3 Sheets—Sheet 1.

J. McCORMICK.

Compound Retort and Boiling Apparatus.

No. 32,636. Patented June 25, 1861.

Fig. 5

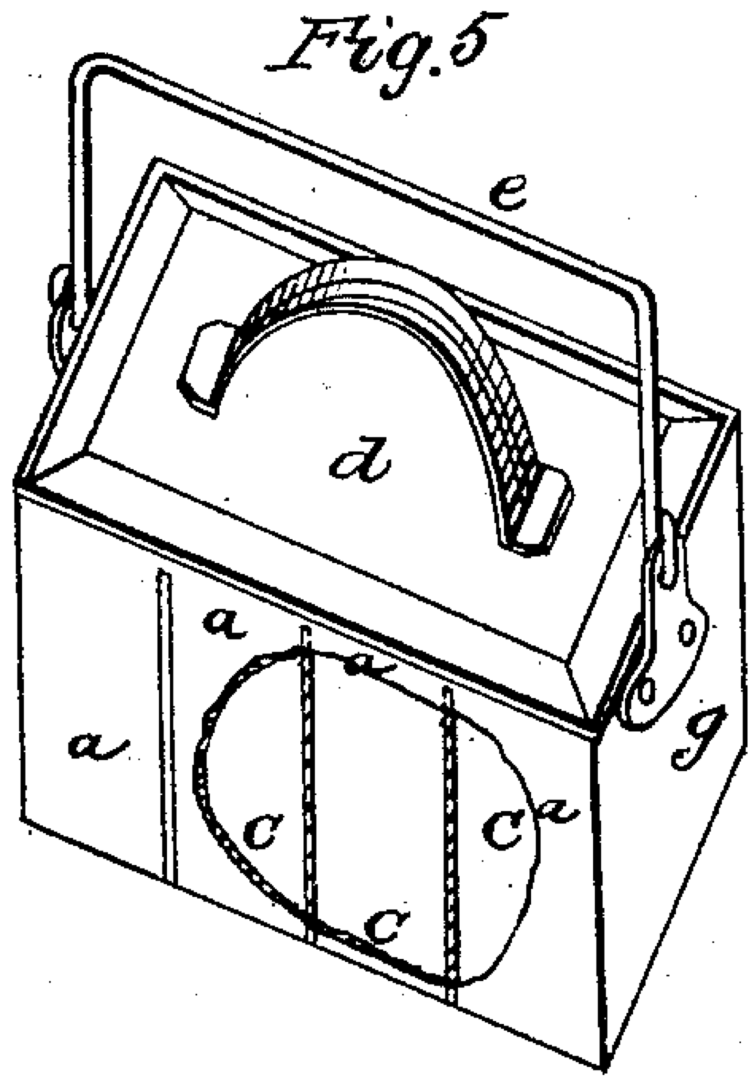


Fig. 1

