July 6, 1926. 1,591,286

A. DAHLSTRUM

DEHYDRATOR

Filed March 16, 1926

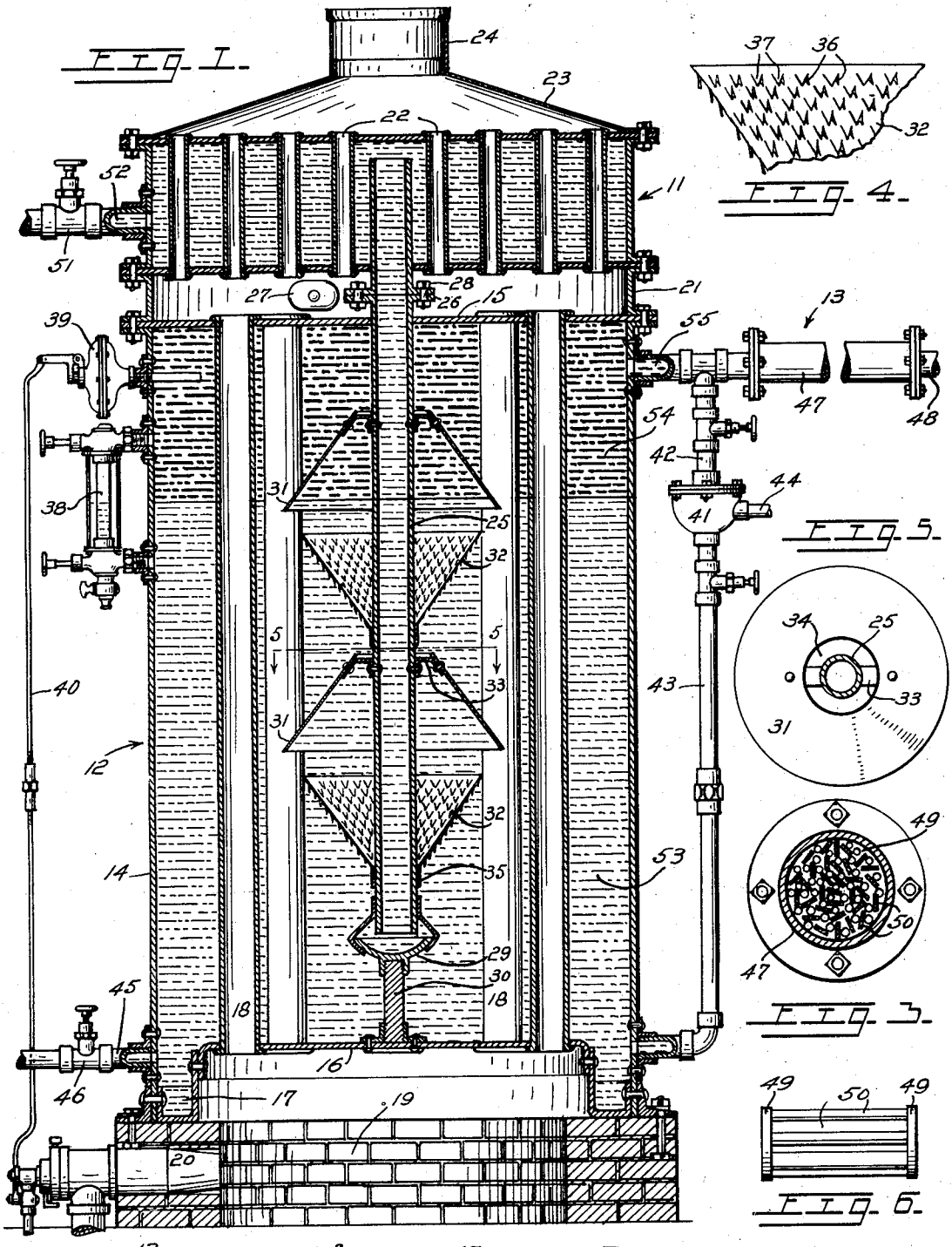

FIG. 1.

FIG. 4.

FIG. 5.

FIG. 3.

