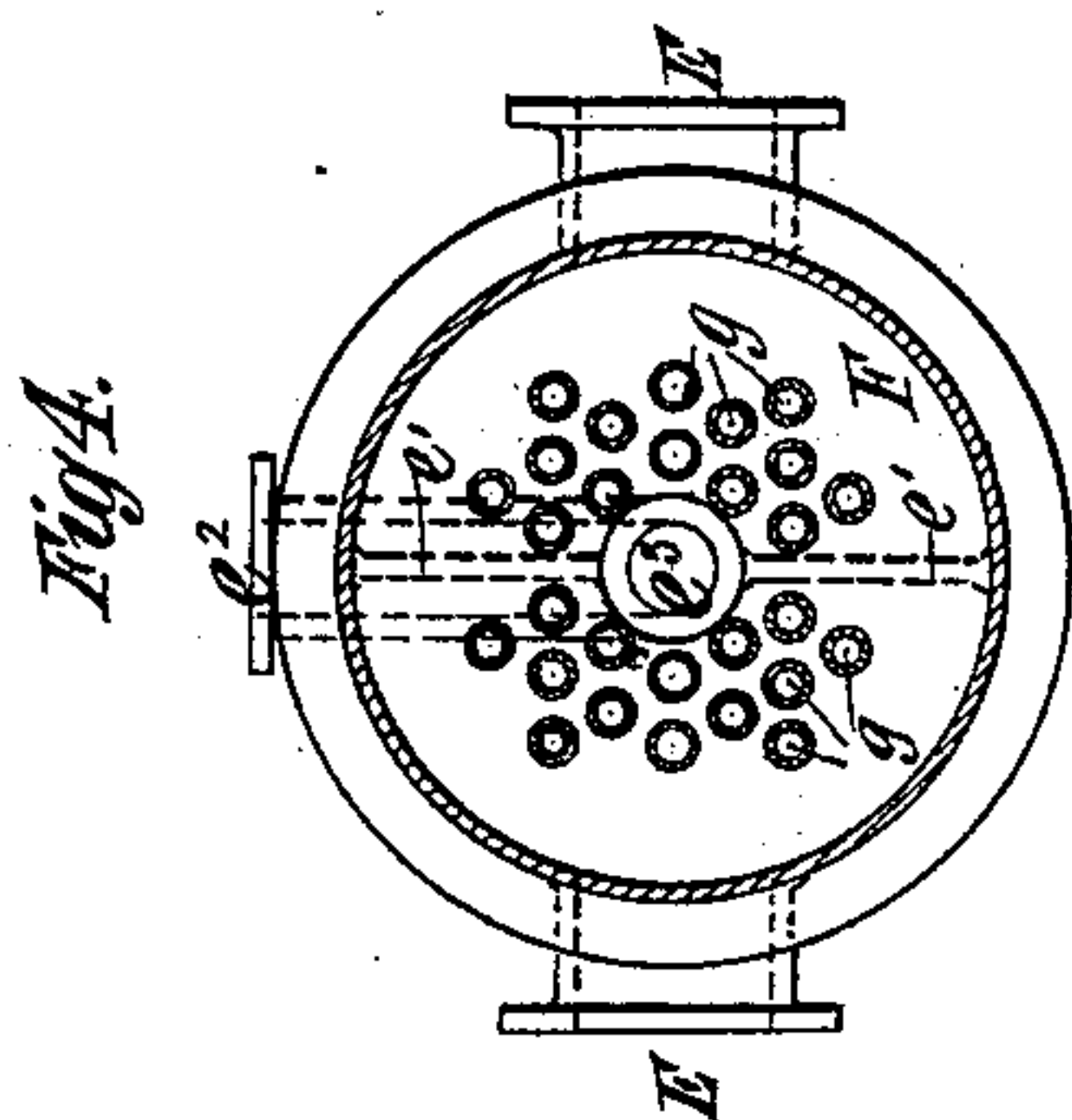
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Witnesses

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UNITED STATES PATENT OFFICE.

DANIEL KELLY, OF PHILADELPHIA, PENNSYLVANIA, AND WILLIAM H. HOFFMAN, OF PASSAIC, NEW JERSEY, ASSIGNORS OF ONE-THIRD TO WALTER K. LUDWIG, OF PHILADELPHIA, PENNSYLVANIA.

FEED-WATER HEATER AND PURIFIER FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 251,243, dated December 20, 1881.

Application filed October 6, 1881. (No model.)

To all whom it may concern:

Be it known that we, DANIEL KELLY, of the city and county of Philadelphia, in the State of Pennsylvania, and WILLIAM H. HOFFMAN, of the city and county of Passaic, in the State of New Jersey, have invented certain new and useful Improvements in Feed-Water Heaters and Purifiers for Steam-Boilers, of which the following is a specification.

