

No. 707,021.

Patented Aug. 12, 1902.

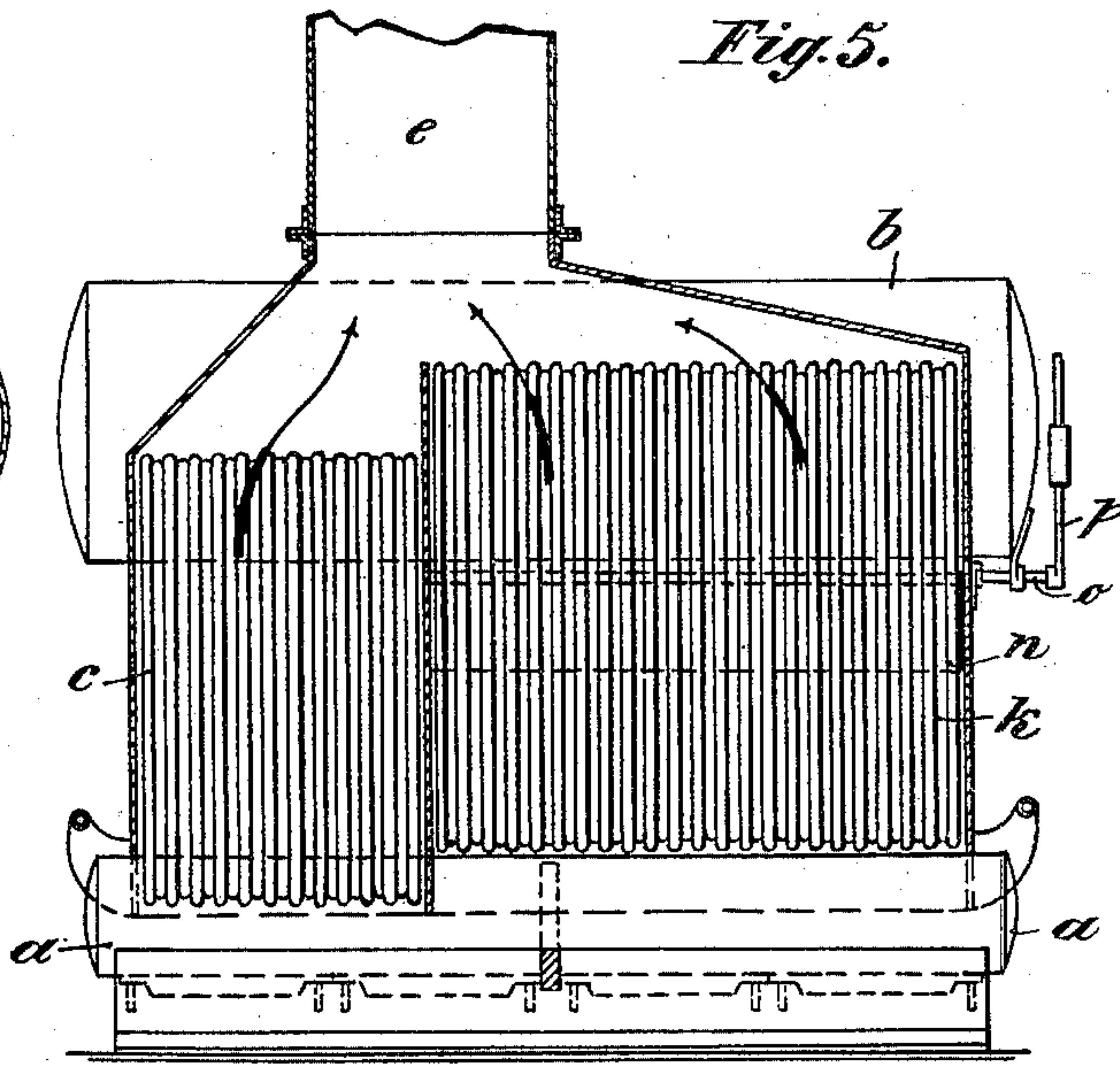
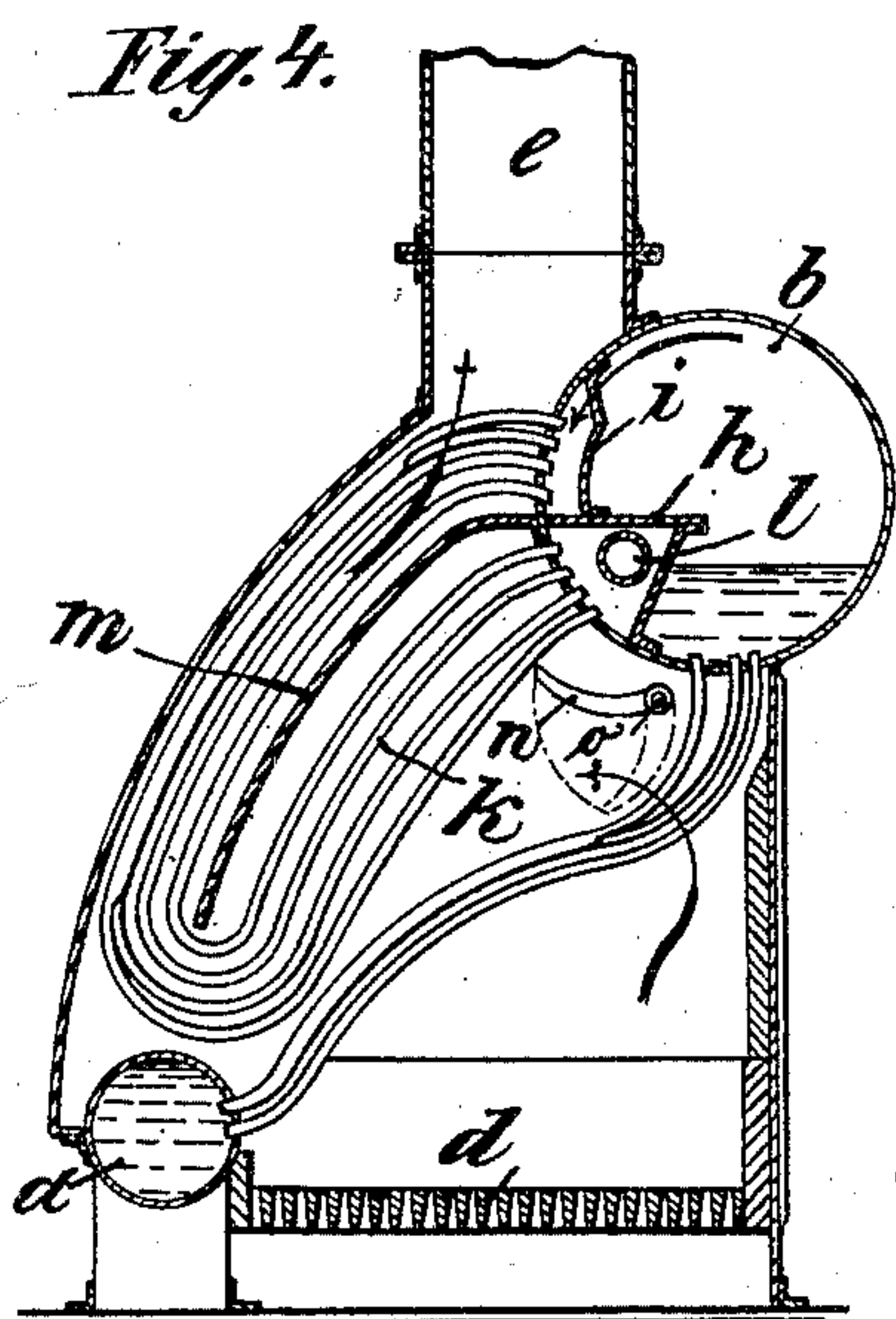
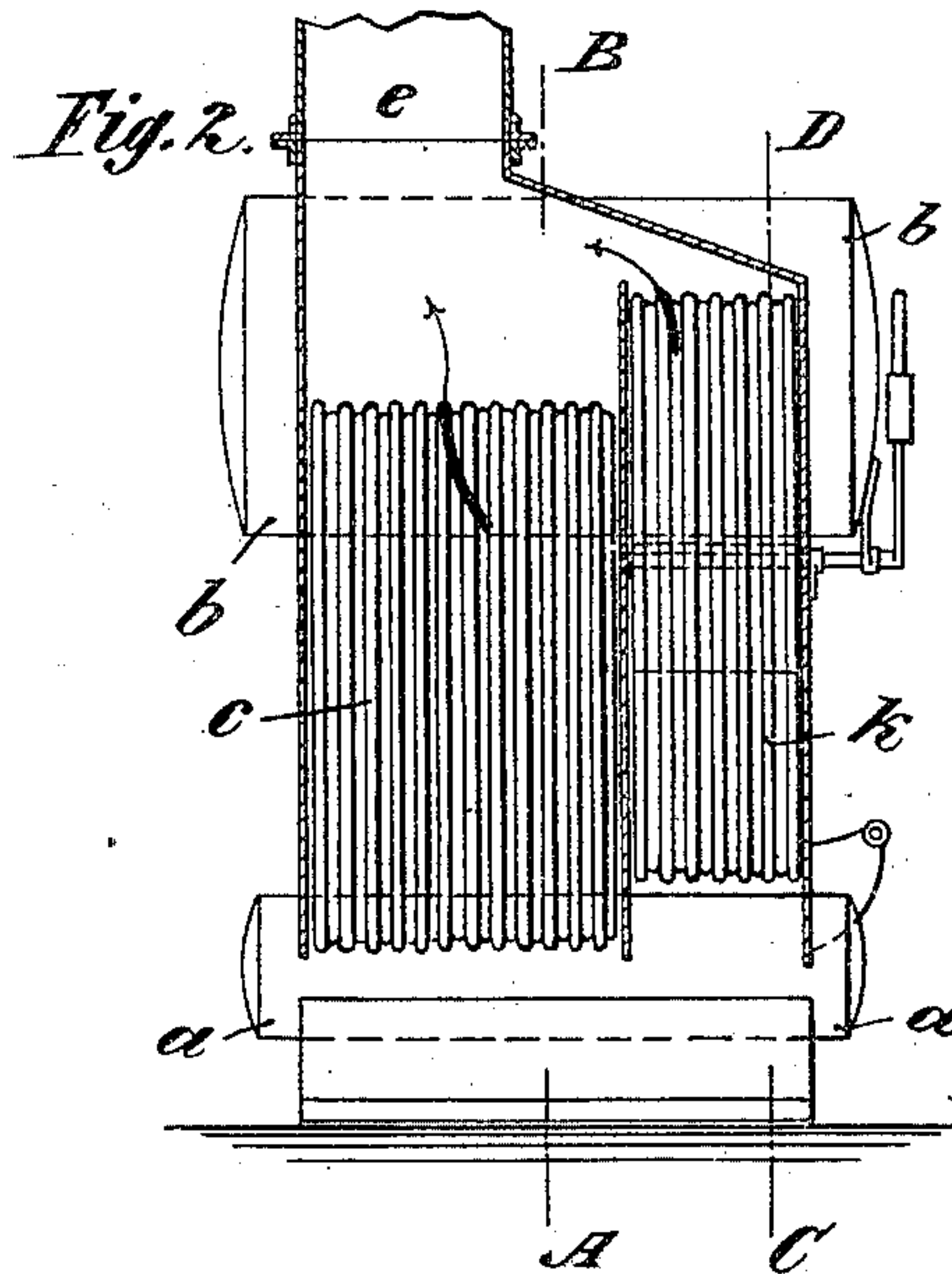
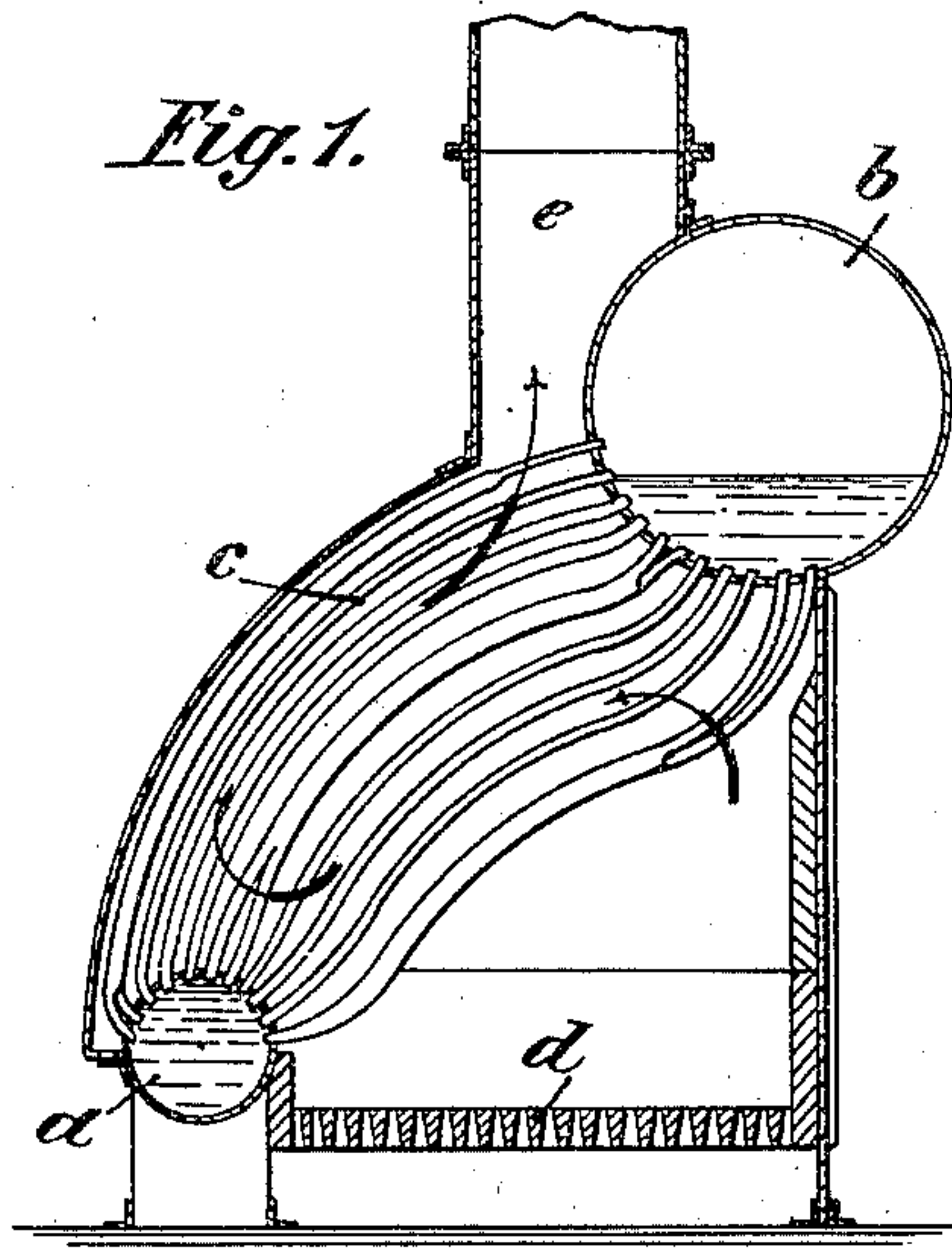
R. SCHULZ.

