Nov. 18, 1947. F. E. MASON 2,431,060

PETROLEUM PRODUCT CRACKING APPARATUS

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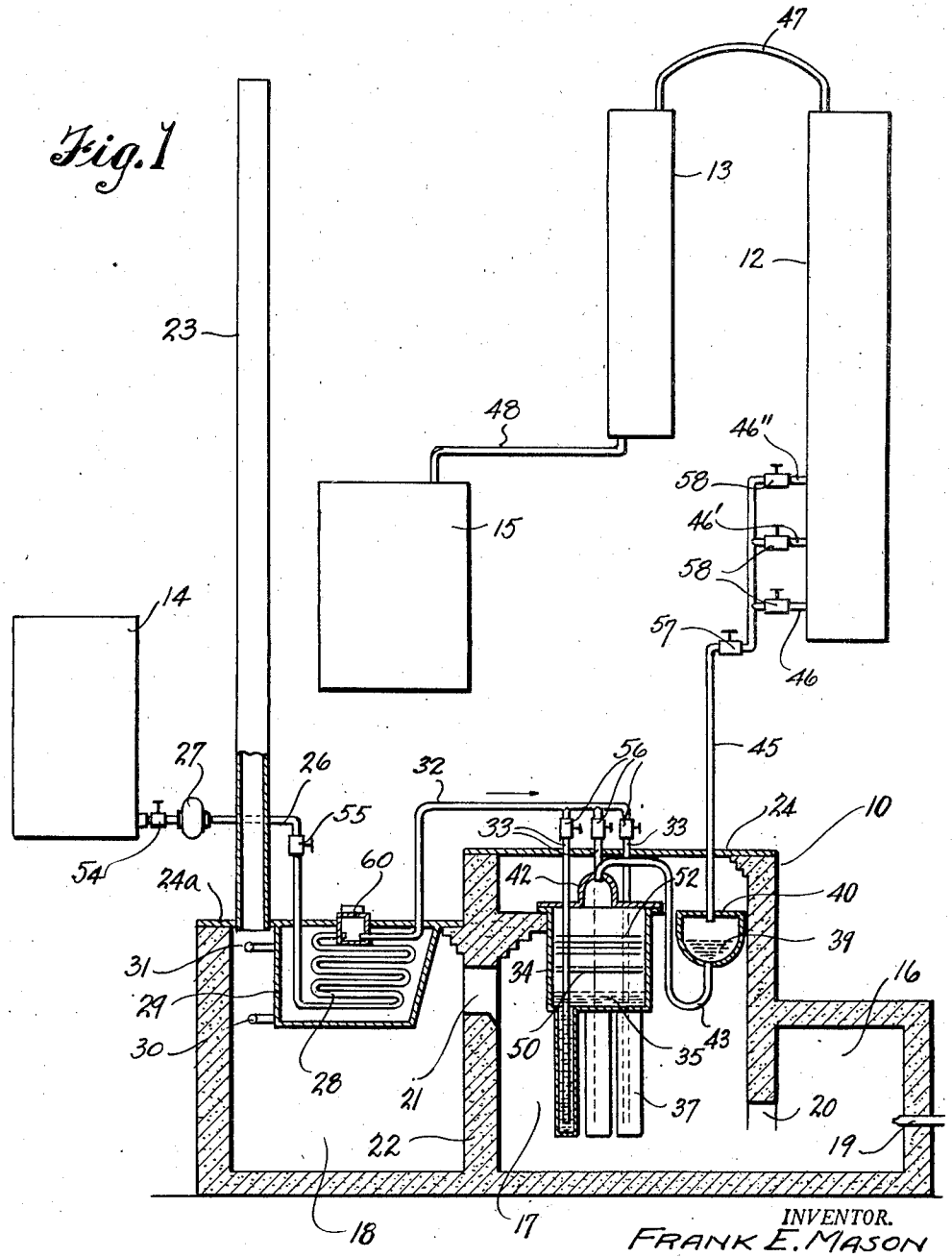
Fig. 1



