(No Model.) 4 Sheets—Sheet 1.

J. KLEIN.

LIQUID COOLER.

No. 444,558. Patented Jan. 13, 1891.

Fig. 1.

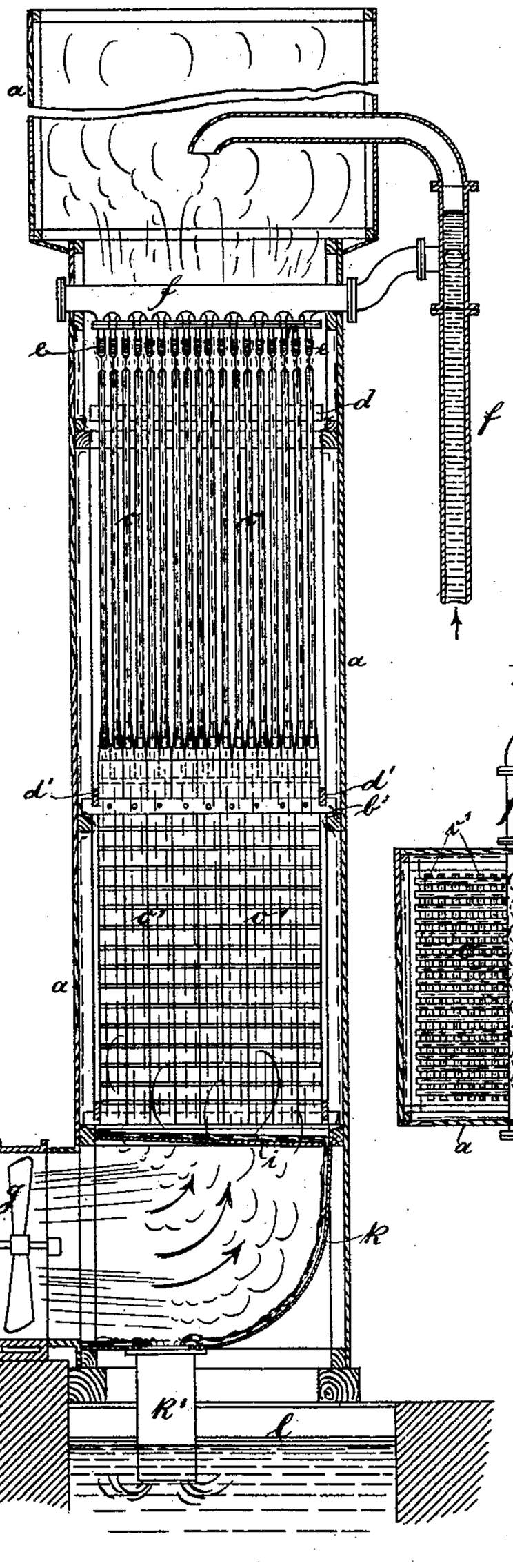


Fig. 3.