FIG. 6.

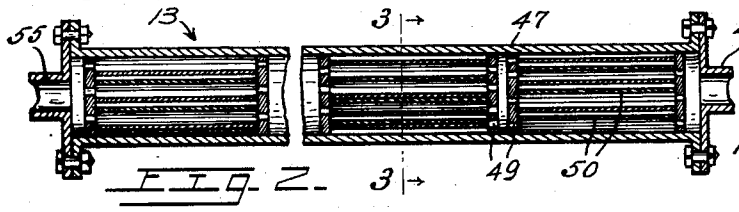

FIG. 2.

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UNITED STATES PATENT OFFICE.

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DEHYDRATOR.

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In this specification, and the accompanying drawing, I shall describe and show a preferred form of my invention, and specifically mention certain of its more important objects. I do not limit myself to the forms disclosed, since various changes and adaptations may be made therein without departing from the essence of my invention as hereinafter claimed; and objects and advantages, other than those specifically mentioned, are included within its scope.

My invention relates to oil dehydrators, and particularly to means for dehydrating emulsions of oil in water. Its principal objects are; first, to provide means whereby water may be almost or completely removed from oil emulsions; second, to furnish facilities for accomplishing the dehydrating as a continuous process; and third, to supply a relatively simple and inexpensive device adapted for these purposes.

My objects are attained in the manner illustrated in the accompanying drawing in which:—

Figure 1 is a central section of my complete device in elevation;

Figure 2 is an enlarged central section in elevation of the portion of my apparatus in which the dehydrating process is completed;

Figure 3 is a further enlarged cross section of the construction shown in Fig. 2, taken on the line 3—3;

Figure 4 is a fragmentary view in elevation of the dentated surface of one of the inverted cones that I employ for accomplishing the preliminary step of my dehydrating process;

Figure 5 is a plan view of one of the plain open top cones used in said preliminary step, illustrating the means whereby it is mounted; and

Figure 6 is an elevation of one of the dehydrated sections employed in the final step of my dehydrating process.

Similar reference numerals refer to similar parts throughout the several views.

It is well known in the oil industry that crude oil frequently is accompanied by rather large percentages of water; and that a considerable portion of the yield often is emulsified. The value of the crude is lowered by the presence of the emulsion and it is of great importance that the water should be extracted therefrom. Hitherto this has been a difficult and relatively expensive operation but in my improved dehydrating apparatus it may be accomplished as a continuous process at small cost.

The form of my invention selected for illustrative purposes comprises a pre-heater 11, a preliminary separator 12, and a final dehydrator 13.

The preliminary separator closely resembles a vertical fire-tube boiler having a cylindrical shell 14, an upper tube sheet 15, a lower crown sheet 16, and a water leg 17. A plurality of fire tubes 18 extend through said tube and crown sheets, and are expanded therein in the usual manner. This construction is mounted above a circular furnace 19 provided with a suitable oil burner 20.

The pre-heater 11 is mounted above separator 12 and is slightly spaced therefrom by a flanged ring 21. The pre-heater and separator are somewhat similar in general construction, and both are adapted for withstanding internal pressure. The pre-heater is shorter than the separator and is usually provided with a larger number of smaller diameter fire tubes 22. The total cross-sectional area of the tubes in the two devices is substantially equal. The spacing ring 21 provides a chamber in which the combustion of the furnace gases is completed, and also serves to distribute these gases for equalizing the flow through the preheater tubes 22.

Above the pre-heater is a smoke cone 23 and stack 24 for carrying off the products of combustion.

Pre-heater 11 and separator 12 are in communication through the centrally located pipe 25 which extends nearly to the top of the pre-heater and to the lower portion of the separator. This communicating pipe is intermediately flanged at 26, so that the heater and separator may be readily disassembled when desired, and a hand-hole 27 is provided in ring 21 to make the flange bolts 28 accessible.