COMBINED SUPERHEATER AND STEAM GENERATOR.

(Application filed Sept. 20, 1901.)

(No Model.)

8 Sheets—Sheet 1.



Witnesses:
Attest

B. H. Summers

Inventor:
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by *Henry H. H. H.*
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Fig. 3.

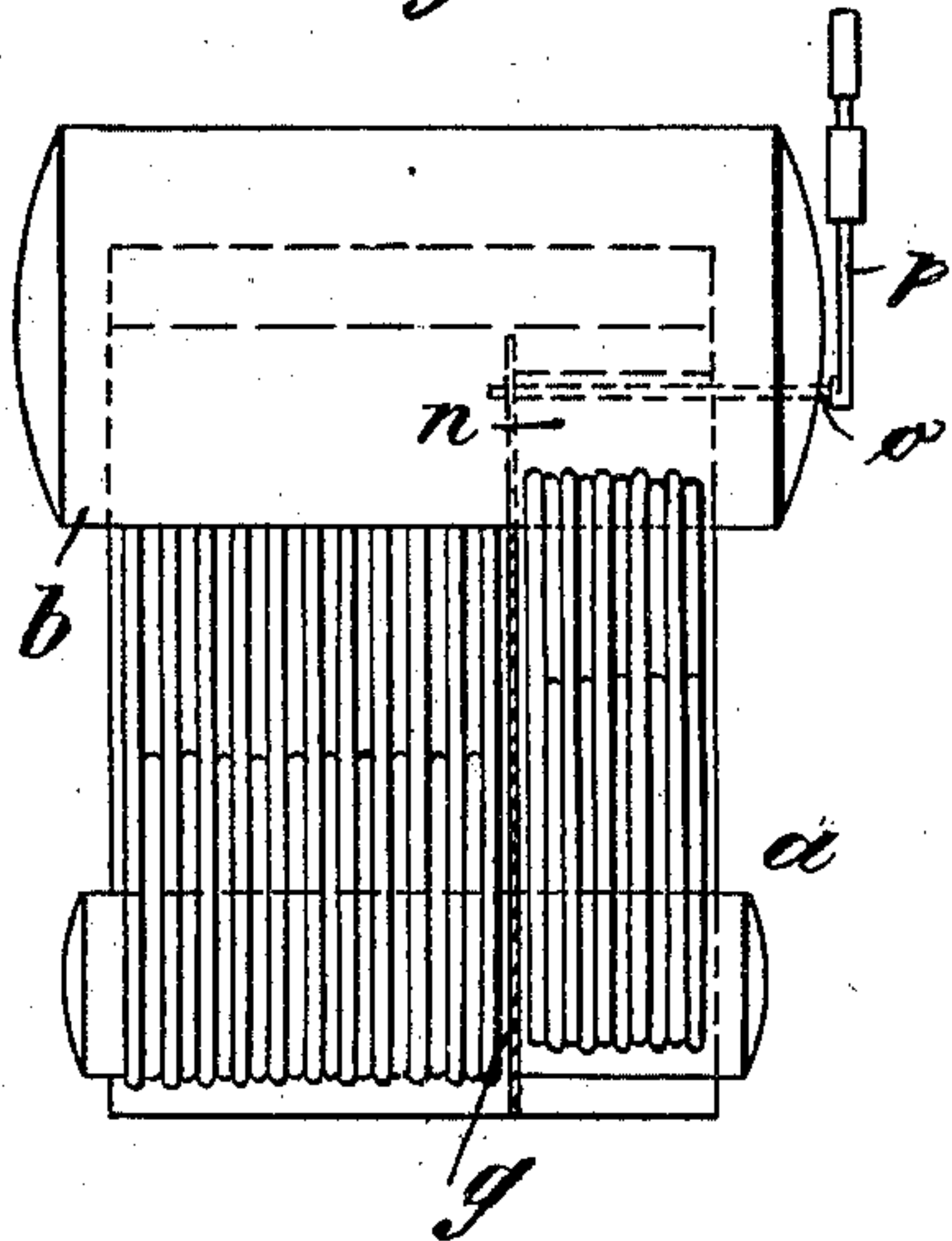


Fig. 6.

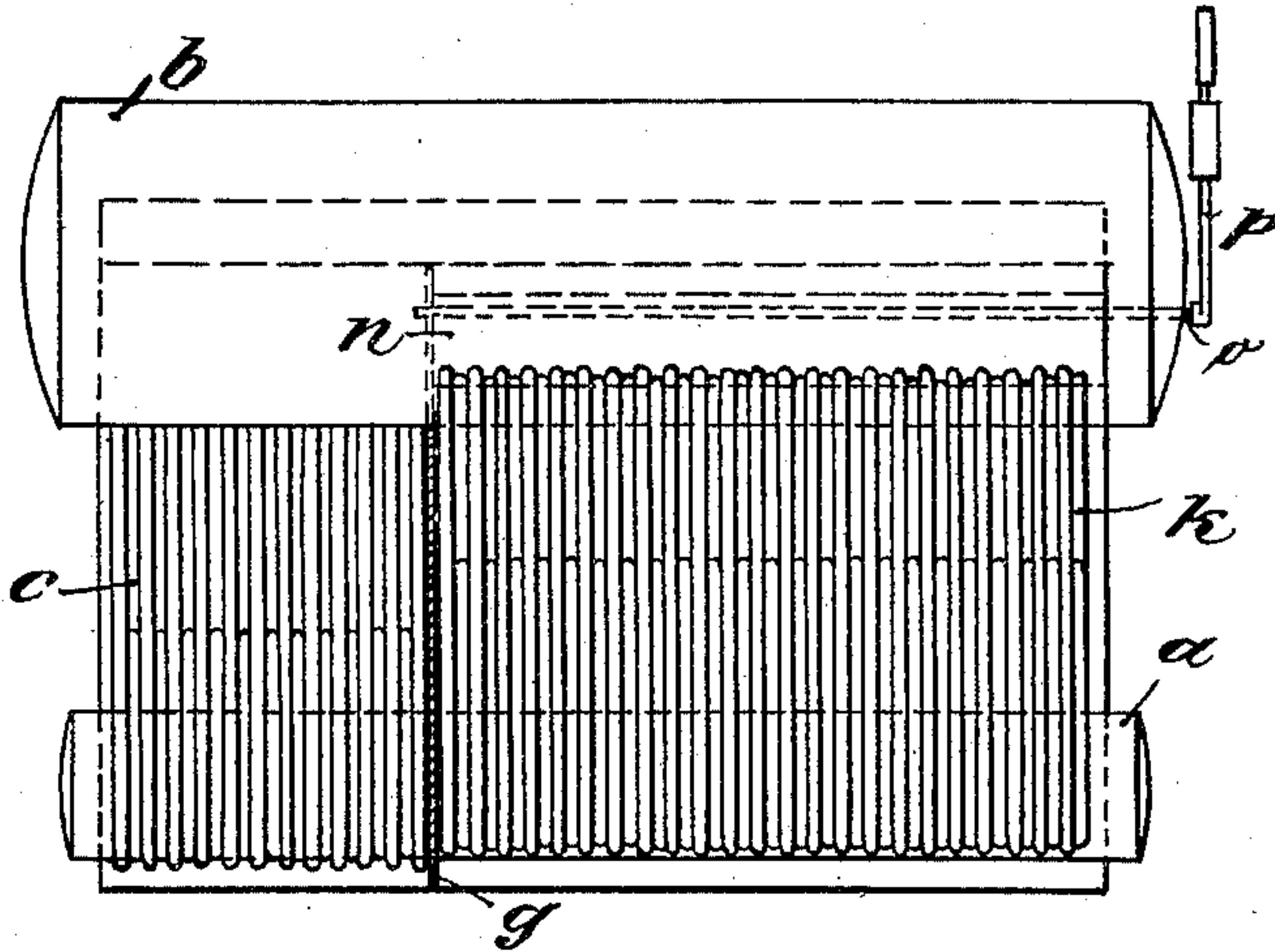


Fig. 7.

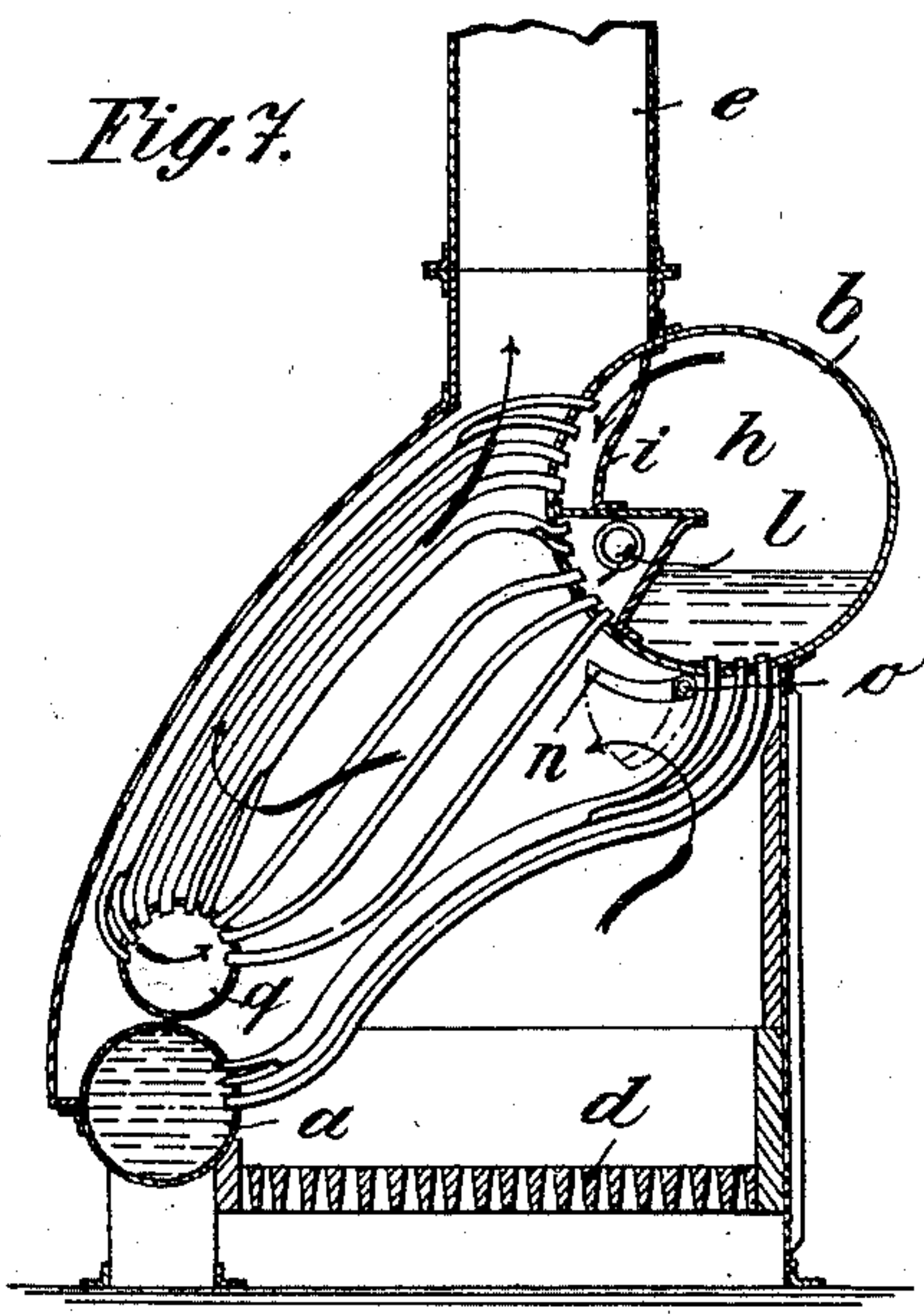
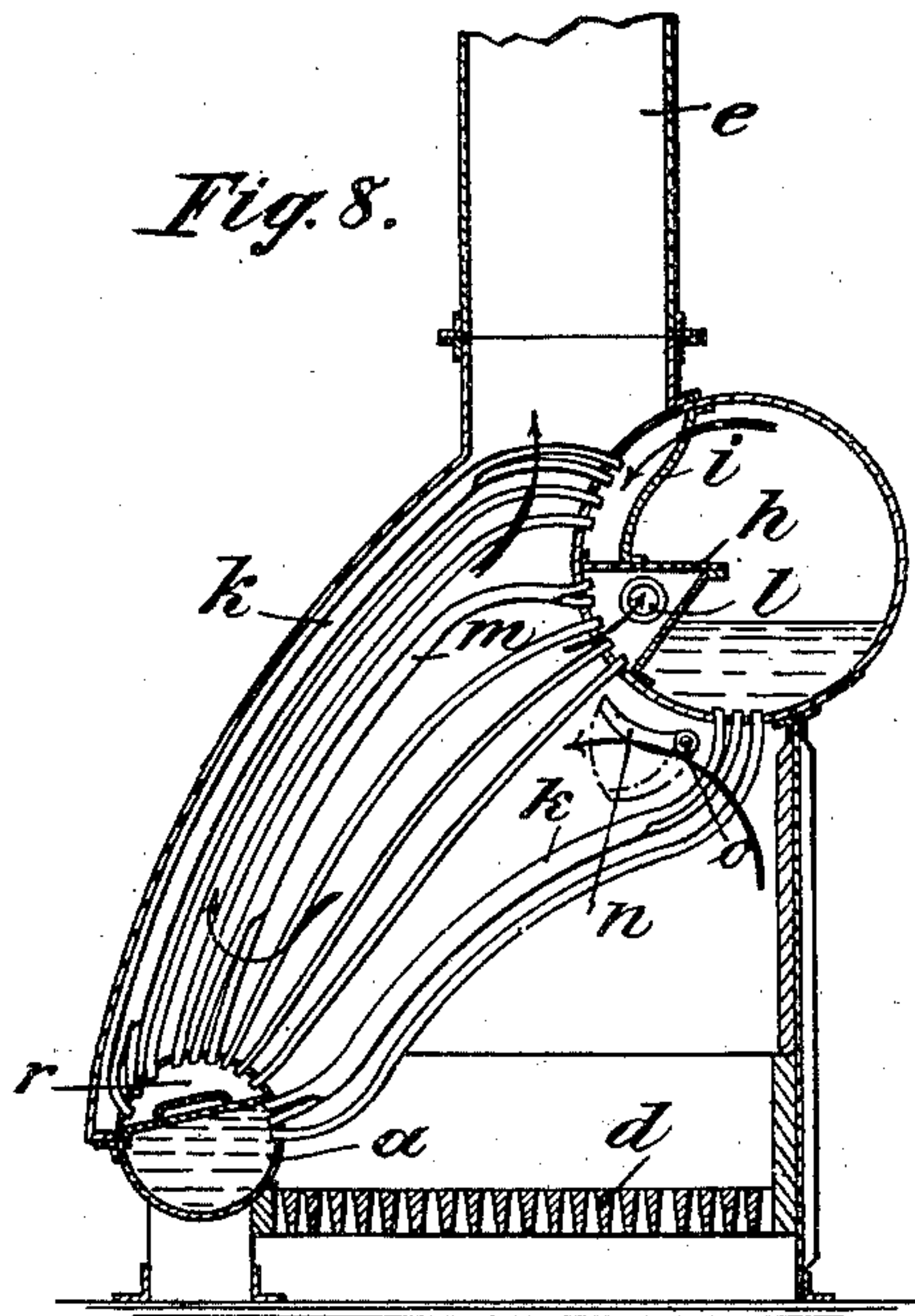


Fig. 8.