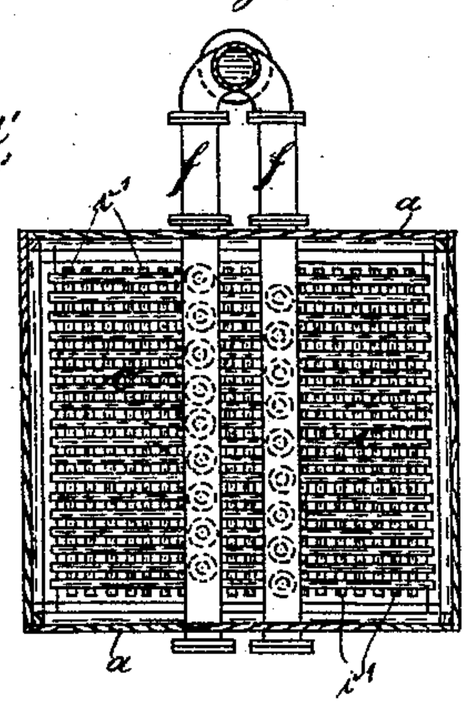
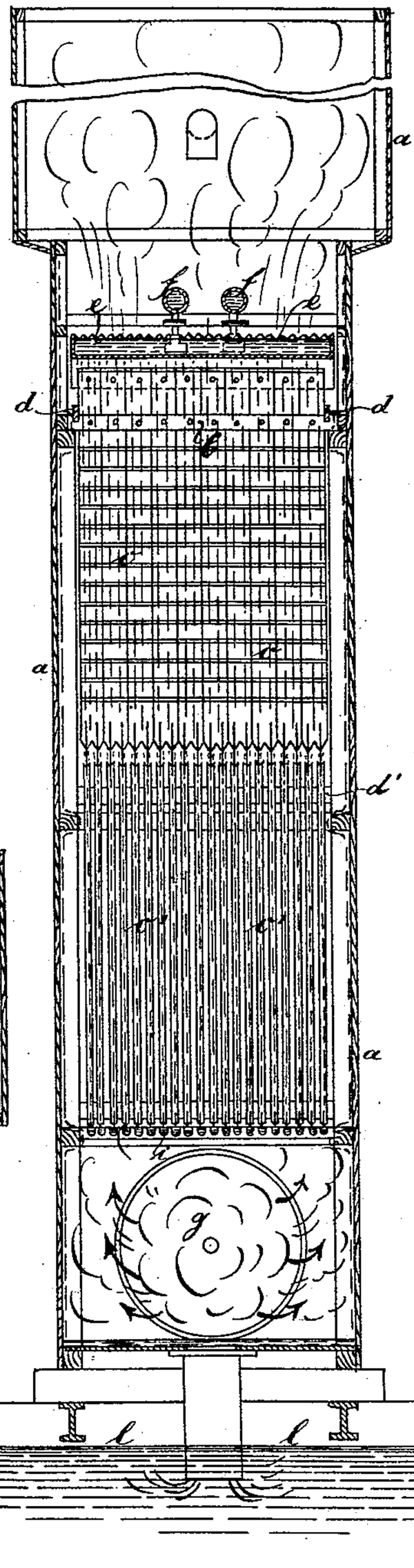


Fig. 2.



Witnesses.
Gustav A. Dittman
S. Brashears Jr.

Inventor
Johann Klein
by Wm. H. Babcock
Attorney

(No Model.)

4 Sheets—Sheet 2.

J. KLEIN.

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Fig. 4.