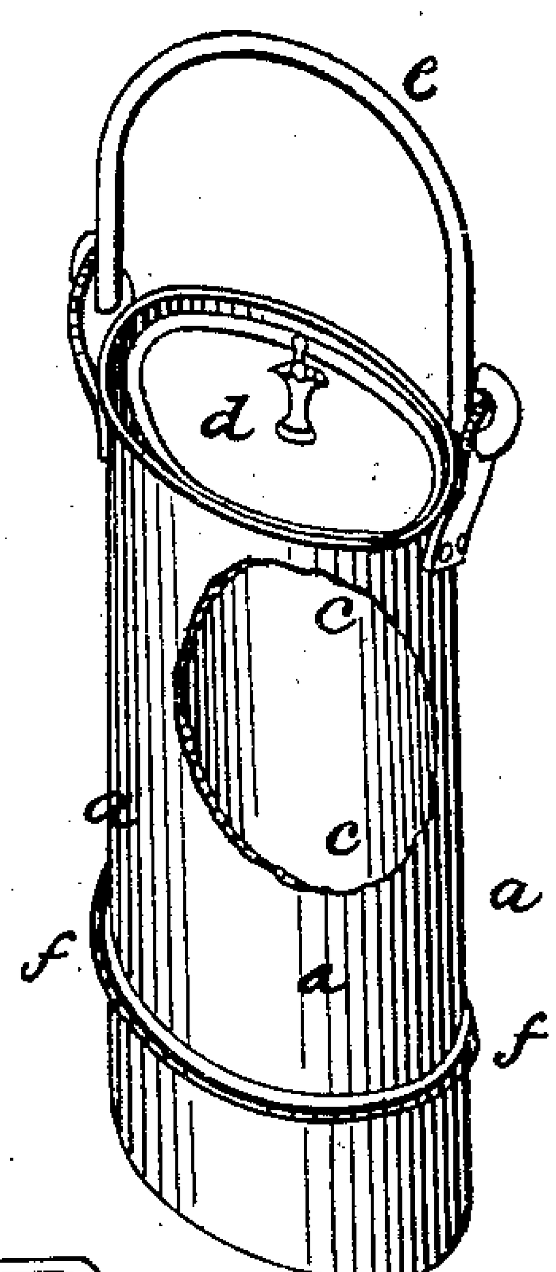


Fig. 2

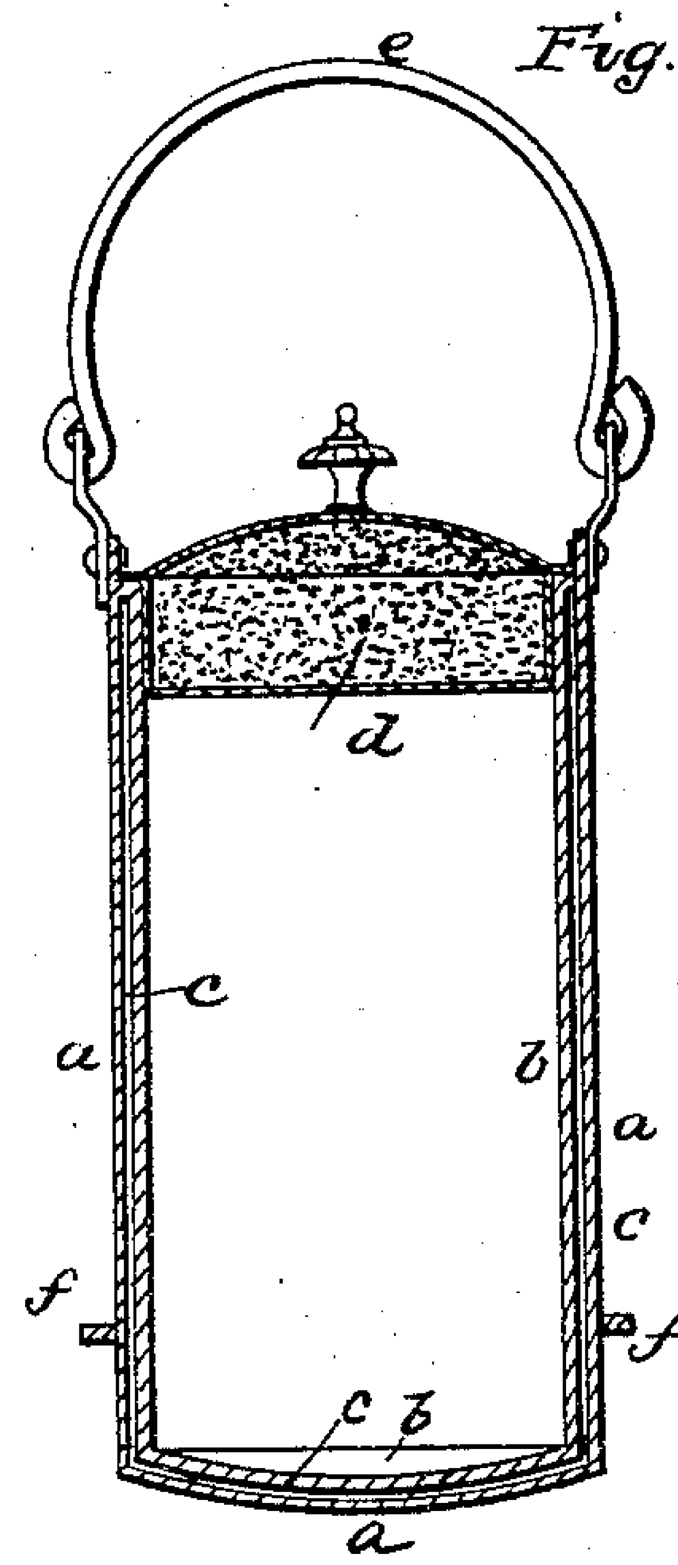


Fig. 6

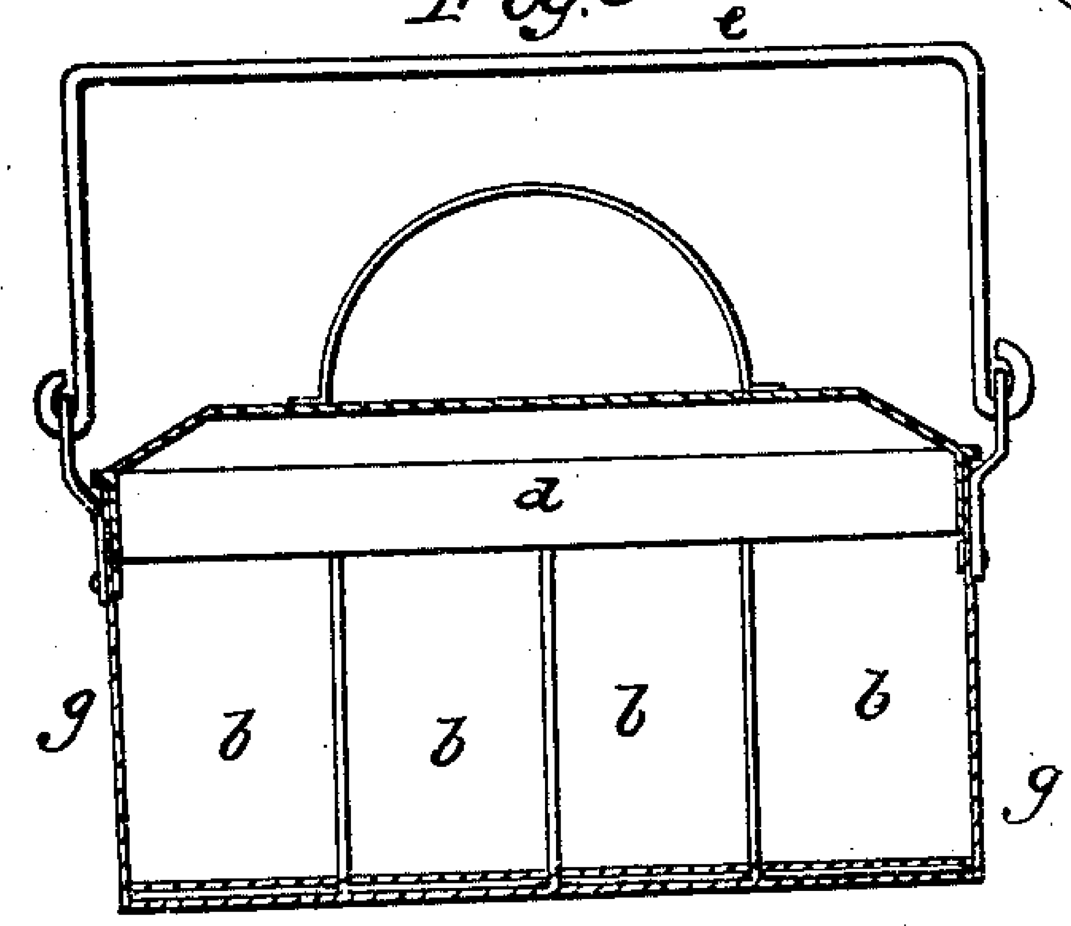
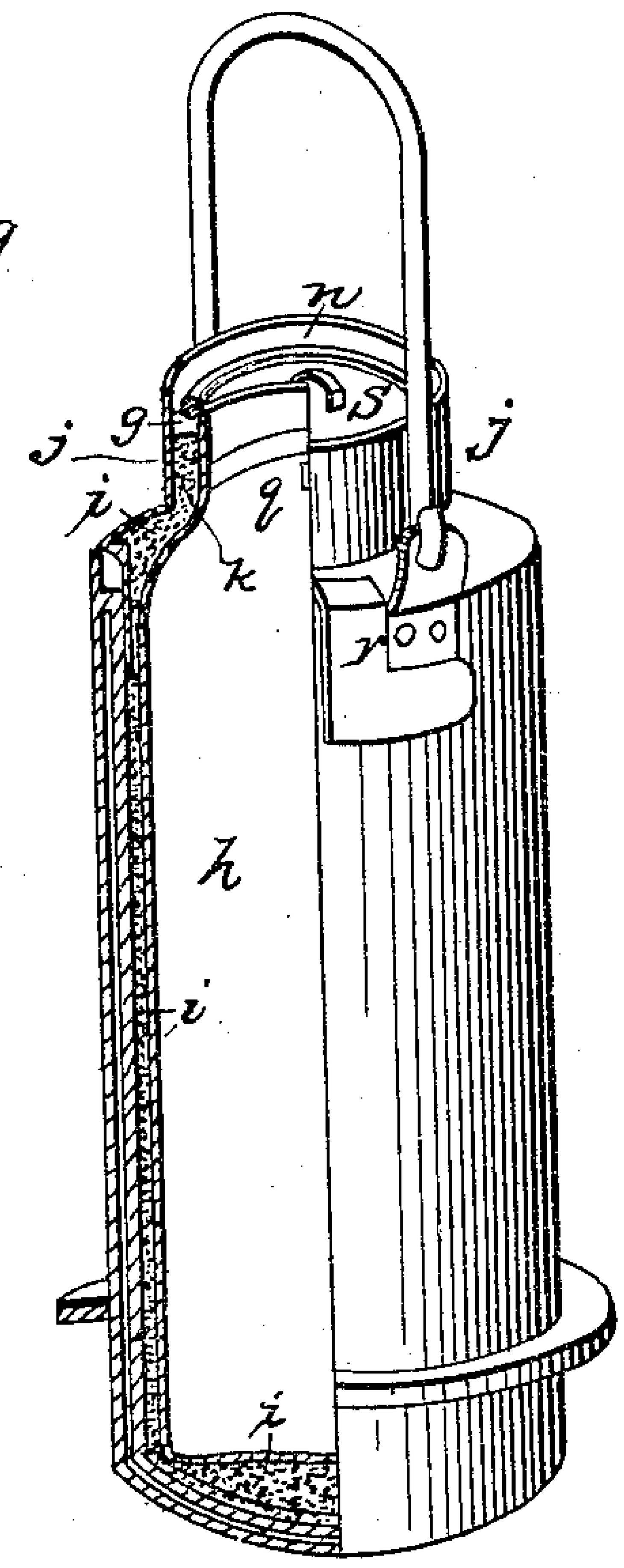


