Tank Truck Installations

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THE suggestions made in this article will be found especially applicable to the small tank truck used for supplying butane or propane to the so-called "semi-bulk" plants of consumers having permanently located storage tanks. Deliveries of 50 to 500 gallons are usually made to these customers, and an accurate system of metering is important.

While it would be very difficult to show the many possible ways in which layouts could be developed for such installations, due to the great variety of equipment available, essential design features will be pointed out which will help to insure satisfactory operation and meet the average requirement.

It must be again emphasized that in pumping butane and propane, the fluid is being handled *at its boiling point,* which is far different from handling water or oil or even gasoline, which are comparatively stable fluids. The type of equipment and its installation must therefore be much more carefully considered if we are to secure maximum output and generally satisfactory operation.

In the first place, to get the best results it is necessary to avoid every possible condition tending to produce vapor in the pump supply line. Not only is it important that the pump be amply supplied with solid fluid, but also a continuous flow of new fresh liquid through the pump must be maintained, sufficient to carry away any heat which may be generated in the pumping process.

It is in part to bring about this result that a by-pass valve must be provided in the pump discharge line, and the capacity of this valve should be sufficient to return the entire pump output back to the tank without the development of excessive pressure, whenever other pump discharge valves may be closed. Also, when such regular discharge outlets are limited in their flow rate, as, for example, when filling only one or two small containers at a time, the by-pass valve must be relied on to return enough fluid to the tank to keep a continuous flow through the pump to carry off excess heat and avoid vaporization. This subject has been covered more completely in earlier articles, but its importance prompts the present repetition.

The sketches here presented illustrate an assembly of valves, standard fittings and other equipment which may be used for a successful, small truck installation, assuming a tank capacity of 1000 gallons, and a rotary pump rated at 50 GPM delivery, direct driven at 500 RPM by the truck power take-off.

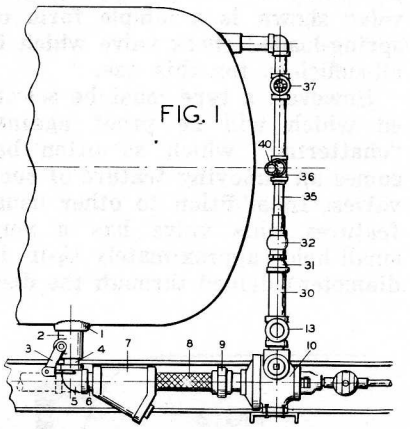
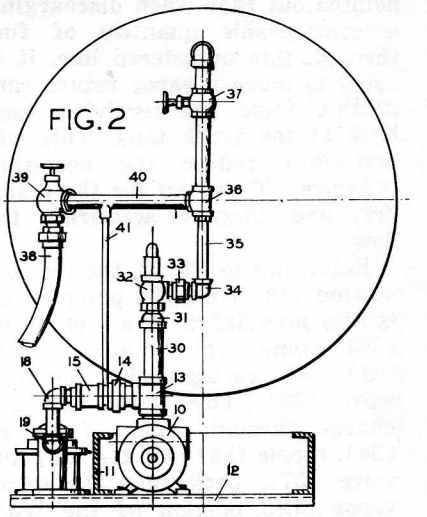


Fig. 1 shows a side view of the forward end of the truck tank, having a bottom tank outlet at (1) which is tapped 3-in. standard pipe size. While it is quite common to apply an excess flow check valve to this outlet, an internal valve (2) operated by a lever (3) is here shown. This valve has a 2-in. tapped outlet at the bottom to receive nipple (4) and a 2-in.x2½-in. reducing ell (5) into which a 2½-in. nipple (6) is screwed to receive 2½-in. line strainer (7). A flexible metallic pipe section (8) includes a union (9) connecting to the 2½-in. tapped inlet of the pump (10).

As has frequently been emphasized in previous articles on pump installation, it is quite essential that the pump inlet line be ample in size as well as short and direct. This is for the reason that butane or propane should be carried *into* the pump by gravity head alone, if a large portion of the pump capacity is not to be lost as is the case when the inlet pressure is reduced by suction, and quantities of vapor or foam replace the solid fluid entering the pump. Tests have shown that the type of internal valve illustrated affords a larger and more direct passage than that found in the usual excess flow valve.

In addition to this, it also avoids the necessity for adding an exterior shutoff valve at the tank outlet, since the one valve answers both requirements. The internal valve lever (3) is connected by rod or cable (not shown) so that the valve may be operated by a hand lever placed in the truck cab, and appropriate safety features may be incorporated to insure that this valve is always closed while the truck is on the road between delivery points. The fact that this valve is never opened except during the withdrawal of fluid, affords an excellent feature of safety protection.

The short 2-in. open nipple (4) offers no material area restriction, while the 2½-in. strainer suggested provides an advantageous increase in screen area over that found in the 2-in. size. The 2½-in. flexible tube (8) with union connection to the pump takes care of any weaving strain between the tank and the pump, which is a desirable feature. The end intake on the pump permits a direct flow and positions the pump at a height so that a nearly straight universal drive to the truck power take-off is possible.



Looking above to Fig. 2, which shows an end view of the truck tank as seen from the truck cab, pump (10) is shown located just inside the truck frame (11) and is supported by crossbar (12) to which it is bolted. This pump is provided with three 2-in. tapped outlet ports, to permit piping to enter either side or vertically, whichever may be most convenient. In the present example, the vertical port only is used, the other two

being closed by permanent pipe plugs.

