

J. E. EGGLESTON.
 APPARATUS FOR UTILIZING SULFUR CONTAINING PETROLEUM.
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908,400.

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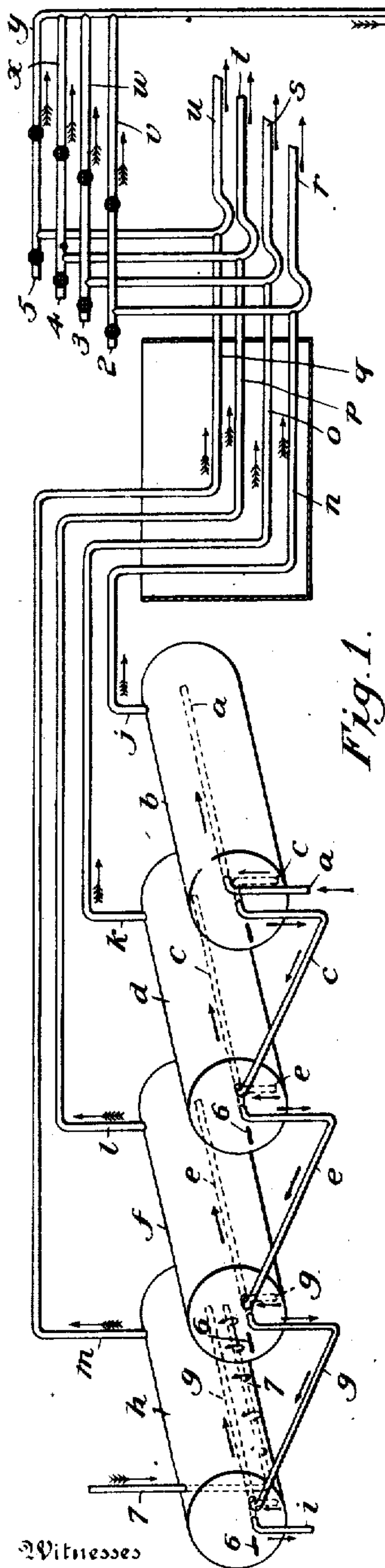


Fig. 1.

Witnesses

Edwin L. Bradford
 John E. Burch.

