LPG PUMP PROBLEMS

Four Services With A Single Pump

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MOST butane and propane distribution plants are today being expanded, or have plans to increase their capacity as soon as equipment is available. Where deliveries have been made principally by small tank trucks calling directly on individual consumers, new bottling plant equipment is being added to fill cylinders on a production basis and thereby make it possible to serve hundreds of new customers with a minimum of cost in service time.

In this issue, we show a diagrammatic layout of a plant using a single 100 GPM butane-propane pump to handle four services namely: (1) unloading tank cars; (2) unloading tank truck and trailer units; (3) loading small delivery tank trucks; and (4) operating a four to six manifold bottling plant.

This particular layout is made for pump operation in one direction of rotation only. When used in connection with a reversing switch, considerable simplification of the piping is possible, since the in and out flow can pass through the same piping and valves. However, many users prefer single-direction operation.

We must emphasize, again, the importance of keeping the inlet line to the pump as free from restriction as possible, since pump capacity is largely dependent on gravity flow from the fluid source to the pump.

While it is difficult, in a simple sketch as shown, to present a layout other than in one plane, it will be readily understood that a considerably shorter inlet line from the tank truck unloading position would be possible if this unloading area were to be located directly behind the pump and to one side of the storage tank.

In connection with the inlet piping, one important consideration is to avoid abrupt changes in the direction of fluid flow such as occur in short radius ells, and particularly in globe valves and excess flow valves of small size. Such changes cause far greater resistance to flow than any fluid friction developed in long, straight lengths of pipe. This is because the viscosity of butane or propane is extremely low, or about one-tenth that of water.

Experiments have proved that it is really not pipe line friction but the inertia losses through directional changes that result in the greatest resistance to flow; in other words, it is the actual total of energy lost in creating high velocities through restricted passages, over and over for each change of direction, in passing through each of the valves included in the line.

What we have often expressed, in advocating direct flow and large valve areas, applies specifically to the pump intake lines, since here there is no pressure to insure flow, other than that of gravity, for if pump suction is depended upon, this will reduce the pressure in the intake line to less than that in the storage tank, and this results in the development of a high vapor content in the pump intake, with consequent reduction in the volume of liquid output.

In the present article, we show all main lines running underground. This is a worth while safety feature, but has the slight disadvantage of having an initial liquid-filled vapor return line, and a consequent added resistance to vapor return, equal to the head pressure developed to raise this liquid to the top of the discharge point within the storage tank.

Another feature which we wish to emphasize is the importance of keeping the intake line level, or slightly inclined from the pump to the supply tank. This is so that any vapor which forms in the pump, will pass back through the line to the tank, and in this way avoid the possibility that sun heat on the pump will completely evacuate the liquid from the pump, as might be the case if the intake line were dropped to pass underground. When it is absolutely necessary that the pump inlet lines pass down from the pump, as shown here in Figs. 1 and 3, and the by-pass line can still be returned to the tank without such a dip, it is, in our experience, a wise precaution to drill a 1/8" hole through the by-pass valve disc.

This will permit any gas formed in the pump (as by sun heat) to constantly trickle back through the by-pass line to the tank, and insure that the pump temperature is kept the same as that of the tank fluid.

Insurance Against Vapor Lock

We consider this to be a very worth while feature to incorporate in any case, since it insures against vapor lock, and also materially helps in vapor elimination where metering is concerned. The volume loss through direct by-passing of liquid through this small hole will not be appreciable as compared with the total pump capacity.

In the accompanying drawings, we have shown how a single pump may be applied to carry four services. However, some users have preferred to locate one pump near the railway siding, exclusively for unloading tank cars. A second pump is then installed adjacent to the storage tanks for pumping to the loading rack. This, of course, is quite necessary if the storage tanks are located some distance from the tank car unloading zone, since it is always desirable to maintain the shortest possible connection from the supply source to the pump.

A third pump may then be put in for the sole purpose of handling the bottling plant. This system has the advantage of non-interference of one operation with another, since, in this way, the bottling plant may be operated at the same time that tank cars are being unloaded.

