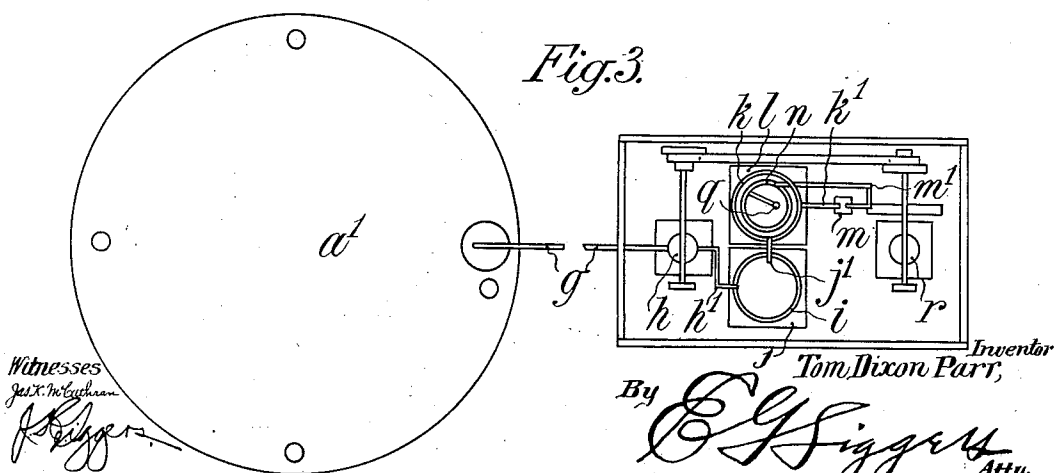
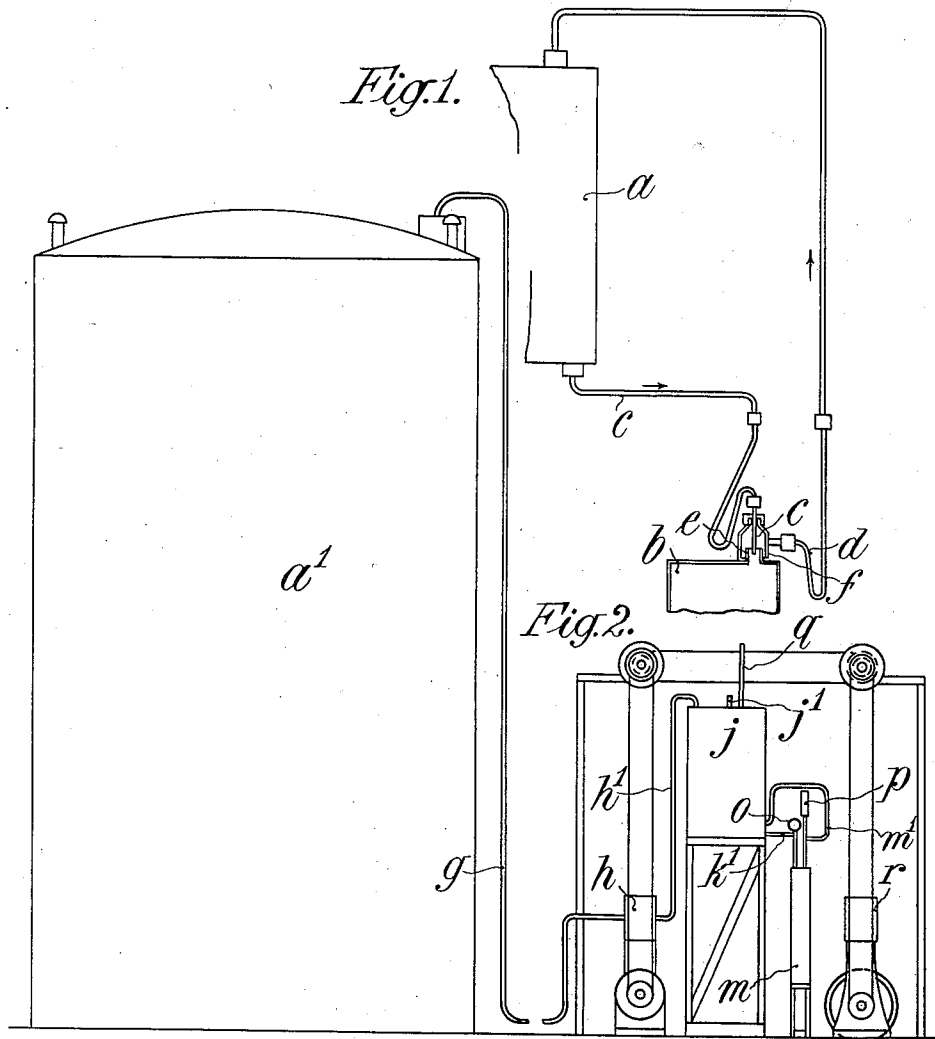


T. D. PARR.
PROCESS OF RECOVERING THE VAPOR OF VOLATILE LIQUIDS.
APPLICATION FILED OCT. 10, 1914.

1,269,639.