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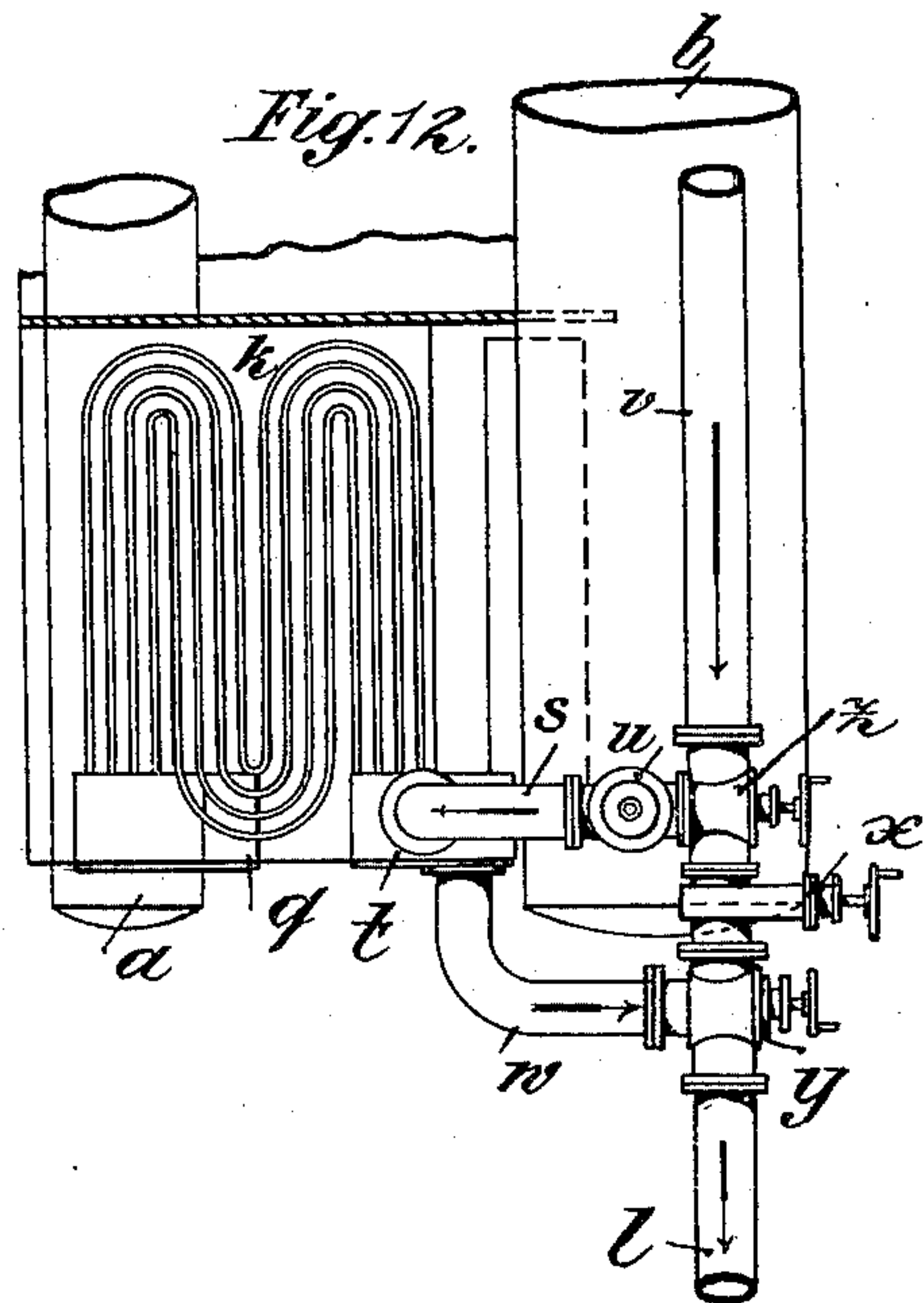
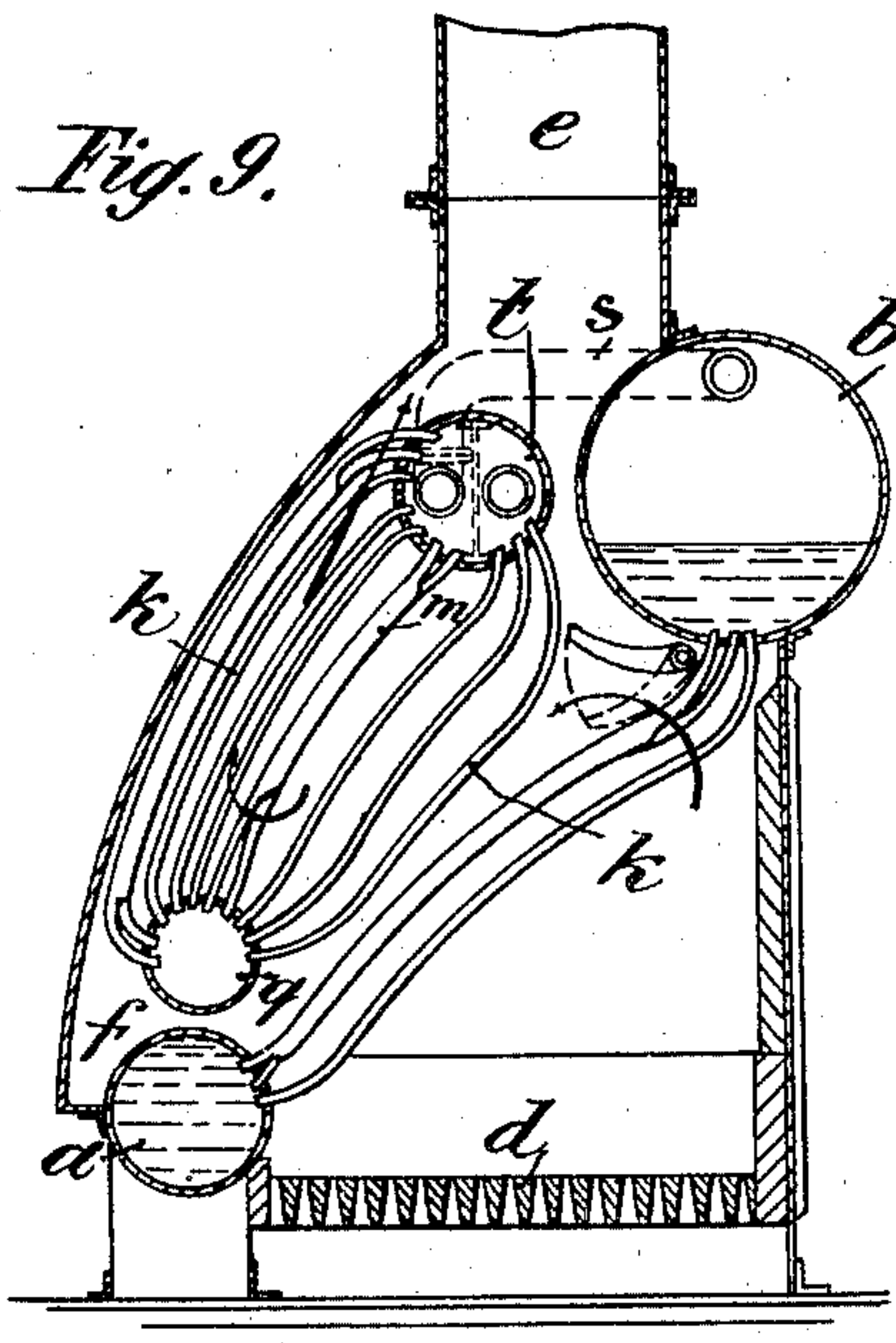
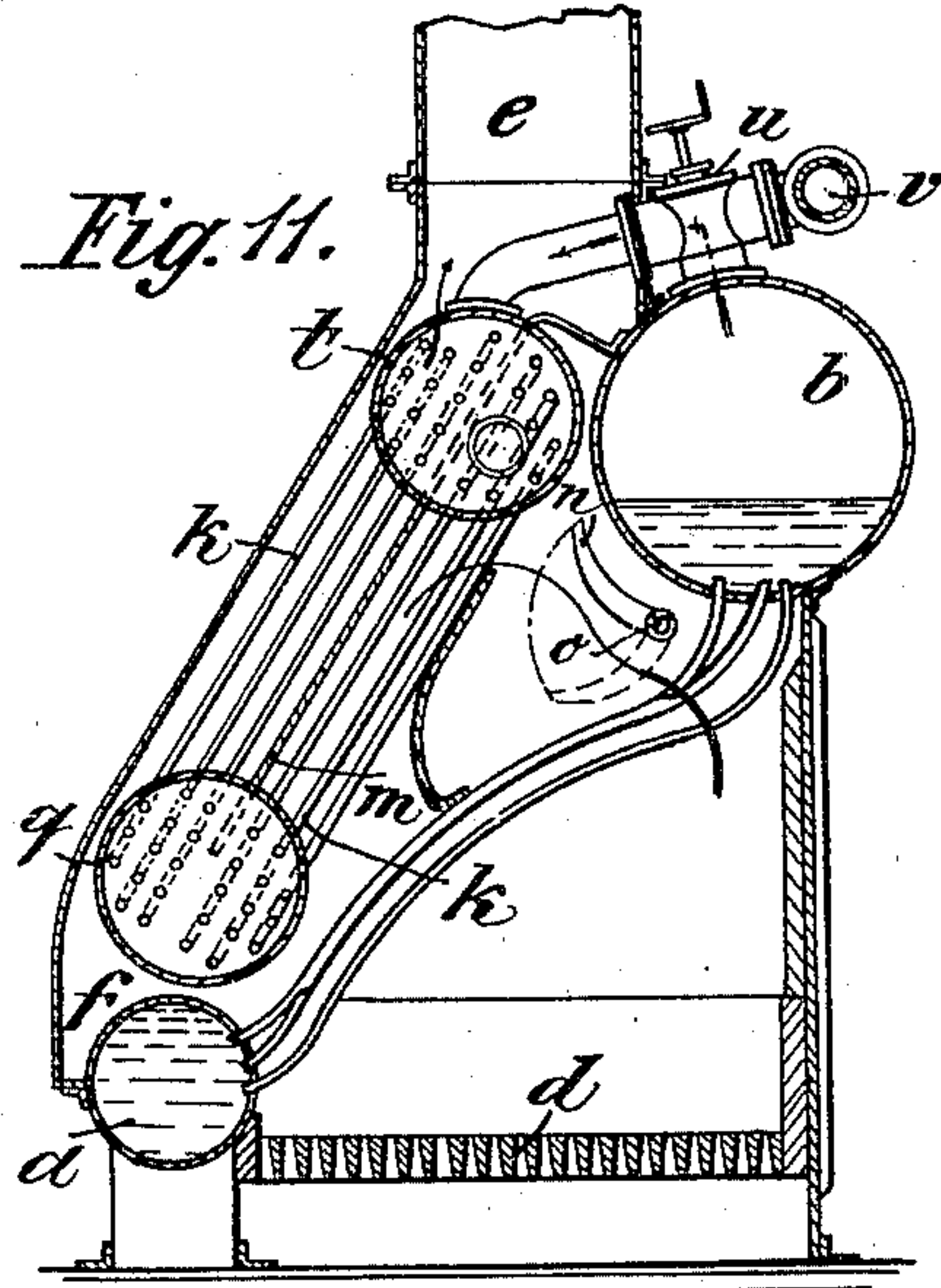
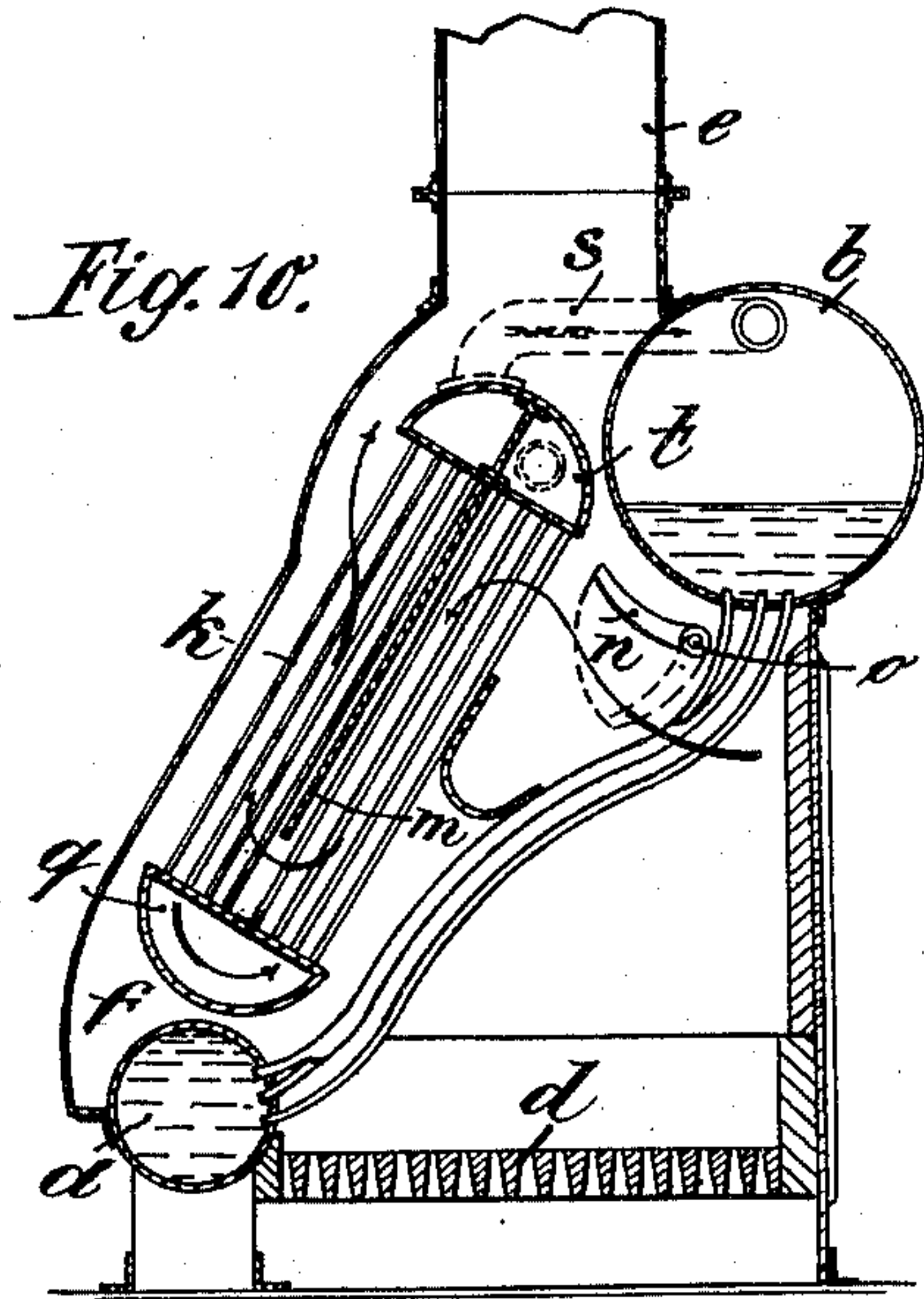
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Witness:
