$ DOLLARS AND SENSE ¢

THE

SMITH PRECISION PRODUCTS CO.

BOOKLET ABOUT

L.P. GAS TRUCK PUMPS

- HOW TO INSTALL THEM
- HOW TO USE THEM
- HOW TO GET THE MOST OUT OF THEM

BY

LAWRENCE W. SMITH

- You can save $1,000 or more per year per truck by following the suggestions in this booklet.
- This booklet is not for sale. Additional copies available on request free of charge, as a customer service.
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DEDICATION

As the pioneer manufacturer of positive displacement pumps designed especially to handle LP-Gas, the Smith Precision Products Company has been actively concerned with the pumping problems of the LPG Industry since its infancy. From hundreds of inspections made of trucks all over the United States, Canada, and Mexico, we know that the proper installation of piping, valves and fittings has a great deal to do with satisfaction, long pump life, and fast LPG delivery. This booklet is dedicated to our pump customers in the LPG Industry, with the sure knowledge that the simple principles outlined will pay them big dividends by reducing labor time per delivery, and extending pump life. By explaining how to use truck pumps most effectively, we are trying to say "Thank you" to the thousands of LPG distributors who have placed their confidence in Smith Pumps over the past many years.

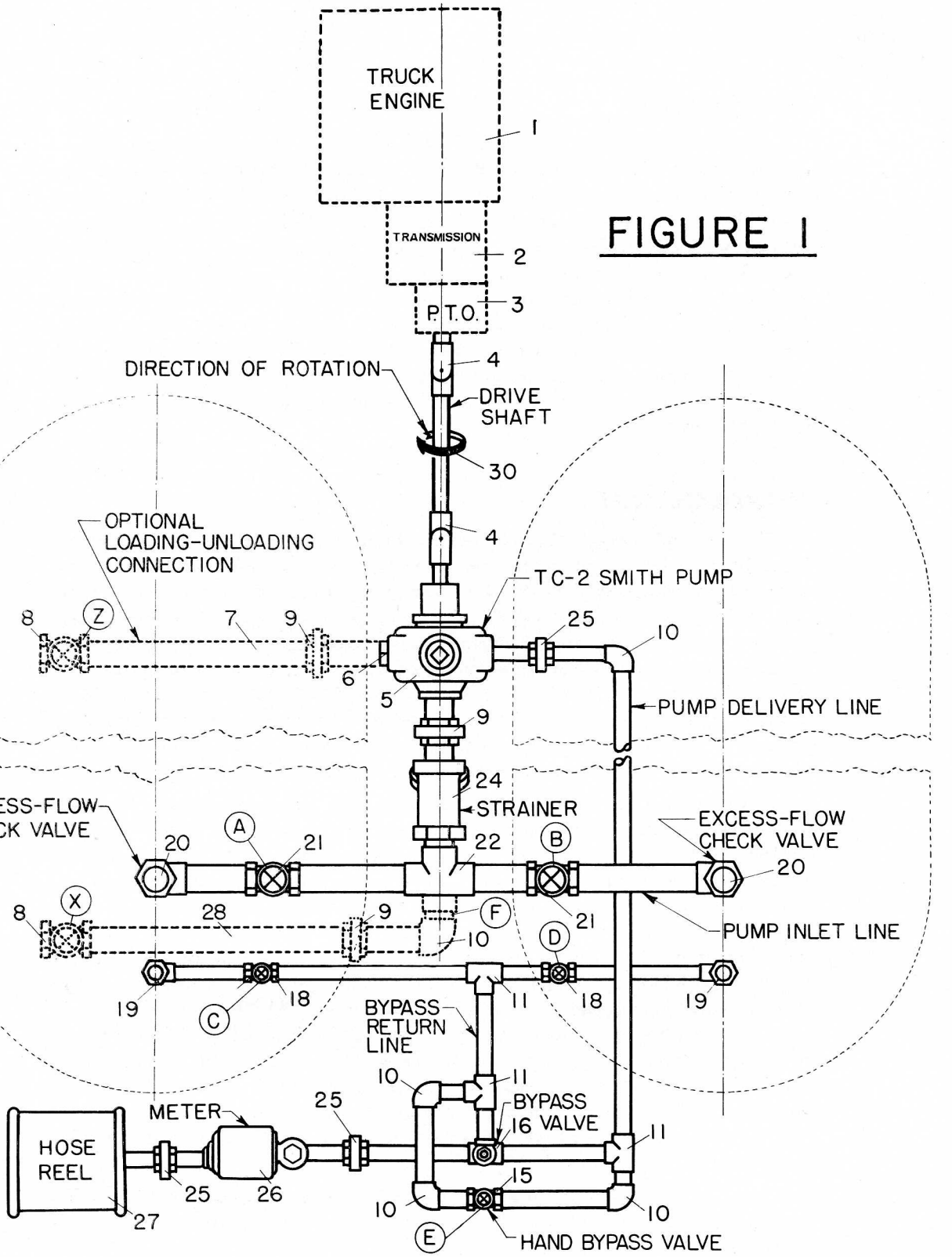
INTRODUCTION

Since the end of World War II, our LPG Industry has grown to the point where it has become practical for a few large companies, mostly tank manufacturers, to put together delivery trucks fully piped, complete with pumps, meters, tanks, hose reels, valves, etc., on a production basis, for resale. These trucks have often been sold very competitively, with price being a major consideration. There has thus been an incentive for some delivery truck producers to cut corners on the pump installation, and in some cases this has made it impossible for the pump to perform properly, resulting in slow delivery rates and high pump upkeep or maintenance costs. It is regrettable that such a situation should have arisen. We know of nothing else that has caused us or our customers more trouble from a pumping standpoint.