Patented June 18, 1918.



UNITED STATES PATENT OFFICE.

TOM DIXON PARR, OF LONDON, ENGLAND.

PROCESS OF RECOVERING THE VAPOR OF VOLATILE LIQUIDS.

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Specification of Letters Patent.

Patented June 18, 1918.

Application filed October 10, 1914. Serial No. 866,120.

To all whom it may concern:

Be it known that I, TOM DIXON PARR, a subject of His Majesty the King of England, residing at Russell Square, in the county of London, England, have invented certain new and useful Improvements in Processes of Recovering the Vapor of Volatile Liquids, of which the following is a specification.

10 This invention relates to improvements in methods of filling storage and transport vessels with volatile liquids of emptying the same and of recovering, in liquid form, the vapor contained therein.

15 At the present time nearly all vessels to be filled with, say, petrol, contain a considerable quantity of vapor which is displaced and allowed to go to waste when the vessel is refilled. This method is not only dangerous but exceedingly wasteful, and the waste is repeated at each handling as from ship to store, thence to railway tank wagon, road tank wagon, storage tank and 2 gallon tin or can.

25 According to the present invention the displaced or collected vapor or air and vapor, from the storage and transport vessels to be filled or emptied at a depot is withdrawn by means of a compressor or ex-
30 hauster and the vapor recovered by a process of condensation or (and) absorption as hereinafter described.

The system may be worked either under pressure or vacuum by means of air, steam, 35 water or the like. In the case of a partial vacuum all the vessels concerned in one operation would be in the same condition, the partial vacuum being maintained by means of a compressor.

40 The invention is hereinafter described with reference to the accompanying drawings in which:—

45 Figure 1 is a partly sectional elevation showing a method of filling a can from a receiver tank.

Fig. 2 is a diagrammatical elevation of a suitable plant for recovering the vapor, and

Fig. 3 is a plan of same.

50 When filling one vessel from another the work should be done under seal, that is, as the liquid passes from one vessel to the other, the displaced vapor or air and vapor

from the vessel being filled would be passed to the vessel being emptied.

55 A very simple and inexpensive equipment for this purpose is shown in Fig. 1 without the compressor or exhauster. As the liquid passes from the receiver tank *a* to a can or vessel *b* through the supply pipe *c*, 60 the vapor or mixture of air and vapor displaced from the can *b* would escape to the tank by means of a pipe *d*. The end of the supply pipe *c* would project through the neck *e* of the can *b* and be surrounded by a 65 dome or cap *f* to which the pipe *d* is connected. The can or vessel *b* after being emptied would be returned to its depot to be refilled when the process is repeated, the vapor or vapor and air being passed from 70 said vessel into the tank *a* to displace the liquid drawn off from the latter. The top of the receiver tank *a* would, in turn, be connected to the top of a storage tank in similar manner as owing to the intense evapora- 75 tion which takes place when a volatile liquid is disturbed, there will be a bulk of vapor or vapor and air passed to the tank *a* in excess of that contained in the can or vessel *b* during filling. Whatever this bulk 80 may be it eventually finds its way through the various tanks to the condensing apparatus hereinafter described. By this method, all the vapor contained in all the subsidiary vessels and cans is returned to the distribu- 85 tion center or depot, where it would be dealt with as described later.

In the case of tank steamers and other large containers which at present are voided by means of a steam ejector or the like, the 90 mixture of air, steam and vapor would be passed through a condenser to convert the steam into water and a portion of the vapor into liquid while still in contact with air. A separator will provide for the separation 95 of the water and the liquid, the water passing to waste and the liquid to a storage tank.