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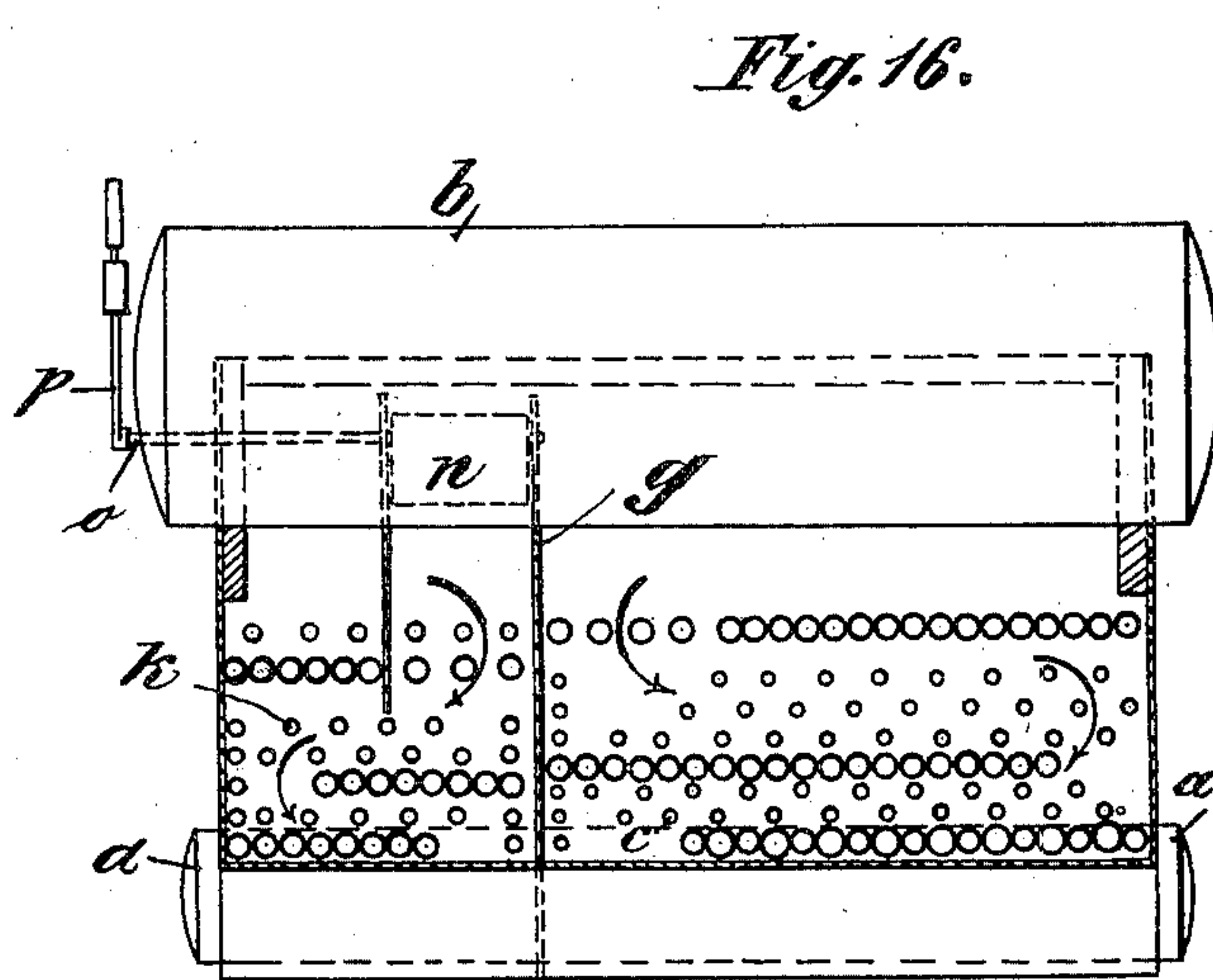
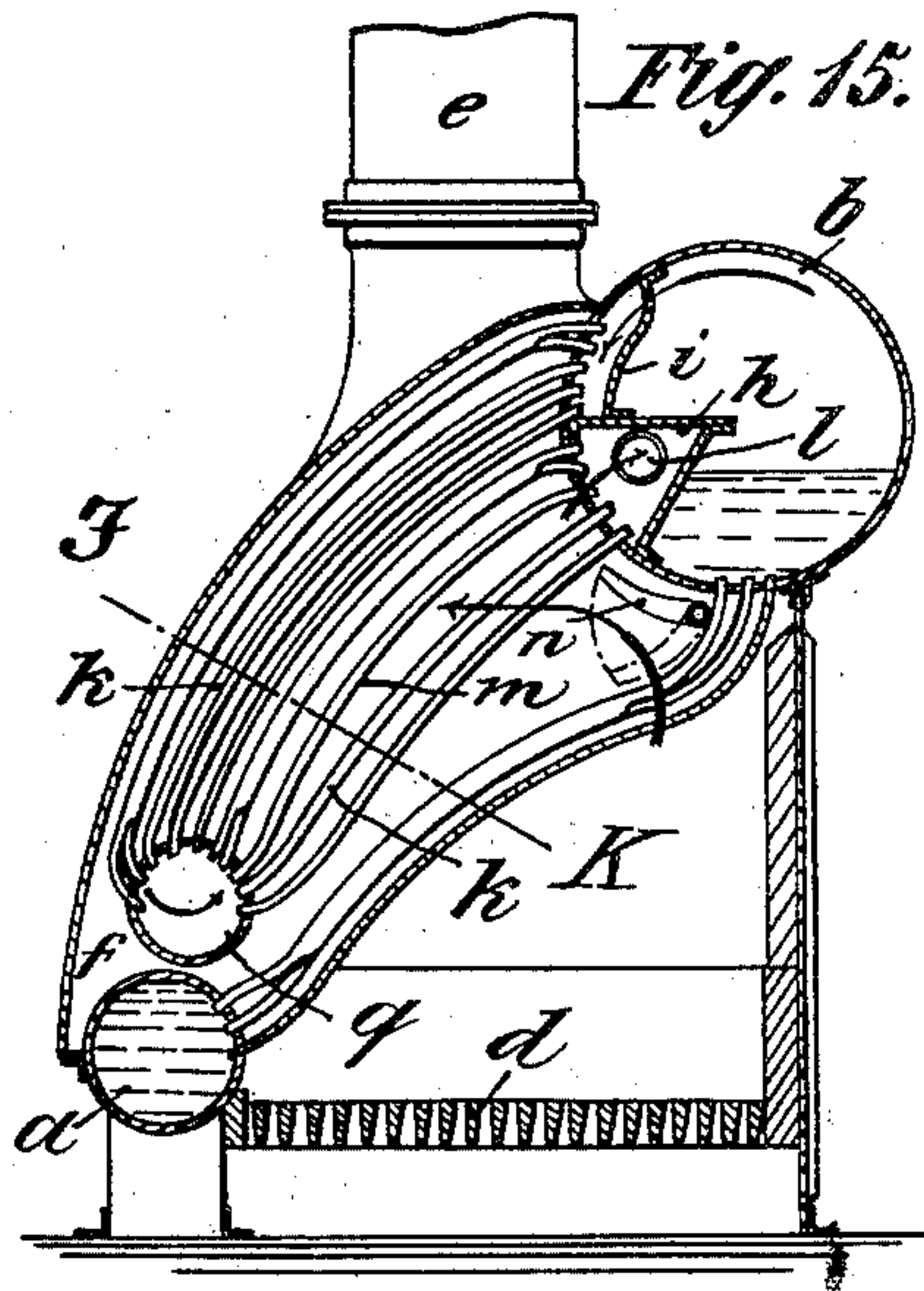
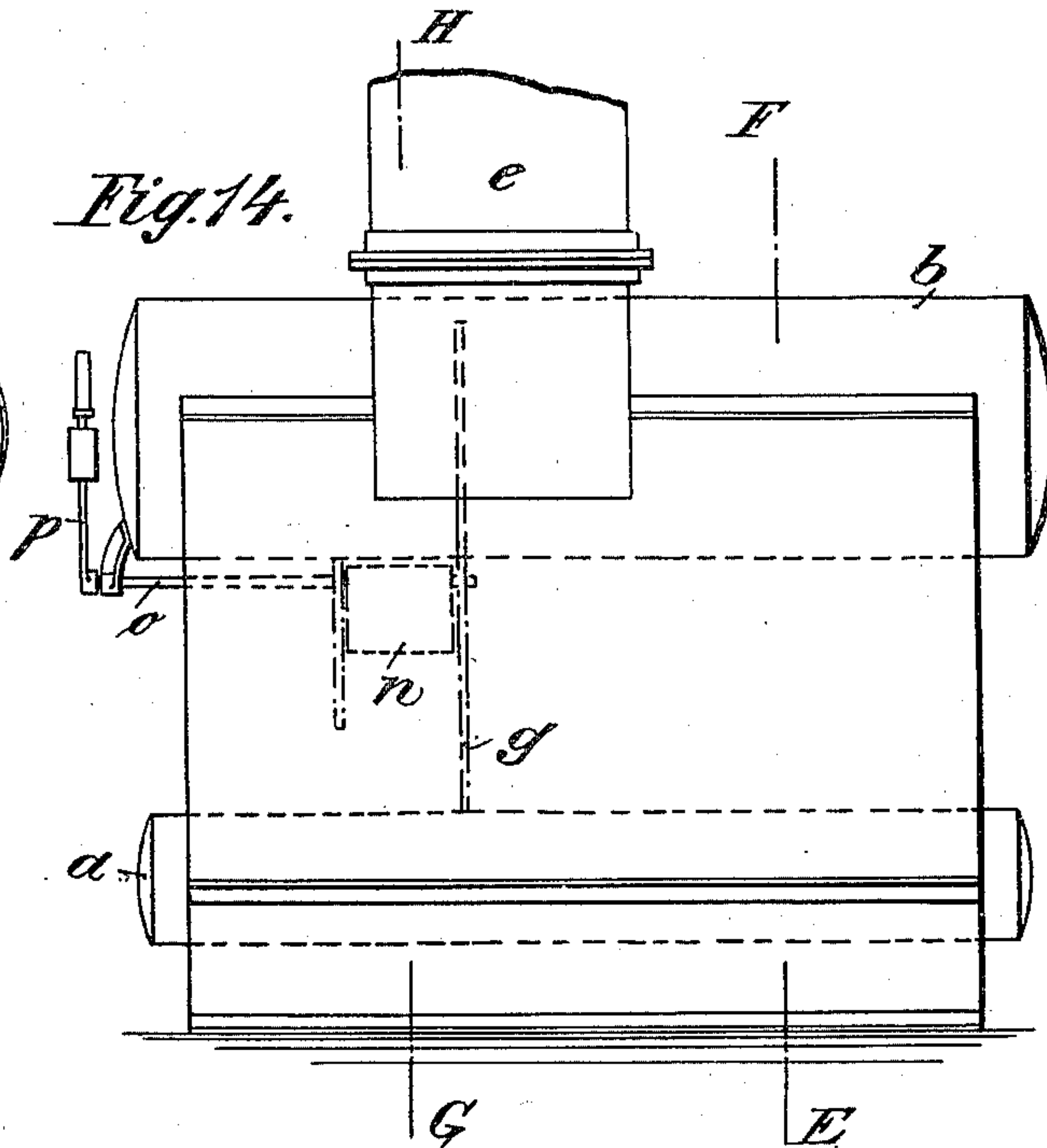
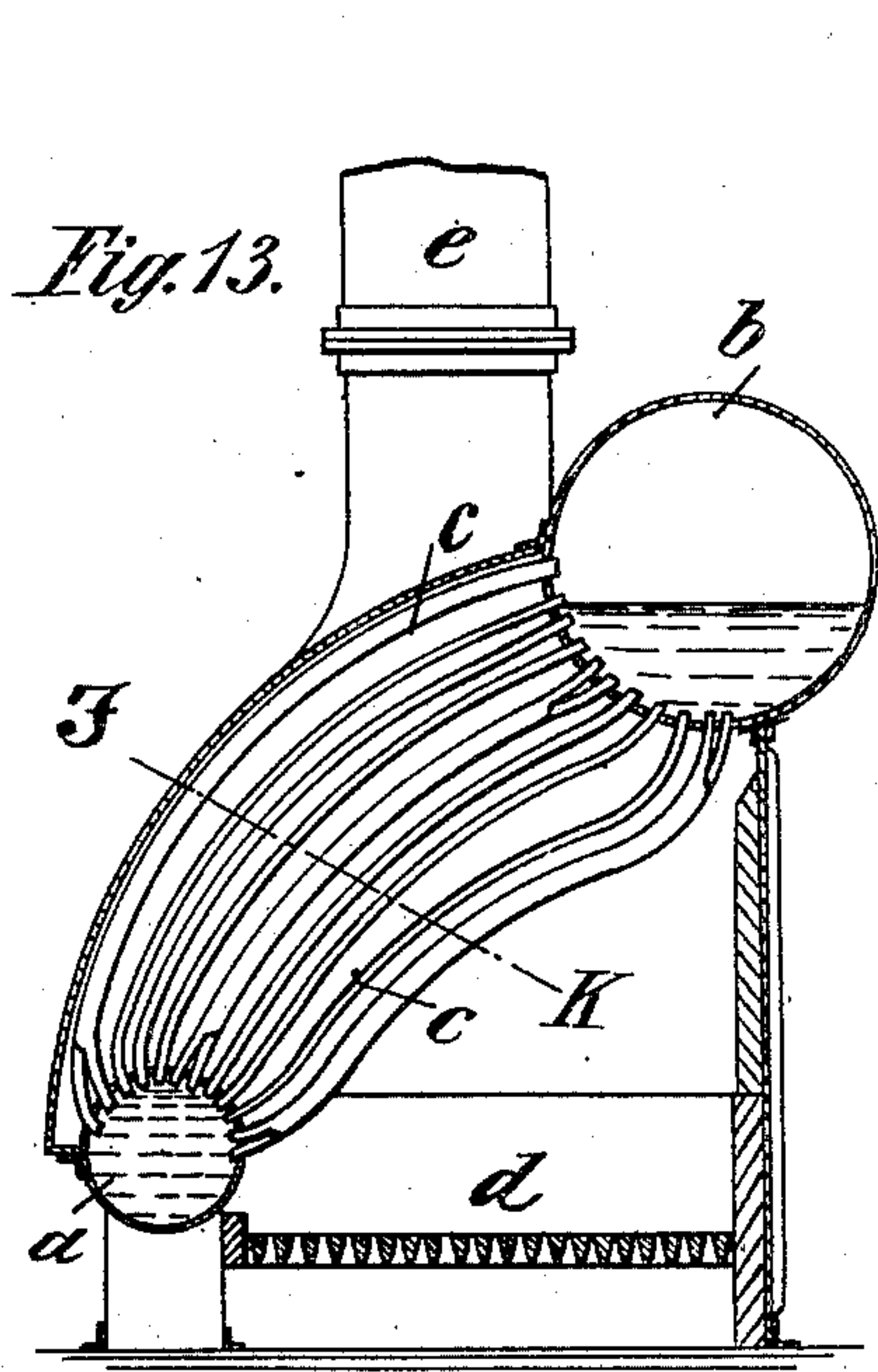
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(Application filed Sept. 20, 1901.)

