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STORAGE OF VOLATILE HYDROCARBONS, PARTICULARLY BUTANES

Walter G. Whitman, Whiting, Ind., assignor to Standard Oil Company, Chicago, Ill., a corporation of Indiana

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9 Claims. (Cl. 196—8)

The present invention relates to the storage of volatile liquid hydrocarbons, such as butanes and the like, and refers more particularly to a system wherein gases from various sources containing desired light hydrocarbon vapors are passed to a recovering operation for the separation of the said desired hydrocarbon constituents therefrom, the separated desired hydrocarbons being stored in the system and portions of the stored hydrocarbons which become volatilized during storage being passed to said recovering operation wherein the desired constituents of said volatilized portions are recovered, preferably in liquid form, and returned to the liquid hydrocarbons in storage.

In the art of refining mineral oil for the production of motor fuels of the gasoline type, it may be desirable to blend certain low-boiling volatile liquid hydrocarbons, such as butane, with such gasoline products. These low-boiling volatile hydrocarbons may be obtained from various sources, however, it is the general practice to recover them from certain gases produced in various refinery operations, such as cracking and distillation operations. Also, these low-boiling volatile hydrocarbons are often removed from casing head or natural gases. Owing to the volatility of these light hydrocarbons, i. e., butanes, etc., it is often the practice to add relatively small quantities of such hydrocarbons to a gasoline to be used in the warm summer season and to add relatively larger quantities to a gasoline to be used in the cooler seasons. By means of the present invention, these volatile hydrocarbons can be recovered from available gases the year 'round, the excess quantities not used in the warm seasons, being stored up for the cool seasons.

The invention will be fully understood from the following detail description, taken in conjunction with the accompanying drawing which is a diagrammatic elevational view of apparatus for carrying out the present invention.

Referring more in detail to the drawing, the numeral 5 indicates a closed storage tank adapted to contain highly volatile hydrocarbons, for example, butanes, etc. The walls of the tank 5 are preferably insulated or lagged by suitable material. The tank 5 is preferably not entirely filled with the stored liquid hydrocarbons in order to provide space for accumulation of vapors formed during storage of the volatile hydrocarbons. The vapors formed during storage are passed from the upper portion of the tank 5 through a line 6 to the inlet of a compressor 7 which may be operated by a suitable source of power, for example, an electric motor 8. The compressed vapors are forced from the compressor 7 through a line 9, cooling or condensing coil 10, and a line 11 and into a liquid-vapor separating drum 12, wherein liquefied or condensed portions separate from the vaporous or uncondensed portions. The separated liquid and vapors within the drum 12 are maintained under a substantially high pressure, the liquid being withdrawn from the lower end of the drum 12 through a line 13 from which it may be passed to either of a pair of branch lines 14 and 53. The branch line 14 is provided with a pressure reducing valve 16 and discharges into an expansion drum 17 maintained under a substantially reduced pressure, for example, approximately atmospheric pressure. The hydrocarbon liquid portion so introduced into the low-pressure expansion drum 17 undergoes partial flashing into vapors, thus cooling or refrigerating the remaining unvaporized portions of the light hydrocarbons to substantially the same temperature as prevails in the storage reservoir 5 which may be approximately 0° C. more or less. The cooled or refrigerated liquid portion is passed from the bottom of the drum 17 through a valved line 18 and into the lower portion of the storage tank 5, and the expanded cool vaporized portions are passed from the upper end of the chamber 17 through a valved line 19 and into the line 6, whereby the cool vapors become admixed with the vapors passing through the line 6 from the storage tank 5 to the compressor 7. If necessary for any reason, all or a portion of the liquid withdrawn from the high pressure drum or separator 12 through line 13, may be passed through valve 15 and branch line 20 directly into the lower portion of the storage tank 5, the line 20 being provided with an expansion valve 21, whereby the compressed liquid is caused to undergo expansion and be thereby refrigerated as it flows to the tank 5. However I prefer not to operate the system in this manner as I find that the vapors released from the liquid butane at pressure reducing valve 21 set up a violent agitation in storage tank 5 and cause greater evaporation than when the butane is admitted as a precooled liquid. In fact, the more nearly quiescent the contents of the storage reservoir can be maintained, the less the refrigeration required.

The operation of the compressor 7 is preferably controlled by means of a device responsive to the pressure conditions on the vapors in the storage tank 5. In the present embodiment one of the lead wires to the electric motor 8 is provided with a fluid-pressure operated switch 22 connect-

2. The method of storing volatile normally gaseous hydrocarbons at substantially atmospheric pressure, which comprises maintaining in liquid form by refrigeration a body of such hydrocarbons, withdrawing portions of said hydrocarbons which become volatilized during storage and compressing them, cooling and thereby condensing a portion of said compressed hydrocarbons, separating the resulting condensate from the uncondensed vapors and thereafter substantially reducing the pressure upon said condensate thereby flashing a portion of said condensate and effecting refrigeration thereof, separating the liquid and flashed vaporous portions, and passing the cooled liquid portion only to said stored liquid body of hydrocarbons.