INVENTOR.
FRANK E. MASON

BY
Cook & Robinson
ATTORNEYS

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Fig. 2

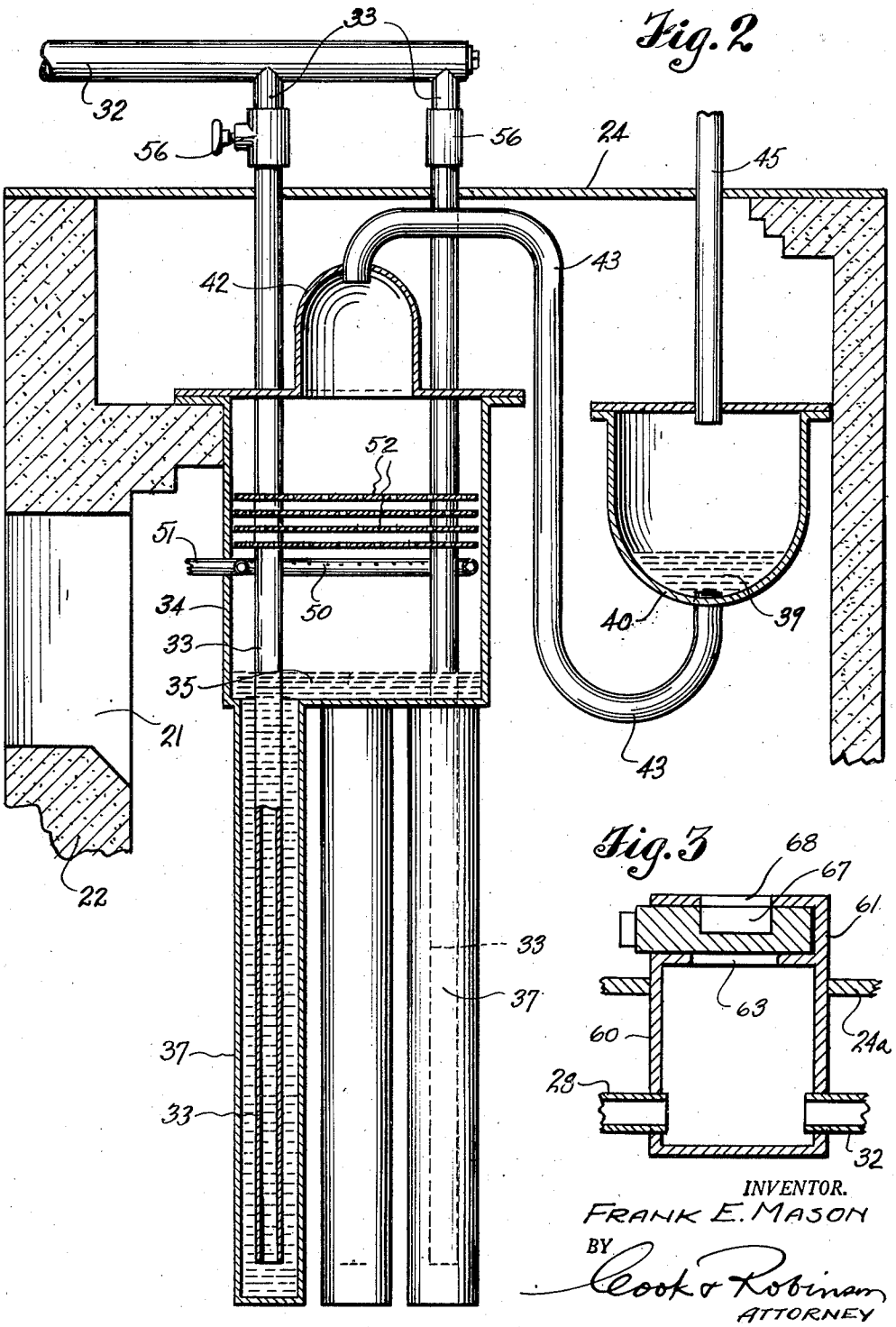

Fig. 3

INVENTOR.
FRANK E. MASON
BY
Cook & Robinson
ATTORNEY

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PETROLEUM PRODUCT CRACKING APPARATUS

Frank E. Mason, Seattle, Wash.

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1 Claim. (Cl. 196—118)

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This invention relates to an apparatus to which I refer as a "rectifying plant" and more particularly to apparatus for the treating of certain petroleum products, by heat and pressure; for example, to treat low grade or third structure gasoline to improve its quality.

More specifically stated, the invention has for its object to provide an improved apparatus for carrying out a certain treatment, or cracking process, whereby the octane value of third structure gasoline may be substantially increased and the product rendered more volatile and better fuel values obtained.

It is also an object of this invention to provide apparatus for the above stated purpose that is an improvement upon the apparatus that was described and illustrated in U. S. Letters Patent No. 1,652,563, issued to David E. DeLape on December 13, 1927, in that it is more effective for the general purposes therein stated, and for the various objects above stated.