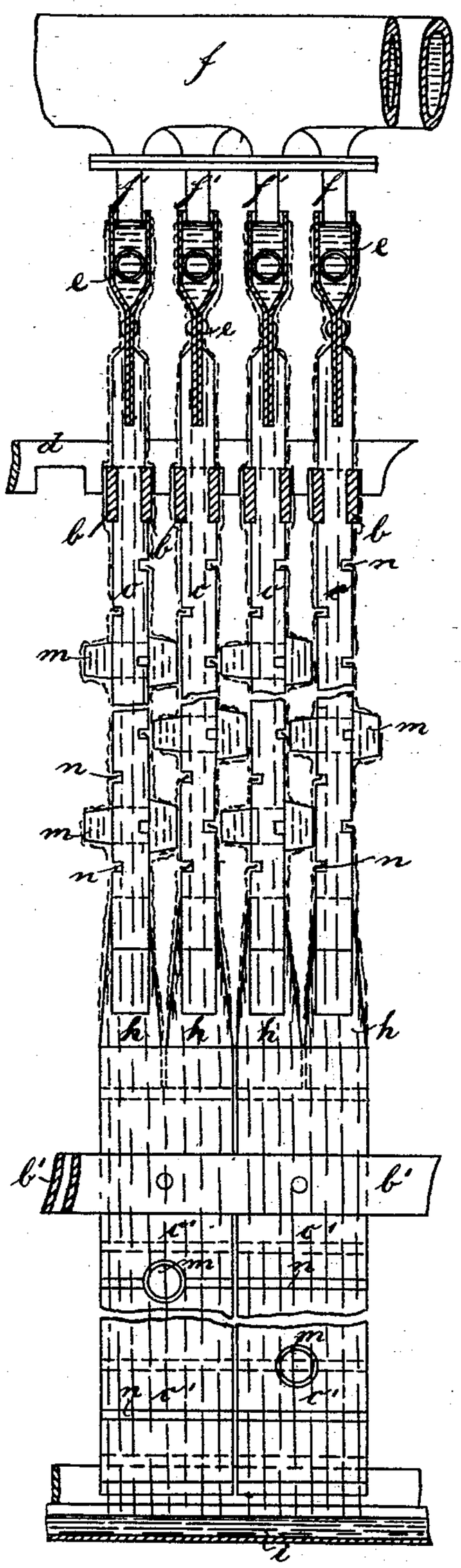
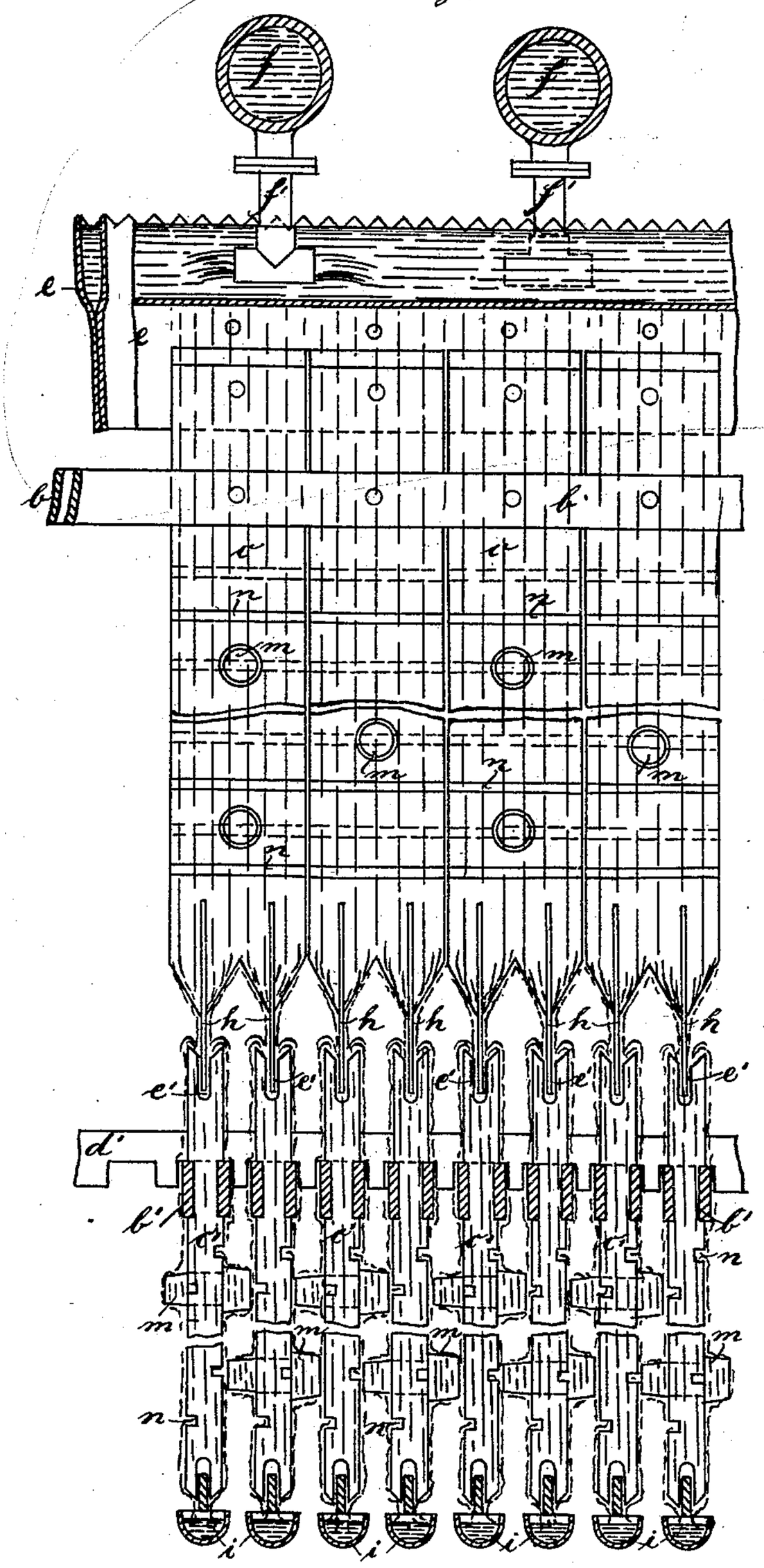


Fig. 5.



Witnesses.
Gustav A. Pitkin.
S. Brashear Jr.

Inventor
Johann Klein
by Wm H. Babcock
Attorney

(No Model.) 4 Sheets—Sheet 3.

J. KLEIN.

LIQUID COOLER.