If we are to solve these problems, we must work them out together. As pump manufacturers, we must continually strive to improve our pumps so they are less subject to all kinds of abuse. We accept that responsibility. LPG distributors can help by studying the requirements of a good pump installation and by educating their drivers on how to use the pump in a good installation. This booklet has been written with this in mind. But distributors must also do another thing that is almost more important: they must let the truck manufacturers know that they are willing to pay a few hundred dollars more to get the pumps properly installed. They can do this because a good pump, properly installed, can save $1,000 *or more* per truck per year by cutting labor costs through speeding deliveries, and by reducing pump maintenance expense. Do *you* accept *this* responsibility? LPG truck manufacturers should do all possible to promote this. The ideals expressed above are intimately connected with the growth and profit picture in our Industry, and will result in satisfied customers coming back with repeat orders for more and still better trucks over the years.

You may be assured of our sincere desire to cooperate in every way possible, to these ends.

FIGURE 1



LIQUID PIPING ON TWIN TANK LPG TRUCK

DESCRIPTION FOR FIGURE 1

NUMBER ON DRAWING	PART NAME	RECOMMENDED SIZES OR PART NOS. TC-2 PUMP	TC-1044H PUMP	TC-1044 PUMP
1	Truck Engine	—	—	—
2	Transmission of Truck	—	—	—
3	Power Take-Off (Speed)	500 RPM	900 RPM	500 RPM
4	Universal Joint	1″ or larger	1″ or larger	1″ or larger
5	Smith Pump	TC-2	TC-1044H	TC-1044
6	Plug (comes with Pump)	2½″	1½″	1½″
7	Extra-heavy Steel Pipe	2½″	2″	2″
8	Globe Valve	2½″	2″	2″
9	Forged Steel Union	2½″	2″	2″
	Swaged Reducing Nipple (between union and pump)	—	2″ x 1½″	2″ x 1½″
10	Forged Steel Elbow	1¼″	1¼″	1″
11	Forged Steel Tee	1¼″	1¼″	1″
15	Globe Valve	1¼″	1¼″	1″
16	Forged Steel Tee	1¼″	1″	1″
	Steel Bushing	—	1¼″ x 1″	—
	Bypass Valve	1¼″	1″	1″
18	Globe Valve	1¼″	1¼″	1″
19	Forged Steel Elbow	1¼″	1¼″	1″
	Steel Bushing	—	—	1¼″ x 1″
	Excess-Flow Check Valve	2″ x 1¼″	2″ x 1¼″	2″ x 1¼″
20	Forged Steel Elbow	2″	2″	2″
	Excess-Flow Check Valve (Rego)	A7537FL	A7537FL	A7537FL
21	Valve: If free-flow type	2″	2″	1½″ or 2″
	If globe or angle type	2½″	2″	2″
22	Forged Steel Tee	2½″	2″	2″
	Steel Bushings (one at each end of tee)	2½″ x 2″	—	—
24	Strainer (Sarco)	2½″	2″	2″
25	Forged Steel Union	1¼″	1¼″	1″
26	Meter (maximum capacity)	30 GPM	30 GPM	15 or 20 GPM
27	Hose Reel (if convenient)	—	—	—
28	Extra-Heavy Steel Pipe	2½″	2″	2″
30	Drive Shaft	1″ or larger	1″ or larger	1″ or larger

NOTES:

1. This drawing shows liquid piping only. The meter and some bypass valves may require auxiliary connections to vapor piping.