3. The method of storing in liquid form a body of volatile normally gaseous hydrocarbons, which comprises maintaining a refrigerated body of such liquid hydrocarbons, withdrawing portions of said hydrocarbon body which become volatilized during storage and compressing them, cooling and thereby condensing a portion of said compressed hydrocarbons, separating the resulting condensate from the uncondensed vapors and thereafter substantially reducing the pressure upon said condensate thereby flashing a portion of said condensate and effecting refrigeration thereof, separating the liquid and flashed vaporized portions, returning the vaporized portions to said compressing operation, and passing the cooled liquid portion to said stored liquid body of hydrocarbons.

4. The method of storing volatile normally gaseous hydrocarbons which comprises maintaining a refrigerated body of the hydrocarbon liquid in a closed storage chamber, withdrawing vaporized portions of said hydrocarbons and passing them to an absorption operation wherein desired hydrocarbon constituents are absorbed in a fluid absorbing medium and thereby separated from undesired excessively volatile constituents of said vapors, heating the enriched absorbing liquid to vaporize the desired hydrocarbons and separate them from said absorbing liquid, condensing the desired hydrocarbon vapors under pressure, releasing the pressure on the condensed hydrocarbon vapors and conducting only the remaining liquid condensate to said storage chamber.

5. The method of storing a body of volatile normally gaseous hydrocarbons which comprises maintaining in liquid form a refrigerated body of such volatile hydrocarbons, withdrawing vapors evolved from said stored body of liquid hydrocarbons, compressing and cooling said withdrawn vapors to effect condensation of desired hydrocarbon constituents thereof, separating the resulting condensate from uncondensed vapors passing the said separated vapors to an absorption operation wherein desired volatile hydrocarbon constituents thereof are recovered in liquid form, and passing the recovered liquid hydrocarbons together with the condensate produced in the compression and cooling step to the stored body of liquid hydrocarbons.

6. In apparatus for storing volatile normally gaseous hydrocarbons, the combination of an enlarged closed storage chamber, a compressor and condenser, conduit means for conveying vapors from said storage chamber to said compressor and condenser, a pressure separator drum provided with vapor discharge means connected to said condenser, a flash drum connected to said storage chamber, conduit means for passing liquid from said separator drum to said flash drum, conduit means for conducting liquid thence to said storage chamber and conduit means for conducting flashed vapors away from said flash drum.

7. In apparatus for storing volatile hydrocarbon oils, the combination of an enlarged closed storage chamber, a compressor and condenser, means for conveying vapors from said storage chamber to said compressor, a liquid-vapor separator drum connected to the outlet of said condenser, and means for passing liquid from said separator drum to said storage chamber, an absorber for volatile hydrocarbons, means for passing vapors from said separator drum to said absorber, means for recovering volatile liquid hydrocarbons from said absorber, means for withdrawing vapors from said volatile liquid by reducing the pressure thereon and means for passing the recovered liquid to said storage chamber.

8. In apparatus for storing volatile liquefied normally gaseous hydrocarbons, the combination of an enlarged closed storage chamber, a compressor and condenser, means for conveying vapors from said storage chamber to said compressor and condenser, a liquid-vapor separator drum connected to the outlet of said condenser, means for passing liquid from said separator drum to said storage chamber, an absorption system, means for passing vapors from said storage chamber directly to said absorption system, means for passing vapors from said separator drum to said absorption system, means for withdrawing recovered liquid hydrocarbons from said absorption system, means for removing the most volatile constituents from said liquid hydrocarbons and means for conducting the remaining recovered liquid hydrocarbons to said storage chamber.

9. The method of storing a body of normally gaseous hydrocarbons which comprises maintaining in liquid form a refrigerated reservoir of such volatile hydrocarbons, continuously maintaining a slight subatmospheric pressure on said body whereby loss of vapors of said hydrocarbons is entirely prevented although contamination by air is encountered due to leakage into said reservoir, withdrawing vapors of said liquid hydrocarbon body which become volatilized during storage and compressing them, condensing the compressed hydrocarbons, separating uncondensed contaminating air, expanding the liquid hydrocarbons whereby they are cooled to a temperature substantially equal to the temperature of the storage reservoir, separating flashed vapors from the cooled liquid hydrocarbons and thereafter returning the said liquid hydrocarbons only to said reservoir.

WALTER G. WHITMAN.

