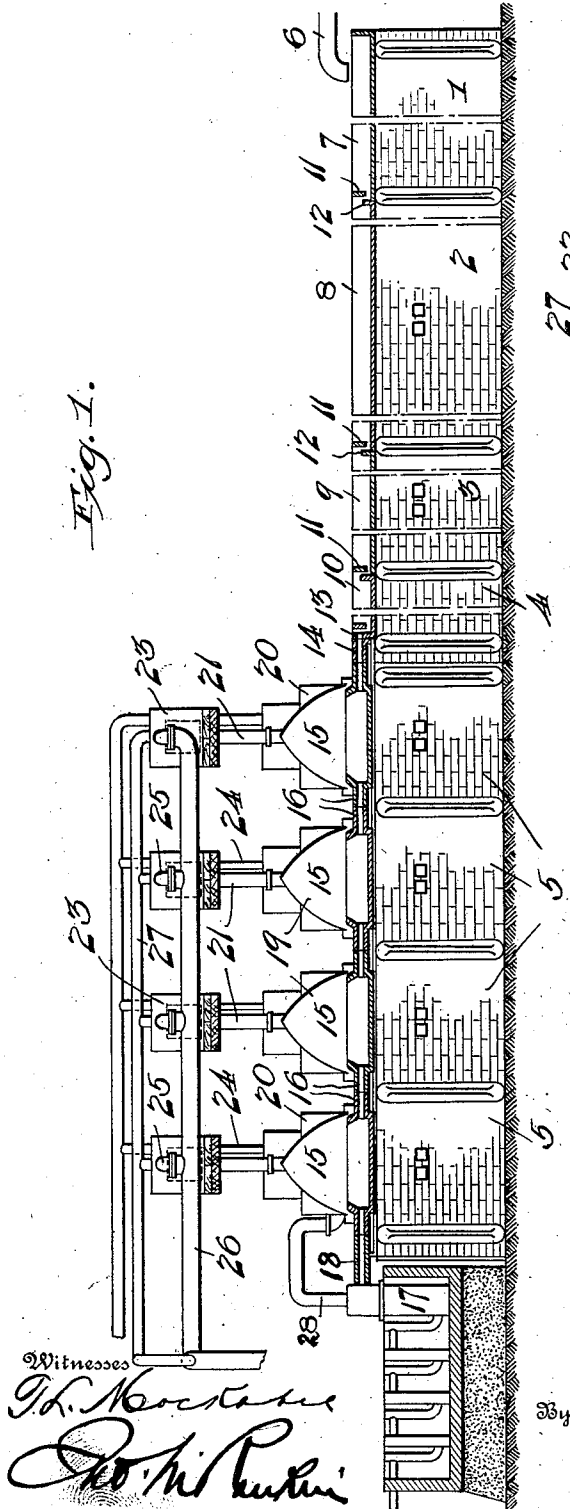


E. B. GRAY.
 APPARATUS FOR CONCENTRATING ACID.
 APPLICATION FILED SEPT. 22, 1905.

1,005,425.

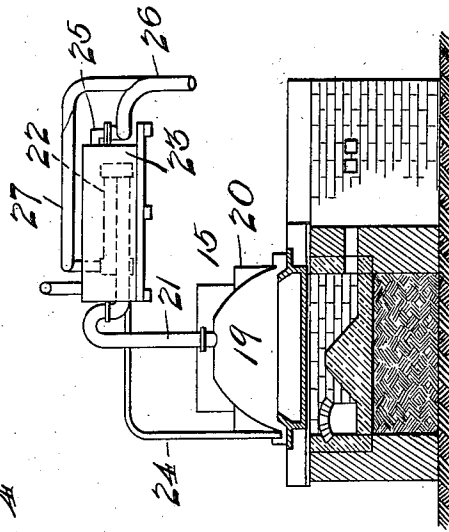
Patented Oct. 10, 1911.

Fig. 1.



Witnesses
J. H. Macomber
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Fig. 2.



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APPARATUS FOR CONCENTRATING ACID.

1,005,425.

Specification of Letters Patent.

Patented Oct. 10, 1911.

Application filed September 22, 1905. Serial No. 279,744.

To all whom it may concern:

Be it known that I, ELISHA BURRITT GRAY, residing at Beaumont, in the county of Jefferson and State of Texas, have invented certain new and useful Improvements in Apparatus for Concentrating Acid; and I do hereby declare the following to be 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.