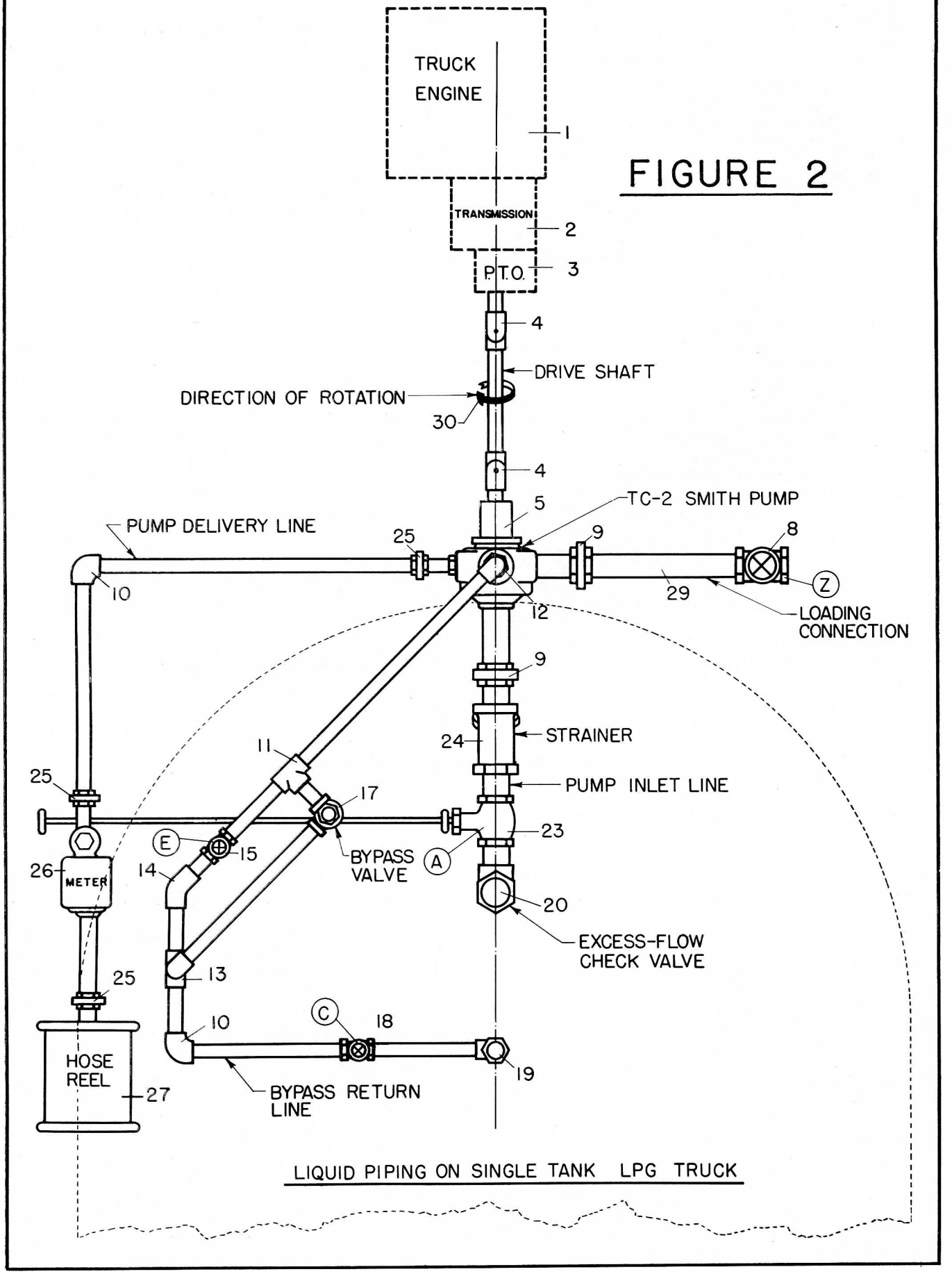
2. Tank liquid outlets (20) may be further back or further forward, as convenient for ease in opening hand valves A and B. Bypass outlets (19) may be further back, if desired, for ease in opening valves (18). Pump delivery line can be placed further to right, so meter may be nearer the center of rear compartment.

3. Truck piping drawings are so difficult to follow that we have simplified this one in the interests of readability. No hydrostatic (pop-off) pressure relief valves are shown. These should be installed between any two shut-off valves in the system. If you follow this drawing *exactly,* three pop-off valves will be needed: (a) In the pump delivery line (you can use the ¼″ tapped plug in the pump case, provided for this purpose); (b) between bypass valve (16) and either of hand valves (18); (c) between meter and hose reel. We strongly recommend that a ¼″ plug be included in the system between meter and hose reel in any case, this to be used for the insertion of a pressure gage to test the meter and meter strainer for excessive pressure drop in case trouble ever develops. No vapor piping is shown, nor have we shown some pipe unions that may be necessary only for convenience in making up pipe connections.

4. Some safety authorities will not approve the bypassing system shown, because of the chance it might be made inoperative by a driver leaving both valves (18) closed through error. If you run up against this problem, you may install a second bypass valve *around the pump,* and set this 25 psi higher than the setting on bypass valve (16). The second bypass valve will never open except in an emergency (due to its higher setting), so it would not affect normal delivery operations.