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Fig 6

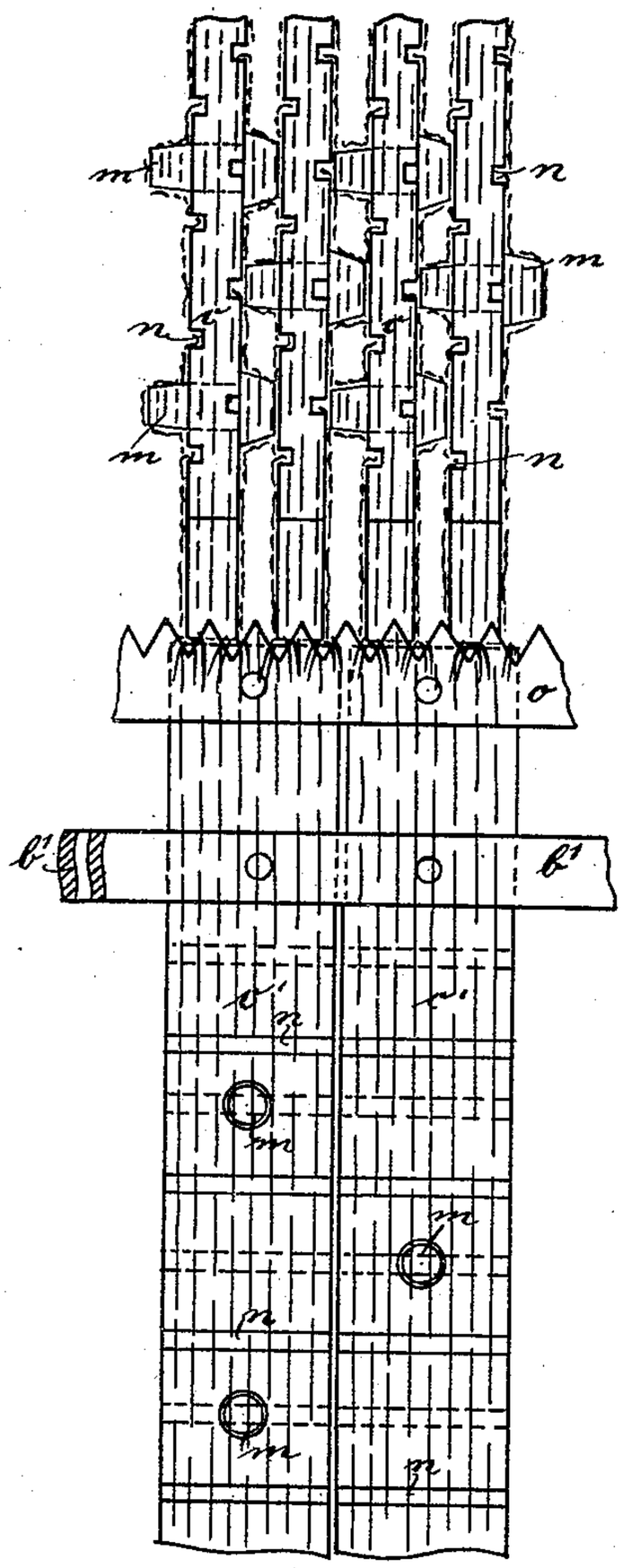
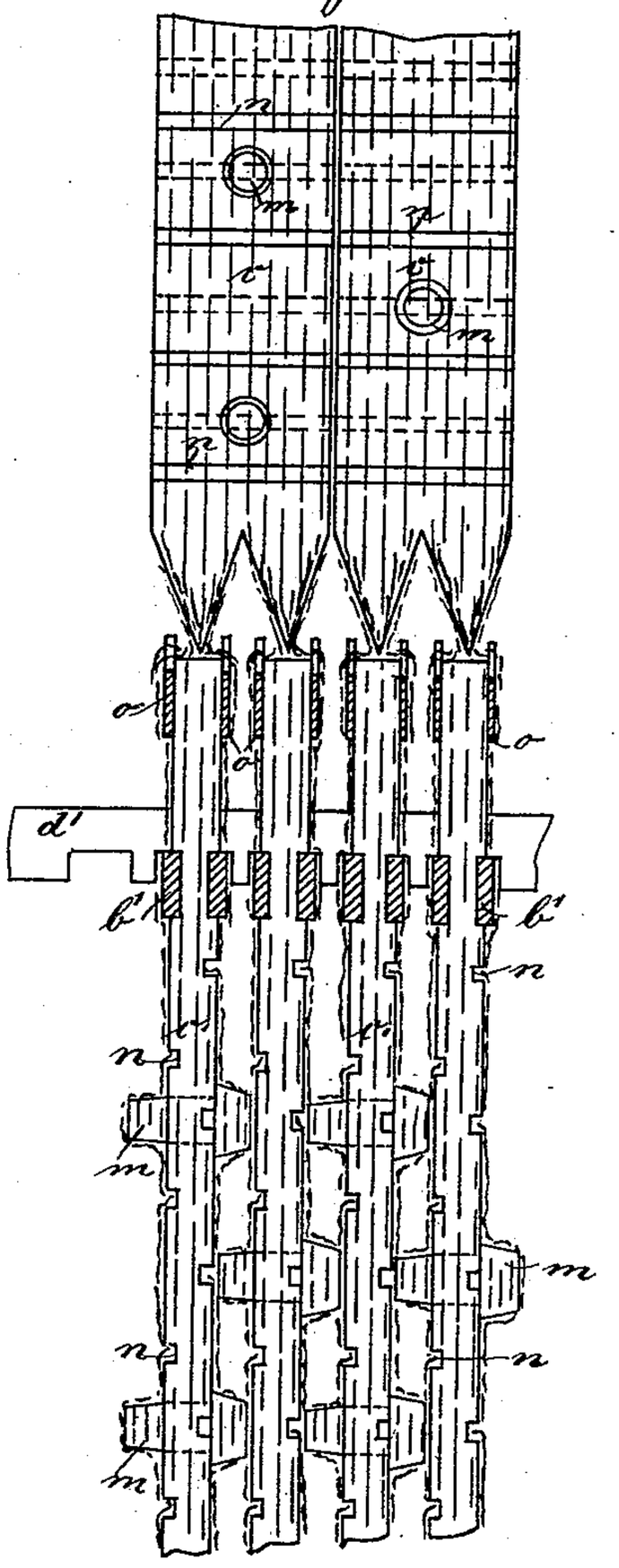