Yet another object of the present invention is to include means therein whereby the heretofore unused butane gas that is produced in the heretofore used cracking operations, may be returned to the still or retort and there neutralized and caused to combine with the vaporized stock, thus to increase the gasoline output from the operation.

Yet another object of this invention is to provide novel means for the use and neutralization of the butane gas through the injection of cadmium or an equivalent metal into the vaporizing coil.

Still further objects of the invention reside in the details of construction of the various parts of the apparatus, in their combination, relationship and use to produce the results and to accomplish the objects above set forth.

In accomplishing the above mentioned, and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is a view diagrammatically showing the arrangement and connection of parts of the present apparatus.

Fig. 2 is an enlarged, cross sectional view of the lead bath retorts and connections.

Fig. 3 is a sectional detail of one of the parts.

The present invention contemplates the controlled drawing off of stock to be treated, such as low grade or third structure gasoline, from a source of supply, forcing it under definite pressure and specified high temperature through a pipe coil wherein the stock is vaporized or gassified under definite pressure; the vapors and gases therein mixed with the selected agent for neutralization of the butane gas; then passing the vapors through a first and second molten lead bath, under high temperature and pressure for cracking or decomposition under the pressure of the lead bath and ultimately delivering the gases to a fractionating tower and finally condensing and returning the condensate to storage. The apparatus, in its improved construction, for the stated purpose, is arranged as follows:

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The principal elements, or units of the present improved apparatus comprise a suitable masonry furnace, designated in its entirety by reference character 10, a fractionating column or tower 12, and a condenser 13. The stock, or product that is to be treated, is here indicated as being drawn from a tank 14 and the finished product, after the rectifying treatment, is discharged from the condenser into a storage tank 15.

The furnace 10, in a preferred construction, comprises a fire box 16, a primary combustion chamber 17 and a secondary combustion chamber 18. Preferably such a furnace would be oil fired and therefore it is here shown as being equipped with a typical oil burner designated at 19.

Gases of combustion flow from the fire box 16, through a wall passage 20 into the primary combustion chamber 17 and from the latter, flow through a passage 21 in a cross wall 22 that divides the furnace, and into the secondary chamber 18. A stack 23 extends from the furnace for carrying off the gases from the chamber 18.

The top of the furnace chamber 17 is covered by a plate 24 and likewise chamber 18 is covered by a plate 24a and these are formed with openings as may be required for passage of pipes, flues and the like.

Stock to be treated is drawn from the storage or supply tank 14, through a pipeline 26 and is delivered under a definite hydrostatic pressure by a suitable pump 27 that is interposed in the pipe line, into the lower end of a pipe coil 28. This coil is enclosed within a housing 29 located

inside the furnace chamber 18 and suspended from the cover plate 24a. This housing may be in the nature of a tank through which water is adapted to be circulated to regulate or limit the temperature to which the coil may be subjected. For this purpose, the tank is shown as being equipped with the pipe connections 30 and 31. From the upper end of pipe coil 28, a pipe line 32 leads across the top of the furnace where it is connected with a plurality of downwardly extended branch pipes 33, which extend through plate 24 into the furnace and then through the top wall of a closed pot or chamber 34 containing a molten lead bath designated at 35, that is contained in the lower or base portion of the pot. Opening into the base of the pot are a plurality of tubular wells 37 also filled with the molten lead. The pipes 32 extend down into these wells and open thereinto near their lower ends. These wells give a desired and an effective depth to the lead bath and thereby an effective pressure in the pipe system.

Adjacent the primary lead bath 35, is a secondary lead bath 39 in a closed vessel or pot 40. Both pots 34 and 40 are contained in the chamber 17, and the pot 34 is equipped with a gas dome 42 extending up from its top wall. A gooseneck pipe line 43 leads from this dome to the pot 40 opening upwardly into the latter through its bottom wall.

From the top of the pot 40, a pipe line 45 leads up through top plate 24, and connects with a series of branch lines 46—46'—46'', which lead off at different levels into the fractionating column or tower 12; and from the top of tower 12, a pipe line 47 leads to the top of condenser 13 and from the lower end of the condenser, a line 48 extends to the storage tank 15. The tower 12 is of the usual types as is also the condenser.