(No Model.)

8 Sheets—Sheet 4.



Witnesses
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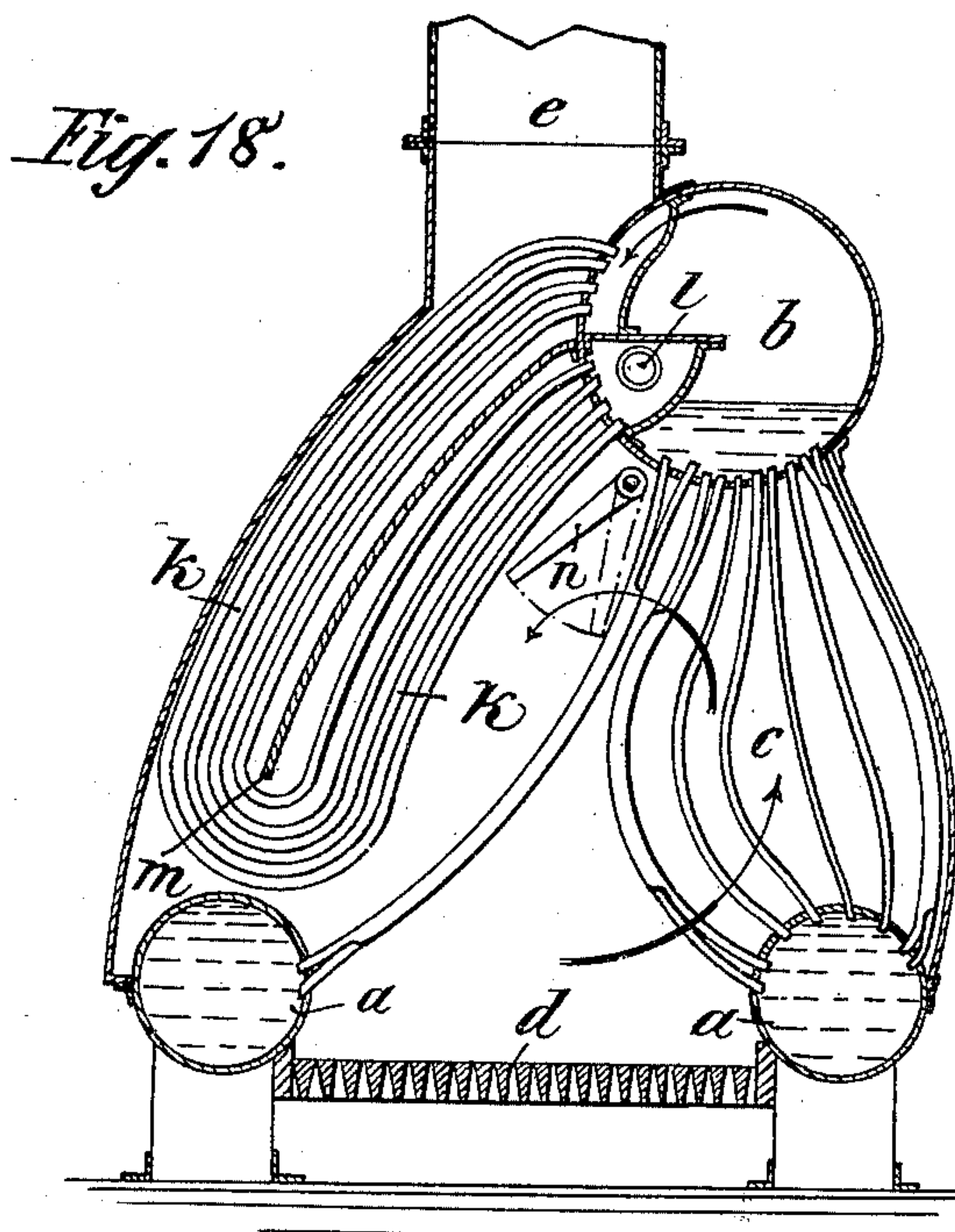
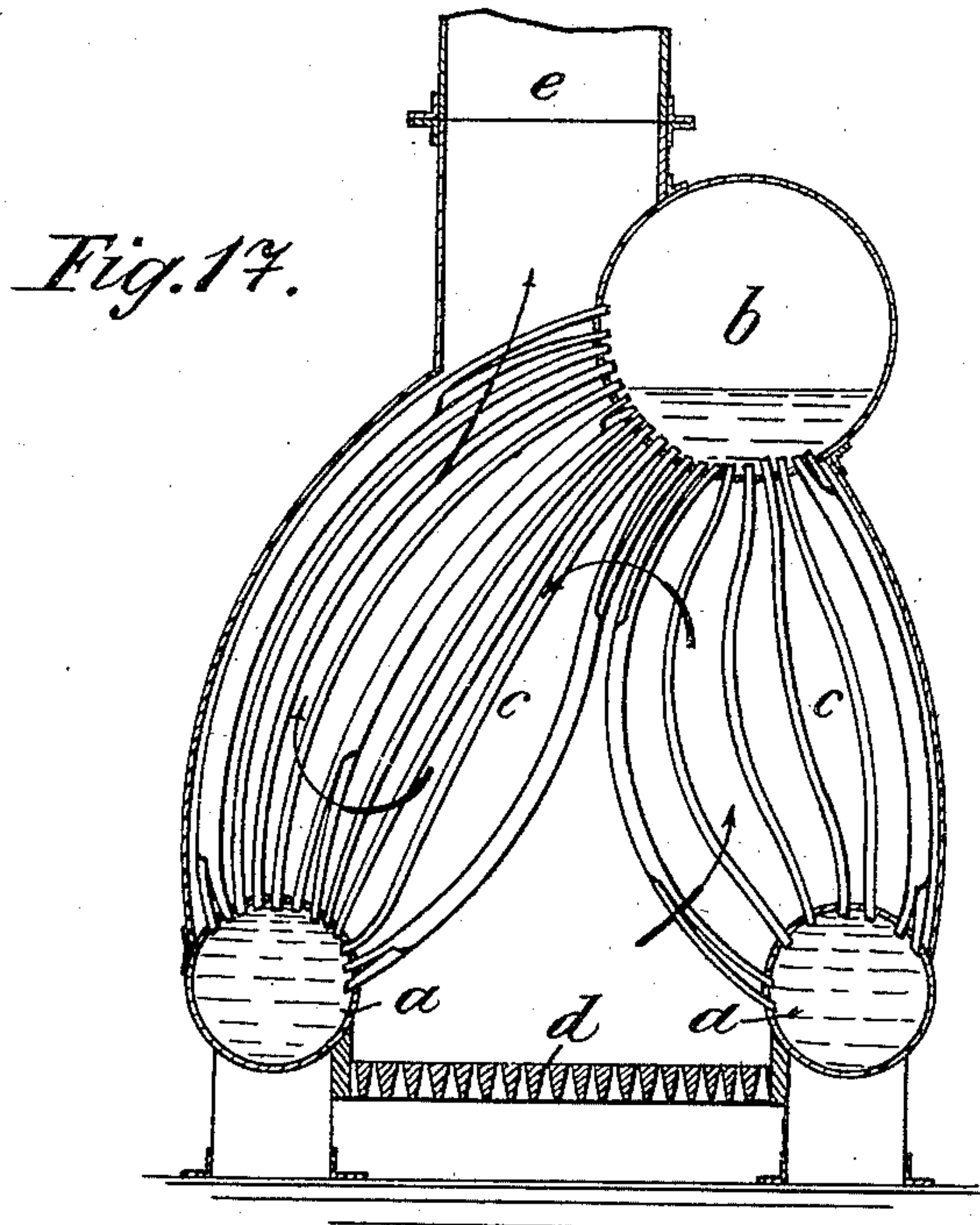
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(Application filed Sept. 20, 1901.)

(No Model.)

8 Sheets—Sheet 5.



Witnesses
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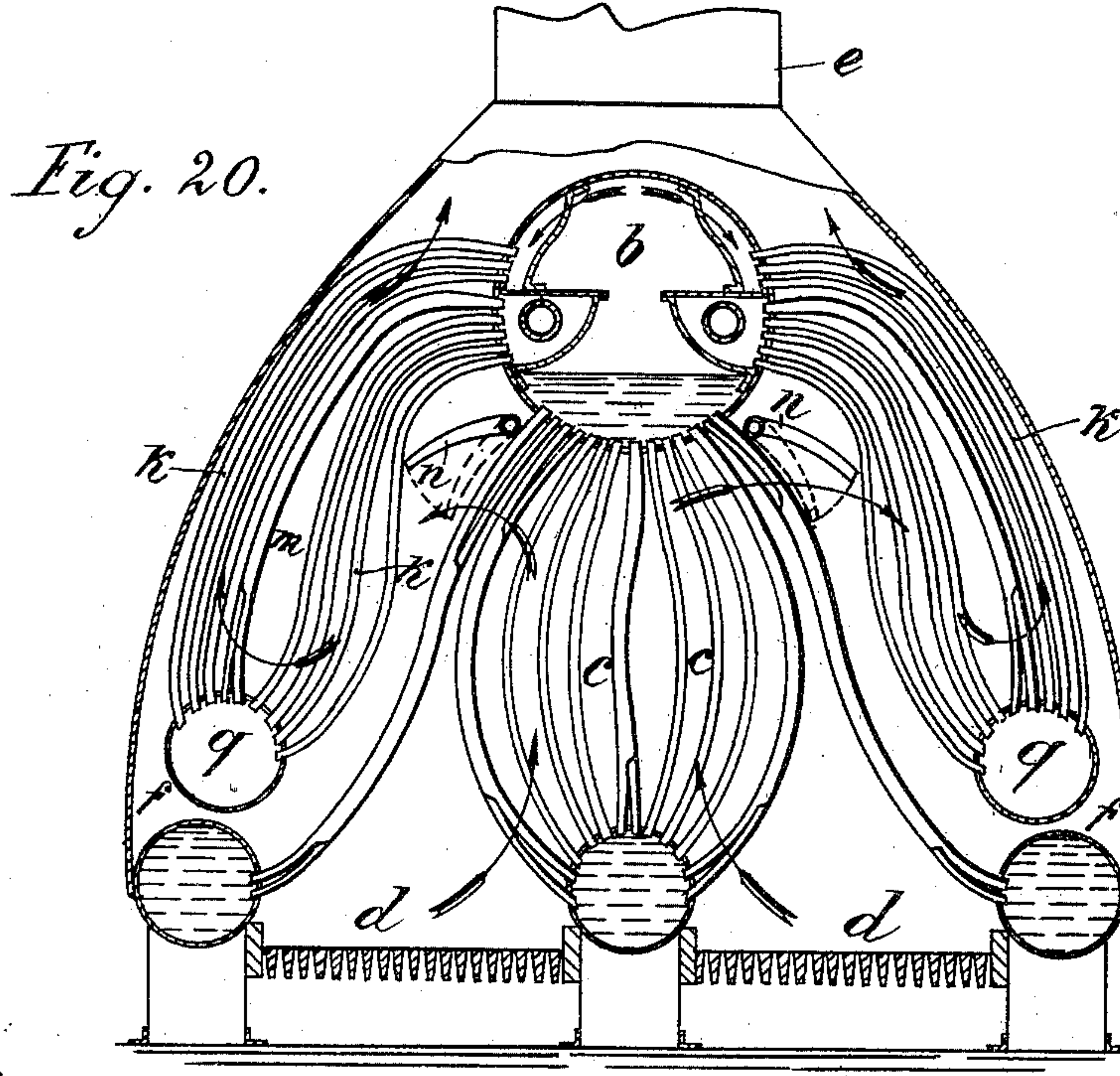
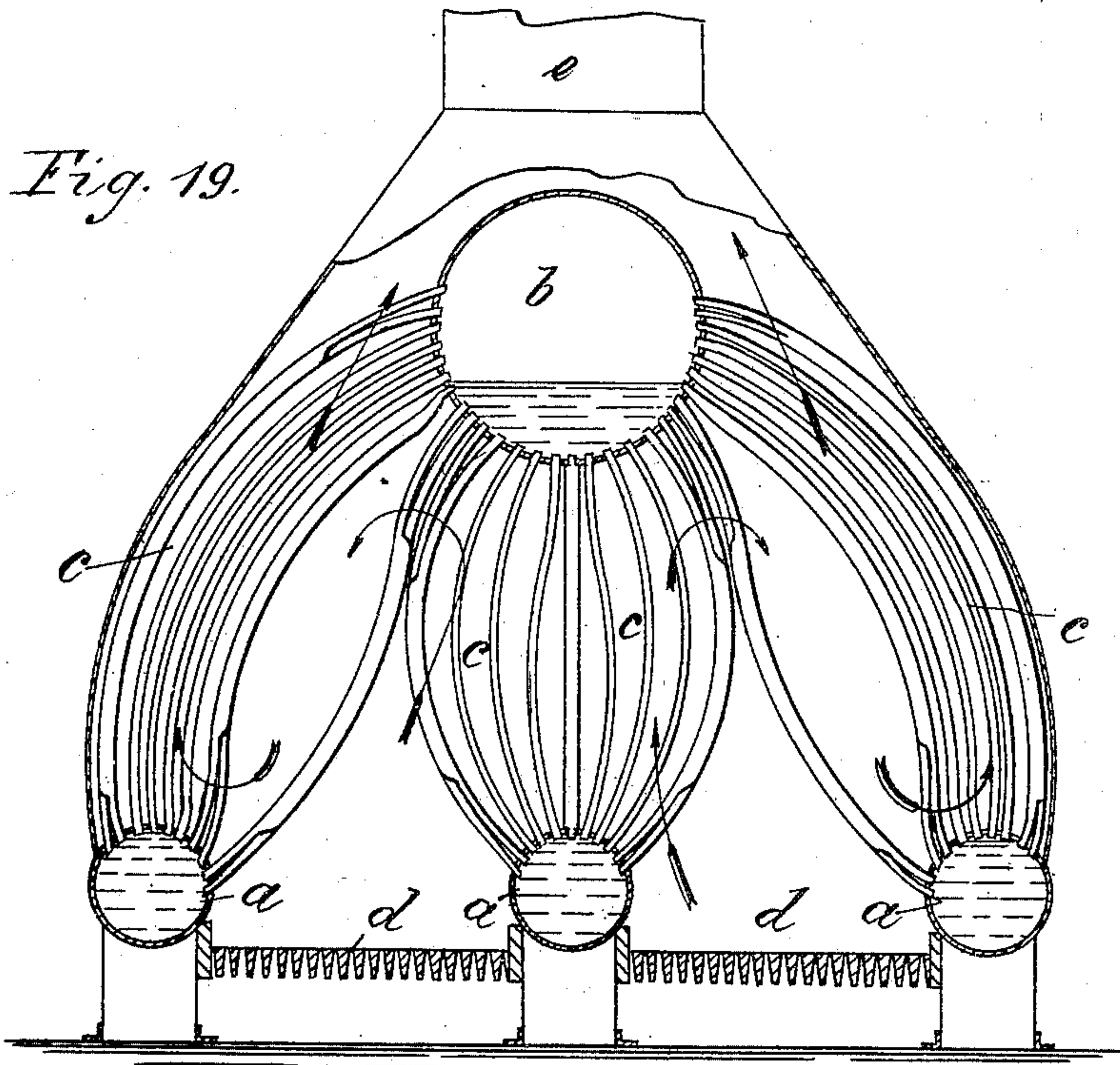
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(Application filed Sept. 20, 1901.)

