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APPARATUS FOR HYDROCARBON OIL CRACKING OPERATIONS

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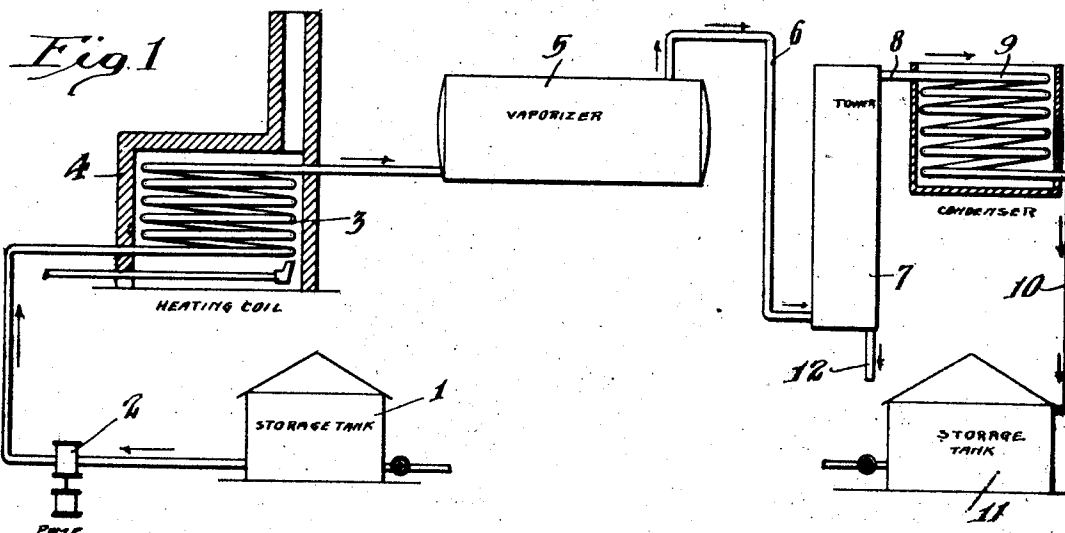
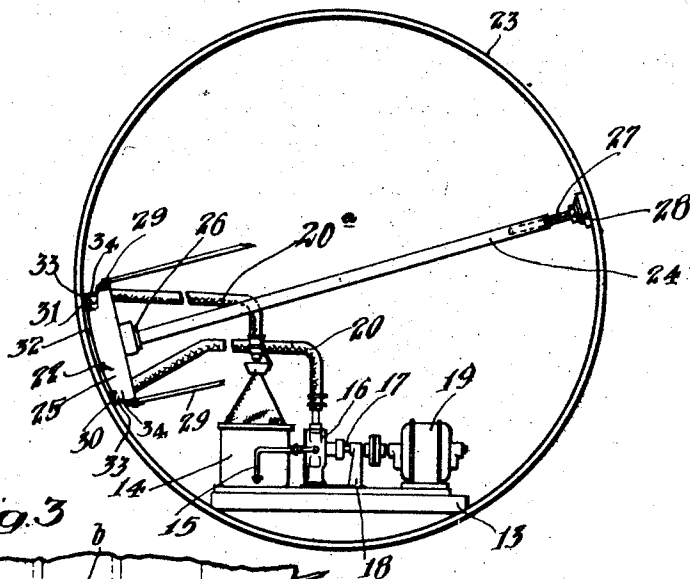
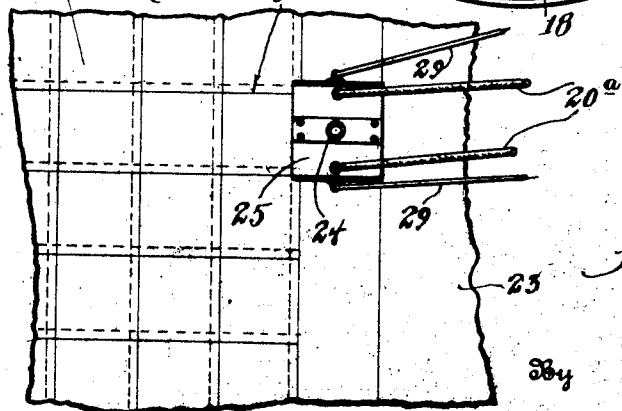


Fig. 2



a Fig. 3



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR HYDROCARBON-OIL-CRACKING OPERATIONS.