Fig 7.



Witnesses
Gustav A. Littman
S. Brashears Jr

Inventor
Johann Klein
by Wm H Babcock
Attorney

(No Model.) 4 Sheets—Sheet 4.

J. KLEIN.

LIQUID COOLER.

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Fig 8

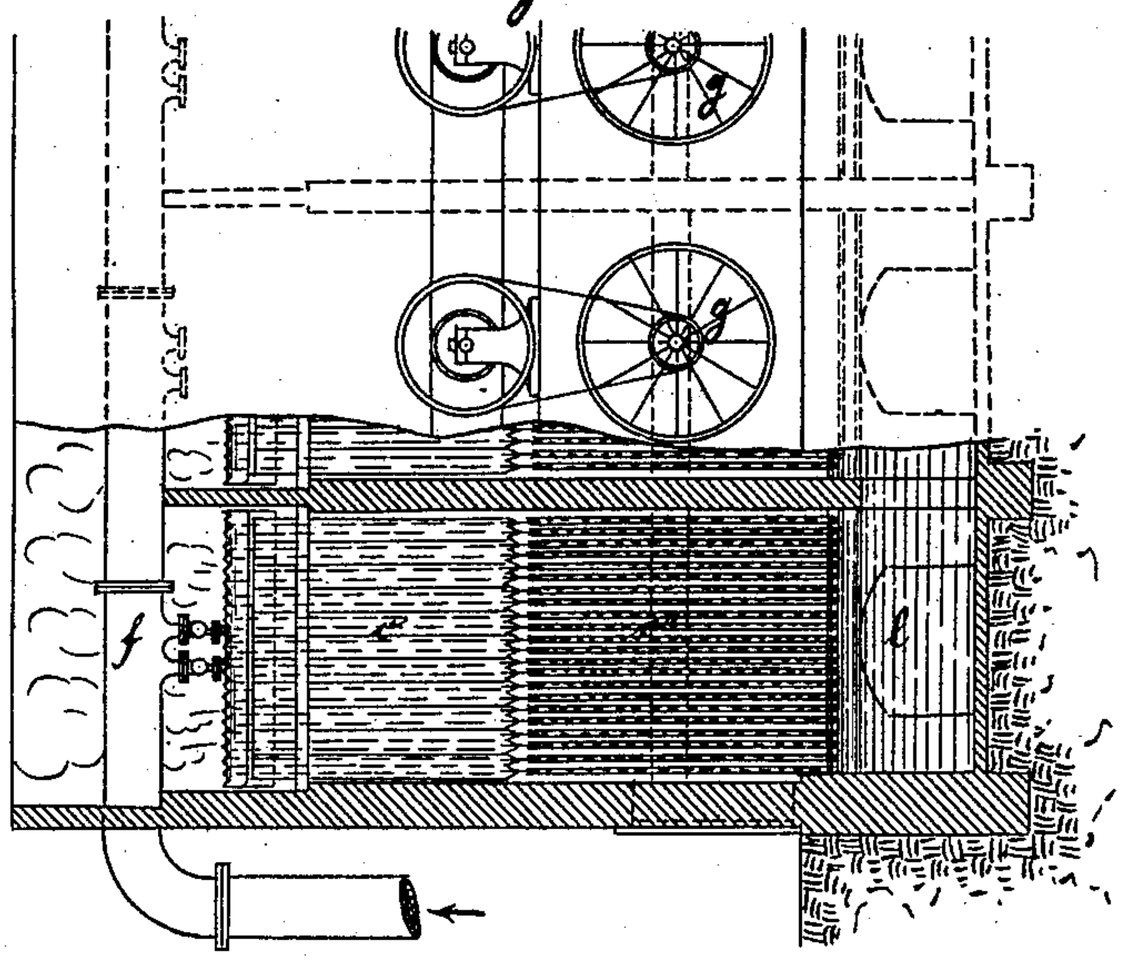
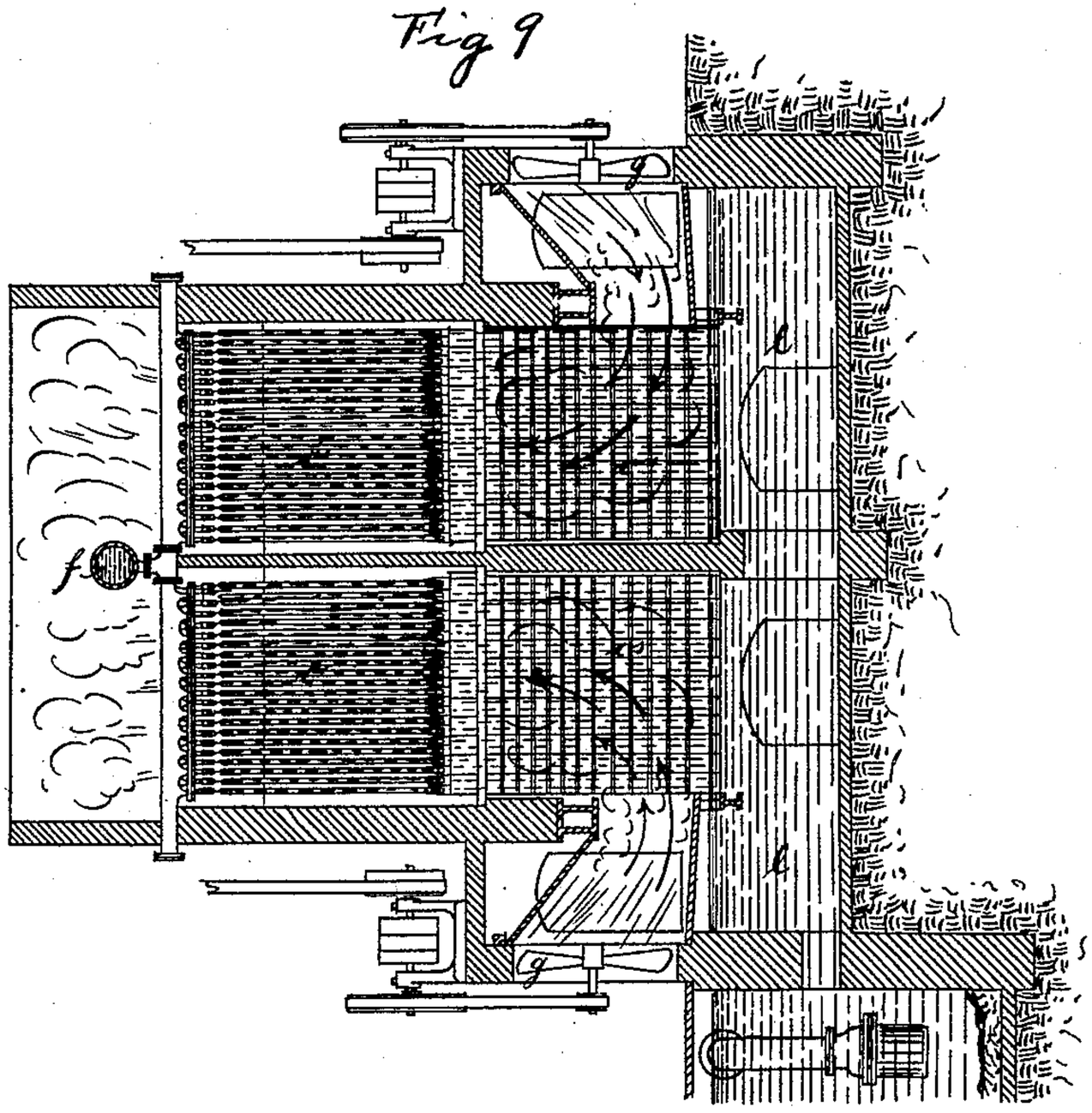