(No Model.)

8 Sheets—Sheet 6.



Witness:
Attest.

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No. 707,021.

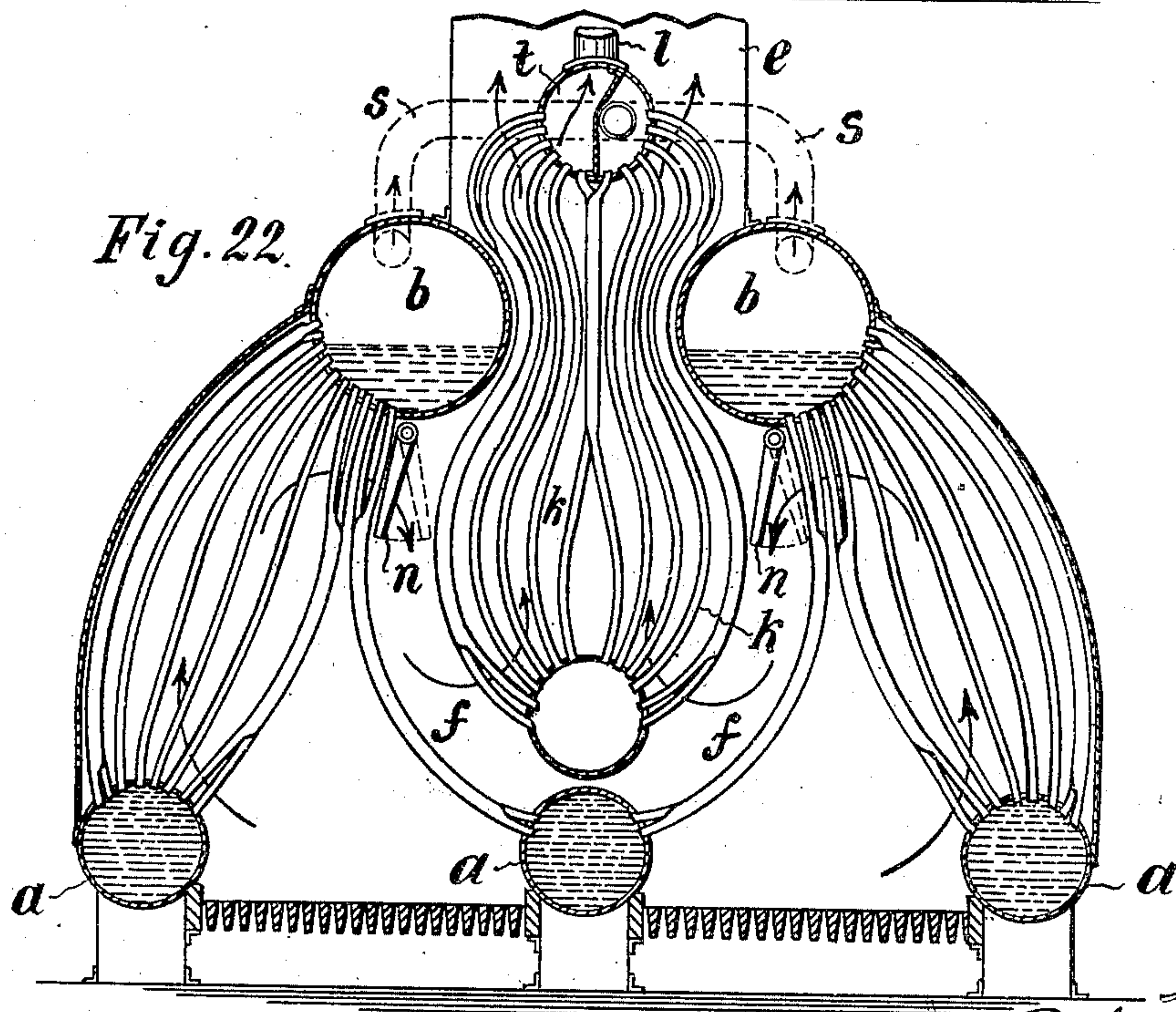
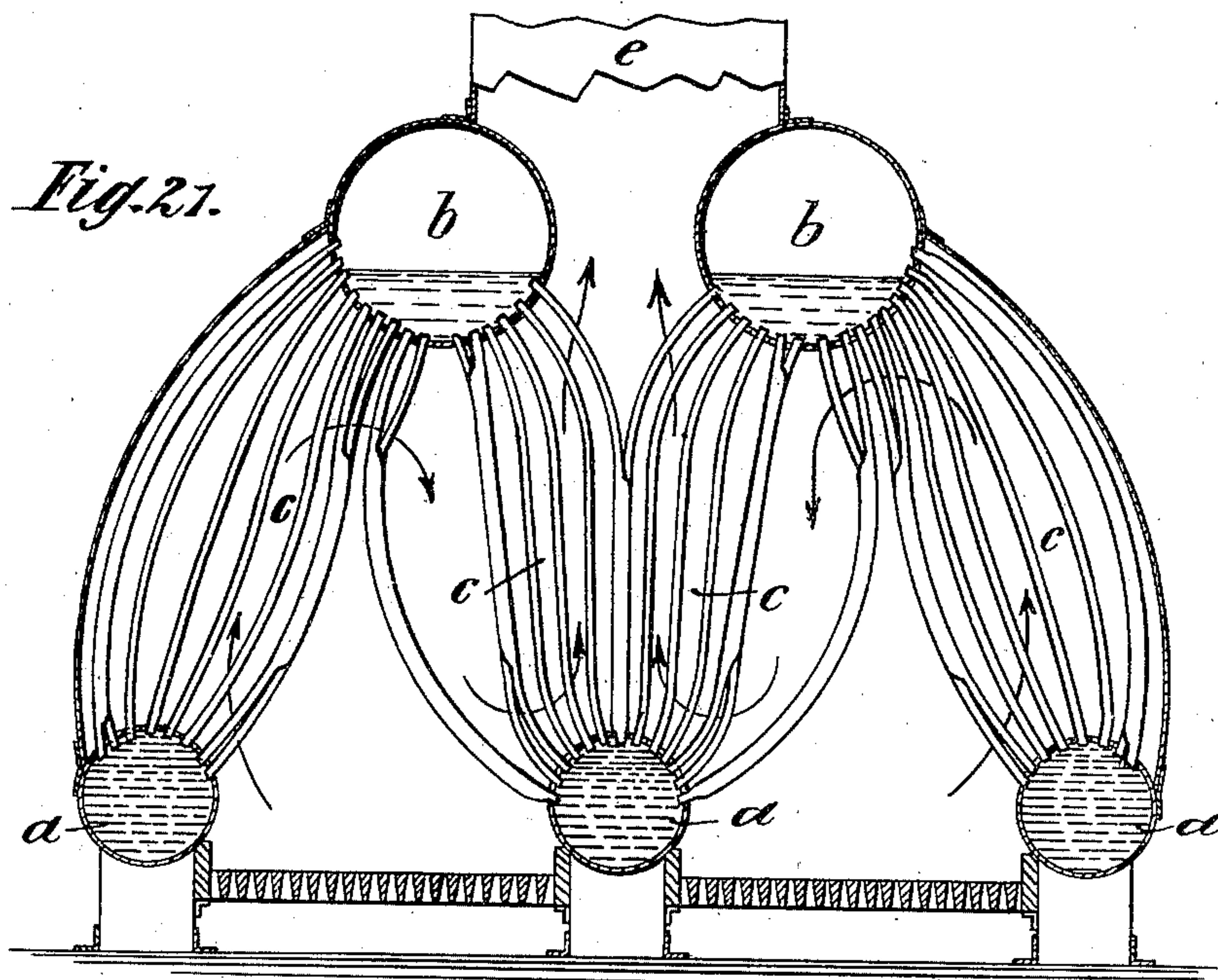
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(Application filed Sept. 20, 1901.)

(No Model.)