My invention relates to an apparatus for concentrating weak acid separated from petroleum sludge.

In the treatment of petroleum, as is well known, there is created a residuum which is termed sludge and which contains a large amount of acid, which, after it is diluted with water in washing, is generally termed "weak acid." Various processes have been employed for separating the acid from the sludge. In the patent of J. L. Gray, No. 923,429 of June 1, 1909, he has described a new process for separating acid from petroleum sludge. My present invention for concentrating this weak acid is therefore rendered more important because of the larger quantity of acid which the processes of J. L. Gray enable me to separate from the sludge.

It has been understood as a general rule that it is not economical to concentrate acid when it is much below 40° Bé. In the processes hitherto in use it has been customary to treat the weak acid successively in "steam pans", "open pans", "surface pans" and "iron stills". By this old familiar process the sludge is first heated in a "steam pan", which is a lead pan with a lead steam coil in the bottom. This preliminary heating causes a considerable amount of sludge or tarry matter to separate and rise to the top of the acid. This may then be dipped off and thus prevented from entering the succeeding pans. These succeeding pans, of the old apparatus used in practicing the old process, are rectangular in shape and are made of lead and set on brick arches, with the fire underneath the brick arches, and are generally known as "open pans". After the heating in the open pans the acid, now at a gravity of from 50 to 55 degrees Bé., enters what are known as "surface pans". These surface pans are rectangular in shape and are made of sheet lead. They are water

jacketed on the sides and are lined with acid brick on the interior, sides and bottom, and are set on cast iron plates and covered over the top with fire brick arches. These surface pans are so constructed to protect the lead from the action of the hot acid at the gravity and temperature mentioned. The fire passes over the top of the acid, being guided by the arch. A large amount of acid, in this old process, is consumed in the surface pans by reason of the action between the hydro-carbons of the sludge and the acid when in close proximity with fire, and a considerable amount of the acid is carried off mechanically by the action of the strong flow of the gases of combustion in picking up and largely destroying or decomposing the fine spray which arises from the vigorously boiling acid. The gases which pass from these surface pans are conducted through an absorbing tower filled with coke in the usual way, the absorbent agent being a stream of water which discharges into the sewer. The only service of the tower is to avoid contamination of the atmosphere by these acid bearing gases. However, all of this acid or sulfurous gas escaping from the surface pans cannot be so absorbed. Even where lead chambers are adopted for this absorption, the results are only partial and considerable gas is still permitted to escape into the atmosphere, destroying vegetation and in many places violating the law. The lead chamber which is sometimes so used in the absorbing step is expensive and even when it is used a yield of from 75 to 85% of the 66° acid contained in the product delivered to the concentrating pans is about as good a yield as can be obtained. In this old process the acid leaves the surface pans at from 60 to 64° Bé., and enters the cast iron pans which are set in a furnace with the fire underneath and are covered with a lead dome which is water jacketed, these pans being, in effect, stills.

At the higher temperatures and gravities obtaining in the cast iron pans or stills a large amount of acid is vaporized, which it has been customary to draw, by means of a steam jet on the outside end, through a lead condensing coil immersed in water, the condensate running back into the cast iron pans or elsewhere in the plant and the non-condensable gas escaping into the atmosphere. By the process and apparatus of my inven-

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tion I propose to cheapen the construction and lessen the fuel consumption for concentrating and the amount of steam used in the condenser, to do away with the absorbing tower or chamber, steam pans, etc., previously employed to prevent any appreciable amount of gas escaping into the atmosphere, and to secure a yield of concentrated acid in many instances as high as 98%. To do this I employ practically open pans and iron stills instead of the previously described succession of steam pans, open pans, surface pans and iron stills commonly used in the art, and I so arrange the conduct of the gases from the iron stills through a condenser that I am enabled to eventually absorb the non-condensable gas by means of water in a down take pipe.

In the accompanying drawing I have illustrated a form of apparatus which I have successfully employed in carrying out my process.

In this drawing, Figure 1 is a combined side elevation and section. Fig. 2 is a combined end elevation and partial vertical section.

In this drawing, 1, 2, 3, 4, and 5 represent furnaces, which in this instance I have somewhat conventionally illustrated as of an oil burning pattern.

6 is a supply pipe through which the weak acid flows into the first pan.