10 The principal object of our invention is to enable the feed-water for a steam-boiler employed for supplying steam to a steam-engine to be heated to as high a degree as possible by the exhaust steam from the engine, and then
15 still further heated by the waste gases, smoke, and heated products of combustion escaping from the boiler-furnace; but certain features of the invention are applicable to steam-boilers which are employed for heating and various purposes other than supplying steam to
20 steam-engines.

Another object of the invention is to free the feed-water as far as possible from all solid matters and impurities before it enters the
25 boiler.

The invention consists in the combination, with a steam-boiler, of what we term a "precipitator," through which the feed-water is passed, and which is arranged in the front
30 breeching or other part of the flue or flues through which the products of combustion escape from the boiler-furnace to the chimney, whereby the feed-water is heated by the waste products of combustion before it enters the
35 boiler, and a filter arranged in proximity to the boiler or outside the boiler-setting, and through which the feed-water is forced in passing from the precipitator to the boiler. Where the steam-boiler is employed for supplying
40 steam to a steam-engine we combine with the above-described precipitator and filter an exhaust-steam feed-water heater, through which the feed-water passes, and wherein it is partially heated before it enters the precipi-
45 tator; and our invention also consists in the combination, with an engine and boiler, of an exhaust-steam feed-water heater and a precipitator and filter arranged as above described.

The invention also consists in the combina-

tion, with the above-described exhaust-steam
50 feed water heater, precipitator, and filter, of a novel arrangement of pipes and valves, hereinafter specifically described, whereby provision is afforded for blowing off the precipitator and filter and also the exhaust-steam feed-wa-
55 ter heater.

The invention also consists in novel details of construction to be hereinafter described.

In the accompanying drawings, Figure 1 represents an elevation, partly in section, of our
60 improved apparatus applied to a steam engine and boiler. Fig. 2 represents a front elevation of the precipitator, filter, and boiler. Fig. 3 represents a vertical section of the heater upon a larger scale than Fig. 1; and Fig. 4 represents a transverse section on the dotted line
65 *x x*, Fig. 3, and on the same scale.

Similar letters of reference designate corresponding parts in all the figures.

A designates a steam engine, and B designates a portion of a steam-boiler for supplying
70 steam thereto, here shown as of the return tubular type. The boiler is represented as set in brick-work in the usual way, and beneath it is the furnace C, provided with the usual
75 grate, *a*, and fire and ash-pit doors *b* and *c*. From the furnace the products of combustion escape over the bridge-wall D to the rear of the boiler. From the rear they return through
80 the tubes (not here shown) into the breeching B' at the front of the boiler, and finally pass rearward over the top of the boiler to the chimney. In lieu of this arrangement of breeching,
85 flues, &c., the passages or flues for the products of combustion might be of any suitable character and arrangement to suit the construction of boiler to which our invention is applied.

E designates the exhaust-pipe of the engine A, by which the exhaust-steam is conducted
90 to and through a feed-water heater, F, and thence upward to the atmosphere.

The feed-water heater F may be of any suitable construction, but as here represented is composed of an outer shell or casing, *d*, a lower
95 steam-chamber, *e*, divided by a transverse bridge, *e'*, an upper steam chamber or dome, *f*, and tubes *g*, connecting said lower steam-

chamber, *e*, and said upper steam chamber or dome *f*.

The pipe *E* delivers the exhaust-steam into the lower steam chamber, *e*, upon one side of the bridge *e'*, and from thence the steam passes upward through certain of the tubes *g* to the steam-dome *f*, and thence downward through other tubes *g* to the steam-chamber *e* upon the opposite side of the bridge *e'*, from whence it escapes through the pipe *E* into the atmosphere.

The feed water is supplied to the outer shell or casing, *d*, of the heater *F* by a pipe, *h*, and after circulating around the steam-tubes *g* passes out at the top of the heater through a pipe, *i*. The upper portion of the casing or shell *d* consists of a removable dome or head, *d'*, and the upper steam chamber, *f*, likewise has a removable dome shaped head; and it will therefore be seen that by removing the dome or head *d'* and the dome shaped head of the steam-chamber *f* provision is afforded for inserting a swab down through the tubes *g* and thoroughly cleaning them out.

Multitubular feed-water heaters frequently have U-shaped tubes bent so as to make return-passages; but such tubes are liable to crack in bending, and cannot be readily swabbed out, as can our straight tubes.

The bridge *e'* is shown in dotted lines in Figs. 3 and 4, and in it is formed a conduit or passage, *e³*, which opens at the upper end into the feed-water space of the heater, and is provided with a blow-off pipe, *e²*, at the lower end, through which the heater can be blown off, as herein-after described.

In the pipe *i* is a check-valve, *i'*, opening from the heater; and *i²* designates a blow-off pipe leading from the pipe *i* and provided with a valve, *i³*. The pipe *i* conveys the feed-water from the heater *F*, wherein it is heated as much as possible by the exhaust-steam, to a precipitator arranged in the front breeching, *B'*, of the boiler, and here represented as composed of a horizontal head or chamber, *j*, and a number of upright tubes or legs, *j'*, which communicate at their upper ends with the shell or body *G* of a filter, arranged above the boiler and exposed to the atmosphere.