8 Sheets—Sheet 7.



Witnesses:
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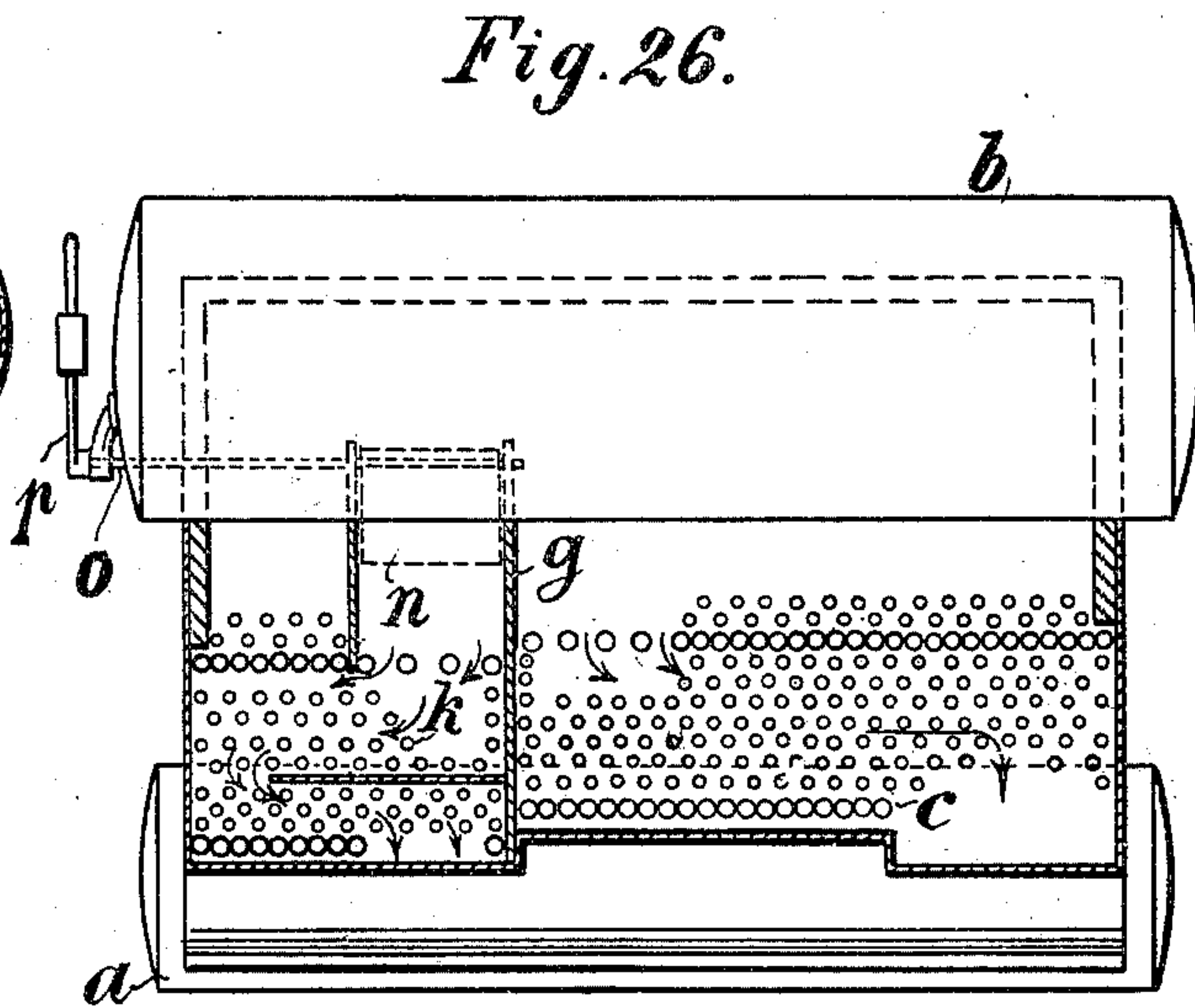
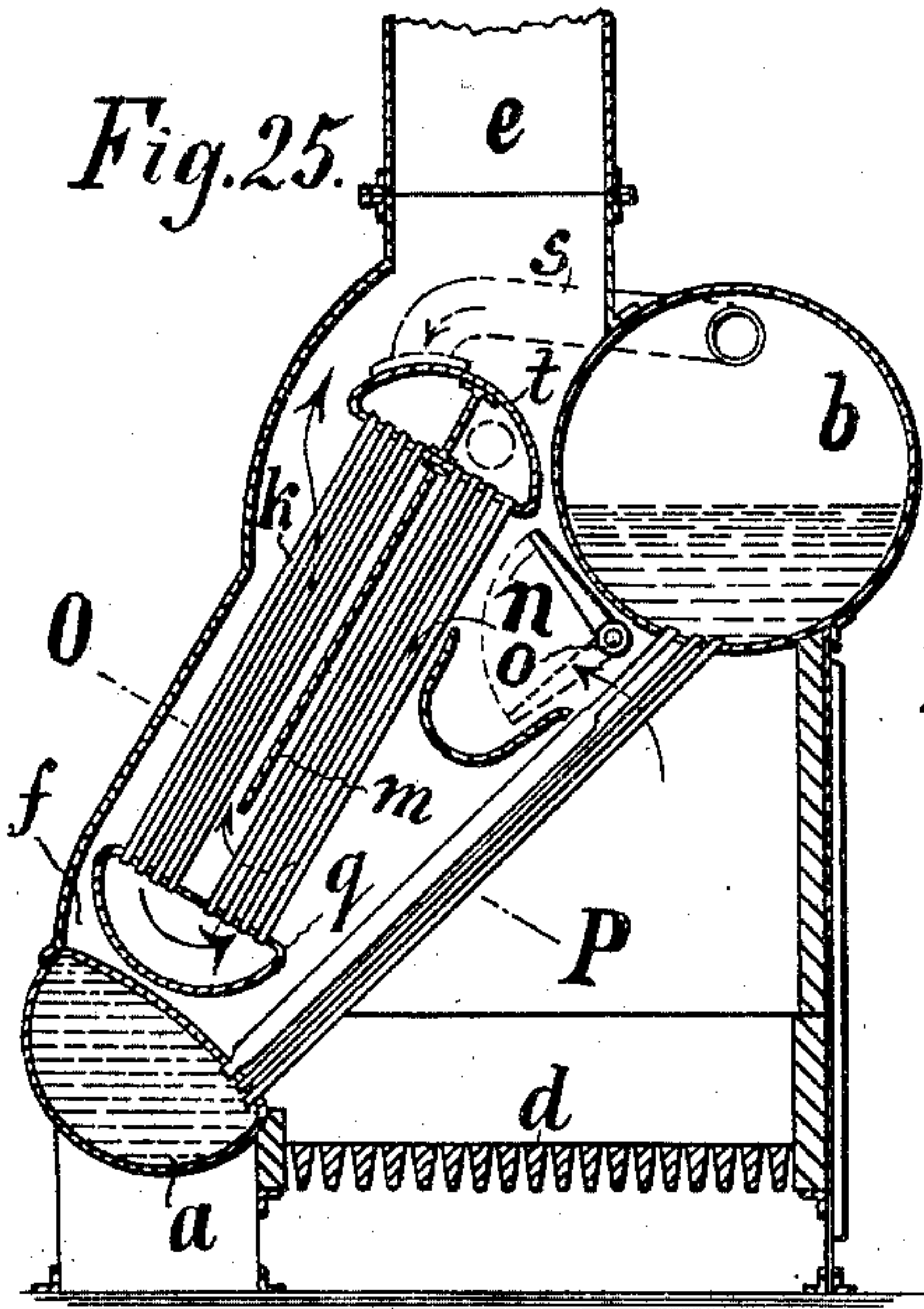
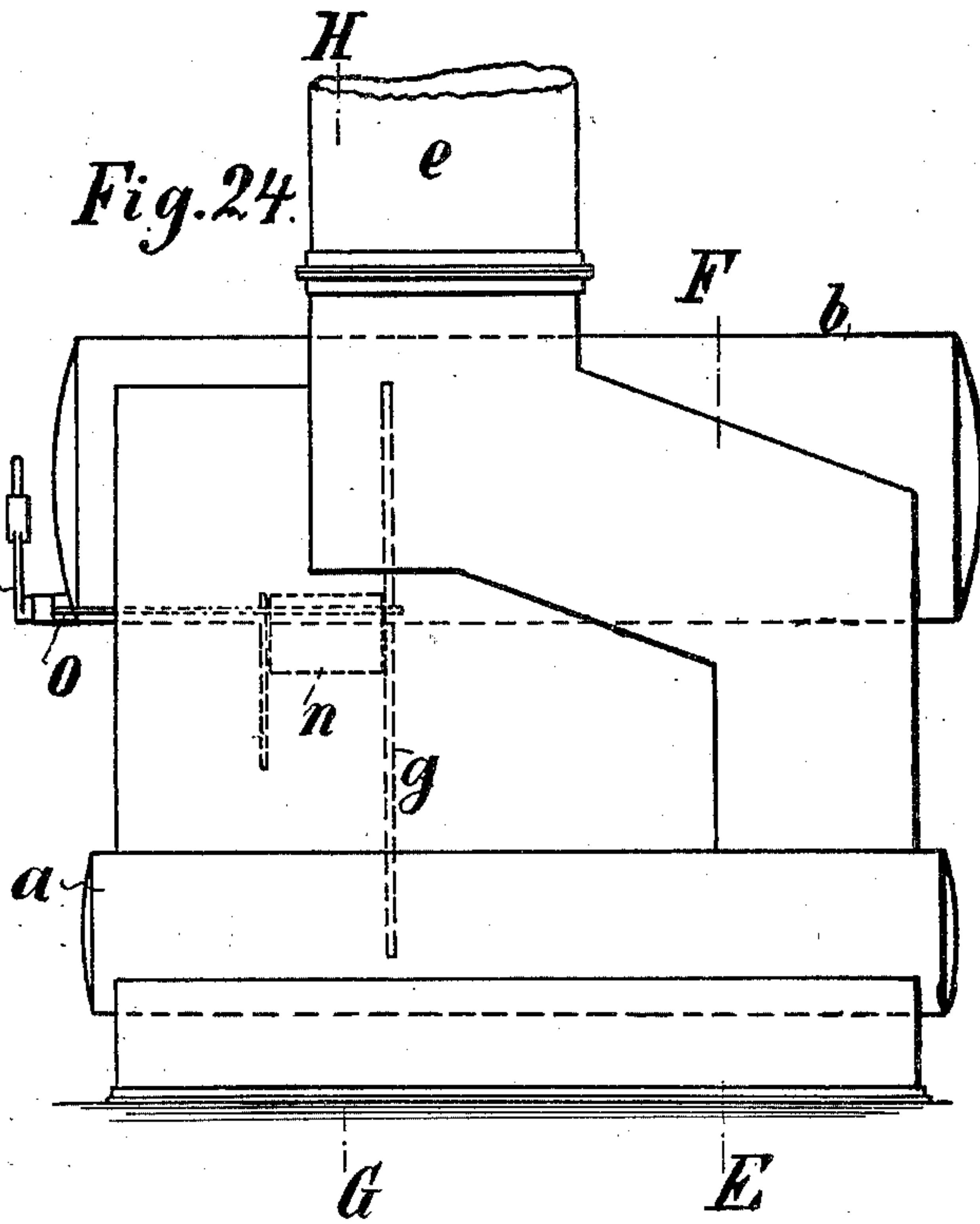
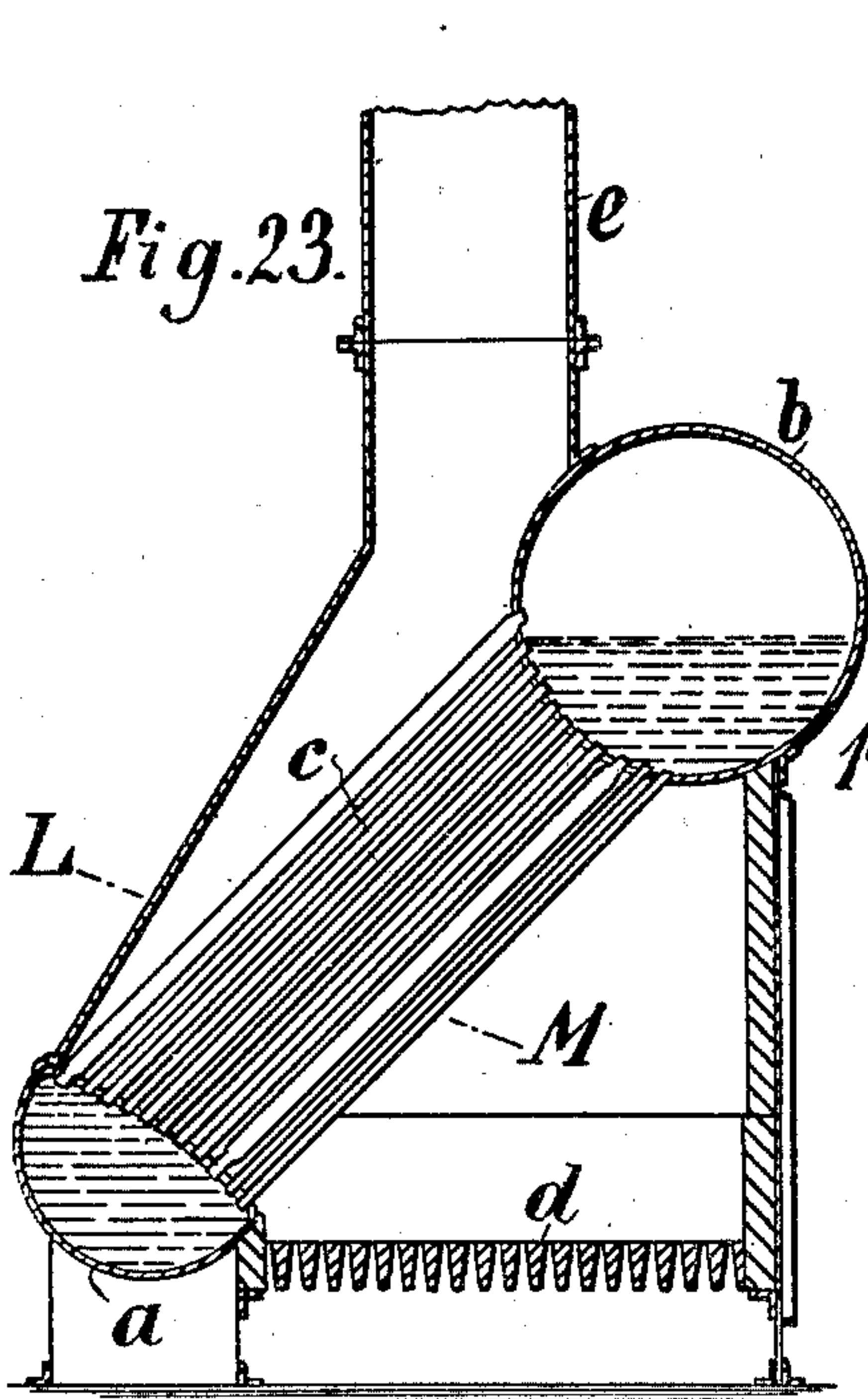
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(No Model.)

8 Sheets—Sheet 8.



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UNITED STATES PATENT OFFICE.

RICHARD SCHULZ, OF BERLIN, GERMANY.

COMBINED SUPERHEATER AND STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 707,021, dated August 12, 1902.

Application filed September 20, 1901. Serial No. 75,832. (No model.)

To all whom it may concern:

Be it known that I, RICHARD SCHULZ, a subject of the King of Prussia, Emperor of Germany, residing at Berlin, Germany, have
5 invented certain new and useful Improvements in a Combined Superheater and Steam-Boiler; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others
10 skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

15 My invention relates to water-tube boilers provided with superheaters, said superheaters being tubular and located in or formed as part of a water-leg. In some well-known superheaters used in connection with
20 water-tube boilers the furnace-gases are conducted through the superheaters in such a manner that they will leave them at the lowest temperature at the stack. In other arrangements the superheater is made as small
25 as possible and is therefore suitable to superheat the steam to a small degree. Even in very irregular running, as on ships, such superheater cannot be damaged, because the gases do not come in contact with them at a
30 very high temperature. Other superheaters that are designed for high-temperature working are very easily overheated by reason of irregular running, thereby increasing the liability to explosion and danger to workmen.

35 The object of this invention is to form in steam-boilers provided with water-tubes connecting a steam and water drum a superheater that will afford a satisfactory working during normal running and adapted to
40 be operated under all possible circumstances.

The arrangement consists in removing from the water-leg for a certain distance along the boiler some of its water-tubes and substituting in the chamber so formed one or more
45 superheaters, at the same time protecting the superheater from the direct action of the gases in the fireplace and separating them from the remaining water-tubes along the length of the boiler by means of a wall, said
50 wall being either solid metal or composed of water-tubes forming part of the water-tube

boiler or formed of steam-tubes that form part of the superheater.

Referring to the drawings, in which like parts are similarly designated, Figure 1 is a
55 cross-section taken on the line A B of Fig. 2 of a boiler provided with a single water-leg. Fig. 2 is a longitudinal section partly in elevation. Fig. 3 is a top plan view. Fig. 4 is a
60 section taken on the line C D of Fig. 2 through the superheater. Fig. 5 is a longitudinal section, partly in elevation, of a similar boiler, showing the superheater extending along a greater length of the boiler than the
65 water-tube portion; and Fig. 6, a top plan thereof. Fig. 7 is a cross-section of similar boilers, showing the superheater provided with a lower drum or head *q*. Fig. 8 is a view similar to Fig. 7, showing the head or drum
70 of the superheater forming part of the water-drum of the boiler. Fig. 9 is a similar view showing a superheater provided with two heads. Fig. 10 is a like view showing such a superheater made of straight tubes. Fig. 11
75 is a cross-section, and Fig. 12 a partial top plan, of so much of the boiler as is necessary to show a superheater composed of coiled tubes. Fig. 13 is a section taken on the line E F of
80 Fig. 14; Fig. 14, a side elevation; Fig. 15, a section taken on the line G H of Fig. 14; and Fig. 16, a section taken on the line I K of Figs. 13 and 15, showing a divided course for the
85 fire-gases, one directly through the superheater and the other through the water-tube boiler both in a back-and-forth direction. Fig. 17 is a cross-section through the water-legs, and Fig. 18 one through the superheater
90 portion of the boiler provided with two water-legs. Fig. 19 is a cross-section through the water-legs, and Fig. 20 one through the superheater portion of the boiler provided with
95 three water-legs. Fig. 21 is a section through the water-tube portion, and Fig. 22 one through the superheater portion of a twin boiler. Fig. 23 is a cross-section taken on the line E F of
Fig. 24. Fig. 24 is a side view of a water-tube boiler provided with straight tubes. Fig. 25
is a section taken on the line G H of Fig. 24, showing a superheater composed of straight
100 tubes; and Fig. 26 is a section taken on the lines L M of Fig. 23 and O P of Fig. 25, showing a divided course for the gases, one portion

going through the superheater and the other through the water-tube section of the straight-tube boiler.