For the purpose of increasing the quality of low boiling point hydrocarbons produced in this apparatus, an annular tube 50 is provided in the upper portion of the pot or still 34 for the introduction of hydrogen; the tube 50 is perforated and is connected at its outer end to a suitable source of hydrogen through a pipe connection designated at 51.

It has been found that the cracking and hydrogenation of petroleum products can sometimes be facilitated by the presence of a catalytic agent; various metals including nickel, having been used for this purpose. Therefore, I have arranged a plurality of grids 52 in the upper portion of pot 34, made of the suitable catalyst. Each grid may be of a desired form and here are shown to consist of perforated disks, each disk having its perforations staggered and the disks slightly separated. The grids may be joined as a unit, and the unit arranged to be slid laterally from and into the pot and the pot tightly sealed.

It will be here mentioned that valves 54 and 55 for regulating flow of the stock are set in the pipe line 26 at opposite sides of the pump 27. Also, suitable valves 56 are interposed in the upper ends of the several branch pipes 33 adjacent their connection with the pipe line 32 to regulate flow to the retort 32. Also, a valve 57 is interposed in pipe 45 and individual valves 58 are applied to the branch pipe lines 46—46'—46'' leading into the fractionating tower.

For the purpose of injecting the selected agent for neutralization of the butane gas formed in the pipe system prior to the vapor or gases entering the lead bath, I extend the upper end of pipe coil 28 and the adjoining end of pipe line

32 into a closed housing 60 in which provision is made for the placing of the agent without permitting loss of pressure. For this purpose, the housing is provided within its upper portion, which extends from the retort, with a cylinder 61 containing a rotary valve member. This valve covers a top opening 63 leading into the housing. The valve is provided between its ends with a laterally opening pocket 67 adapted to contain a quantity of the selected agent. The valve may be rotated a half turn to register the pocket 67 for filling through a top opening 68, then rotated back to discharge the agent into the housing through the opening 63.

The agent which is now found quite desirable for this purpose is cadmium, but thalium or germanium may also be used with satisfactory results.

When this metal is injected in the housing, it vaporizes and in this state is picked up by or mingles with the gas or vapor flowing through the housing to pipe 32. This gasified agent converts sulphur into lead sulphide and incidentally increases the octane content.

With the apparatus so constructed, the operation and use thereof would be substantially as follows:

Stock from the supply tank is admitted under pressure to the coil 28 which is maintained at a regulated temperature where it is vaporized and flows through pipe 32 and the various branch pipes 33 into the first lead bath. From the dome of this chamber, the vapors and gases arising through the lead pass to the second lead bath and from this are delivered through the pipe 45 to the fractionating column. From the column, they are delivered through pipe 47 to the condenser and ultimately to the storage tank.

The particular arrangement of wells in connection with the first lead bath permits of a desired depth of lead without excessive volume. These wells may be flanged and removably connected with the base of the container in order that should any one of them burn out, it can be replaced without necessitating draining of the entire lead chamber.

Heat in the chamber 17 should be maintained at approximately 1000° temperature. Pressure in the first lead bath chamber is about fifty pounds, or more if necessary. Cadmium, or the equivalent metal, is injected into the line, which at that point is at about 780° F. The vapor produced from this injected metal acts on the butane gas to effect its neutralization.

By this process, the octane value of the gasoline treated is substantially increased and the product rendered more volatile and a better fuel.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is:

An apparatus of the character described, comprising a furnace, a retort in the furnace comprising a closed chamber formed in its bottom with a plurality of relatively deep wells, a lead bath filling the wells and partially filling the chamber, a second closed chamber in the furnace for containing a quantity of molten lead, a preheating coil in the furnace, a pipe line from a source of supply of hydrocarbon liquid leading to a pressure pump, a pipe line for delivery of the liquid hydrocarbon under pressure to the preheating coil from the pump, a valve mechanism in the preheating coil for the injection of a butane-neutralizing agent into the liquid, a

pipe line leading from the coil to the retort and having branch pipes therefrom directed downwardly through the retort chamber and each extended into one of the said wells to near the lower end thereof for the admission of the hydrocarbon to the retort through and against the hydrostatic head pressure of the lead bath, a series of perforated catalyzing grids fitted in the chamber above the lead bath, a pipe connection from the top of the retort to the bottom of the second closed chamber for conduction of gases into the latter through the lead, a fractionating column, a condenser for receiving products from the fractionating column and a receptacle for receiving condensed products from the condenser.

FRANK E. MASON.

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