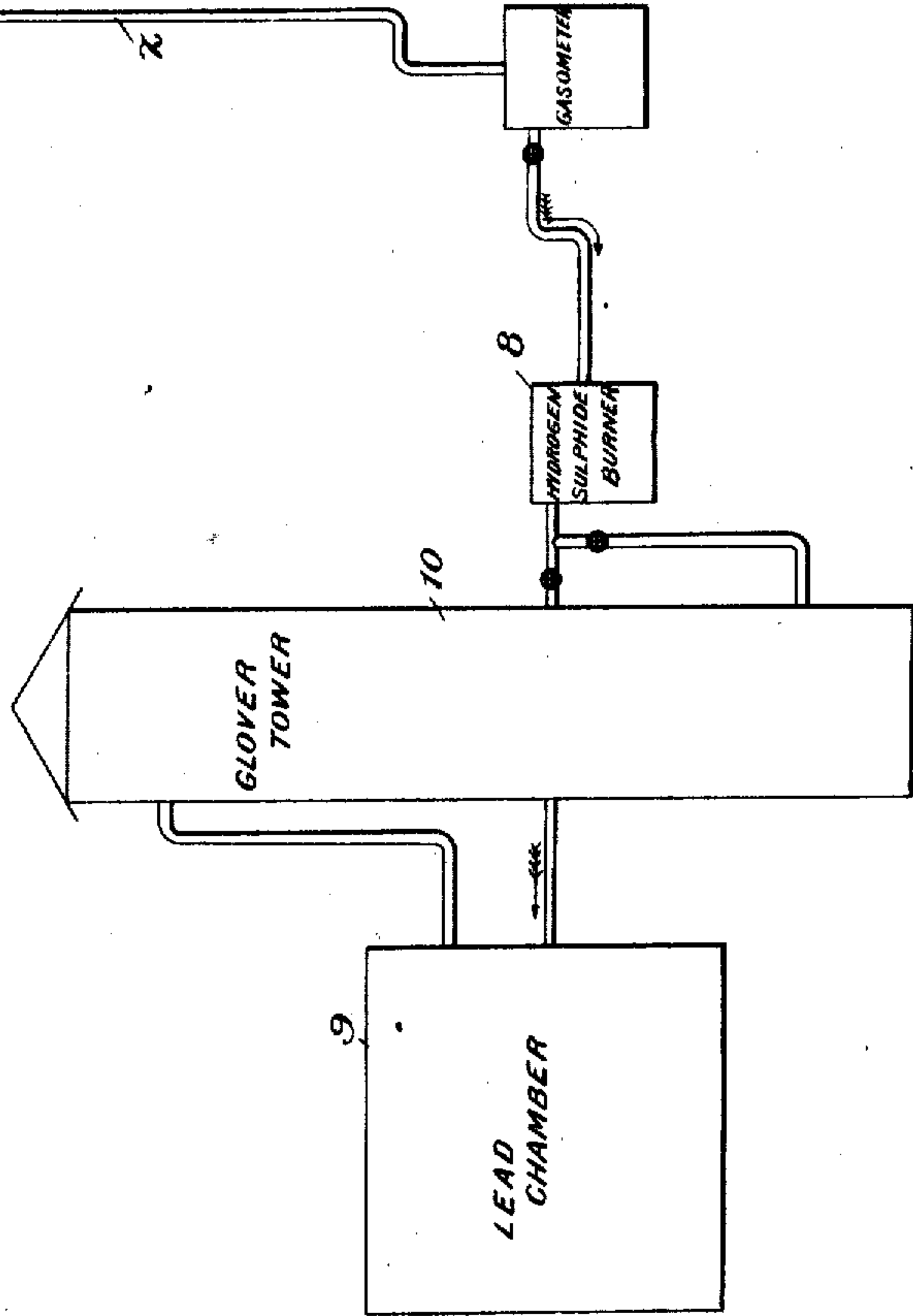
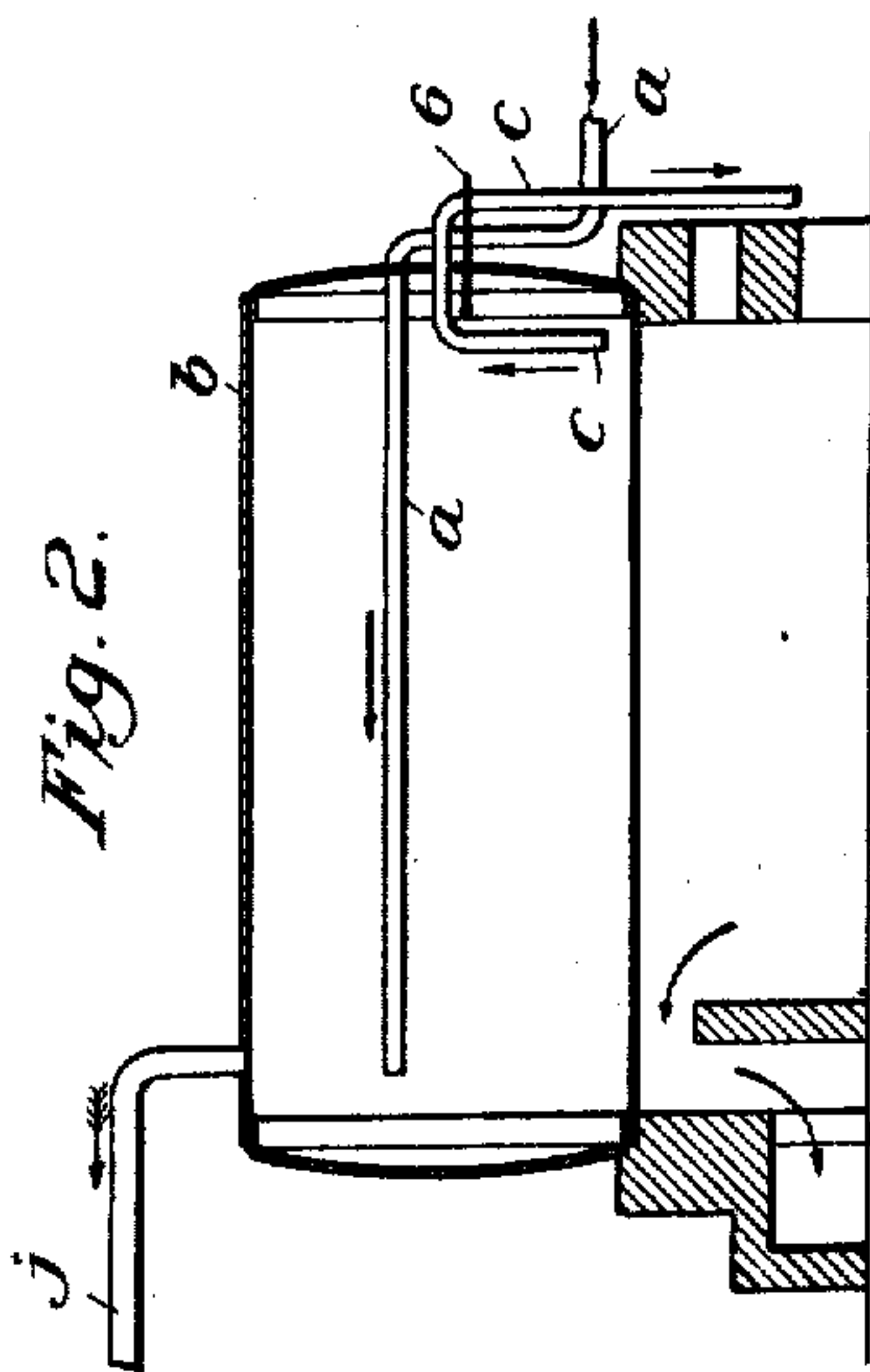