Fig 9



Witnesses.
Gustav A. Littmar.
S. Brashears Jr.

Inventor
Johann Klein
by Wm H Babcock
Attorney

UNITED STATES PATENT OFFICE.

JOHANN KLEIN, OF FRANKENTHAL, GERMANY.

LIQUID-COOLER.

SPECIFICATION forming part of Letters Patent No. 444,558, dated January 13, 1891.

Application filed July 17, 1890. Serial No. 359,031. (No model.) Patented in Austria-Hungary February 24, 1890, No. 1,077.

To all whom it may concern:

Be it known that I, JOHANN KLEIN, a citizen of the Empire of Germany, residing at Frankenthal, in the Kingdom of Bavaria and Empire of Germany, have invented certain new and useful Improvements in Liquid-Coolers, (for which I have obtained a patent as follows: in Austria-Hungary, No. 1,077, Johann Klein, in Frankenthal, apparatus for cooling of liquids respectively precipitating vapors or gases, allowed February 24, 1890, priority dating from 2d of November, 1890. First tax paid. Open 40/568;) and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In the different branches of manufacture making use of cooling-water to obtain the products it becomes often necessary that the cooling-water once used has to be used over again, either because the water is scarce or that the cost of getting water is relatively high. In such cases the water may be cooled down by means of a proper apparatus so far that the water can be used again. The simplest and cheapest way is to bring the water in most intimate contact with air, as thereby one part of the water evaporates, and the heat required for this evaportion is taken from the remaining water. The temperature of the latter will consequently fall. The evaporation and therewith the cooling off depends from the intimate contact of the water with the air. In order to obtain a good result, the mixing of water and air must be so intimate that the capability of the air to evaporate water and to take up the vapors is utilized to the utmost point.

The apparatus hereinafter more in detail described are composed of a more or less polygonal or cylindrical vertical shaft, wherein water rippling down from the top is brought into most intimate contact with a current of air moving in the opposite direction.

The accompanying four sheets of drawings represent such apparatus, and Figures 1 and 2, Sheet 1, are vertical sections through the apparatus. Fig. 3 is a top view, and Figs. 4 and 5, Sheet 2, are details of the apparatus on an enlarged scale. Figs. 6 and 7, Sheet 3, also represent detail views of parts of the apparatus. Figs. 8 and 9, Sheet 4, show vertical sections of a similar apparatus, but with the modification that a certain number of apparatus is employed aside of each other or one behind the other. Fig. 1 on Sheet 4 is a cross-section through the apparatus, and Fig. 2 an elevation, partly in section.