5. Excess-flow check valves (19) can be replaced with back-check valves that will allow flow *into,* but *not out* of, the tanks. Some authorities consider this to be a safer design.

FIGURE 2



LIQUID PIPING ON SINGLE TANK LPG TRUCK

DESCRIPTION FOR FIGURE 2

NUMBER ON DRAWING	PART NAME	RECOMMENDED SIZES OR PART NOS. TC-2 PUMP	TC-1044H PUMP	TC-1044 PUMP
1	Truck Engine	—	—	—
2	Transmission of Truck	—	—	—
3	Power Take-Off (Speed)	500 RPM	900 RPM	500 RPM
4	Universal Joint	1″ or larger	1″ or larger	1″ or larger
5	Smith Pump	TC-2	TC-1044H	TC-1044
8	Globe Valve	2½″	2″	2″
9	Forged Steel Union	2½″	2″	2″
	Swaged Reducing Nipple (between union and pump)	—	2″ x 1½″	2″ x 1½″
10	Forged Steel Elbow	1¼″	1¼″	1″
11	Forged Steel Tee	1¼″	1¼″	1″
12	Steel Bushing	2½″ x 1¼″	—	—
	Forged Steel Elbow	1¼″	—	—
13	Forged Steel Tee	1¼″	1¼″	1″
	Steel Bushing	—	1¼″ x 1″	—
	Forged Steel Elbow	1¼″	1″	1″
14	Forged Steel 45° Elbow	1¼″	1¼″	1″
15	Globe Valve	1¼″	1¼″	1″
17	Bypass Valve	1¼″	1″	1″
	Forged Steel Elbow	1¼″	1¼″ x 1″	1″
18	Globe Valve	1¼″	1¼″	1″
19	Steel Bushing	—	—	1¼″ x 1″
	Forged Steel Elbow	1¼″	1¼″	1¼″
20	Excess-Flow Check Valve (Rego)	A7537FL	A7537FL	A7537FL
	Forged Steel Elbow	2″	2″	2″
23	Valve: If free-flow type	2″	2″	1½″ or 2″
	If globe or angle type	2½″	2″	2″
	Steel Bushing	2½″ x 2″	—	—
24	Strainer (Sarco)	2½″	2″	2″
25	Forged Steel Union	1¼″	1¼″	1″
26	Meter (maximum capacity)	30 GPM	30 GPM	15 or 20 GPM
27	Hose Reel (if convenient)	—	—	—
29	Extra-heavy Steel Pipe	2½″	2″	2″
30	Drive Shaft	1″ or larger	1″ or larger	1″ or larger

NOTES:

1. This drawing shows liquid piping only. The meter and some bypass valves may require auxiliary connections to vapor piping.

2. Truck piping drawings are so difficult to follow that we have simplified this one in the interests of readability. No hydrostatic (pop-off) relief valves are shown. These should be installed between any two shut-off valves in the system. If you follow this drawing *exactly,* three pop-off valves will be needed: (a) In the pump delivery line (you can use the ¼″ tapped plug hole in the pump case, provided for this purpose); (b) between bypass valve (17) and hand valve (18); (c) between meter and hose reel. We strongly recommend that a ¼″ plug be included in the system between meter and hose reel in any case, this to be used for the insertion of a pressure gage to test the meter and meter strainer for excessive pressure drop in case trouble ever develops. No vapor piping is shown, nor have we shown some pipe unions that may be necessary only for convenience in making up pipe connections.

3. Some safety authorities will not approve the bypassing system shown, because of the chance it might be made inoperative by a driver leaving valve (18) closed through error. On a single-tank system, valve (18) may be left out, to satisfy this requirement, if excess-flow check valve (19) is replaced by a back-check valve that will allow flow *into,* but *not out of,* the tank. However, valve (18) is sometimes convenient for use when testing to see if the bypass valve (17) is functioning properly. Perhaps the best solution to this problem is to install a second bypass valve *around the pump,* and set this 25 psi higher than the setting on bypass valve (17). The second bypass valve will never open except in an emergency (due to its higher setting), so it would not affect normal delivery operations.

4. Model TC-1044H and TC-1044 pumps have only two side ports in the pump housing. The top housing outlet is omitted on these. With TC-1044 and TC-1044H pumps, the pipeline leading to bypass valve (17) must take off from a tee in the pump delivery line, somewhere between pump (5) and meter (26).

GENERAL COMMENTS FOR BOTH DRAWINGS, FIGURE 1 AND FIGURE 2

1. These drawings show screwed fittings throughout, with ground joint unions for convenience in making connections. In order to assure against leaks in an LPG system, screwed joints must be of good quality. They must be made up tightly, and a good joint compound must be used. We advise against "litharge and glycerine" for this purpose. While this makes a very tight joint, it hardens so strong that it is sometimes impossible to unscrew the threads without doing damage if pumps, meters, or valves have to be removed later for repairs. There are several other good compounds. Some have the approval of Underwriters' Laboratories. The type we use in our own work is John Crane Plastic Lead Seal, manufactured by the Crane Packing Company, Chicago, Illinois.