Fig. 2.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR UTILIZING SULFUR-CONTAINING PETROLEUM.

No. 908,400.

Specification of Letters Patent.

Patented Dec. 29, 1908.

Original application filed August 21, 1903, Serial No. 170,357. Divided and this application filed March 22, 1907.
Serial No. 363,868.

To all whom it may concern:

Be it known that I, JOHN E. EGGLESTON, a citizen of the United States, residing at Bayonne, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Apparatus for Utilizing Sulfur-Containing Petroleum, of which improvements the following is a specification.

- 10 This invention relates more particularly to apparatus for utilizing the sulfur content of such petroleum as is obtained from the oil fields in the State of Texas, near the town of Beaumont, in Jefferson county.
- 15 This oil differs from Pennsylvania petroleum (among other respects) in that it contains a notable quantity (between one and two per cent., according to my experience) of sulfur; whereas, Pennsylvania oil is comparatively free from this element. It differs from Lima, Ohio, oil, which also contains a notable amount of sulfur, in that the sulfur exists in Beaumont oil in such form that it can be evolved as hydrogen sulfid,
- 20 whereas, in the case of Lima oil it takes other forms.

- The expression "Beaumont oil" or "Beaumont petroleum" is used herein for convenience of reference to indicate, not only the oil found near Beaumont, but oil of substantially similar composition wherever found or however obtained. It is evident, moreover, that there may be oil otherwise substantially different in composition from
- 30 Beaumont oil, but analogous thereto in containing naturally a notable quantity of sulfur which can be evolved as hydrogen sulfid.

- The new and improved apparatus of this invention, also each of the new, useful and original parts, improvements and combinations exhibited therein, is intended to be secured for all the uses to which the same may be applicable. Omissions, additions and other changes can be made indefinitely
- 45 so long as the substance is taken of any one or more of the claims at the end of this specification.

- In the accompanying drawings: Figure 1 is a diagram of such new or improved apparatus, and Fig. 2, a vertical longitudinal section of one of the stills.
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The crude sulfur-bearing Beaumont petroleum, or an analogous crude oil, is supplied by pipe *a* to the inlet end of the