Fig. 3



Witnesses
[illegible]
[illegible]

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3 Sheets—Sheet 2.

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Compound Retort and Boiling Apparatus.

No. 32,636. Patented June 25, 1861.

Fig. 4

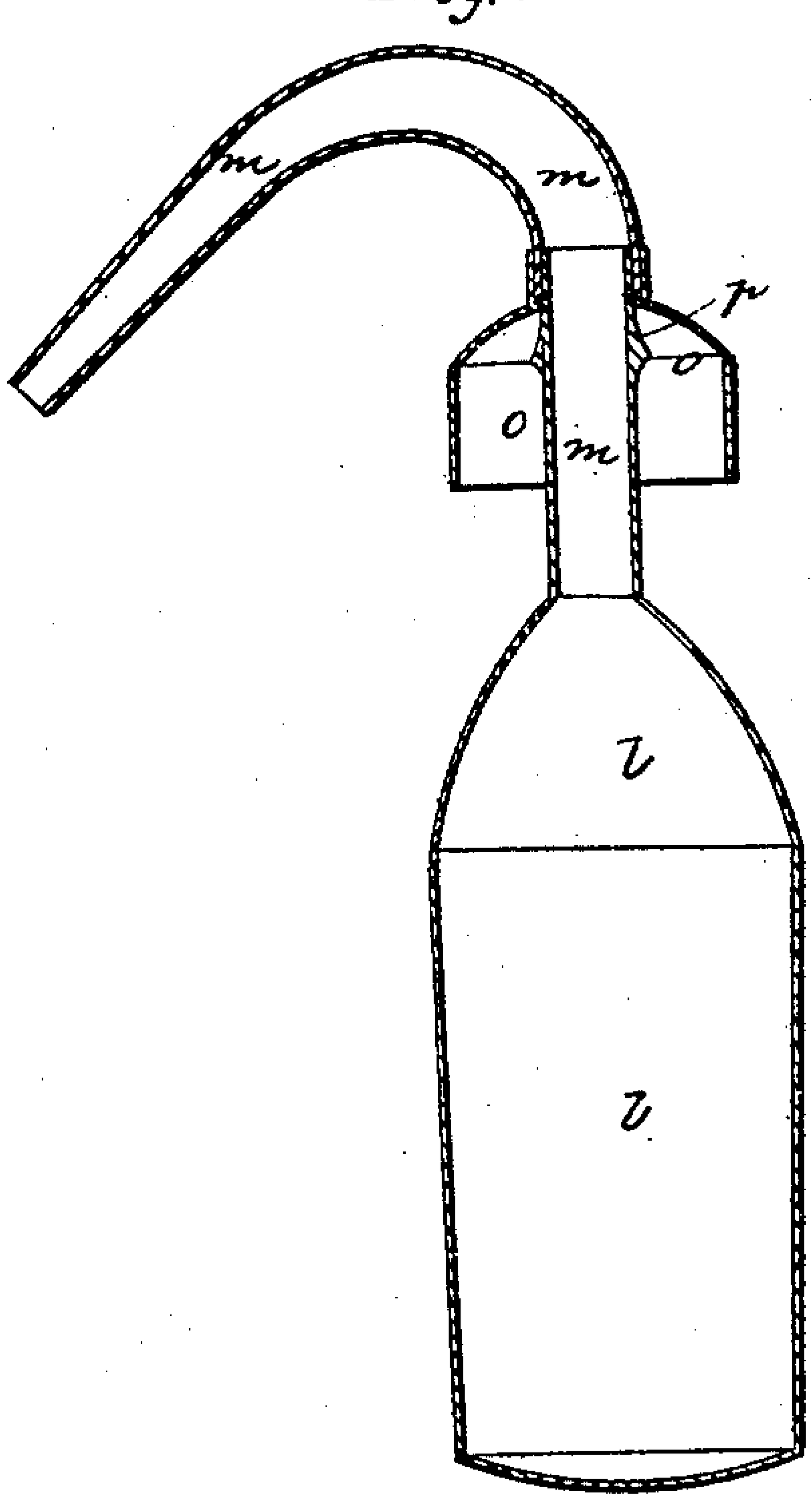