2. A better job can sometimes be made by using flanged joints instead of unions, and specifying welding fittings where possible instead of screwed fittings. Such a piping system is more expensive, but it is stronger, and perhaps, safer if workmanship is of the best.

3. In order to assure against leakage, any piping system should be tested under pressure before being placed in service. We advise against hydrostatic tests using water as a test fluid, as some water will remain in the system after the test is completed, and cause rusting in critical parts. The best and safest test we know of is to fill the piping with compressed air. Use a low pressure first, to be sure there are no large leaks or open joints. Then, gradually increase the pressure to the desired level, and go over all joints and parts with a paint brush, using a strong soap-and-water solution. Smith Pumps are all tested before leaving the factory with 300 psi of air pressure. Our experience has been that even only 150 psi of air pressure will easily show leaks that would be difficult to detect with a hydrostatic test of several times that figure. Leaks in the packing of hand valves and pumps, and any defects in the materials from which piping, valves, and fittings are made, can also be very easily detected in an air test. If the test can be carried out in an area free from outside noises, the sound of escaping air will aid in the detection of leaks.

4. If an air compressor is not available for testing, a cylinder of carbon-dioxide gas may be substituted. This gas is cheap and non-inflammable.

5. All drawings in the booklet have been checked and double checked, to eliminate the possibility of error as far as seems possible. However, the Smith Precision Products Company will assume no liability for their use, nor make any guarantees of pump performance and delivery rates in the systems shown, unless such liability and/or guarantees are expressed in special written form, signed by an officer of the Company. Our engineering department will be glad to discuss such matters at any time.

6. Figures 1 and 2 show the pump as it would appear if the tanks were removed from the truck, and you looked down on the chassis from the top. In other words, these are TOP VIEWS. The outlines of the tanks are shown in dotted lines.

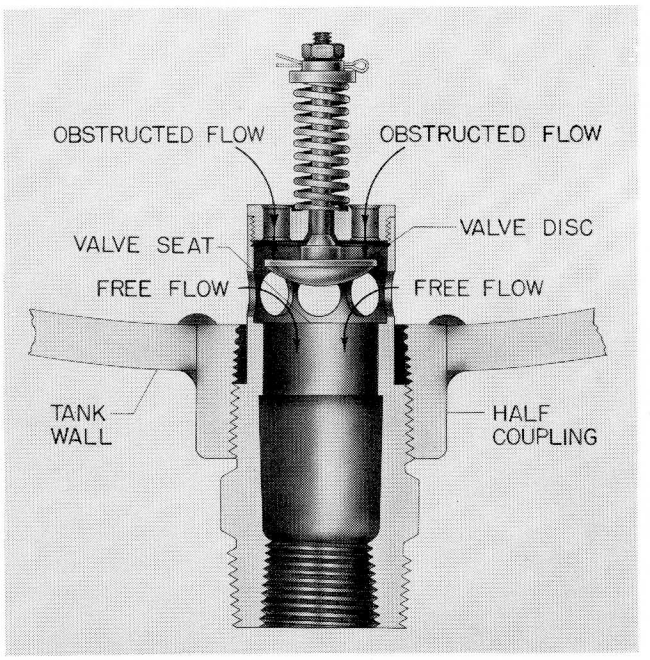


FIGURE 3 **Free-flow type threaded excess-flow check valve having short body (such as Rego No. A-7537-L), mounted in tank liquid outlet made from half-coupling. Note free unobstructed flow through side entrance holes. Flow can also come through top holes, but this is obstructed by valve disc, as in older excess-flow check valves. With this short-body valve, entrance holes for liquid are near the bottom of the tank. Pump can drain tank nearly dry, but will pick up weld-shot, scale and rust that has settled to bottom of tank.**