Figs. 1 to 12 show an arrangement of boiler in which the gases leaving the grate take a downward and then an upward course. Figs. 13 to 16 show an arrangement in which the gases are conducted back and forth between the tubes. Figs. 17 to 22 show arrangements of a single steam-drum connected to two or more water-drums, the gases passing first through one leg and then through another, one or more of the water-legs containing a chamber in which is located a superheater. Figs. 23 to 26 show a modification similar to those shown in Figs. 13 to 16 comprised in a straight-tube boiler.

Referring more particularly to Figs. 1 to 4, *b* is the steam-drum, *a* is a water-drum connected to it by curved water-tubes *c*, *d* is the grate, and *e* is the stack. The gases passing from the grate *d* take a course through the tubes, as indicated by the arrows, first downward and then upward, there being formed within the series of superheater-tubes a wall by placing such tubes in juxtaposition, so as to compel the gases to take this course, the construction being already well known. In the rear of the furnace some of the tubes *c* are removed, so as to form a chamber *f* for the reception of superheater-tubes *k*, which are separated from the water-tube portion proper of the water-leg by means of the wall *g*. Some of the water-tubes *c*, especially those that are in direct contact with the gases over the grate, remain, so as to protect the superheater from too great a temperature and at the same time form a deflecting wall or roof for the fireplace. These tubes are of course suitably staggered or otherwise separated at their ends to permit the furnace-gases to pass between them. The superheater-tubes in this figure are continuous, one end being connected to the steam-space of the steam-drum and protected by a plate *i*, are then bent first downward and then upward again into the chamber *h*, connected to a line or service pipe *l*, said chamber *h* being formed within the steam-drum. The chamber *h* can be located at such a height as not to be surrounded at all by boiler-water, as shown, for instance, in Fig. 20. A deflecting-wall *m*, Fig. 4, is placed intermediate the tubes of the superheater, so as to direct the gases and compel them to take a downward and then an upward course through the superheater. Where the gases from the grate enter the superheater-chamber *f*, there is a damper *n*, secured to an operating-rod *o* and moved by hand-lever *p* from outside the furnace. This damper controls a quantity of gas admitted to the superheating-chamber. In place of such a damper any other equivalent mechanism may be used—as, for instance, a slide.

Referring more particularly to Figs. 5 and 6, they differ from the previous figures only

in that the length of the superheating-chamber is greater than that of the water-tube portion proper, it being the reverse in the previously-mentioned figures, the wall *g* being set somewhat farther to the front of the boiler.

Fig. 7 shows a superheater composed of two sets of tubes, each set connected at one end to the steam-drum, one set taking steam from behind the protecting-plate *i* and the other set delivering the superheated steam to the chamber *h* inside the water-drum, while their opposite ends are connected to a tube or head *q*, situated in the superheating-chamber *f* above the water-drum *a*. Some of the tubes of this superheater are placed in juxtaposition to form a deflecting-wall *m* and staggered at their lower ends to permit the passage of the gases on their upward course to the stack. Fig. 8 is a similar construction, the superheater-tubes being connected at their lower ends to the water-drum, said drum being divided by a suitable partition 25 to form the steam-chamber *r* common to all the superheater-tubes.

Fig. 9 shows the superheater independent of the interior construction of the steam-drum *b*, the tubes *k*, formed in two sets, connected to an upper head or drum *t*, said upper drum being divided by a partition 26, one side of which, 27, is connected by pipe *s* to the steam-drum. The tubes connected to the upper head on one side of this partition take the steam down to the head *q*, common to all the superheater-tubes, into the other set of tubes leading from said head *q* to the other side of the head *t*, and thence by service or line pipe *l* to the engine or other machine. In this structure also the more central tubes are placed in juxtaposition to form a deflecting-wall *m*, whereby the gases will be deflected downward and then upward through the superheater, said superheater being entirely independent of the steam-drum and connected thereto only by pipe *s*. The course of the steam will be in opposition to the course of the fire-gases.

The modifications shown in Fig. 10 differ from the last-described one only in that the tubes of the superheater are perfectly straight, and the two groups of tubes, the up and the down takes, are divided by a deflecting-wall *m*, not formed by the tubes of the superheater.

Figs. 11 and 12 show coils of superheater-tubes connected to the lower head *q*, near the water-drum, and an upper divided head *t*, one side being an intake and the other the delivery side of this head. The inlet side of the head *t* is here connected by the pipe *s* to the steam-drum *b* through the valve *u*, controlling the admission of steam thereto. *v* is a branch pipe from another boiler entering a union *z*, that is connected to the pipe *s* and controlled by a suitable valve, whereby steam from another boiler can also be admitted to the superheater. *x* is a by-pass valve. *w* is

a delivery-pipe from said superheater connected to the head *t* and controlled by valve *y*, delivering steam to the line or service pipe *l*. Should it be desirable only to superheat the steam generated in this particular boiler, the valve in the union *z* is closed and those *u* and *y* are opened. Steam then circulates from the steam-drum *b*, valve *u*, pipe *s*, inlet side of the head *t* through one set of tubes to the lower head *q*, through the other set of tubes to the delivery side of the head *t*, pipe *w*, into the line-pipe *l*. Should it be desirable also to superheat in this boiler steam generated in another boiler not provided with a superheater, the by-pass valve *x* is closed and the valve in union *z* is opened, as well as the valve *y*. Steam will take a similar course to that just described above. That from the pipe *v* will pass through union *z* to the superheater, together with the steam from drum *b*, coming through valve *u* and pipe *s* to the superheater, as previously described. Should it be desired to use steam not superheated, the valve *n* is closed, substantially cutting off the furnace-gases from the superheater, valves *u*, *x*, and *y* are opened, and both boilers will deliver steam to the service-pipe *l*.

In the modifications shown in Figs 13 to 16 both the water-tubes and the superheater-tubes are arranged in juxtaposition to form substantially solid walls, thereby causing the gases to take a winding course back and forth among the respective sets of tubes, as indicated by the arrows, the superheating-chamber and the water-tube chamber being separated from one another by the wall *g* and the former controlled by a valve *n*, as heretofore described.

Referring to Figs. 17 and 18, in which is shown a boiler having two water-legs, the chamber *f* is left in that water-leg in which the gases enter last, and the construction of this water-leg is similar in all respects to that shown in Fig. 4.

In Figs. 19 and 20 the former is a section through the water-tube portion and the latter a section through the superheater portion of the boiler, the side water-legs each containing a chamber *f* and a superheater *k*, these superheaters comprising two series of tubes connected at their lower ends to the head *q* and at their upper ends to the steam-drum, which is provided with two outlet chambers *h*, formed within the steam-drum for the reception of the superheated steam, there being also a deflecting-wall *m*, composed of superheater-tubes between the two sets of tubes in each superheater. Suitable dampers *n* control the entrance of the gases from the central water-leg to the superheating-chambers contained within the side water-legs, the course of gases being indicated by arrows.

Figs. 21 and 22 indicate twin boilers. The superheater is here shown located between the boilers and within the central water-leg

and is composed of sets of tubes *k*, connected at their lower ends to the head *q* and at their upper ends to the head *t*, divided into an inlet and an outlet chamber, pipes *s* connecting the two steam-drums with the inlet side of the upper head *t*, while the service-pipe *l* is connected to the delivery side. The center tubes of the superheater are arranged intermediate the heads, so as to form a deflecting-wall *m*.

Figs. 23 to 26 indicate an arrangement of the superheater composed of straight tubes, the gas entering at the rear of the water-tube portion and issuing at the front thereof, while the gases in the superheater take a back-and-forth course between the superheater and water-tubes. The arrangement here shown permits a larger or smaller superheater to be built in the boiler, as desired, according to the length and width of the superheating-chamber, using a proportional quantity of gases for superheating. After a portion of the gases have lost their high temperature by coming in contact with the wall of water-tubes that deflects them they are conducted to the superheater. The remaining gases, however, circulate around the water-tubes in the well-known manner. By suitably positioning the valve the temperature of the superheater-chamber can be regulated, and the gas cut off therefrom will then be made to pass around the water-tubes of the water-legs. The superheating-chamber can be entirely cut off without influencing in the least the operation of the boiler. This construction can be used in other forms of water-tube boilers that are not specifically set forth in this description. Their form can be modified advantageously, so that, first, the gases can be conducted among the tubes in various ways; second, the water caused to circulate in various ways through the tubes, and, third, steam to be superheated takes another course, either in a reverse or a divided manner through the superheating-tubes.

It will be observed in all the structures set forth the superheater is located in and forms substantially a part of the water-leg and comprises substantially downtake and uptake tubes connected to an upper head, which is either independent of or formed by or within the steam-drum. These superheating-tubes may be continuous or for the convenience of construction connected at their opposite ends to a steam-head common to all of them, said steam-head forming a union between the two sets of tubes. The superheater is protected by a wall of water-tubes from immediate contact by the gases at the fireplace.

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

1. The combination with a water-tube boiler provided with a casing, a steam-drum, and a water-drum, and water-tubes connecting them, of a tubular superheater between

the casing and water-tubes, and means to cause furnace-gases to pass downward between the water-tubes and the tubes on one side of the superheater and then between the casing and other side of the superheater-tubes, substantially as set forth.

2. The combination with a water-tube boiler having steam and water drums, and water-tubes connecting them, of a superheater comprising a series of tubes both ends connected to a head forming part of the steam-drum, one end of said tubes opening into the steam-space of the steam-drum and the other end into a steam-chamber formed in said drum, substantially as set forth.

3. In a water-tube boiler, the combination with the steam and water drums and water-tubes connecting them, of a superheater connected to the steam-drum and comprising a series of tubes, the water-tubes arranged to form a deflecting-wall with passages near the steam-drum, whereby furnace-gases will be admitted to the superheater at the top and means to direct the gases downward and then upward through the superheater, substantially as set forth.

4. In a water-tube boiler, steam and water drums, and water-tubes connecting them, a superheater comprising an upper and a lower water-head, steam-tubes connecting them, said tubes having the same general direction and located beside the water-tubes, said water-tubes arranged to form a wall with passages near the steam-drum to admit furnace-gases at the top of the superheater and means to direct said gases downward and then upward through the superheater, substantially as set forth.

5. In a water-tube boiler, the combination with the steam and water drums, and water-tubes connecting them, of a superheater comprising an upper head formed within the steam-drum and a lower head forming part of the water-drum, and steam-tubes connecting said heads, substantially as set forth.

6. The combination with a water-tube boiler having steam and water drums, and tubes connecting them, of a superheater comprising a head forming part of the steam-drum, one end of said tubes entering the steam-space and the other end terminating within a chamber forming part of and within the steam-drum, substantially as set forth.

7. In a water-tube boiler, the combination with the steam and water drums, and water-tubes connecting them, of a superheater comprising an upper and a lower head, and steam-tubes connecting them, the direction of said steam-tubes being substantially parallel to the water-tubes and located to one side of them, substantially as set forth.

8. In a water-tube boiler, the combination with the steam and water drums, and water-tubes connecting them, of a superheater comprising an upper and a lower head, and steam-tubes connecting them, some of said steam-tubes arranged to form a medial deflecting-

wall, whereby furnace-gases will be directed down one side and up the other side of said superheater, substantially as set forth.

9. The combination with a water-tube boiler having steam and water drums and water-tubes connecting them, of a superheater comprising an upper head forming part of the steam-drum, and a lower head, said heads connected by steam-tubes, and a deflecting-wall in the superheater formed by the juxtaposition of some of said steam-tubes, substantially as set forth.

10. The combination with a water-tube boiler having steam and water drums, water-tubes connecting them and a fireplace, of a superheater comprising an upper head forming part of the steam-drum and a lower head, said heads connected by steam-tubes adjacent the fireplace, said steam-tubes having substantially the same direction as the water-tubes, substantially as set forth.

11. The combination with a water-tube boiler having steam and water drums and water-tubes connecting them, of a superheater comprising a divided upper head, a steam connection between one side thereof and the steam-space of the steam-drum, and a lower head, said heads connected by steam-tubes, substantially as set forth.

12. The combination with a water-tube boiler having steam and water drums and water-tubes connecting them, of a superheater comprising a divided upper head, a steam connection between one side thereof and the steam-space of the steam-drum, a lower head, suitably-curved tubes connecting the heads and a deflecting-wall formed by the juxtaposition of some of the steam-tubes intermediate their ends, substantially as set forth.

13. The combination with a water-tube boiler having a fireplace, steam and water drums, water-tubes connecting them, of a superheater, comprising a chamber formed in the steam-drum, a lower head, and steam-tubes connecting the steam-space of the boiler with the lower head and similar tubes connecting the lower head with said chamber, a protecting-wall of water-tubes between the fireplace and superheater bent at their ends to form passages for the furnace-gases and a damper controlling the passages of the gases therethrough, and a wall dividing the water-leg to separate the superheater from the water-tube portion, substantially as set forth.

14. The combination with a water-tube boiler having steam and water drums, and water-tubes connecting them, a wall dividing the water-tubes into two sets and a superheater comprising a lower head and an upper head forming part of the steam-drum, and a plurality of deflecting-walls formed by the juxtaposition of some of the steam-tubes intermediate their ends, substantially as set forth.

15. The combination with a water-tube boiler, comprising two steam and three water drums, water-tubes connecting them, of a superheater between the steam-drums com-

prising a divided upper head one side thereof
connected to the steam-spaces of the steam-
drums and the other side to a service-pipe, a
lower head and steam-tubes connecting them,
5 and dampers to control the admission of fur-
nace-gases to the superheater, substantially
as set forth.

In testimony that I claim the foregoing as
my invention I have signed my name in pres-
ence of two subscribing witnesses.

RICHARD SCHULZ.

Witnesses:

JOHANNES HEIN,
WOLDEMAR HAUPT.