An important advantage of the single pump system, shown in the present writing, is that since the one pump can be made to serve all uses, a second standby pump may be kept in reserve, or when desired, installed beside the first pump with parallel piping. This second pump is then ready to take over the entire load at any time, should any emergency pump trouble develop. In many cases, this system affords a better insurance against possible delays in the event of necessary repairs.

(OVER)

YOUR PUMP IS THE HEART OF YOUR BUTANE-PROPANE PLANT

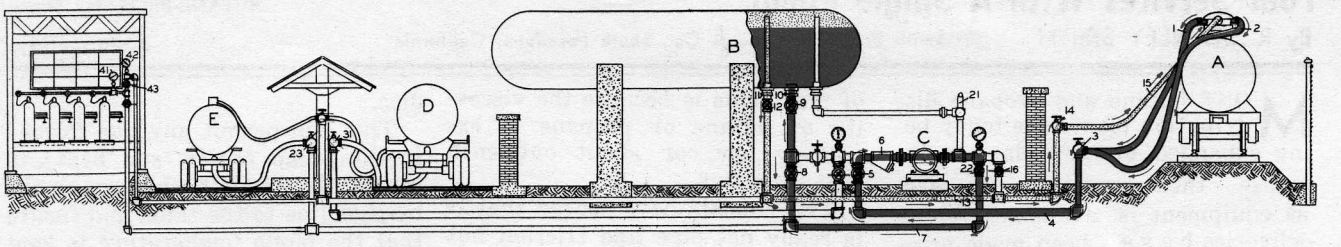

FIG. 1. This is a diagrammatic layout showing connections for unloading a tank car (A) to storage tank (B) by means of a positive displacement rotary gear pump (C). Two 2" hose connections (1) and (2) are connected to valve (3) by a Y connection. Fluid flow is through 3" line (4), valve (5), strainer (6), 100 GPM pump (C) and discharge line (7), valves (8) and (9) and excess flow valve (10), to storage tank (B). A 2" return vapor line is provided through excess flow valve (11), valve (12), pipe (13), valve (14), and hose connection (15).

For the initial elimination of vapor from the lines and to start the siphon lift within the tank car, valve (16) in the pump outlet may be opened. This reduces to practically zero the necessary pump differential operated against. As soon as a liquid flow is developed in the hose lines, and solid liquid is delivered to the pump, valve (16) may be closed. It will be apparent that direct delivery may be made to tank car loading station (E) by closing valve (8) and making the necessary connection to tank truck. This avoids the necessity of holding up loading operations during tank car unloading operations.

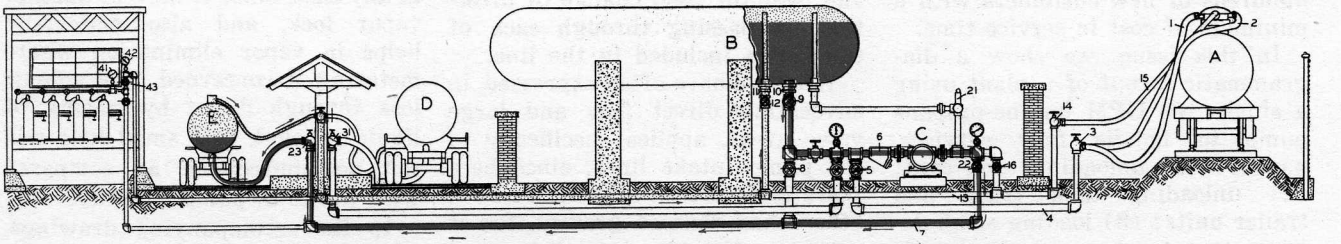

FIG. 2. The sketch above presents a flow diagram for loading tank trucks at station (E). Closed valves are indicated by the straight lines across the valve centers. In this use and other loading operations shown, there is no use made of the by-pass valve (21) other than as a safety element in case pump delivery is cut off as by valve (22) at the pump, or valve (23) at the loading rack.

