PUMP PROBLEMS

Important Installation Features — A Summary

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BUTANE-PROPANE News NOVEMBER — 1946

AROUND 90% of the butane-propane pumps shipped out by our company during the present year, have been installed by customers who are no doubt already familiar with the special problems involved in their use. These pumps are giving satisfactory service with no request for special information.

Approximately 10% of our purchasers have requested installation advice, most of which has been adequately answered by sending reprint copies of the articles contributed by the writer during the past year, for publication in BUTANE-PROPANE *News*. That these articles have at least proven helpful in these cases has been an inspiration to continue to cover other basic principles in B-P Gas pumping, and to help in the solution of new installation problems which continue to come up under varying conditions of operation.

It will be the purpose of the present article, as well as that of several succeeding articles, to summarize the main items which have most frequently been found troublesome, and to cover the basic differences to be considered in the pumping of B-P Gas as against the comparatively simple handling of other fluids such as oil, water, or gasoline.

1. The Pump Intake Line.

(a) Place the pump as close as possible to the source of supply, and keep the tank level as high above the pump inlet as is practicable.

REASON: The liquid must flow into the pump by gravity, since any reduction of the pressure in the intake line by suction to a pressure less than that in the tank, will cause the liquid to vaporize, resulting in a definite reduction in the volume of liquid pumped.

(b) The intake line must be of ample size to carry the flow without material resistance. The substitution of 45° elbows or bent pipe is desirable over the use of 90° elbows.

REASON: Same as for item (a) above. Each change of flow direction adds to the total head pressure required to feed the pump intake without the formation of vapor. Such vapor proportionately reduces the volume of solid liquid flowing into the pump.

(c) If globe valves are used in the inlet line, have these oversize. Lubricated, plug type valves are to be preferred except for the difficulty of keeping them from leaking.

REASON: A globe valve presents a tortuous path for the flow of liquid, with many directional changes, while a plug type valve has a straight-through run. The restriction of a globe valve may be reduced to as much as one-fourth, if the size is increased so the passage areas are doubled. Plug type valves operate best and give a minimum of leakage trouble in service, if they are given limited lubrication after each use. (See Note 1 below).

(d) "Excess-flow" valves cause a very serious resistance to gravity flow. For the tank liquid outlet line, provide an oversize excess-flow valve where this is practical. Certain types of so called "internal valves" permit a much freer flow, when these can be substituted for the conventional "excess-flow" valve.

REASON: The usual excess-flow valve has a very restricted flow area, as well as requiring many changes of flow direction in the passage of the fluid. Doubling the area of the flow passage will theoretically reduce the flow resistance to one-fourth, when this can be done. Internal valves have a more direct flow path and therefore cause considerably less resistance. (See Note 2 below).

(e) Provide an oversize strainer. Keep it clean.

REASON: Regardless of the usual strainer screen area being considerably greater than the pipe area, the division of the flow through the myriad of screen passageways usually causes a resistance far greater than the pipe area. Clogging of the strainer is a frequent cause of noisy pump action, with unsatisfactory volume or pressure development.

NOTE 1. Considerable additional information is contained in the article "Pump Starvation—Cause, Effect and Cure," published in BUTANE-PROPANE *News*, July, 1945.

NOTE 2. See "Tank Truck Installations," BUTANE-PROPANE *News*, February, 1946.