Fig. 7

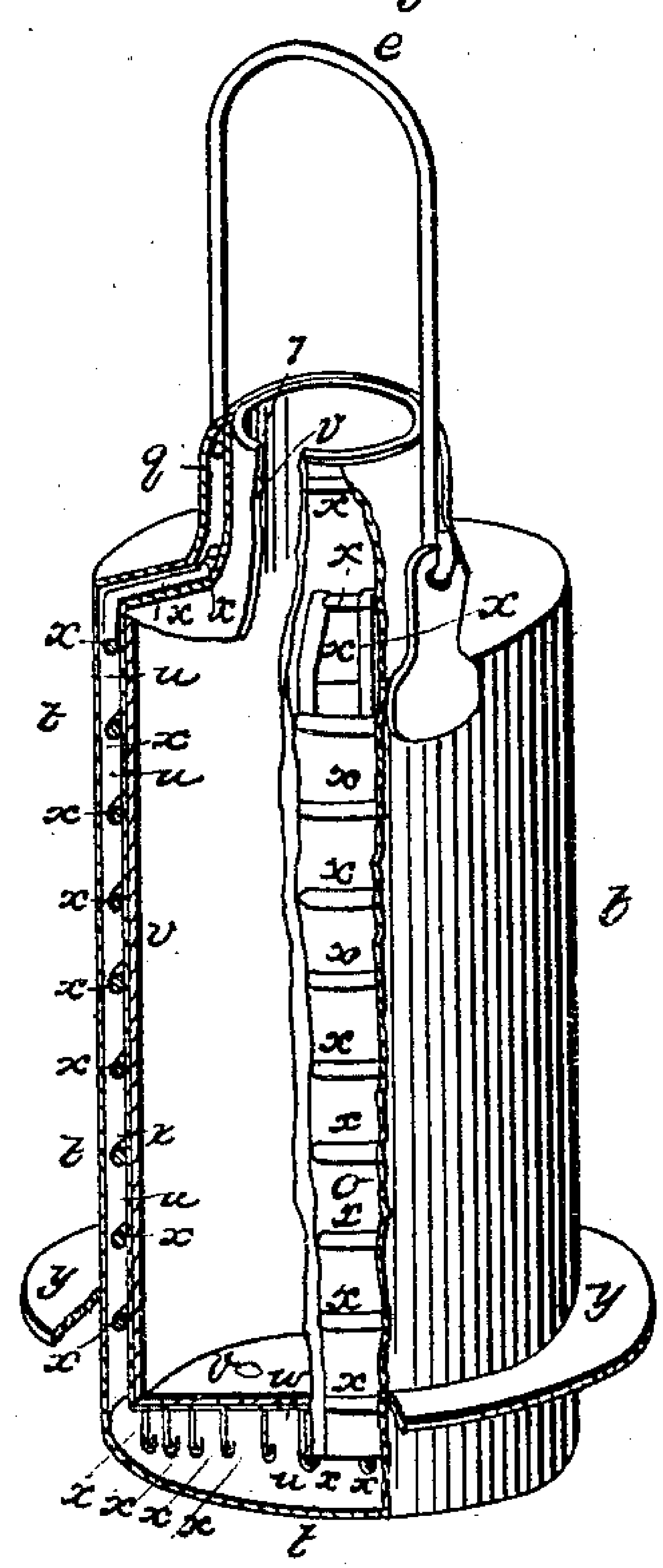
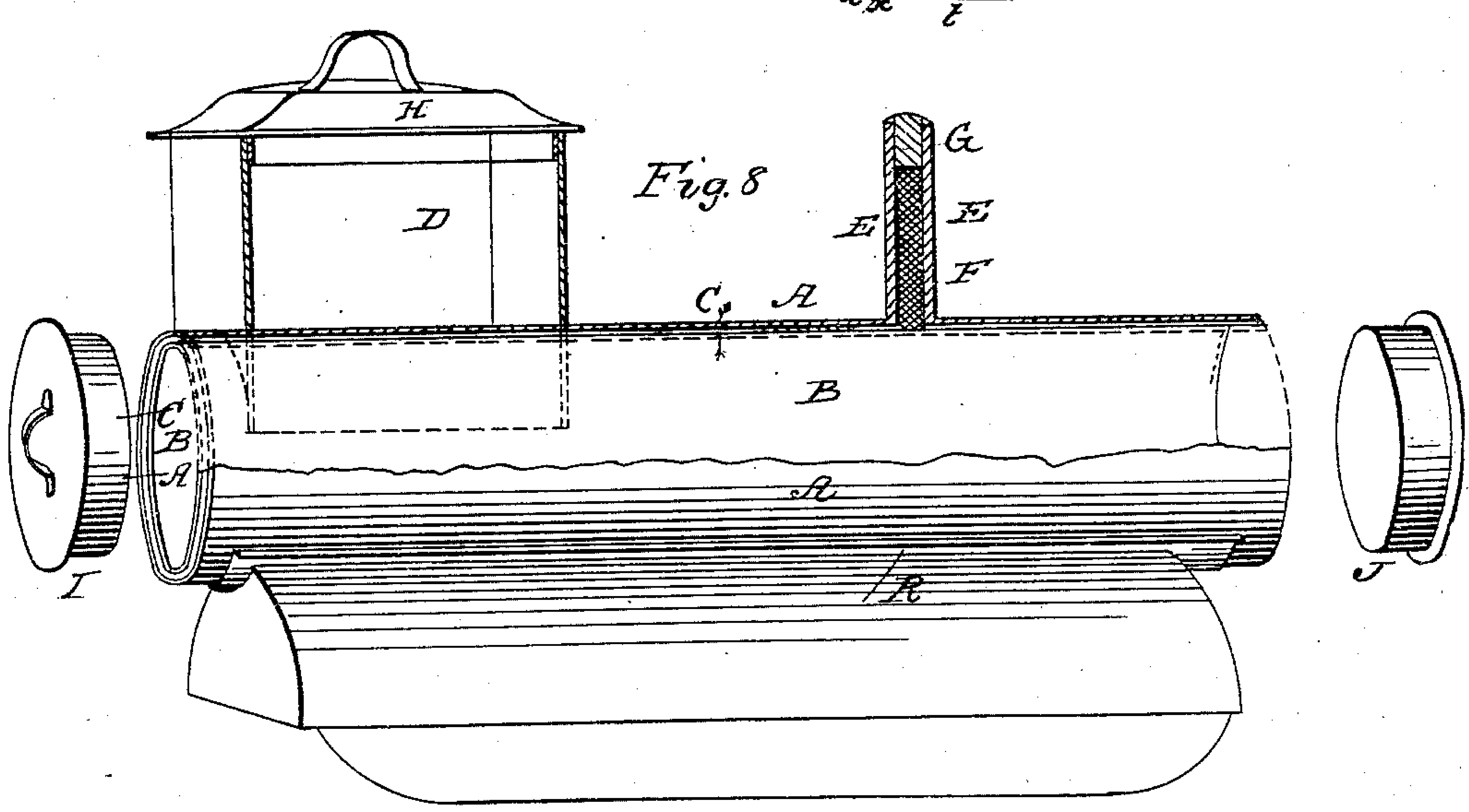


Fig. 8



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Compound Retort and Boiling Apparatus.

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Fig. 9.