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To all whom it may concern:

Be it known that I, KENNETH V. KING, a citizen of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented a new and useful Apparatus for Hydrocarbon-Oil-Cracking Operations, of which the following is a specification.

This invention relates to containing apparatus for hydrocarbon oil cracking operations, comprising containers, receptacles, or the like in which the hydrocarbons are contained during the cracking operation, and is more particularly directed to rendering the hydrocarbon contacting surface thereof resistant to the action of corrosive agents produced by a hydrocarbon oil cracking operation.

As produced, the hydrocarbon oils obtained from such sources as shale or petroleum oil contain many active constituents such as sulphur compounds, and other ingredients which, due to their corrosive action, are particularly injurious to the metal comprising the containers, receptacles, or the like in which the hydrocarbon oils are contained during the cracking operation. During the distilling of these oils, due to the heat to which they are subjected, the activity of these sulphur compounds, and other corrosive agents, is greatly intensified so that the containers, receptacles, or the like in which they are treated are of short life.

The intensity of action of these sulphur compounds and other corrosive agents becomes very great during and subsequent to the destructive distillation or cracking of the hydrocarbons so that the heating tubes, stills, evaporators, fractionating towers, cooling coils, storage tanks, and the like, with which the distilled or converted oil or oil undergoing conversion comes in contact, are of very short life.

This inherent corrosive feature prevails with any and all the processes or any combination of the processes now employed for oil converting or oil cracking processes or which it is contemplated will be employed.

Many attempts have been made throughout the country to provide suitable containers, receptacles, or the like for oil cracking operations which would resist the destructive action of the sulphur compounds and other corrosive agents, but without substan-

tial success. The particularly destructive and active agent resulting from the cracking or distillation of hydrocarbon oil which appears to be largely responsible for the corrosion of these containers, receptacles, or the like is hydrogen sulphide. This is particularly true when dealing with California or Mexican oils for, as is well known, these oils are often found to possess a high sulphur content so that the cracking of them presents a difficult problem. Furthermore, the activity of this hydrogen sulphide as a corrosive agent becomes very greatly accelerated at temperatures above 600° F. so that for the temperatures employed in cracking operations conditions are very favorable for the maximum corrosive effects. It is particularly true that the large pressure drums or the so-called cracking bottles, which are often under great pressure, are very rapidly eaten away or corroded, this corrosion being somewhat more rapid on that part of the drum which is in contact with the vapors than it is where the liquid is in contact with the metal. On the lower part of fractionating towers corrosion is also many times faster than elsewhere so that these large vessels are at practically any time during the cracking process liable to fail and cause great destruction of life and property due to fire that would result from such failure and to the spraying or throwing of the extremely hot hydrocarbon oils in all directions.

It will thus be seen that, with the equipment as heretofore employed the corrosive feature inherent in the process causes the cracking of oil to be attended with great danger and the profits derived from practice of the process to be materially reduced by the short life of the equipment.

The object of this invention is to render the containers, receptacles, or the like employed in oil cracking operations resistant to the action of the corrosive agents produced by the cracking operation by suitably protecting all or part of any surface of the containers, receptacles, or the like that contacts with such corrosive agents.

I have discovered that apparatus having an interior surface of chromium metal is particularly resistant to the action of the reaction or active products or constituents of hydrocarbon oils such as hydrogen sulphide,

that act to corrode the interior or apparatus as heretofore constructed, and that apparatus having an interior surface of chromium metal is practically unaffected by these active constituents of hydrocarbon oils. I have found it advantageous to obtain this chromium surface by an electrolytic method.

I have also discovered that the electrolyte used for obtaining this chromium coating need not be chemically pure but may comprise commercial or technical salts of chromium.

Furthermore, I have found that deposits of other than chromium alone are resistant to the corrosive action encountered in the apparatus and that the electrolyte used and the anode employed, may therefore be such as to deposit either tungsten, vanadium, cobalt or molybdenum or any combination of these metals along with the chromium.

The metals vanadium, tungsten, cobalt and molybdenum may also be used alone in this invention and, therefore, may be employed as effective substitutions for chromium. When the apparatus hereinbefore referred to is coated with either of these metals or with combinations of them, and in the absence of chromium, satisfactory resistance to the corrosive agents encountered is obtained.