horizontally disposed cylinder still *b*, this latter being the first of a series of four fire heated stills. It fills the still *b* to above its firing line, and overflows from its outlet end by the pipe *c*, which conveys it to the inlet end of the still *d*. It similarly fills still *d* and overflows from its outlet end by the pipe *e*, which conveys it to the inlet end of the still *f*, from which it overflows at the outlet end thereof by the pipe *g*, into still *h*, at its inlet end. From the outlet end of still *h* it overflows by the pipe *i*. The supply pipe *a*, the overflow and supply pipes *c e g*, and the overflow pipe *i* are so arranged that the oil flows by gravity through the stills *b, d, f, h*. These should each hold several barrels of oil at a minimum. Stills with a charging capacity of six hundred barrels (forty gallons to the barrel) of oil measured at 60° F. have been found efficient. In running the still *b* may hold 610 barrels, the still *d* 580 barrels, and the stills *f* and *h* 500 barrels each of oil measured at the respective still temperatures. The several stills being heated, vapors and gas pass off by the goose-necks, *j, k, l, m*, to the corresponding condensing worms *n, o, p, q*, wherein the vapors and gas are so cooled as to reduce the vapors to the liquid state and thus to separate them from the gas. The liquids pass off by the pipes *r, s, t, u*. The gas passes off by the pipes *v, w, x, y*, to the gas line *z*, which conveys the gas to the apparatus for utilizing its sulfur content. The gas pipe from each worm has a branch 2, 3, 4, 5, respectively, into which the gas is made to pass, by appropriate valves, whenever it becomes too impure for satisfactory utilization for its content of sulfur, instead of being allowed to proceed to the gas line *z*. The gas thus switched off can be burned as fuel or disposed of in any desired way.

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The heating of the several stills is regulated as follows: the still *b* in such manner that the oil near the outlet has a temperature of about 350° F., more or less; the still *d* in such manner that the temperature of the oil near the outlet is about 400° F., more or less; and the stills *f* and *h* in such manner that the oil near the outlet has a temperature, respectively, of about 400° F., more or less, for still *f*, and about 485° F., more or less, for still *h*. At points 6 are indicated

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thermometers for taking the temperatures. Free steam (ordinary live steam from a boiler, or it may be exhaust steam, or steam more or less superheated) is let through pipe 5 7 into the body of oil in still *h* in small quantity, say, ten pounds of water in the form of steam to each hundred pounds of crude oil admitted into still *b*.

The hydrocarbons are evaporated less and 10 the hydrogen sulfid evolved more in the still *d* than in those (*b* and *f*) which precede and follow it; and the hydrogen sulfid from these latter is less pure than that from the middle still *d* of the series of three. According to my experience, the gas from stills *b* 15 and *f* should be about 84% or 85% hydrogen sulfid, while that from still *d* should be over 96% this substance.

The gas from pipe line *z* is delivered to 20 a hydrogen sulfid burner 8, by the combustion in which sulfur dioxide and water (with insignificant amounts of carbonic acid from hydrocarbons present) are produced. The products of combustion pass to the lead 25 chamber 9, wherein the sulfur dioxide is oxidized to sulfuric acid in the known manner. The said combustion products can be sent through a Glover tower 10 on their way to the lead chamber; but, on account of the 30 large amount of water vapor present, this is not recommended. The dilute chamber acid can be concentrated in any known or suitable way. The products from burning the hydrogen sulfid, instead of being sent into a 35 lead chamber, could (after being suitably freed by known methods from more or less of the water vapor therein) be sent into a contact apparatus for oxidizing the sulfur dioxide in the known way; or if it should be 40 desired to utilize said products otherwise than in making sulfuric acid, they could be subjected to appropriate known operations in any known or suitable apparatus for the purpose. If it should be desired to utilize 45 the hydrogen sulfid, without burning, the gas from the worms *n*, *o*, *p*, *q* (one or more of them) could be subjected to known operations, appropriate to such utilization of the sulfur content of said gas, in any known or 50 suitable apparatus.

The distillates from the worms *n*, *o*, *p* and *q* consist each of lighter hydrocarbons belonging to the burning oil fraction of the Beaumont or analogous petroleum. In my 55 experience those from the worms *n* and *o* can be used, in burning oil, after the ordinary sulfuric acid treatment; whereas, the distillates from worms *p* and *q* would have to be made less smoky by other means before, they would be suitable for such use, 60 unless they should be added to such a proportion of non-smoking oil as to make a non-smoking mixture. Such a mixture could be made, for example, with Pennsylvania oil. 65 The amount of the non-smoking distillate

from worms *n* and *o* would be insufficient by itself to make a non-smoking mixture if mixed with the smoky distillate from worms *p* and *q*, as I have obtained it. The reduced oil from the oil outlet *i* of still *h* will (ac- 70 cording to my experience) be in volume about 90% of the crude oil let into still *b*, about 10% of the latter being obtained as distillate, and have a sulfur content of about a half per cent. as against about one and 75 six-tenths per cent. in the crude oil. Such reduced oil can be made into burning oil (kerosene) or other petroleum products; or it can be used as fuel, if this should be found more profitable. In either case it 80 will have been improved by the removal (in part) of its sulfur content.