It is well to place stop and start explosion-proof push buttons at each of the several stations, as at the pump, at the loading rack and at the bottling manifold. In this way the pump may be controlled from any of these working positions, and less by-passing of liquid under high pressure will be required.

Arrows in these drawings indicate the flow of fluid and return flow of vapor. The dead sections of piping are not indicated as containing fluid or vapor as this would confuse the line of flow under consideration in each of the sketches.

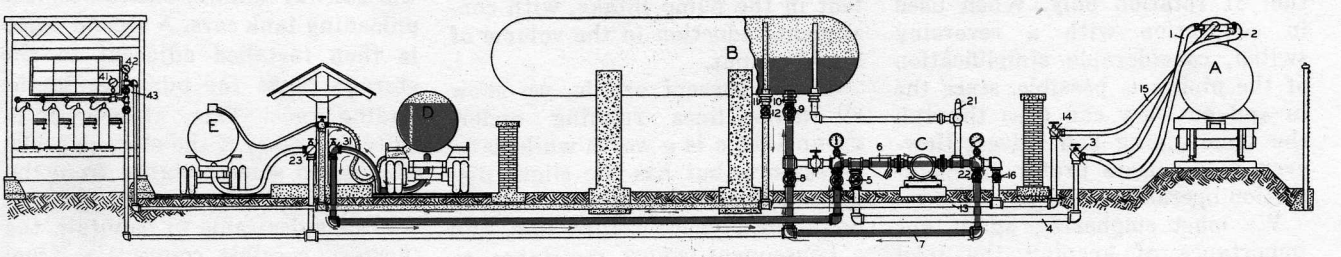

FIG. 3. This sketch indicates the flow of fluid when delivering a transport load in position (D) to storage tank (B). When delivery is made by a truck and trailer unit, a Y fitting should be provided on valve (31) at the truck station so that hose lines from both tanks can be attached at the same time, thus greatly reducing the total time of unloading.

As suggested in the text of this article, the unloading position as shown in this diagram could be advantageously placed closer to the pump, such as in the position immediately behind the pump, alongside the storage tank. It is always important to keep the intake lines to any pump as short and direct as possible, although the points of delivery as to loading rack and bottling plant may be located further away when this is more convenient.

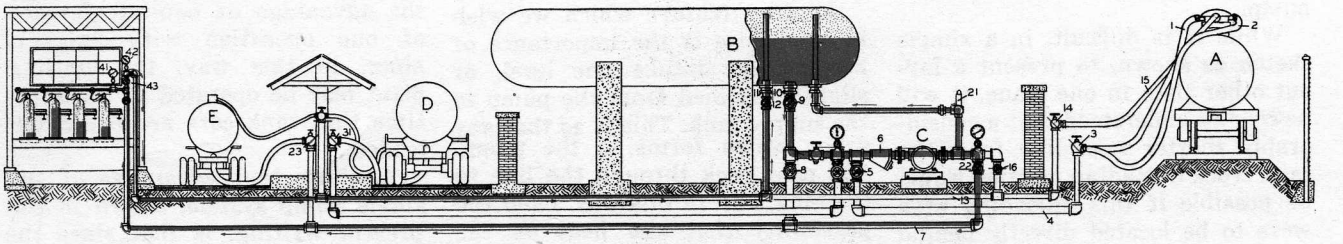

FIG. 4. Above is a flow diagram showing delivery lines and valving to a small 4 or 6 scale manifold. Since such a plant will absorb only a part of the full delivery of the pump, operation of the by-pass valve is shown. A differential pressure of 50 to 60 lbs. has been found very satisfactory and under this pressure four 100 lb. single valve cylinders may be filled in less than five minutes.

Approximately forty 100 lb. cylinders can be handled per hour by a single operator. Pressure gauges (41) and (42) are extremely valuable to enable the operator to watch his pressures. Valve (43) of the semi-needle type also is a great help to control the pressure and to release pump pressures when only one or two cylinders are being filled.