My invention will be apparent from the following detailed description of a preferred embodiment thereof as illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is a diagrammatic side elevation of an apparatus for use in carrying out a cracking process.

Fig. 2 is a sectional end elevation of a pressure drum illustrating in side elevation one form of plating apparatus for plating the interior of such a drum to provide an interior surface therefor that is resistant to the corrosive reaction products of hydrocarbon oils.

Fig. 3 is an enlarged fragment of such a drum illustrating the manner of plating the interior thereof.

In the drawings, 1 illustrates a storage tank in which petroleum oil which it is desired to crack is stored. The oil from the tank 1 is pumped by means of a pump diagrammatically illustrated at 2 to cracking coils 3 which are situated within a furnace 4. The oil heated in the coils 3 is conducted to a pressure drum 5. This drum may function as a so-called digester or as an evaporator, depending upon the particular cracking process employed. It is sometimes termed a "bottle." The vapors from this vessel 5 are conducted through a line 6 to a fractionating tower 7 where the same are separated and the light vapors leave the fractionating power 7 through a line 8

through which they are conducted to cooling coils 9. The condensed distillate leaves the cooling coils 9 through a line 10 and passes to storage in tank 11. The heavier constituents obtained from the cracking process leave the fractionating tower 7 through a pipe 12 and are conducted to a storage tank or other point of disposal, not shown.

The portions of this cracking apparatus which are particularly subjected to the severe corrosion of the sulphur compounds and other corrosive agents are the cracking coils 3, pressure drum 5, the vapor lines 6 and 8, the fractionating tower 7, and the storage tank 11. The greatest destructive action of these compounds takes place in the pressure drum 5 and the bottom of the fractionating tower 7, due to the higher temperature of the hydrocarbon oils in these containers, and due to the fact that a great number of these active corrosive compounds are formed in the pressure drum 5, and their action is greater during their formation than subsequent thereto. For this reason, this invention is particularly directed to the provision of large and expensive vessels, the interior surface of which is resistant to the corrosive action of these compounds. As is herein-after mentioned, however, it is also adaptable to the provision of heating tubes, vapor lines and the like.

While the present invention is not limited to the specific method and means employed for electrolytically plating the surface of the apparatus it has been found that some form of electroplating is essential to a satisfactory result and that it is necessary to provide a suitable means and method for performing the plating operation as no satisfactory method or means has been found in the art. One method that has been developed to be employed for large pressure drums is illustrated in the accompanying drawings Figs. 2 and 3, and is more particularly set forth below as comprising a base 13 upon which an electrolyte container 14 is positioned and which electrolyte container 14 is connected by means of a pipe 15 to the intake of a circulating pump 16. The circulating pump 16 is connected by means of a shaft 17 journaled in the standard 18 to a motor 19. The outlet of the circulating pump 16 is connected by means of a flexible hose connection 20 to a portable plating cell 22 which portable plating cell 22 is maintained in contact with the inner surface of the container 23 by means of the rod 24 which is connected to the frame 25 of the cell 22, as is illustrated at 26 and which rod 24 is provided with a jack 27 at its opposite end so that as the head 28 of the jack 27 is screwed outward the cell 22 is wedged in position and when it is desired to move the cell 22 to a second position the jack 27 is loosened and the cell moved to that position and the

jack retightened to maintain the cell in its new position.

Distributing chambers 30 and 31 are placed at the entrance and exit, respectively, of the cell 22 so as to distribute the electrolyte uniformly during its passage through the cell. These distributing chambers may be in contact with and serve as a part of the anode. The anode is preferably a neutral metal, that is, one that is not acted upon by the electrolytic action. Lead is a very satisfactory metal to use. In any event the anode will comprise a sheet of metal substantially of the same area as the surface being plated. Electrical connections 29 are secured to the anode and serve to convey the electric current to the cell. The container 23 is made the cathode of this plating operation. The electrolyte conveyed through the flexible hose 20 is delivered through perforations in the distributing chamber 30 thus filling the space within the cell. It then leaves the cell through the distributing chamber 31, flexible hose 20^a and thence back to the container 14. A ring 33 which may be of steel, wood, or other suitable material, is secured to the frame 25 and an insulating gasket 34 is secured in position between the ring 33 and the frame 25 and extends over the inside edge of the ring 33 so as to insulate the same from electrolyte and the container 23. The insulation 34 also forms a gasket which prevents the leakage of the electrolyte from the electroplating chamber 32.