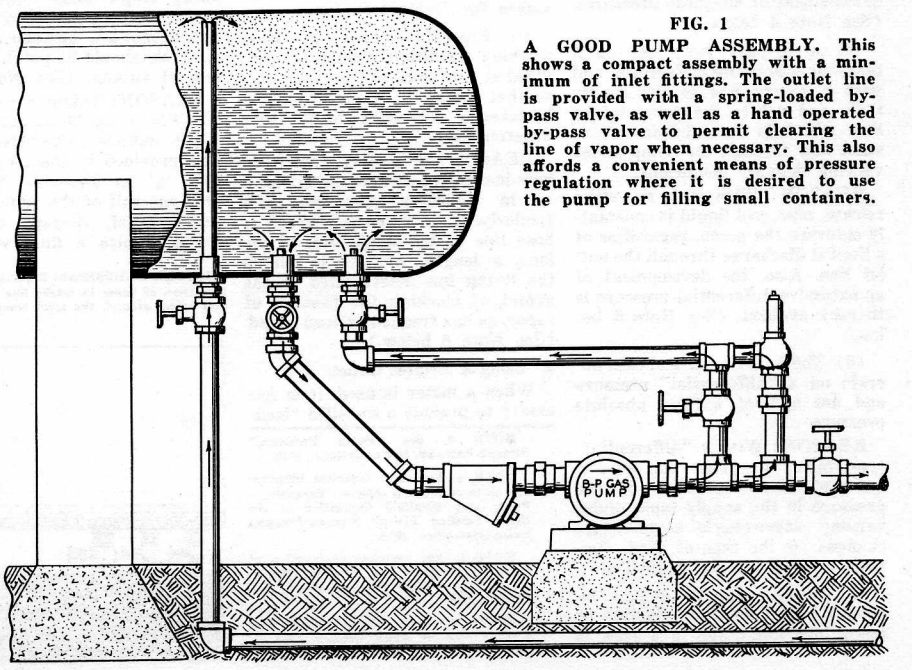


FIG. 1

A GOOD PUMP ASSEMBLY. This shows a compact assembly with a minimum of inlet fittings. The outlet line is provided with a spring-loaded by-pass valve, as well as a hand operated by-pass valve to permit clearing the line of vapor when necessary. This also affords a convenient means of pressure regulation where it is desired to use the pump for filling small containers.

(f) Do not expect as good results when pumping out of a tank having a so-called dip-tube construction, (as shown in Fig. 2) in place of a bottom tank outlet.

REASON: In addition to the greater restriction of flow area usually found in the dip tube type outlet, the raising of the fluid by siphon action brings about the formation of a large vapor content in the pump inlet line. (See Note 3 below).

(g) Avoid vapor pocketing in the pump. This can be prevented by having a rising line from the pump to the supply tank.

REASON: If inlet line is dropped as shown in drawing FIG. 3, the sun's heat may cause vapor to form in the pump body, which it will be difficult to eliminate on starting the pump. This condition results in serious pump wear, the same as in operating the pump dry, and it will also be difficult at times to pick up the liquid flow. Refer to item 6b, appearing later in this article.

2. The Pump Outlet Line.

(a) It is a good rule to see that the flow from the pump is never restricted to less than one-fourth of its rated capacity.

REASON: If the passage of liquid is too much restricted, there may not be enough through-flow to carry off the normal heat generated in the pump, thereby causing vaporization. (See Note 4 below.)

(b) While it is less important that the outlet line be large and free, as is advocated for the inlet line, too much restriction will result in the development of an unnecessarily high differential pressure with a loss of power and increased pump wear.

REASON: If the outlet is not properly proportioned to the pump capacity, there will be a considerable backslip through the pump gear teeth, generating heat and consequent vapor. This may make the pump noisy and erratic in the development of adequate pressures. (See Note 4 below.)

(c) A by-pass valve set at a reasonable pressure differential and with a return line to the supply tank, and not to the pump intake line, will help to maintain a constant flow through the pump under varying delivery conditions.

REASON: With such an outlet release, new, cool liquid is constantly entering the pump, regardless of a limited discharge through the outlet line. Also, the development of an excessive differential pressure is thereby avoided. (See Note 5 below.)

(d) The by-pass valve should operate on a "differential" pressure and not against a fixed absolute pressure.

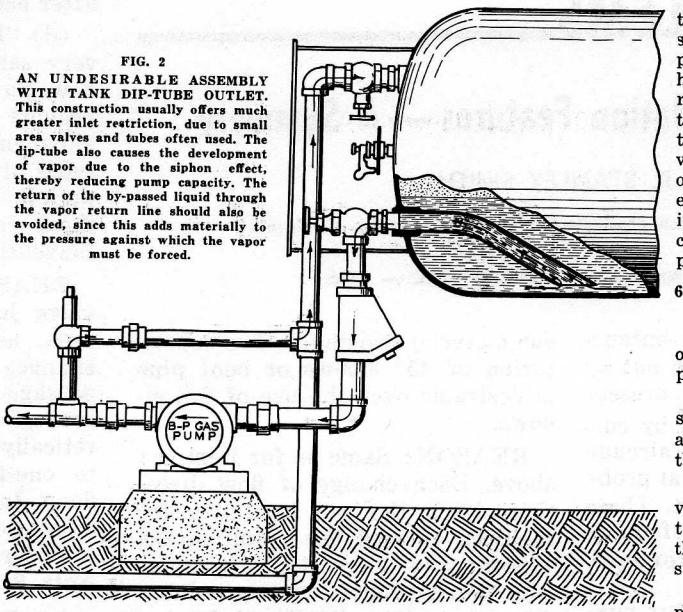
REASON: With a "differential" type valve, the pump will have a constant load regardless of the pressure in the supply tank, under varying atmospheric temperature changes, or the type of fluid, (butane or propane) being handled.

(e) Pressure gages should be provided for convenient reading of pump inlet and outlet pressures. It is advised that these be protected by the insertion, ahead of the gage, of ¼" pipe size needle valves.

REASON: It is impossible to know just how a pump is performing without an accurate check of the pressure differential developed. The use of a needle valve ahead of the gage makes it possible to control vibration of the gage hand, so prolonging the life of the gage. It is also possible to entirely remove the gages, inserting them only at intervals for test purposes. It is also advisable to reverse the position of the gages during test, as a check on their accuracy.