The precipitator may be constructed in any other suitable manner, and, instead of being arranged in the front breeching, *B'*, may be arranged in any other of the passages or flues through which the heated products of combustion pass. The precipitator being arranged where the heated products of combustion may circulate around it, the water passing through it becomes very highly heated—say to a temperature of four hundred degrees, (400°,) if the waste products of combustion are of that temperature; and hence when the feed-water enters the boiler it is heated to a temperature at which it will generate steam.

The feed-water pipe communicates with one end of the head or chamber *j*, as seen in Fig. 2, and as there is no current through the precipitator, or, at most, a very sluggish current,

the sediment and all solid matters are precipitated and deposited in the head or chamber *j*, which may be cleaned by removing one of its heads.

In the filter shell or body is arranged a filter-pot or filter proper, *G'*, through which the water, after leaving the precipitator, is forced upward; and *k* designates a pipe through which the highly-heated feed-water enters the boiler, under control of a check-valve, *k'*, opening toward the boiler.

The upper part or steam-space of the boiler *B* is connected with the upper part of the filter by means of a blow-off pipe, *l*, in which is a check-valve, *l'*, opening from the boiler and toward the filter, and a stop-valve, *l²*, for controlling the passage of steam from the boiler through the pipe *l*.

When it is desired to blow through the filter and precipitator, the valve *i³* in the blow-off pipe *i²* is opened and the valve *l²* in the blow-off pipe *l* is also opened, whereupon the contents of the precipitator and filter are blown backward through the pipe *i*, and as the course of the water is stopped by the check-valve *i'* the water, with the impurities and solid matters held in suspension, is forced out through the blow-off pipe *i²*.

The top of the filter shell or body *G* is connected by a pipe, *m*, with the feed water pipe *h*, and in said pipe *m* is a check-valve, *m'*, opening from the filter and the stop-valve *m²*.

Where the boiler to which our improved apparatus is applied is employed for supplying steam to an engine, grease or other matters which will float may be carried into the feed-water up through the filter *G* *G'*; and in order to discharge such floating matters the valve *l²* in the blow-off pipe *l* and the valve *m²* may be opened, while the valve *i³* in the blow-off pipe *i²* is closed, whereupon the water and all floating matters in the filter shell or body *G* above the filter proper, *G'*, will be blown off through the pipe *m*, and thence through the heater *F*, and out through the conduit or passage *e³* and blow-off pipe *e²* in the bottom thereof.

Where the boiler to which our apparatus is applied is used for heating, or for some other purpose than supplying a steam-engine with steam, the feed-water heater would not be employed and the pipe *m* would be dispensed with; but the filter and precipitator would be arranged as here shown and described.

It will be seen that by our invention we provide a very effective feed-water-heating apparatus, whereby the feed-water is heated to a high temperature before entering the boiler by heat that would otherwise be wasted, and which is so constructed that the several parts may be readily blown out and kept clean.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The combination, with a steam-boiler, of a precipitator arranged in the breeching or in a passage or flue for the products of combustion, a feed-pipe connected therewith, and a fil-

ter arranged external to said breeching, passage, or flue, and adapted to receive water from said precipitator, substantially as specified.

2. The combination, with the boiler B, of the
5 precipitator arranged in the breeching B', and composed of the head *j* and one or more upright tubes or legs, *j'*, and the filter G G', substantially as specified.

3. The combination, with a steam engine and
10 boiler, of an exhaust steam feed-water heater, a precipitator arranged in the breeching of the boiler or in a passage or flue for the products of combustion, a pipe for conducting water from said heater to said precipitator, and
15 a filter arranged external to said breeching, passage, or flue, and adapted to receive water from said precipitator, substantially as specified.

4. The combination, with a steam boiler, of
20 a precipitator arranged in the breeching or in a passage or flue for the products of combustion, a pipe for feeding water into said precipitator, provided with a blow-off, a filter arranged external to said breeching, passage, or

flue, and communicating with said precipita- 25
tor, and a blow-off pipe leading from the boiler to the filter, whereby, when the blow-off in the feed-pipe is open, steam may be admitted to the filter to blow out the contents of the filter and precipitator through the said blow-off in 30
the feed-pipe, substantially as specified.

5. The combination, with the engine and boiler, the feed-water heater, filter, and precipitator, arranged substantially as specified, of the pipe *i*, with the valves *i'* *i*³ and blow-off 35
*i*², the pipe *k*, with the valve *k'*, the pipe *l*, with its valves *l'* *l*², and the pipe *m*, with its valves *m'* *m*², as and for the purpose herein described.

6. The combination, in an exhaust-steam feed water heater, of the shell or casing *d d'*, 40
the lower steam-chamber, *e*, the upper steam-chamber, *f*, having a removable head, and the straight tubes *g*, all substantially as specified.

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