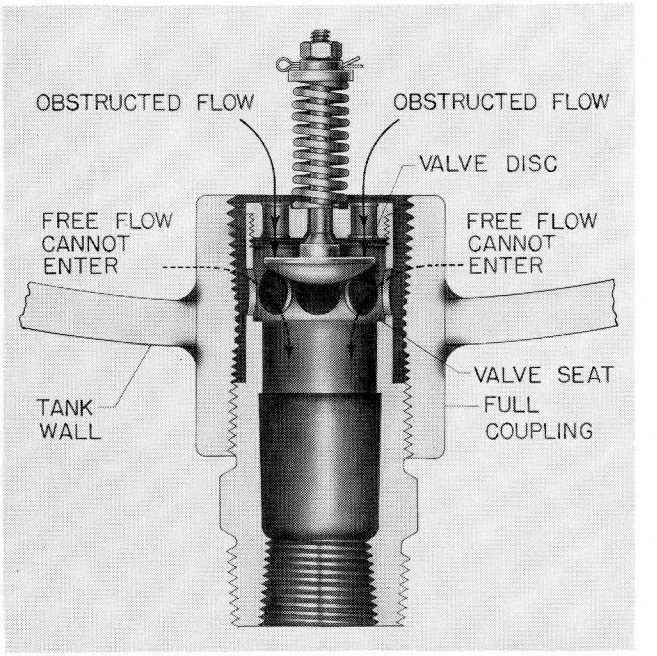


FIGURE 4 **Free-flow type threated excess-flow check valve having short body (such as Rego A-7537-L), mounted in tank liquid outlet made from full coupling. Flow cannot run freely through side holes due to obstruction of coupling on inside of tank. See dotted arrows. Top holes are still obstructed by valve disc. Do not attempt to use these valves in full couplings.**

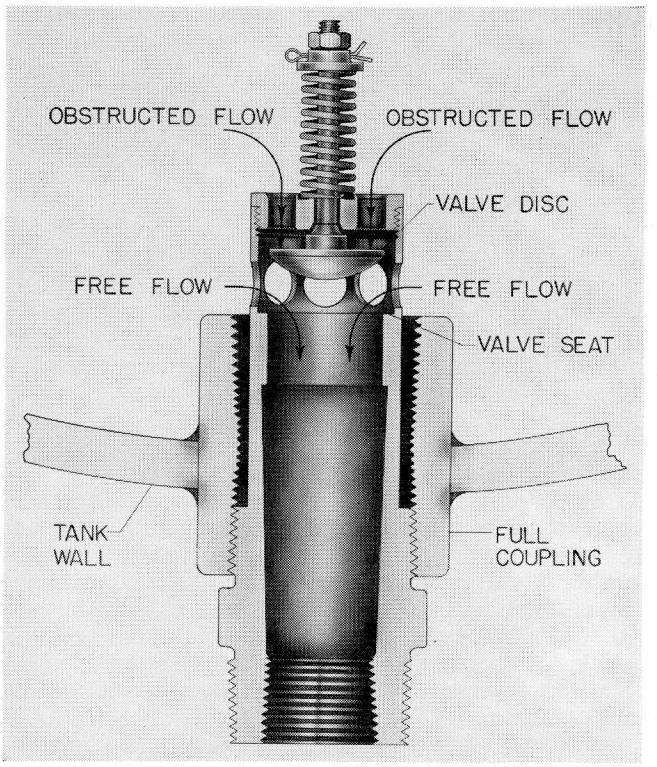


FIGURE 5 **Free-flow type threaded excess-flow check valve having long body (such as Rego No. A-7537-FL), mounted in tank liquid outlet made from full coupling. Compare with Figure 4. Note that long body makes side holes raise above top of full coupling, allowing free, unobstructed liquid flow. Always specify the long-body type valve when your tanks have full couplings, or if you are not sure whether they have half- or full-couplings.**

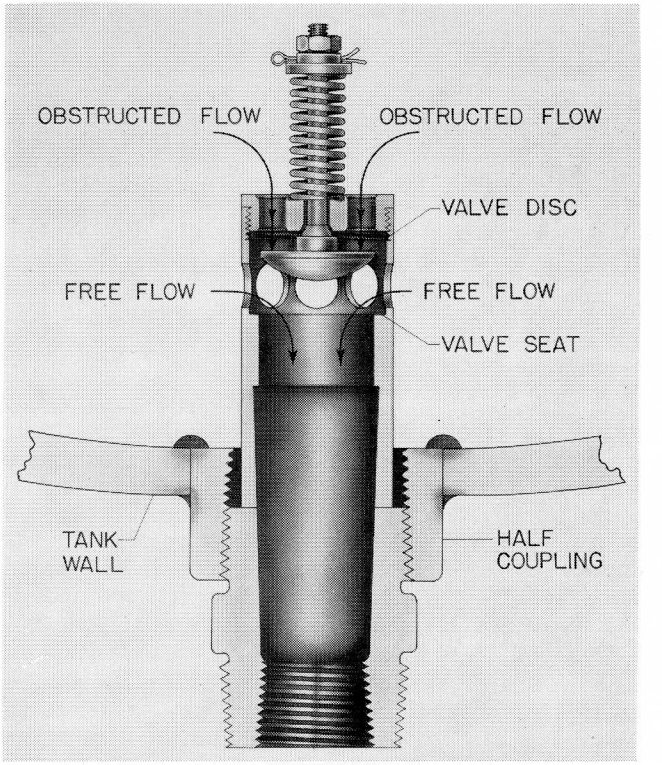


FIGURE 6 **Free-flow type threaded excess-flow check valve having long body (such as Rego No. A-7537-FL), mounted in tank liquid outlet made from half coupling. Note that side holes for free-flow of liquid are 3 inches above bottom of tank. Tank can never be ocmpletely drained of liquid, but foreign matter that may have settled to tank bottom cannot easily enter pump inlet line. Recommended for old tanks that may have been out of service for some time, as rust and scale from tank is less likely to damage pump or meter. Compare with figure 3.**