FIG. 2

AN UNDESIRABLE ASSEMBLY WITH TANK DIP-TUBE OUTLET. This construction usually offers much greater inlet restriction, due to small area valves and tubes often used. The dip-tube also causes the development of vapor due to the siphon effect, thereby reducing pump capacity. The return of the by-passed liquid through the vapor return line should also be avoided, since this adds materially to the pressure against which the vapor must be forced.



3. The Vapor Return Line.

(a) An adequate vapor return line should be provided for all large deliveries.

REASON: This insures a considerable reduction in the pressure differential pumped against, and makes for faster transfer.

(b) Pressure gages in good working condition should be provided at both ends of the vapor line, so that comparative readings may be taken to determine the pressure differential.

REASON: It is often surprising how ineffective a vapor return may be in balancing pressures, particularly if it is completed by a hose line of too small size, of too long a length, or one in which the lining has deteriorated to the extent of blocking the passage of vapor, as has frequently been found (See Note 6 below.)

4. Using A Metered Outlet.

When a meter is used, it is necessary to provide a so-called "back pressure" valve. Do not have this set for too high a pressure differential.

REASON: The purpose of the back-pressure valve is to prevent the formation of vapor in the meter. Without such a provision, were the outlet valve to be opened, the pressure might momentarily be reduced in the meter to a point where it was less than the pressure in the supply tank. In this case, the fluid would tend to boil, and the gas so formed in passing through the meter would register the same as an equal volume of liquid. A back-pressure of 5 to 10 pounds is usually enough to avoid forming gas, and a greater back-pressure only adds to the total resistance which must be pumped against. (See Note 7 below.)

5. Filling Single Cylinders and Small Containers.

It is not good practice to attempt filling single small units with a large capacity pump. Where bottling operations are contemplated, a manifold should be provided having several outlets. (See Note 4.)

REASON: Taking for example, a 50 GPM pump filling into a single 100 lb. cylinder. The valve passageway provided in these cylinders is only ¼" in diameter. To deliver even one-half of the pump capacity, or 25 GPM, through this valve would involve a fluid velocity in the valve passage of 250 feet per second, requiring very heavy pump pressures to attain. On the other hand, if the pump were to be arranged to feed a manifold to carry this volume to four such bottles at the same time, the pressure involved would drop theoretically to one-sixteenth that involved in the example above and actually result in a much increased output with comparatively little strain on the pump.

6. General Operating Cautions to Promote Best Service from Pump.

(a) Do not permit pump to be operated after supply tank has been pumped dry.

REASON: Nothing causes more severe pump wear than operating against pressure without liquid in the pump.

(b) A hand-operated by-pass valve is often a very desirable feature in any installation, to clear the pump and lines of vapor when starting.

REASON: Assuming that the pump is exposed to the sun's rays, or is housed in a warmer place than the storage tank, this absorbed heat will vaporize the fluid in the pump and drive it back through the pump inlet into the tank. Under these conditions, the pump may be completely dry when started, and it may be difficult to draw liquid to the pump, should the only outlet be against a higher pressure. See drawing Fig 1. (Also see Note 8 below.)

(c) Do not permit initial leaks to develop either in your pump packing box or in your lubricated plug valves.

REASON: If considerable attention is given to your pump packing box and the lubricated plug valves, particularly during the first few weeks of operation, so that no initial gas leaks are developed, you will probably experience very little trouble from leaks later on. On the other hand, if gas leaks are not given attention, channeling through the packing or grease seal may result, after which it becomes much more difficult to stop the leak without completely repacking, or reworking in the case of plug valves.

NOTE 3. See "Pump Problems," BUTANE-PROPANE *News*, October, 1945.

NOTE 4. For more complete information on these subjects refer to "Balancing Pump and Manifold Capacities in the Small Bottling Plant," BUTANE-PROPANE *News*, November, 1945.

NOTE 5. For complete explanation of by-pass installation see "By-Pass Merry-Go-Round." BUTANE-PROPANE *News*, September, 1945.

NOTE 6. See "Pump Problems," BUTANE-PROPANE *News*, October, 1945.

NOTE 7. For greater detail information relative to these subjects see "Tank Truck Installations," BUTANE-PROPANE *News*, February, 1946.

NOTE 8. See "Cause and Prevention of Vapor Lock," BUTANE-PROPANE *News*, June, 1945.

FIG. 3.

ANOTHER UNDESIRABLE PUMP INLET LINE ASSEMBLY. 1. Tank is too low, resulting in formation of vapor in intake line when liquid level is low. 2. In order to place part of the inlet line below ground, the total length of the intake line has been increased, besides adding two 90° elbows, all of which increases inlet friction. 3. Due to the dipped inlet line, the pump and piping section indicated by the line and arrow points, form a vapor trap. This section will become filled with vapor during idle periods, due to the sun heat. Enough pressure can be developed in this way to force all the liquid from this section back into the tank. Starting the flow then becomes difficult without some means of bleeding off the vapor to permit the return of liquid to the pump.