The pump discharge is through the 2½-in. tee (13), union (14), tee (15) and then through pipe (16) running away from the observer and better shown in the truck side view, Fig. 3, as extending to an outlet valve (17). However, going back to Fig. 2, a second outlet through tee (15) passes through reduced ells (18) and (19), union (20) (see Fig. 3) and through meter inlet (21), meter strainer (22) and into meter (23).

Meter outlet (24) connects by nipple (25) to back pressure valve (26), nipple (27) and shutoff valve (28), which discharges through hose coupling (29) to a suitable flexible hose and fittings to customer's tank.

All deliveries which must be metered pass through this meter line, just traced. However, when it is not necessary to meter the discharged fluid, it may be passed through line (16) and valve (17), previously indicated, which may be of larger size so as to permit faster discharge under less pressure restrictions. Also it should be pointed out that when discharging a considerable quantity of fuel through this unmetered line, it is usual to make a vapor return connection from the receiving tank back to the truck tank. This will materially reduce the necessary pressure differential for the transfer, and thereby accelerate the flow.

Returning to Fig. 2, the tee connection (13) from the pump outlet is also provided with a pipe outlet (30) connecting through reducer (31) to spring-loaded by-pass valve (32). This valve will discharge through union (33), ell (34), nipple (35) into tee (36) and valve (37), back into the upper vapor filled portion of the truck tank. A vapor return hose line as suggested above is indicated by (38), connected to valve (39) and line (40) back into tee (36). Valve (37) is left open at all times but is necessary to permit emergency shut-off in the event of pump or meter repair.

To complete the list of piping and fittings, a copper tube line (41) connects between back-pressure valve (26) (Fig. 3) and some portion of vapor return line (40) below valve (37) as shown. The construction and operation of valve (26) and (32) will be more fully described later. Provision for filling the truck tank may be made by substituting a tee in place of the ell fitting (5) as is shown by dotted lines in Fig. 1, or a separate filling outlet may be provided especially for this purpose.

It should be particularly noted that the by-pass valve in this layout is placed at the highest point in the pump discharge line. This aids in the rapid elimination of any initial accumulation of gas in the pump or fittings. The by-pass valve shown is a simple form of spring-loaded check valve which is all-sufficient for this use.

However, a type must be selected which will be proof against "chattering" which so often becomes an annoying feature of such valves. In addition to other usual features, this valve has a very small hole (approximately ⅛-in. in diameter) drilled through the disc.

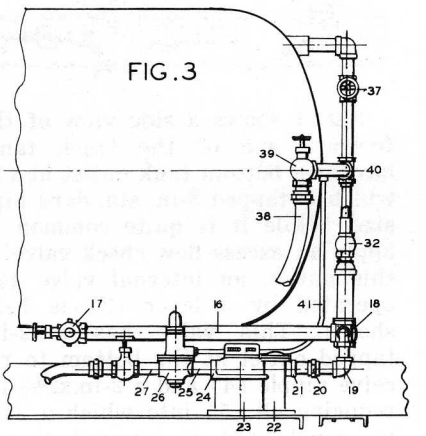


FIG. 3

This is an important variation from usual practice since it permits the continuous bleeding off of gas from the pump, meter, and adjoining lines, particularly while the tank is being filled, and prior to the operating of the pump. This tiny port also affords a continuous open by-pass during the pumping operation, but only to the extent of approximately a half gallon of liquid per minute, which is an insignificant part of the total pump output. However, in operation, as the tank nears the empty point, this small port is capable of passing a volume of gas or vapor nearly 100 times as great as its capacity for fluid. This rapid escape of vapor reduces the pressure on the outlet stream and so slows up the flow through the meter as to prevent the passage of vapor which would otherwise disturb meter accuracy.

When used in propane service, this method of gas elimination has proved to be quite a bit more effective than the usual type of eliminator tank with its more or less complicated float controlled valve mechanism. However, its success is very much dependent on correct piping layout and the high positioning of this valve.

The back pressure valve (26) (Fig. 3) is usually of the diaphragm type, and is so arranged that until the pressure of the flow from the meter exceeds the tank vapor pressure by eight to ten pounds, the valve remains closed and will not permit the passage of fluid. As soon as the pressure increases above this point, flow through the valve is no longer restricted.

There are several reasons, often not too well understood, why it is necessary to maintain this increased pressure within the meter. In the first place, if a volumetric, positive displacement meter is to measure definite volumes of liquid, the liquid to be measured must necessarily be solid and free from any possible gas content. Since liquid butane or propane will instantly start to boil with any slight increase in temperature or reduction of pressure over that in the storage tank, the only safe way of insuring solid fluid in the meter is to maintain this increased pressure during the metering operation.

Also, when a differential pressure of eight to 10 pounds per square inch is maintained, this may be depended on to collapse any vapor which may have formed in or ahead of the meter prior to operating the pump. A further and often less appreciated advantage in holding such a differential pressure is that it creates a sufficient force to rapidly discharge any necessary, large volume of gas back to the tank under conditions such as occur when the last fluid is being drawn from the tank by the pump.

Many other important features of tank truck installation have been omitted in the present article for lack of space, but will be covered later in the necessary detail. In all layouts such as suggested above, proper mechanical protection against road hazards must be well considered and provided.