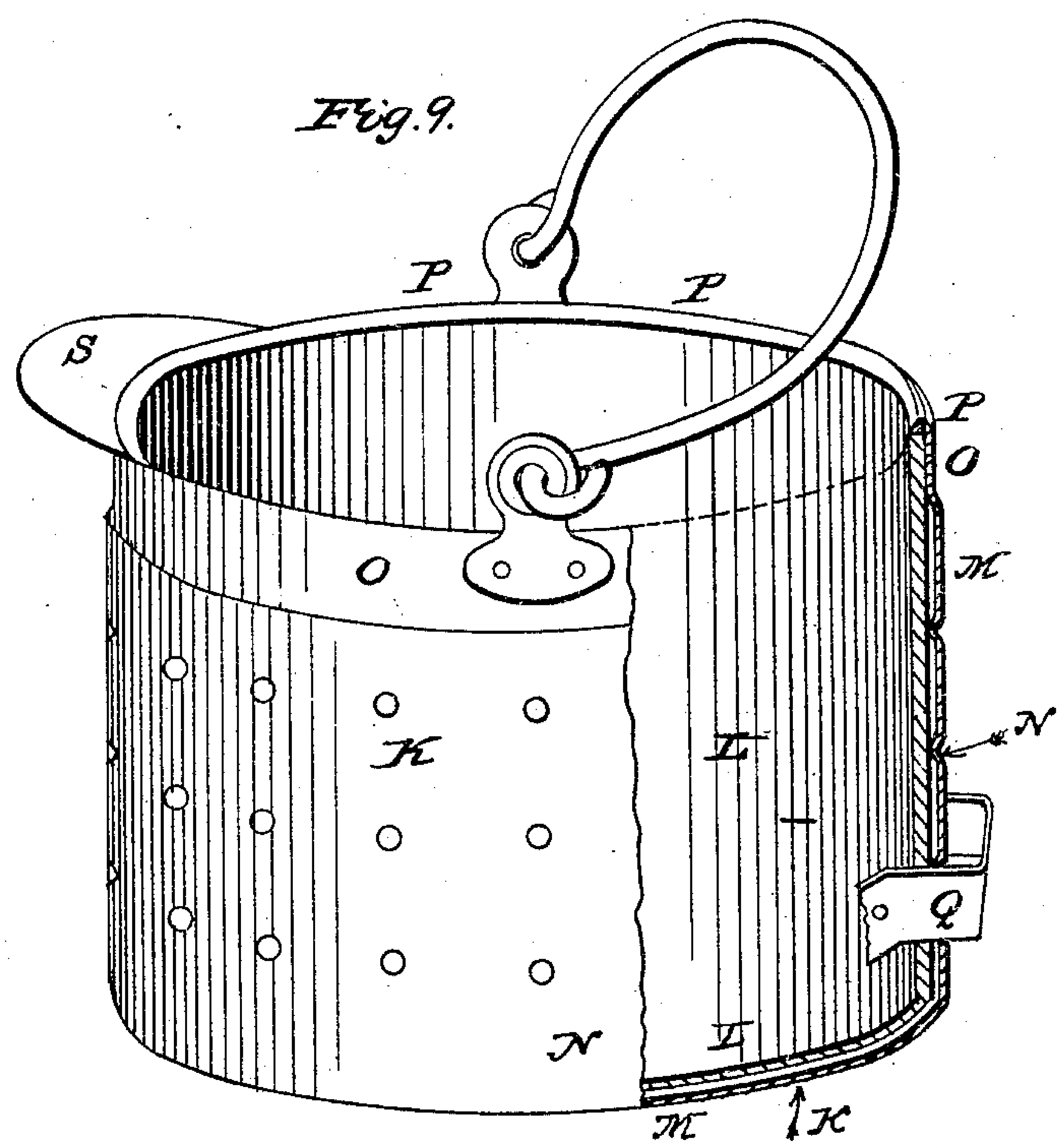
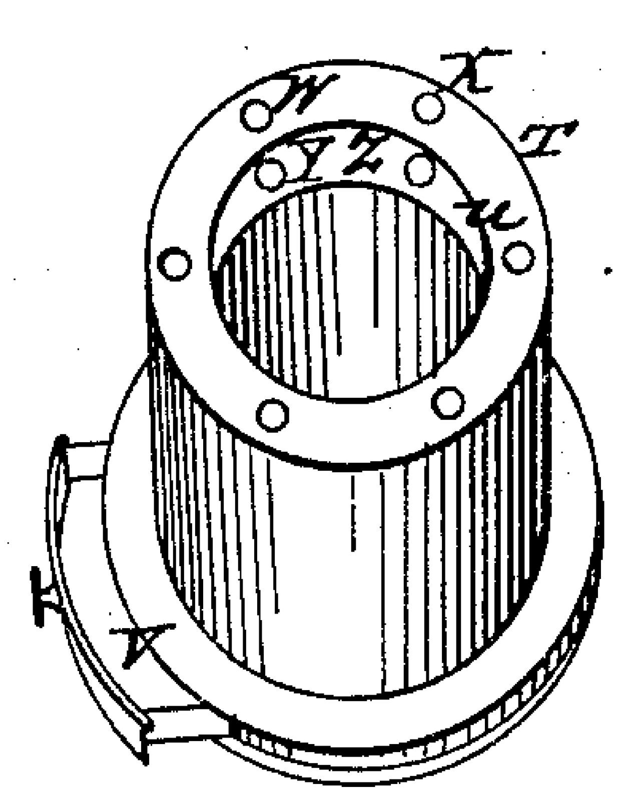


Fig. 10



Witnesses

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UNITED STATES PATENT OFFICE.

JOHN McCORMICK, OF MADISON, INDIANA.

IMPROVED BOILING APPARATUS.

Specification forming part of Letters Patent No. **32,636**, dated June 25, 1861.

To all whom it may concern:

Be it known that I, JOHN McCORMICK, of Madison, in the county of Jefferson, in the State of Indiana, have invented new and useful Apparatus termed "McCormick's Water-Heat-Equalizing Compound Retort and Boiling Apparatus," for chemical, culinary-chemical, and various other purposes; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification, in which—

Figure 1 is a perspective and Fig. 2 a longitudinal sectional view of apparatus marked No. 1; Fig. 3, a longitudinal sectional view of apparatus marked No. 1, combined with a glass jar and iron borings or their equivalent; Fig. 4, a longitudinal sectional view of apparatus marked No. 2; Fig. 5, a perspective and Fig. 6 a longitudinal sectional view of apparatus marked No. 3; Fig. 7, a longitudinal sectional view of apparatus marked No. 4; Fig. 8, a sectional view of apparatus marked No. 5; Fig. 9, a sectional view of apparatus marked No. 6; Fig. 10, a perspective view of the furnace for apparatus No. 1.

Some of the chief advantages in the use of this invention, which are not to be derived from the use of the common water-heat-equalizing (or glue-pot) arrangement or of vessels heated by jets of steam, are its superior portability; the economy of its construction and its durability, especially upon a large scale; the very great economy in the use of fuel; the great speed of its action—boiling, boiling rapidly, even baking—by which speed very superior work can be done in the desiccation of fruits; its convenience in not needing the water replenished, and much more uniform action being thereby attained than is attained by the glue-pot arrangement; its superior safety from injury by frost.

Some of the chief advantages to be derived from the use of this invention, which are not to be derived from the use of any of the various steam-heat-equalizing devices in which the steam is held under pressure for obtaining a temperature above 212° Fahrenheit, are, first, its perfect safety as to explosive action even in the hands of the most inexperienced persons, which safety arises from the peculiarly diminutive quantity and disunited condition of the water in the air-tight water chamber or chambers and the diminutive strength of the apparatus for holding the water under pressure; secondly, its being better adapted to come into general use, and for a greater variety of purposes, which adaptation arises from its safety, its simplicity and economy in being without a valve and valve-gear, in being more portable and durable, which portability and durability arise from its peculiar mechanical construction in having the heating, evaporating, and baking and irradiating surface of the apparatus so arranged as to perpetually retain the water in the air-tight water-chamber, which of course requires a smaller quantity of water than when it would be occasionally wasting. The water being perpetually retained prevents the safety of the apparatus (from injury by the fire) from depending upon a contingency. This perpetual retention of the water causes the action of the apparatus to be for all ordinary purposes much more uniform, therefore being better suited for boiling, baking, and for retorts, &c., as more fully described hereinafter.