From this point the remaining mixture of air and vapor may be treated in conjunction 100 with that from smaller vessels and the vapor contents of the transport vessels returned to the depot as described above. The recovery plant for the mixture of air and vapor in addition to a compressor or 105 exhauster may consist of a vessel containing

a substance or carrier having an affinity for the vapor to be dealt with and also possessing a high boiling point such as a suitable oil, through or (and) over which the mixture is passed, the air being separated out and passing to waste. The oil containing the vapor in liquid form is then passed to a boiler or evaporator, the temperature of which is regulated to a point intermediate between those of the liquid to be recovered and of the oil. Here the liquid is driven off in the form of hot vapor which is passed to a condenser and so to a storage tank, while the oil is cooled down to a normal temperature and is then used again, the process being continuous. The absorption of the vapor by the oil may be carried out in stages if required, the respective flows being uni- or contra-flow as desired.

In the case of businesses consuming considerable quantities of volatile liquids, each firm might install its own recovery plant so as not to return (or, in other words, waste) the amount of liquid represented by the vapor remaining in the vessels used for transport, as well as the small amount of liquid usually remaining in the vessels.

An alternative method of recovery of the vapor would be by compression and reduction of temperature in a suitable plant, such as that shown in Figs. 2 and 3. Thus, a pipe g may lead from the top of the storage tank a' to a compressor h . This pipe would preferably be sufficiently large to carry off all the mixed vapor and air which may be displaced when the tank is filled at the highest rate. Where several tanks are connected to one compressor a suitable water seal or other isolating device may be adopted to prevent direct communication between one tank and another and between the tanks and the compressor.

The compressor h may be of an ordinary type with one or more stages and suitable cooling arrangements to prevent any undue rise in the temperature of the mixture; or, what is generally known as a cold air machine may be used, (such as is generally used for refrigerating purposes). By this latter means the air contained in the mixture after being compressed, cooled and separated from the liquid may be expanded in a second cylinder in order to utilize the stored up energy of same.

The mixture having been compressed passes through a pipe h' to a coil i in a tank j through which water or other cooling fluid circulates to carry off the heat of compression, the mixture in the coil being reduced to normal temperature. It then passes through a pipe j' to a second coil k immersed in brine in a tank l in order to further reduce it to the lowest possible temperature and condense the vapor.

It is well known that mixtures of petrol

vapor and air tend to condense in pipes at low pressures, so I may use a series of coils, straight tubes or the like in a cold brine tank for condensing purposes. The brine may be either inside or outside the tubes the mixture being on the opposite side.

The resulting liquid passes on with the air to an enlargement of the coil in order to reduce the speed of flow and allow any mist or small particles to settle. Any suitable form of baffle may be inserted to assist in collecting small particles. The enlargement may be provided with a false bottom having a few small holes through which the liquid will run and so be isolated from the current of air.

The liquid then passes with the air through a pipe k' into a receiver tank m and may be drawn off by suitable means. The receiver may be jacketed or a cooling coil be immersed in the liquid in order to prevent any tendency to re-evaporate.

The condensed petrol vapor is then returned from the receiver m to the storage tank, or, if required to another tank. Up to this point the air, vapor and liquid are all under pressure. The air having been deprived of nearly all the vapor, may now pass from the receiver m through a pipe m' and be expanded as mentioned above, either in an expansion cylinder and pass thence to a coil, or be expanded direct into a coil n , or the like, in the brine tank l in order to absorb the heat of compression of the mixture, and then pass to the atmosphere or be first used to assist the cooling in the earlier parts of the process. A pressure gage is represented at o and a relief valve at p . The waste air from the coil n passes through a pipe q . The compressor h is driven by means of an engine r through suitable belts and shafting such as shown. If the mixture be made to impinge violently on very cold baffles the pressure need not be so high.

The temperature and pressure in the system may be so regulated as to permit a certain quantity of the vapor to remain in the air, and this having served all the purposes required may be used as a source of heat or light or of power in an internal combustion engine or otherwise.

Any aqueous vapor condensed in the system may be withdrawn by suitable means.

The system may be modified by having a separate appliance for providing the cooling medium, when, if the temperature produced be very low the pressure in the system may be reduced.

Evaporation being continuous day and night it would be necessary, were no other means adopted, to run the compressor h day and night also, but this may be avoided by the use of a tank containing water, the top of this tank being connected by a pipe to

the top of the storage tank or tanks *a'*. The rate of evaporation and the amount of air leakage being known and the water tank filled, it will be clear that if the water be
 5 allowed to run from said tank at a certain rate, there will be a displacement equal in amount to the vapor and air coming from the storage tank or tanks. The water tank may have a capacity equal to, say 12 hours' supply of mixture which, during the day,
 10 may be displaced by again filling the water tank, the mixture being sent to the compressor.