In the hereinafter written claims where the following expressions occur they have 85 the following respective meanings: The expression "still as specified" means primarily one in the form of an elongated horizontally disposed cylinder with oil inlet at or near one end and oil outlet at or near the other, the outlet being formed by an overflow pipe 90 receiving oil from the lower part of the still, so that a compact body of oil, amounting at a minimum to several barrels, is maintained in the still. By passing a stream of oil into and out of such a still it becomes a continu- 95 ous one in contradistinction to the intermittent still which is the common form for oil distillation and which is filled, worked off, emptied and filled again for a new run. The expression "still as specified" includes 100 also (1) a box like still in general with an overflow oil outlet so as to keep a compact body of oil in the still, and (2) yet more generally a still of any known or equivalent form which is or can be adapted to con- 105 tinuous working.

By passing a stream of the crude sulfur-containing oil through a "still as specified" at proper temperature, the oil exposed to the heat is constantly changing with the in- 110 coming and outgoing oil. If a box like still provided with an overflow oil outlet is used, this constantly changing oil is in the advantageous form of a compact body much greater in cross section than the stream of 115 oil which enters and leaves the same; while with a "still as specified," as primarily intended, the oil is exposed under what are considered the best conditions.

The expression "specified series of stills" 120 means primarily three or more stills, which severally are "as specified," to wit, as just defined above, and which have the oil outlet of each connected with the oil inlet of the next so as to form a series; but it includes 125 also a series of at the least two such stills so connected; for a series of two stills is more beneficial than a single still, although less so than a series of three or more stills.

The "still" of claims 9 and 10 may be of

any known or suitable form adapted to receive "a free steam inlet," or, in other words, a pipe or its equivalent for introducing free steam into the liquid or the vapor space, or into the liquid and vapor spaces of the still.

The expression "apparatus as specified for utilizing the sulfur content of hydrogen sulfid" means primarily one or more apparatus for converting such content into sulfuric acid, that is to say, for burning the hydrogen sulfid and for oxidizing the resulting sulfur dioxid, with or without preliminarily cooling the hydrogen sulfid to condense and so to separate therefrom the oil vapors; and said expression also includes one or more apparatus for utilizing said content in other ways, such as preparation of sulfur, of sulfite and bisulfite salts, sulfurous acid solutions, and so on, with or without a combustion of the hydrogen sulfid, according to the case, and also with or without a preliminary cooling of the gas to condense and so to separate therefrom the oil vapors.

The use of the singular number as "a still," "one of which," and the like, is not intended to exclude the use of more than one of the devices referred to; and conversely the use of the plural number is not intended to exclude the use of only one of the contemplated devices. Of course, where there is a "series," there must be at least two of the series elements; and where there are "separate worms for the respective stills" of a series there must be two worms at the least.

The present application is a division and continuation of my application of August 21, 1903, No. 170,357, and has been made solely in consequence of official requirement of division.

I claim as my invention or discovery:

1. The combination with a continuous crude oil still as specified, and its condenser, of a hydrogen sulfid burner, an apparatus for oxidizing sulfur dioxid, and a gas line leading from said condenser through said burner to said apparatus, substantially as described.

2. The combination with a continuous crude oil still as specified, of apparatus for utilizing the sulfur content of hydrogen sulfid, and a gas line between said still and said apparatus, substantially as described.

3. The combination with continuous crude oil stills as specified having the liquid outlet of one connected with the liquid inlet of another to cause the crude oil to traverse said stills in succession and also having means whereby said stills can be heated to different temperatures, of vapor condensing means connected with the vapor spaces of said stills, a hydrogen sulfid burner, an apparatus for oxidizing sulfur dioxid, and a gas line leading from said condensing means

through said burner to said apparatus, substantially as described.