The letters marked on the above-mentioned drawings refer to their different parts, as follows:

In Fig. 1, at *a a a* is represented the outer part, at *c c c* a fragment of an air-tight water-chamber, at *d* a lid, at *e* a bail, and at *f f* a flange.

In Fig. 2, at *a a a* is represented the outer part, at *b b b* the inner part, at *c c c* the air-tight water-chamber, at *d* a lid, at *e* a bail, and at *f f* a flange.

In Fig. 3, at *h* is represented a glass jar, at *i i i* metallic borings or their equivalent, at *j j* a lid, at *r* a projecture of the lid to keep it in its place by sliding under the eyes of the vessel, at *s* a lid for the glass jar, at *k k* a space between the neck of the jar and the lid *j j*, and at *q q* gum-elastic or other packing.

In Fig. 4, at *l l* is represented the body of a retort, at *m m m* the neck of the retort, at *o o* a lid, and at *p* an enlargement on the neck of the retort.

In Fig. 5, at *a a a a* is represented the outer part, at *c c c* fragments of air-tight water-chambers, at *d* a lid, at *g* an end plate, and at *e* a bail.

In Fig. 6, at *b b b b* is represented the inner part, at *c c c c* the air-tight water-chamber, at *d* a lid, at *e* a bail, and at *g g* the end plates.

In Fig. 7, at *t t t t* is represented the outer part, at *u u u u* the air-tight water-chamber, at *w w w* the inner part, at *v v v v* a flint-glass jar at the exit-ribs, at *y y* a flange, and at *e* a handle.

In Fig. 8, at A A A is represented the outer part, at B B the inner part, at C C the air-tight water-chamber, at D a single sheet-metal boiler, at E E a tube, at F gum-packing, at G soft solder, at H a lid, at I and J lids for apparatus marked No. 5, and at R a loose flange.

In Fig. 9, at K K is represented the outer part, at L L the inner part, at M M the air-tight water-chamber, at N N compressions of the outer part in against the inner part, at O O the part of the vessel in which both the inner and outer part are in actual contact for protecting the soft-solder joint at the top of the vessel from injury by heat, at P P P a soft-solder joint which is formed by filling up with solder the triangular corner which is formed by bending the upper edge of the outer part in over the square outer corner of the inner part, at Q a side handle, and at S a lip.

In Fig. 10, at T is represented a movable top of the furnace upon which the flange of apparatus No. 1 rests, at U a disk or circular plate to strengthen the furnace and to prevent the direct action of the fire on apparatus No. 1 except on its bottom, at V a drawer by which the draft of the fire can be controlled, and at W X Y Z part of a number of draft-openings from the fire.

The vessel illustrated by Figs. 1 and 2 is a sheet-copper vessel about six inches in depth and three inches in diameter, having between its inner and outer part an air-tight water-chamber about one thirty-second part of an inch in thickness and about sixty inches in area, filled, with the exception of about one-sixteenth part of its space, with water. (This exception is not indispensable. It helps to protect the vessel from pressure of water which would arise from frost or other causes.) The space not containing water contains air, the vessel being hermetically sealed, thus constituting the contents of the air-tight water-chamber a fixed, permanent, unevaporating part of the vessel. The strength of the vessel is such as to retain the water and air in the air-tight water-chamber under a pressure of about five hundred pounds to the square inch, the water being at a temperature of about 467° Fahrenheit's thermometer. The lid is double, having a body of dry charcoal (or any other good non-conductor of heat) about one inch in thickness between its upper and lower parts. The bail is an ordinary one. The flange is wrought-iron, about one-eighth of an inch in thickness and three-eighths of an inch in width. The portion of the vessel below the flange is to be fire or heating surface. This vessel will bear to remain without any water or other substance except atmospheric air in it without rupturing on a fire that is large enough or heater that is hot enough (such as a common charcoal fire five inches in width and three and one-half inches in depth would be if placed in a furnace suitable to receive the vessel) to boil water rapidly, if contained by it, the strength of the vessel being such as to retain the water in the air-tight water-chamber under a pressure that will admit of the vessel being at so much higher temperature than it would be while water would be boiling in it that the increase in the speed of radiation of heat will take the place of the boiling of the water in its cooling effect, but at a higher temperature, the temperature of the vessel being sufficiently intense to bake bread and for various other purposes where a high temperature is needful.

The same intensity and quantity of heat needful to be applied to the above-mentioned vessel to carry on the action of baking will answer well for the very rapid boiling of fruits, the evaporation of the watery parts of the fruits in boiling very rapidly diminishing the temperature of the vessel, thus protecting the fruits from burning as long as they will need to be boiled.

To better adapt a vessel for the concentration of fruits and such other purposes as will not need so high a temperature as above mentioned, a convenient preserving-vessel similar to apparatus marked No. 6 (which will boil succulent fruits and similar semi-fluid substances rapidly, but that would be injured by remaining on the fire without containing some such evaporable substance) can be made. Thus I use for the inner part a tinned or enameled cast-iron vessel of twelve and a half inches in depth and nine inches in width, and for the outer part a sheet-metal vessel with a small aperture in its side, the two to be soldered or otherwise fastened together at the top, thus constituting it one vessel, having an air-tight water-chamber one sixteenth of an inch in thickness and four hundred inches in area between its inner and outer part. The air-tight water-chamber is to be filled with water, the one-sixteenth part of its space excepted, which one-sixteenth part may contain air. The water can be admitted into the air-tight water-chamber through the above-mentioned aperture, which has been made and left open for that purpose. The aperture is then to be soldered or otherwise hermetically sealed, thus constituting the contents of the air-tight water-chamber a fixed, permanent, unevaporating part of the vessel. The strength of the vessel is to be sufficient to hold the water in the air-tight water-chamber under a pressure of about one hundred pounds to the square inch. This pressure will admit of a temperature of about 330°. If a soft-solder joint is used in fastening the inner part to the outer part, the vessel can be made about one inch and a half deeper than above mentioned, so as to admit of having the inner and outer part in actual contact from the top of the vessel to the distance of about one inch and a half down its side without diminishing the area of the air-tight water-chamber, thus protecting the soft-solder joint from the heat, which would otherwise be transmitted to it by the contents of the air-tight water-chamber. The sides of the outer part of the vessel can be bent or set in against the inner part at about one point for every inch and a half square of the outer surface which is not fire-surface. This indentation is to be to some extent uniformly divided and made before the water is admitted into the air-tight water-chamber. This indentation, although slightly diminishing the size of the air-tight water-chamber, will leave it of sufficient capacity. The use of this compression of small parts of the outer part in against the inner part is to strengthen the inner part by helping to keep it in a cylindrical form and to prevent the wear of the thin outer part, which would be caused by its flexion, arising from the different amounts of pressure to which the vessel will be subjected. The inner part of this vessel, being cast metal, must be superior to the outer part in strength, so that in case of a rupture of the vessel the outer part would be first to yield. This vessel can be used upon an ordinary cook-stove opening by having a flange on the vessel about one inch and a half from its bottom.