7, 8, 9 and 10 represent a series of open lead pans resting respectively on the top of the furnaces 1, 2, 3 and 4. Between each of these pans is a dam or trap formed in the usual manner by adjacent downwardly extending division plates 11 and upwardly extending division plates 12. The last pan 10 has a perforated end plate 13 leading into a pipe 14 which feeds a series of stills 15. Each of the stills bears at the bottom a short pipe 16 on each side so that when they are brought together communication is established between the several stills. The last still discharges into a cooler 17 by means of a pipe 18, where it is cooled to a temperature of about 70° F. for storage. Each still bears a lead dome 19 surrounded by a water jacket 20.

21 represents vapor pipes leading up from each still into a lead condenser coil 22 lying in a condensing chamber 23.

24 represents a return pipe for the condensate which leads from the condenser coil 22 into the corresponding still or elsewhere in the plant.

The gas which is not condensed is entrained by water which flows through the escape pipe 25 into the pipe 26, entraining the non-condensable gases which pass from the condenser coil 22 by means of a pipe 27. This down flow of water in the pipe 26 creates a partial vacuum and draws the gas from the domes 19 and the cooler 17, absorb-

ing it and preventing its escape into the atmosphere.

The weak acid, as will be understood from the previous description, enters through the pipe 6 into the open lead pan 7, flows through the first trap 11, 12 into the open pan 8, then through the second trap into the open pan 9 and then through the trap into the open pan 10. It then passes through the stills 15 over the furnace 5 and finally into the cooler 17. In passing through the stills a large amount of the vapor which is generated is condensed by the water jackets about the stills. The remainder flows by means of the pipe 21 into the condenser coil 22, the product of condensation passing by the pipe 24 into the stills, or elsewhere in the plant, while the non-condensable gases, as previously stated, pass by means of the pipe 27 into the pipe 26 in which these gases are entrained by the flowing water, which also serves to entrain any gas which may flow from the cooler 17 through the pipe 28.

In employing the process and apparatus of my invention, it will be observed that in the preliminary concentration I use nothing but open pans of improved and simple construction, so that the sludge or tarry matter may at all times be removed. By using open pans on the top of the furnaces instead of the surface pans over which the flame passes, I avoid carrying away and destroying the fine spray rising from the boiling acid into the field of flow of the gases of combustion in the old process and plants. As previously observed, I have avoided employing any absorbing tower and chamber. Besides the open pans of my improved design allow of a large saving in fuel over the old style open pans used for this purpose on account of avoiding the passing of all the heat through the brick arch of the old surface pans. It is true that the action of the acid on the lead is greater in the hottest of these open pans than it was in the old surface pans. There is, however, so much less of a plant that the expense of the up-keep in my apparatus is less, and in addition to this economy in the size of the plant I secure a much greater yield by employing these open pans alone. Either of these is a sufficient reason for employing only open pans, to perform all the functions previously performed by the succession of steam pans, open pans and surface pans.

In practice I find that the acid entering the open pans at 40° Bé. leaves them at about 58° Bé. and is finished in the cast iron stills to about 66° Bé., and that I am able to concentrate so as to secure a yield of about 98% of the total acid.

Having fully described my invention, what I claim is:—

1. In an apparatus for concentrating weak acid derived from petroleum sludge, the

combination of a series of inter-communi-
cating open pans, a series of inter-communi-
cating stills and condensers and a furnace,
the pans and stills communicating and being
5 located at the same level upon the furnace.

2. In an apparatus for concentrating weak
acid derived from petroleum sludge, the
combination of a series of inter-communi-
cating open pans, a succeeding series of in-
10 ter-communicating stills, the pans and stills
being arranged on the same level, a furnace
beneath the pans and stills, the last pan com-
municating with the first still, a condenser
connected with each still, and a water-sup-
15 ply and discharge pipe for leading the non-
condensable gases from all the condensers to
the water-supply.

3. In an apparatus for concentrating weak

acid derived from petroleum sludge, the
combination of a communicating series of 20
open pans and stills provided with water-
jacketed hoods and condensers and a fur-
nace; a pipe leading from each still to each
condenser to convey the residue of uncon-
densed vapor from the still to the condenser, 25
a pipe conveying the products of condensa-
tion from each condenser to the stills, a
water-supply pipe and a pipe leading the
non-condensable gases to the water-supply
pipe. 30

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

ELISHA BURRITT GRAY.

Witnesses:

J. A. JUDSON,

THOS. A. HOLLAND.