4. The combination with continuous crude oil stills as specified having the liquid outlet of one connected with the liquid inlet of another to cause the crude oil to traverse said stills in succession and also having means whereby said stills can be heated to different temperatures, of vapor condensing means for separate condensation of vapors from different stills, a hydrogen sulfid burner, an apparatus for oxidizing sulfur dioxid, a gas line leading from said condensing means through said burner to said apparatus, and valved branch pipes for enabling the gas from particular stills to be cut into and out of said gas line, substantially as described.

5. The combination with continuous crude oil stills as specified having the liquid outlet of one connected with the liquid inlet of another to cause the crude oil to traverse said stills in succession and also having means whereby said stills can be heated to different temperatures, of vapor condensing means connected with the vapor spaces of said stills, an apparatus for utilizing the sulfur content of hydrogen sulfid, and a gas line between said condensing means and said apparatus, substantially as described.

6. The combination with continuous crude oil stills as specified having the liquid outlet of one connected with the liquid inlet of another to cause the crude oil to traverse said stills in succession and also having means whereby said stills can be heated to different temperatures, of vapor condensing means for separate condensation of vapors from different stills, an apparatus for utilizing the sulfur content of hydrogen sulfid, a gas line leading from said condensing means to said apparatus, and valved branch pipes for enabling the gas from particular stills to be cut into and out of said gas line, substantially as described.

7. The combination with continuous crude oil stills as specified having the liquid outlet of one connected with the liquid inlet of another to cause the crude oil to traverse said stills in succession, of an apparatus for utilizing the sulfur content of hydrogen sulfid, and a gas line between the vapor spaces of said stills and said apparatus, substantially as described.

8. The combination with continuous crude oil stills as specified having the liquid outlet of one connected with the liquid inlet of another to cause the crude oil to traverse said stills in succession and also having means whereby said stills can be heated to different temperatures, of an apparatus for utilizing the sulfur content of hydrogen sulfid, a gas line between the vapor spaces of said stills and said apparatus, and valved branch pipes for enabling the gas from par-

ticular stills to be cut into and out of said gas line, substantially as described.

9. The combination with a still provided with a free steam inlet, of a condenser, a burner, an apparatus for oxidizing sulfur dioxid, and a gas line leading from said condenser through said burner to said apparatus, substantially as described.

10. The combination with a still provided with a free steam inlet, of apparatus for utilizing hydrogen sulfid, and a gas line between said still and said apparatus, substantially as described.

11. The combination with a continuous still as specified provided with a free steam inlet, of a condenser, a burner, an apparatus for oxidizing sulfur dioxid, and a gas line leading from said condenser through said burner to said apparatus, substantially as described.

12. The combination with a continuous still as specified provided with a free steam inlet, of apparatus for utilizing hydrogen sulfid, and a gas line between said still and said apparatus, substantially as described.

13. The combination with the specified series of stills, one of which is provided with a free steam inlet, of a condenser, a burner, an apparatus for oxidizing sulfur dioxid, and a gas line leading from said condenser through said burner to said apparatus, substantially as described.

14. The combination with the specified series of stills, one of which is provided with a free steam inlet, of apparatus for

utilizing hydrogen sulfid, and a gas line between said still and said apparatus, substantially as described.

15. The combination with a still in the form of an elongated horizontal cylinder of several barrels' minimum capacity with a liquid inlet at one end and a liquid outlet pipe at the other end opening at the bottom of the cylinder and rising so as to retain a depth of liquid above the outlet opening, of vapor condensing means connected with the vapor space of said still, a burner, an apparatus for oxidizing sulfur dioxid, and a gas line leading from said condensing means to said apparatus through said burner, substantially as described.

16. The combination with a still in the form of an elongated horizontal cylinder of several barrels' minimum capacity with a liquid inlet at one end and a liquid outlet pipe at the other end opening at the bottom of the cylinder and rising so as to retain a depth of liquid above the outlet opening, of apparatus for utilizing the sulfur content of hydrogen sulfid, and a gas line between said still and said apparatus, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN E. EGGLESTON.

Witnesses:

E. N. JOHNSON,
A. P. ARNOLD.