To give the last-above described preserving-vessel proper strength, the inner part should be about one-tenth or one-twelfth of an inch in thickness. Its outer part can be made of sheet-copper about one-thirtieth or one-fortieth of an inch in thickness. The bottoms should be slightly thicker than the sides. The thickness of both bottoms and sides will of course depend upon the quality of the materials used. Its bottom should be convex enough to have its center about one-inch below its outer circumference when the vessel is standing vertically.

Fig. 3 represents a view of apparatus marked No. 1, in combination with a glass jar and iron borings, the use of the iron borings being to fill the space between the inner part of the vessel and the glass jar, to protect the jar from breaking by concussions, and also to act as a conductor of heat. The lid has an opening in its center large enough for the neck of the glass jar to pass through and leave a small space between the neck of the jar and the lid. The use of this lid and the elastic packing is to retain the borings in their place. The borings should be about uniformly distributed between the jar and the vessel containing them. The space between the neck of the jar and the lid, with the exception of where the packing is placed, should be filled with metallic borings to keep the different parts of the glass at as uniform temperature as possible. Vessels of different sizes and materials may be used in the place of the glass jar, the opening in the lid and the quantity of metallic borings being increased or diminished to suit the different sizes. When a glass jar is used in this combination, the mouth of the jar should not stand much if any above the top of the vessel on account of the necessity of keeping the different parts of the glass at about a uniform temperature.

Fig. 4 represents a view of apparatus marked No. 2, which can be used in combination with apparatus marked No. 1 instead of the glass jar, the lid of Fig. 4 being movable on the tube of the retort, and, being of a proper size to fit the opening in the center of the lid of Fig. 3, No. 3 will answer to be slid down the neck of the retort and over the upper part of the lid of Fig. 3 until it will fit tightly enough on it and on the enlargement on the tube of the retort to keep the metallic borings in their proper place around the retort as they have been kept around the glass jar. This retort can be of glass or any other suitable material for retorts. If it be of glass it should not come into actual contact with the solid metal of the outer retort at any point at which the temperature of the parts coming into contact would not be similar. The metallic borings can be kept from passing out between the neck and lid by luting or otherwise. The neck of the retort can be without a joint and can pass out through an opening that may be made in the upper part of the side of lid *o o*.

The apparatus marked No. 1 and illustrated by Figs. 1 and 2 can be used as a single heat-equalizing retort by removing lid *d* and placing the vessel in combination with the lid *j j*, the lid *o o*, and the part of the neck marked *m m*. The neck *m m* and lid *o o* and lid *j j* and lid *o o* can be luted or otherwise fastened together. The lid *j j* can be fastened in the same manner to the mouth of the vessel which is illustrated by Figs. 1 and 2, thus preparing it to be joined to an alembic or condenser. The vessel illustrated by Figs. 5 and 6 is a sheet metal vessel about five inches in length, two and one-half inches in depth, and two and a half inches in width, having its sides and bottom formed by the joining together of four air-tight water-chambers, which extend around the vessel from the top of one side to the top of the opposite side. The vessel is finished by closing up the ends with the single sheet-metal end plates. The end plates not being air-tight, water-chambers are not designed to have any part of them used as fire-surface. The bottom of the vessel is to be used as fire-surface. The lid and handle are of the ordinary kinds.

Apparatus marked No. 4 is a sheet-metal vessel about seven inches in depth and three inches in diameter. It consists mainly in the proper union of four parts—the inner part, the outer part, the contents of the air-tight water-chamber, (which are about eleven cubic inches of water and one and one-half cubic inch of air,) and a flint-glass jar. This piece of apparatus is constructed by wrapping all the outer surface of the jar with sheet-tin, the tin to be soldered together in such a way as to bring it closely against the jar. To strengthen this tin that it will bear a pressure of one hundred and fifty pounds to the square inch without collapsing to the injury of the glass, a number of ribs of brass wire of about one-eighth of an inch in diameter are lapped around it and soldered firmly to it. There are also about sixteen or eighteen ribs of similar material bent in such a form as to pass from the top of the wire which is nearest to the top of the body of the vessel over the shoulder of the inner part until they reach the bottom rib of the neck, against which they are soldered, their ends being flattened to give them a proper bearing, as shown by the rib which is exposed to view at the shoulder of the vessel on the left side of Fig. 7. These ribs are also soldered to the inner part the whole of their length. In soldering the inner part around the glass jar or in soldering the ribs to the inner part great care must be taken to keep the glass at as uniform a temperature as possible by having it filled with some substance at a temperature near the melting-point of solder, or by soldering at various parts before finishing at any part, so as to heat it uniformly. There are also thirteen heavy sheet-tin ribs soldered to the bottom of the inner part to prevent it from being pressed with too much force against the glass jar. An end view of seven of these ribs, showing flanges turned on their lower edges, is given at the left side of the bottom of Fig. 7. The outer part is made of heavy sheet-tin, with the exception of the bottom, which is of sheet-copper of about one-sixteenth of an inch in thickness. Its side seam of the outer part has a lap of about one inch. The side seam of the inner part has less than one-inch lap. The other seams of this vessel have laps of about one-eighth of an inch, all the seams being soldered with soft solder. The inner and outer parts are soldered together at the top. The inner and outer parts are sufficiently distant from each other to admit of a circulation of water between them. To prevent the outer part from coming into contact with the ribs of the inner part near the bottom of the vessel, so as to obstruct the circulation of the water on one side of the vessel, several slender strips of wire are soldered to the lower ribs running lengthwise of the inner part and across the ribs, to which they are soldered. This vessel is designed to hold the water in the air-tight water-chamber at a pressure of about one hundred pounds to the square inch.

The apparatus marked No. 5 is designed for boiling and baking at the same time. For baking alone, the heating-surface, in proportion to the radiating-surface and the intensity of heat applied to it, should be similar to that of apparatus No. 1 when it is used for baking, and boiler D would have to be soldered with hard solder in its lower parts, which attach it to the copper. When boiling and baking are done at the same time, this will not be needful if the substance boiling boils at about 212°; but the heating-surface will have to be about double. (The heating-surface of apparatus No. 5 can be regulated by the size of the opening in flange R or the size of the opening in the furnace in which the apparatus is placed, thus suiting it for different purposes.) When it is used for boiling ordinary succulent fruits or similar semi-fluid substances, the lid can (as in the case of the other vessels of this invention herein described) be kept on as long as the fruits will need to boil, which will almost entirely exclude the air from the article which is being acted upon, which exclusion arises from the escaping of the steam under tension from the article which is being acted upon, (the tension or pressure of this steam will depend upon the weight of the lid and the rapidity of the boiling,) thus very much protecting the contents of the vessel from the oxygen of the air, dust, ashes, smoke, &c. For the purpose of distillation the lid can be luted on and have a tube to carry the steam from it to a condenser, being arranged similar to apparatus No. 1 and its combinations. This apparatus No. 5, for baking purposes, would be more convenient to be in some one of the forms of ordinary brick bake-ovens.