By regulating the amount of air admitted to the compressor *h* the strength of the mixture may be maintained sufficiently low to avoid the possibility of explosion in the plant while any other precautions may be taken throughout the plant with the same
 20 object in view.

As it is desirable to limit as far as possible the amount of air leaking into the storage tank or tanks, except when liquid is being drawn off the ventilators, which at
 25 present allow a free opening to the atmosphere, may be replaced by a simple form of valve or the like, one or more to admit air when liquid is being drawn off, working at a pressure of say 1 inch of water, and others for the escape of vapor under abnormal conditions working at about 2 inches or 3 inches
 30 of water.

Can and barrel filling plants being much more difficult to handle as far as recovery of
 35 vapor is concerned, require special care in the arrangements. When these vessels are returned by a customer they invariably contain a small quantity of liquid as well as vapor. On arrival at the depot, if the vessel
 40 does not require repair it is stacked with others, very often with the cap or plug removed. The vapor is then wasted. If the vessel requires repair the vapor has to be blown out to render the vessel safe for soldering or the like. The vessel is then filled
 45 usually standing on a grating over a trough which catches any liquid spill.

The filling plant would be so arranged as to pass all the vapor to the compressor *h* and the petrol to a receiver tank as above described with regard to Fig. 1, but in this case the mixture may be taken direct to the compressor which will form a partial vacuum under the cap or bell *f* and so draw off
 50 the mixture as it is displaced by the incoming liquid. The waste which occurs at present when washing out transport vessels by means of a jet of liquid may be saved by reversing the positions of *b* and *f*, *i. e.* placing
 55 *b* over *f* and passing first a jet of liquid and then a current of air into the vessel. The vapor and air may then be passed to the compressor and any liquid be intercepted by a tank suitably placed.

65 It has already been shown that the air

when discharged from the recovery plant may contain a small proportion of vapor which in practice may cost more to recover than it is worth, but it may be recovered by the absorption process described above. 70

If the empty vessels be voided of vapor as soon as they arrive at the depot say by either inverting them over or connecting them to, a nozzle delivering air to their interiors and provided with a suction receiver or bell for
 75 the escaping vapor or mixture the vapor or mixture may be recovered, but if fresh air be used for the purpose it would take up and finally carry away a small quantity of the vapor. Now, if air which has already been
 80 through the recovery plant be used, it will already contain the minimum quantity of vapor which will be increased when voiding the vessels. On again passing through the recovery plant the whole of the extra quantity taken up will be recovered leaving the former minimum. This will tend to economical working. 85

Suitable automatic devices may be embodied in the system to control the speed of the compressor, the pressure of the air, the vacuum in the tanks and other details, together with the necessary cocks; valves, thermometers, manometers, pressure gages, indicators, recorders and the like. 90 95

Instead of using a water tank for the reception of mixture during the time that the compressor *h* is not working, a gas holder or bell may be used similar to a gas works holder but with the difference that the weights would be heavier than the bell so that the tendency of the latter would always be to rise and draw in mixture, but when the compressor is connected to the interior the vacuum produced would be higher
 100 and the weight of the atmosphere on the top would overbalance the weights and the bell would fall. 105

The two methods described above, *i. e.* absorption and compression, may be used in conjunction with one another to considerable advantage. 110

I am aware that it has previously been proposed in various industries to recover volatile vapors from the air in which they
 115 are contained by first compressing and cooling the mixture and subsequently subjecting it to progressively decreasing temperatures and also by means of an absorption process effected in oil which is afterward heated, but no claim is made to these processes *per se* except in connection with the transference of liquids between storage and transport vessels at a depot as hereinafter pointed out in the appended claims. 120 125

What I claim and desire to secure by Letters Patent of the United States is:—

1. In the transference of volatile liquids from one vessel to another, the method of preventing loss of volatilized matters pro- 130

duced during the transfer, which consists in causing the transfer under seal and removing the volatilized matters and reducing them to liquid condition.

- 5 2. In the distribution of volatile liquids for vending purposes, the method of preventing evaporation losses, which consists in causing the transfer of the liquid from one vessel to another under seal, withdrawing

the vapors produced by such transference 10 and condensing the vapors to liquid form.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

TOM DIXON PARR.

Witnesses:

J. S. WITHERS,

F. J. CLEVELAND.