DOLLARS AND SENSE

The accompanying drawings show outlines of piping systems for (Figure 1) twin tank delivery trucks and (Figure 2) single tank delivery trucks. Since (a) there are many different makes and sizes of trucks, (b) safety inspection requirements vary from one part of the country to the other, and (c) each driver has a different idea on just what he wants in a truck, it is impossible to show in a few drawings, systems that will meet the requirements of every manufacturer and distributor in every area. However, these drawings do point up the important principles, and we know they will be helpful.

QUESTION: From the standpoint of fast and economical pumping, which is better, the twin-tank trucks or the single-tank trucks?

ANSWER: We have never recommended one over the other. The pump can be properly installed on either. You should decide which system to use for other reasons, such as first cost, easy access to parts that may need service attention, the necessity for carrying two different liquids, weight distribution on your particular truck, height of the center of gravity, etc.

QUESTION: Do you think cylindrical tanks are better than spherical tanks?

ANSWER: The shape of the supply tank makes no difference to a pump.

QUESTION: What suggestions do you have regarding the construction of truck tanks?

ANSWER: The tank manufacturer should give attention to keeping the inside of the tank as clean as possible, and the tank should be baffled properly. Baffles and cleanliness of truck tanks go together. Since all modern tanks are of welded construction, the presence of welding slag and weld-shot (fine particles of hard steel, usually in the form of small balls) is almost inevitable. This foreign matter should be cleaned out thoroughly as the tank is built up. Otherwise, the matter will find its way into the piping system, where it will surely damage valve seats, pumps, meters, etc. Sometimes this matter is not loose. It sticks to the sides of the tank. Much of it can be knocked off by the use of power tools when the tank is still partly open, during the last stages of manufacture. However, it will be impossible to get it all out, and this is why proper baffling helps. After the tank is mounted on the truck, and the truck is put in service, the vibration from the truck engine, together with the constant splashing of the liquid in the tank, particularly during sudden stops, will loosen much of this foreign matter. A tank properly baffled will keep the liquid from splashing violently, and in a given period of time a much smaller amount of foreign matter will be loosened. In addition, baffles can be designed to trap much of the matter that is loosened, so it cannot easily reach the liquid outlet running to the pump. Of course, all of the foreign matter will eventually be loosened, but with good baffling it will come out just a little at a time (not in cupfuls), and the strainer on the meter and the one ahead of the pump will be able to take care of it.

QUESTION: Do you mean that strainers cannot handle large quantities of foreign matter?

ANSWER: When strainer screens receive large amounts of foreign matter, this overload of heavy material can cause the screen to burst, flooding the pumping system with quantities of hard, abrasive particles which can ruin the pump and meter, and can even make it necessary to replace some of the valves. Proper attention to cleanliness during the manufacture of the tanks would keep this from happening. Even if screens do not burst, the foreign matter will prevent a full flow of liquid from reaching the pump, and this can cause overheating and fast wear when a pump is operated in this condition for some time.

QUESTION: What about the excess-flow check valves in the tank liquid outlets? How should these be sized?

ANSWER: The excess-flow check valve is without any doubt the most important single item affecting pump operation. Excess-flow check valves must be chosen carefully so they will have low pressure-drop (resistance-to-flow). Otherwise, the pumps will be starved for fuel and their delivery rate will be reduced materially. In some cases, pumps have been so badly starved through the use of the wrong types of excess-flow check valves that they wore out in a few months.

QUESTION: What is the proper way to select an excess-flow check valve? Is it safe to say that if the rated capacity of the excess-flow check valve is greater than the rated capacity of the pump, it is all right?

ANSWER: Positively *no*. Excess-flow check valves are rated on what flow rate makes them close *in an emergency*. Their rating does *not* indicate how much liquid will pass through them under *normal* pumping conditions. As an example, take two 2″ Rego* valves, numbers 3292 and A7537FL. The 3292 is rated to close at 94 gallons per minute, yet it has a pressure drop equal to the resistance-to-flow of 173 feet of 2″ pipe. The A7537FL, on the other hand, closes at 72 gallons per minute, but has a pressure drop equal to the resistance-to-flow of only 37 feet of 2″ pipe. Thus it is almost five times easier for liquid to run through the A7537FL. It is easy to see from this example that the rated flow of an excess-flow check valve has no relationship to the suitability of this valve from a pumping standpoint.