To use apparatus No. 5 for the making of gas from oil or other substances where destructive distillation is carried on, or for other processes requiring higher temperatures than mentioned in relation to any of the apparatus herein described, the materials for the construction of the apparatus must be varied to suit the articles to be acted upon in the particulars of their chemical affinities, the temperatures which they will need, &c. The air-tight water-chamber of this apparatus extends the full extent of the inner and outer parts. The use of the tube E E is for the admission of the water into the air-tight water-chamber, the hydraulic pressure of the water when poured into the tube accelerating the progress of the water as it flows to its proper place in the air-tight water-chamber after a sufficient quantity of water is admitted, leaving the tube empty of water. The gum packing F (or an equivalent substance) can be cut in disks of about one-fourth of an inch in thickness and be driven down the tube, fitting the tube closely and filling it up from the inner part, B B, to the solder, G, forming a compact body between them. The poor heat-conducting quality of the gum and the distance of the solder, G, from the outer part, A A, admits of the main body of the apparatus being hot enough to melt soft solder, or even at a higher temperature, without injury to the solder seal G. The use of said seal is to hermetically close the end of the tube for the permanent retention of the water in the air-tight water-chamber. When this method of sealing is not convenient, other means can be used.

The reasons for making a number of air-tight water-chambers in the construction of one vessel, as above described, is to avoid the difficulties in making large vessels or apparatus according to the table of construction contained in this specification in the particulars of making the air-tight water-chambers thin enough, and, when made thin enough, their deficiency in not transmitting heat rapidly enough.

In changing the form of the above-described apparatus, or of any other description of apparatus belonging to this invention, in giving it less height and more width, &c., than what is mentioned in the foregoing description, suiting it for a greater variety of baking, boiling, &c., it should be borne in mind that the safety and efficacy of this apparatus mainly depend upon the materials of construction, the thickness and areas of the air-tight water-chambers, the strength of the apparatus for holding water in them under pressure, the heat-transmitting power of their contents, and the amount of radiating and fire surface.

In making large apparatus of light materials, or in any case where the pressure would be too great to suit such materials as would be convenient, the inner and outer parts can be riveted or otherwise fastened together at various points to support each other in bearing the pressure; but where the air-tight water-chamber is entirely full of water the apparatus must be flexible enough to give room for the water to expand, as water expands while in a fluid state by being heated.

Where cast metal or other brittle materials are used in the construction of apparatus belonging to this invention, except when such materials are used in combination with wrought metal, as heretofore described, the thickness or area of air-tight water-chamber or the strength of apparatus for holding its contents under pressure must be diminished. The amount of diminution will depend upon the ductility of the materials used. If malleable cast metal be used, the diminution will need to be about nine-tenths.

To increase the area or the thickness of an air-tight water-chamber, or the strength of the apparatus for holding the water in it under pressure, are all about equal in their effect in the construction of the apparatus in the particular of the violence of the action which would take place in case of a rupture of the apparatus in using it, when the accompanying table of construction is taken as a guide.

The heat-transmitting power of water contained in the air-tight water-chambers depends upon the thickness of the layer of water contained, the temperature which it is at, and the direction in which the heat is being transmitted, a downward direction being least favorable and an upward one most suitable. If an air-tight water-chamber which is one thirty-second part of an inch in thickness be increased in height from six inches to twelve inches, it should be doubled in thickness also; or if it should be increased to a height of three or four feet its thickness should then be about one-eight or three-sixteenths of an inch. This thickness will answer for the effectual transmission of heat for all ordinary purposes; but where a very uniform temperature in the different parts of the vessel or apparatus is needful it must be doubled.

In constructing any apparatus appertaining to this invention the accompanying table of construction, or its equivalent, must be taken as a guide. Thus an apparatus having four hundred inches of area of air-tight water-chamber should have it one sixty-fourth of an inch in thickness, and the apparatus should have strength enough to hold the water in the air-tight water-chamber under a pressure of three hundred pounds to the square inch. The strength of an apparatus for holding the water in its air-tight water-chamber can be made less in proportion to the area or thickness of the air-tight water-chamber than is indicated by the table of construction, as also the thickness or area of an air-tight water-chamber can be made less in proportion to the strength of the apparatus for holding the water in it than is indicated in the table, when in the construction of an apparatus its heat-transmitting power and the temperature at which it is intended to be used, suiting it for the purpose for which it is intended, will admit.

The compliance with the table of construction and other parts of the specification will prevent all dangerous explosive action, even in case a rupture of the apparatus should occur.

TABLE OF CONSTRUCTION.

The areas of air-tight water-chambers in square inches.	The thickness of air-tight water-chambers in fractions of an inch.	The pressure in pounds to the square inch at which the apparatus will have strength to retain the water in the air-tight water-chambers.
6,400	$\frac{1}{64}$	25
3,200	$\frac{1}{64}$	50
1,600	$\frac{1}{64}$	100
800	$\frac{1}{64}$	200
400	$\frac{1}{64}$	300
200	$\frac{1}{64}$	400
100	$\frac{1}{64}$	500
50	$\frac{1}{64}$	600
25	$\frac{1}{64}$	700
6,400	$\frac{1}{32}$	$12\frac{1}{2}$
3,200	$\frac{1}{32}$	25
1,600	$\frac{1}{32}$	50
800	$\frac{1}{32}$	100
400	$\frac{1}{32}$	200
200	$\frac{1}{32}$	300
100	$\frac{1}{32}$	400
50	$\frac{1}{32}$	500
25	$\frac{1}{32}$	600
6,400	$\frac{1}{16}$	$6\frac{1}{4}$
3,200	$\frac{1}{16}$	$12\frac{1}{2}$
1,600	$\frac{1}{16}$	25
800	$\frac{1}{16}$	50
400	$\frac{1}{16}$	100
200	$\frac{1}{16}$	200
100	$\frac{1}{16}$	300
50	$\frac{1}{16}$	400
25	$\frac{1}{16}$	500

The foregoing table of construction may be extended by further additions to the upper or lower ends of the columns.

What I claim my invention, and wish to secure by Letters Patent, is—

An air-tight water-chamber containing water or its equivalent, said chamber being hermetically sealed, thereby retaining its contents, thus constituting them a fixed permanent unevaporating part of the apparatus, as set forth, and for the purposes specified in the foregoing specification.

JOHN McCORMICK.

Attest:
JOSEPH P. HOUGH,
G. B. CLARK.