Any suitable source of direct current may be employed, the size of the electroplating chamber and the time required for the electroplating being dependent upon the density of the direct current supplied and the concentration and temperature of the electrolyte employed.

For plating the interior of such a container 23 with chromium I prefer to employ the following electrolyte solution which is commonly known as Sargent's solution. This electrolyte consists of 100 grams chromic oxide and 3.5 grams of chromium sulphate per liter of solution. However, I have found that satisfactory deposits can be obtained using from approximately 50 to 350 grams of chromic oxide and from approximately 2.3 to 3.75 grams of chromium sulphate per liter. In order to obtain the best plating results, I have discovered that a current density of practically 125 amp. per square foot of surface being plated should be maintained.

For plating the interior of such a container 23 with a composite or homogeneous mixture of metals the following illustrative example of one form of electrolyte suitable for such deposition is given:—In 25 cc. of concentrated hydrochloric acid is dissolved 15 of chromic oxide. This solution is then

diluted to about 125 cc. with water, 35 grams of calcium chloride and 2 grams of sodium chloride and 15 grams of cobaltous chloride are then dissolved in the 125 cc. of solution of chromic oxide and hydrochloric acid. This solution is then subjected to practically the same current density as in the use of Sargent's solution.

It is not deemed necessary to set forth the exact preferred electrolyte for the deposition of each of the metals vanadium, cobalt, tungsten and molybdenum or for the composite mixtures thereof as from this disclosure it is believed that those skilled in the art to which this invention is directed will immediately comprehend their adoption and method of use.

Referring now particularly to Fig. 3, the electrolyte plating cell 32 is illustrated as in position for plating one section of the interior of such a container 23. The cell having been moved from a previous position *a* so that the edges of these positions overlap as is illustrated at *b* and I have discovered by this method that a uniform and very satisfactory interior chromium surface may be provided which is entirely free from ridges, grooves, or the like, and that the reaction products liberated from or formed by the hydrocarbon oils do not in any way tend to corrode the interior of a container so treated at these overlapping sections.

In this Fig. 3 the sections are diagrammatically illustrated. However, the interior of such a container will present a continuous plated appearance and there will be no lines or ridges formed or present between the different sections of the plating, the lines herein shown being for the purpose of illustration.

While I have shown a particular form of apparatus well adapted to the plating of large vessels, I have found that my invention is equally applicable to the treating of the interior surfaces of small tubes and pipes, such as, heating tubes employed in the firing zone of a cracking process; and small vapor lines, particularly those vapor lines which convey the volatile products away from the pressure drums or dephlegmating towers employed in cracking process. In coating the inner surfaces of containers, such as small tubes and pipes, by the electrolyte method, it will be apparent that the cell method as described above would be departed from. A very advantageous way which I have employed to effect the desired coating in these instances, resides in so arranging the anode and electrolyte within the tube or pipe being plated, that the entire length of the inner surface of the pipe or tube, or sections of the entire length, may serve as the cathode.

My invention is not limited to the par-

particular method of plating which has been described above for the purpose of illustration, and is of the scope set forth in the following claims, in which I wish to be understood as intending that metals, such as cobalt, vanadium, tungsten and molybdenum and any homogeneous mixture of the same are equivalent of chromium.

I claim:

- 10 1. A container, receptacle, or the like for a hydrocarbon oil cracking operation having a hydrocarbon contacting surface electrolytically plated with chromium to render the container, receptacle, or the like
15 resistant to the action of corrosive agents produced by the cracking operation.

2. A container, receptacle, or the like for

a hydrocarbon oil cracking operation having a hydrocarbon contacting surface electrolytically plated with a chromium alloy
20 resistant to the action of corrosive agents produced by the cracking operation.

3. A container, receptacle, or the like for a hydrocarbon oil cracking operation having a hydrocarbon contacting surface electrolytically plated with chromium to render
25 the container, receptacle, or the like resistant to the action at high temperature and pressure of corrosive agents produced by a cracking operation performed in the appa-
30 ratus.

Signed at San Francisco, California, this
15 day of April, 1925.

KENNETH V. KING.