In the figures, *a* is a square or round shaft, of sheet-iron, wood, or brick-work, wherein several series of wooden partitions *c c* and *c′ c′* are arranged vertically aside of each other in such a way that the partitions *c* of one series stand crosswise in the plane to the other series *c′* or stand under angle. These partitions are supported at the top by two joints *b b*, Figs. 4 and 5, resting upon projections from the wall of the shaft and which are kept apart in the right distance by joists *d d*, placed outside of the partitions but over the joists *b b*, and which are correspondingly notched. The top end of the partitions are provided with strips of sheet metal *e*, riveted together, forming a gutter over each row of partitions and equally distributing the liquid to be cooled which comes from the feed-pipe *f* and the branch pipes *f′ f′*. The borders of the spouts are toothed or indented. At the lower end of the lath blades *h h* are provided for the purpose of equally distributing the liquid coming from above upon the next series of partitions *c′ c′*. These blades increase in width so that their ends come in close contact with each other at the bottom of spouts *e′*, cut into the top of the rows of partitions *c′ c′*, Figs. 4 and 5, and by these means the partitions are also kept in the right distance from each other. The partitions *c′ c′* of the second series, resting also on joints *b′ b′*, supported by projections in the wall of shaft *a*, are also kept apart by notched joists *d′ d′* applied at the sides. The second series of partitions is not in the same plane as the first, but is placed crosswise, so that the liquid coming from the first series *c c* continues to ripple down the partitions *c′ c′* in another plane, finally to be gathered by spouts *i i* at the lower ends of partitions *c′ c′* and to be conducted toward the back side *k*, wherefrom it can pour down through pipe *k′* into the reservoir *l*. In order to effect an even overflow

of the liquid from the first series of partitions *c* upon the second series *c*, the laths *c'* may be provided at their top ends with two indented strips of sheet metal *o o*, Sheet 3, and the partitions *c* may be made to run out in points. The metal strips *o o* act then like spouts and permit the liquid gathering between them to flow off evenly. The current of air necessary for the cooling of the liquid is produced by a ventilator *g*, arranged on the side of the shaft *a*, and is led into the said shaft by means of convenient connections.

The liquid to be cooled is lifted by means of pumps through pipe *f* and branch pipes *f' f'*, and thus carried upon the rows of partitions *c c* and *c' c'*, crossing each other in plane. The same ripples down the partitions in thin and even sheets and the descent is slackened by adhesion and by the grooves *n n*, cut horizontally into the partitions, Figs. 4 and 5, and thus contact with the air passing in opposite direction is made most intimate, whereby part of the temperature passes over to the air, whereupon it arrives cooled off in the reservoir *l*. The water evaporated during the process of cooling escapes with the upward-rushing air through the top of the shaft.

It is obvious that the formation of drops of falling water is avoided by this invention, for the water led to the top of the apparatus is distributed in thin and even quantities on the single rows of partitions and is gathered below by the spouts *i*. The fixed feed-pipe *f*, with its overflow and safety pipe *f''*, Figs. 1 and 2, may be substituted by an oscillating or revolving device, feeding the liquid into the spouts *e*.

Sheet 4 shows a cooling device of the above-described nature adapted for a factory working on a large scale. Several of the superposed series of wooden partitions *c c c' c'* are arranged in brick-work shafts erected beside another as well as behind each other. Fig. 1 is a section through the device, and Fig. 2 is a side elevation, partly in section. *f* is the feed-pipe of the liquid arranged in the middle of the device and leading it evenly sidewise upon the different shafts. *g* are ventilators arranged on the sides, all receiving motion by means of belts and pulleys from one centrally-located point. In principle the device is the same as the one described with reference to Sheet 1 of the drawings. It may be still mentioned that in place of wooden partitions corrugated sheet metal may be employed.

In order to cause eddies in the ascending air, the plugs *m m* are inserted in steps into the partitions, as shown by the figures of Sheets 2 and 3 on a larger scale, so that the ascending air in finding its way obstructed by the plugs will be caused to eddy about the partitions and delayed in its passage, so as to exert its refrigerating-power to the best advantage.

In allowing vapors or gases to enter into the shaft at bottom they will be taken up or dissolved by the water rippling down; also in this respect the apparatus may be employed.

I claim—

1. In a liquid-cooler, a casing *a*, in combination with an upper series of partitions *c* and a lower series of partitions *c'*, the latter being arranged at an angle to the former within said casing, and means for supplying liquid to one end of said casing and a current of air to the other end thereof, substantially as set forth.

2. In combination with an upper series of partitions and a lower series of partitions arranged at an angle thereto, a series of blades attached to the former series of partitions for conducting liquid therefrom into the lower series of partitions without crossing the path of the air-current, a casing inclosing said series of partitions, a fan for forcing air into one end of said casing, and a tube for supplying liquid to the other end, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOHANN KLEIN.

Witnesses:
ARON HERZOG,
ROBERT GROPP.