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HONEY EXTRACTOR CONSTRUCTION

Filed April 3, 1933 3 Sheets-Sheet 1

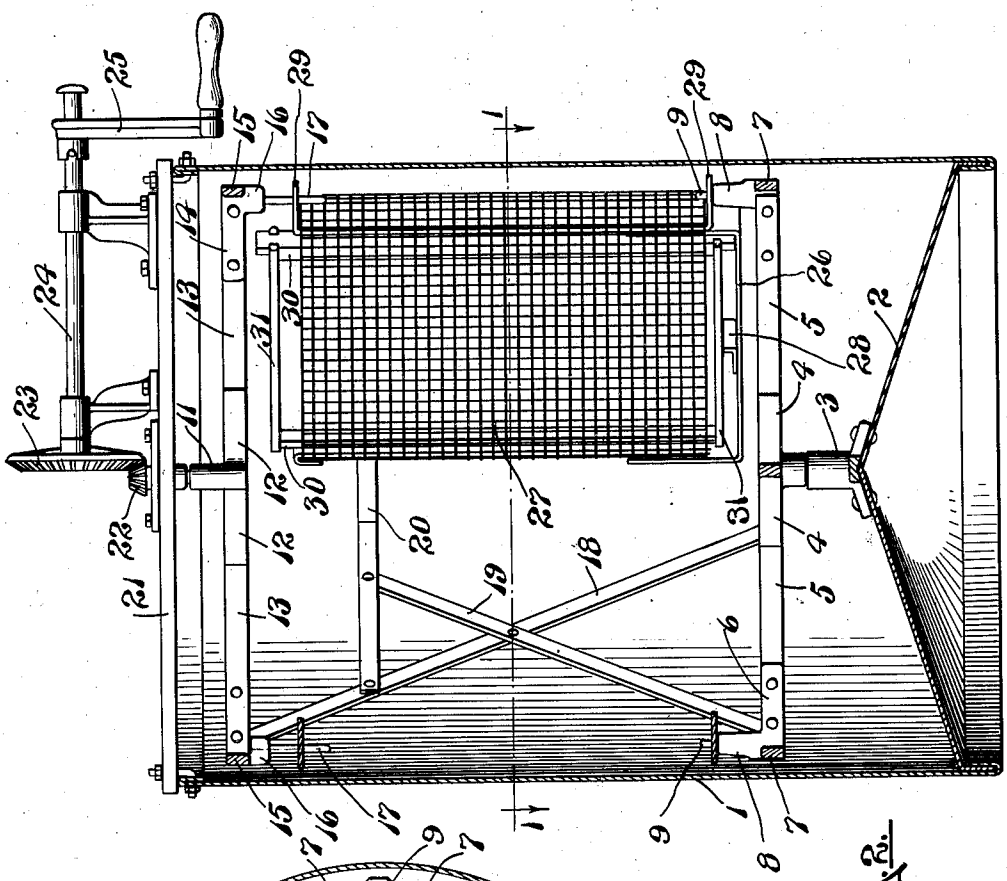


Fig. 2.

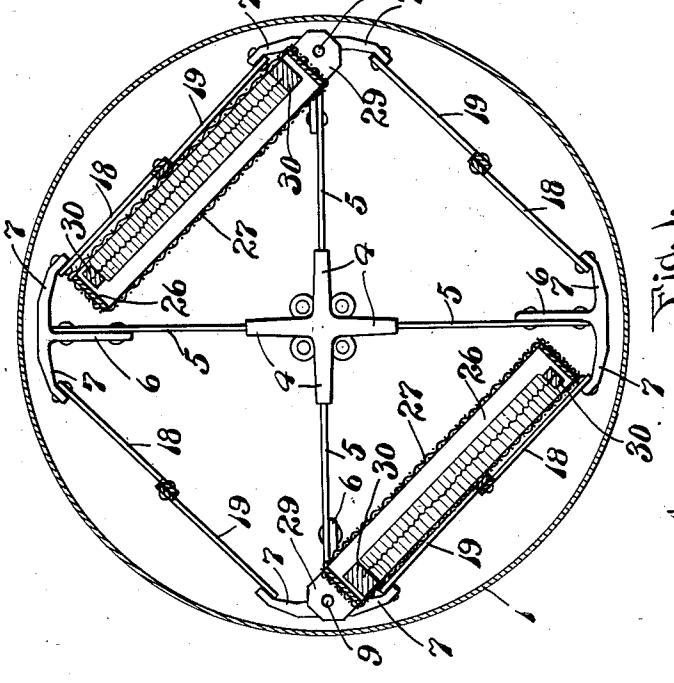


Fig. 1.

Inventor
Albert G. Woodman
By Livernance and Van Antwerp
Attorneys