Beneath the lower end of pipe 25, and spaced therefrom, is a circular deflecting bowl 29, supported on a pedestal 30. Above the bowl, on the intermediate portion of the central pipe, are two upright truncated cones 31 of plain sheet metal, and two inverted truncated cones 32 of specially perforated sheet metal. These cones are positioned on the pipe alternately as shown. The plain cones 31 have open upper ends and are sup-

ported by spiders having radial arms 33 with unobstructed flow passages 34 between them, as shown in Fig. 5. The perforated inverted cones 32 have closed lower ends and are supported by rings 35 which fit the pipe and are attached thereto. The base diameters of upright cones 31 are substantially larger than the base diameters of inverted cones 32.

The perforations of cones 32 consist of small V-shaped apertures 36, made by two-edged triangular punches, and are partially obstructed by the integral V-flaps 37 that are pressed outwardly from the apertures by the punches. This construction is shown best in Fig. 4. The perforations are closely arranged over the entire surfaces of inverted cones 32, and flaps 37 constitute a multiplicity of sharply pointed and downwardly directed teeth on the exterior of these cones.

Preliminary separator 12 is provided with a water gage 38; a suitable thermostatic device 39 having a connection 40 to burner 20 by means of which the burner may be automatically regulated for maintaining a uniform temperature in the separator; and a suitable float valve trap 41, by means of which the water level in the separator may be kept constant. This trap communicates with the upper and lower portions of the separator through pipes 42 and 43 respectively. There is a tendency for water to collect in the separator and this is overcome by the trap, the surplus water being discharged through pipe 44. The separator is also provided with an outlet 45 and valve 46 by means of which it may be drained and the sludge be drawn off.

The process of dehydrating and freeing the oil of emulsion is completed in dehydrator 13. This consists of a cylinder 47, of substantial length, connected in the discharge line 48. Within this cylinder is a plurality of electrolytic dehydrating sections of which one is shown per se in side elevation in Fig. 6. Each of these sections comprises a pair of perforate plates 49 joined together by a plurality of parallel zinc and copper strips 50. These strips are end-welded to the inner surfaces of the plates between the perforations. The number of zinc and copper strips in a section should be about equal and they should be so positioned that they alternate so far as possible. Thus each zinc strip should be adjacent to a copper strip and vice versa.

It will be evident that the dehydrating sections just described constitute closed circuit electrolytic cells when immersed in electrolyte, and that current will flow through the electrolyte between the zinc and copper strips under such conditions. The oil and the remaining emulsion therein that comes from separator 12 contains a small amount of water, and there always is a sufficient amount of dissolved salts in this water to make a weak electrolyte of relatively high resistance. The oil with traces of emulsion therein is thus subjected to an electrolytic current as it passes longitudinally through cylinder 47 between the zinc and copper strips. This current breaks up the emulsion and only dense oil and a small amount of unmixed water is discharged from the dehydrator through pipe 48.

The operation of my invention is as follows: Crude oil containing water and emulsion is admitted to pre-heater 11 through valve 51 and connection 52. The temperature of the oil is raised to the desired point in the pre-heater and it then passes downwardly through pipes 25 to the lower part of preliminary separator 12. The lower two-thirds of the separator is filled with hot water 53 maintained at a constant temperature. The oil upon leaving pipe 25 impinges upon deflecting bowl 29 and is broken up thereby into globules that float upwardly through the water to the lower inverted cone 32. The dense drops of oil pass through apertures 36 in this cone and continue to float upward to the inner plain surface of lower cone 31. The very minute oil particles in the emulsified portion of the oil tend to collect at the sharp points of teeth 37 and gradually form themselves into drops of dense oil which in turn pass upwardly through opertures 36. The exact action of the teeth perhaps is not fully understood but it would seem that they serve to break the surface tension of the minute oil particles in the emlusion and permit them to consolidate.

Lower cone 31, being larger in diameter than cone 32, collects the upwardly floating oil globules, directs them toward the center, and discharges them through the passages 34 at its top. The globules then continue to float upward through the hot water to the upper inverted cone 32 where the above described operation is repeated. Finally upper cone 31 collects the oil globules, directs them inwardly for further consolidation, and discharges them through its passages 34 into the body of oil 54 at the top of the separator. From this point the oil passes out, through the discharge connection 55 to dehydrator 13, and thence to discharge line 48.

Although the precise action of my invention perhaps may not be fully understood, as indicated above, there is no question whatever that it accomplishes its desired objects most satisfactorily. I have found by actual test of my invention on crude oil containing 10% water and 24% emulsion, that the preliminary separator reduced the water content to 8% and the emulsion to 13%. That is to say the oil passing into the dehydrator 13 through connection 55 was 79% dense oil, 13% emulsion, and 8% water. The dehydra-

tor completely consolidated the emulsion in this mixture and the discharge from pipe 48 contained 92% dense oil and 8% water unmixed therewith and easily separable by setting.

I desire particularly to point out that strips do not necesarily have to be copper and zinc. Any two metals of different electric potential will serve, although I have found the zinc and copper most satisfactory. Also alloys of copper and zinc might be utilized, and possibly a metal in cooperation with a non-metal of sufficiently different electric potential, such as carbon.

The thermostatic control 39 and float valve trap 41 are not in themselves a part of my invention and are not claimed herein per se.

I claim as my invention:—

1. A device of the character described comprising; a flow passsage; a pair of transverse perforate spaced plates in said passage; and longitudinal spaced members of different electrical potential joining said plates and in electrical connection therewith.

2. A device of the character described comprising; a tank containing water having an outlet near the top and a central inlet near the lower part thereof; an inverted perforate cone, having a sharply dentated under surface, directly above said inlet; a larger truncated cone with an open top immediately above said perforate cone; and means for maintaining the water level in said tank intermediate said outlet and the bottom of said second cone.

3. A device of the character described comprising; a pre-heater for a mixture of water and oil; a tank containing water having an outlet near its top and a vertical inlet pipe communicating with said pre-heater and extending to the lower part of said tank; an inverted perforate cone having a sharply dentated under surface intermediately mounted upon said pipe within the tank; a larger truncated cone with an open top immediately above said perforate cone; means for maintaining the contents of said tank at a constant temperature; and means for maintaining the water level in said tank intermediate said outlet and the bottom of said second cone.

4. A device of the character described comprising; a pre-heater adapted for heating a mixture of water and oil; a tank containing water, separably connected beneath said pre-heater, having an outlet near its top and a vertical inlet pipe communicating with said pre-heater and extending to the lower part of said tank; an inverted perforate cone having a sharply dentated under surface with downwardly directed teeth, intermediately mounted upon said pipe within the tank; a larger truncated cone with an open top immediately above said perforate cone; thermostatically controlled heating means for maintaining the contents of said tank, at a constant temperature; and float valve means for maintaining the water level in said tank intermediate said outlet and the bottom of said second cone.

5. A device of the character described comprising; a pre-heater adapted for heating a mixture of water and oil; a tank containing water, separably connected beneath said pre-heater, having an outlet near its top and a vertical inlet pipe communicating with said pre-heater and extending to the lower part of said tank; a deflecting bowl beneath the outlet of said pipe whereby the flow therefrom may be directed outwardly; an inverted perforate cone, having sharply pointed downwardly directed teeth pressed outwardly from its perforations, intermediately mounted upon said pipe just above said bowl; a larger truncated cone with an open top immediately above said perforate cone; thermostatically controlled heating means for maintaining the contents of said tank at a constant temperature; and float valve means for maintaining the water level in said tank intermediate said outlet and the bottom of said second cone.

6. The construction set forth in claim 2 in combination with means for subjecting the discharge therefrom to the action of an electric current for re-combining constituent particles of an emulsion contained in said discharge.

7. The construction set forth in claim 2 in combination with an electrolytic cell in the discharge line therefrom, whereby the discharge may be subjected to the action of an electric current for re-combining constituent particles of an emulsion contained in said discharge.

8. The construction set forth in claim 2 in combination with spaced electrically connected members of different electrical potential in the discharge line of said construction, whereby the discharge constituting an electrolyte may be subjected to the action of an electrolytic current for re-combining constituent particles of an emulsion contained in said discharge.

ALFRED DAHLSTRUM.