QUESTION: Would it be a safe guide to say that an excess-flow check valve is O.K. if it has outside threads as large as the threads on the other valves and fittings leading to the pump inlet?

ANSWER: Again, positively *no*. There are quite a number of different makes and types of excess-flow check valves available, and they have very different resistance-to-flow values. As an example, take our Model TC-2 Smith Pump (rated transfer capacity 50 gallons per minute) which is by far the most popular pump sold by us for delivery trucks. This unit is usually piped with a 2″ inlet line, even though the pump is threaded to take 2½″, and our instructions recommend the larger size. Since 2″ piping is used, 2″ excess-flow check valves have often been specified. Of all 2″ excess-flow check valves available until very recently, there has been only one that we could recommend for a 50 gallon pump. This was a free-flow type originally developed by the Phillips Petroleum Company and made to mount in a *flange* on the tank instead of the usual threaded coupling. These have been manufactured for several years by both Bastian-Blessing (3500 series) and Kerotest (P99X07 series). Conventional excess-flow check valves of the threaded type, designed to screw into tank liquid outlets made from 2″ threaded couplings, have all had too much resistance-to-flow for proper use with 50 GPM pumps. For example, Rego number 3292 has the same resistance-to-flow as 173 feet of 2″ pipe. This compares to a resistance equivalent of only 25 feet or less for a wide-open 2″ angle valve, and only 5 feet for a 2″ 90 degree elbow, so it is easy to see that the pressure drop is very excessive compared to that of other items in the line. On the other hand, the resistance of the Phillips flanged-design valve, in the 2″ size, is only equal to 37 feet of pipe, a reduction of almost 500%!

Since good 2″ threaded excess-flow check valves have not been available until recently, and most truck tanks are not designed to use flanged valves, we have in the past advocated the use of the larger 3″ threaded excess-flow check valves for TC-2 pumps. The 3″ Rego No. 2139 has been quite satisfactory, although even this has a resistance-to-flow equal to 63 feet of 2″ pipe, or almost twice as much as the Phillips flanged design in the 2″ size.

Within the last few months, the Phillips design free-flow valves have been put into threaded bodies, and they are just now becoming available for use in standard delivery truck tanks, both in new installations and as replacements for the existing 2″ and 3″ excess-flow check valves having too much resistance-to-flow. We are referring to the new Rego series A7537 and A7539. These valves have the same low resistance-to-flow values as the flanged type, and they are very highly recommended for use in pump liquid supply lines. In further discussion in this booklet, we will refer to them as "free-flow valves."

There is one feature of these valves that could cause trouble unless it is explained. One type is good only for tanks having liquid outlets made from half-couplings. These are numbers A7537L (2″) and A7539R (3″). If your tanks have outlets made from full couplings, or if you are not sure whether they have half or full couplings, order the special long-body models A7537FL (2″) and A7539FR (3″). Figures 3, 4, 5, and 6 illustrate how these valves apply to various couplings, and should make our point very clear.

It is our present opinion that any delivery truck operator who will replace an old style 2″ excess-flow check valve with one of these new free-flow numbers, will save the small cost of the new valve and its installation in a short time by speeding his fuel deliveries, which will lower the labor cost per gallon pumped. In many cases we have been able to show that these valves can save as much as $1,000 per year per truck.

QUESTION: These free-flow valves may be good for the pumps, but are they as safe to use? Do they offer as much protection in case of an emergency as the old numbers?

ANSWER: The new valves are at least as safe, if not safer. Taking again as an example the excess-flow check valves used with our 50 GPM TC-2 pumps, we note that the old style valves, such as 3292 and 2137A, close at flow rates of 94 GPM and 70 GPM respectively. The new series that we recommend (A7537L) closes at a flow rate of 72 GPM. Thus the free-flow type is 22 GPM safer than the 3292, and practically equal in

*In this and some other examples, we discuss Rego equipment because this line is widely used. We do not imply that Rego equipment is better or worse than similar equipment manufactured by other companies. Our bulletin K-3d gives information on many makes of excess-flow valves. Write to us for a copy, or for information on the particular valves that you are using.

safety to the 2137A. There is no reason why these new valves should not be installed on all delivery trucks equipped with older 2″ excess-flow check valves. In fact, we would go so far as to state that any bulk plant manager who does not make this change on all of his trucks as soon as possible is losing a very fine chance to bring in substantial extra profits by speeding his deliveries and making his pumps last longer.

QUESTION: Some trucks have the tank liquid outlets on the sides or ends of the tanks, with a dip-tube inside, instead of having the outlets on the bottom, as shown on your Figures 1 and 2. We can see that placing the outlets this way may make the piping and hand valves more accessible. Is this a good design from a pumping standpoint?

ANSWER: Having a dip-tube in the liquid outlet of the tank is bad for two important reasons: First, this makes the piping subject to vapor-locking in the summer time.

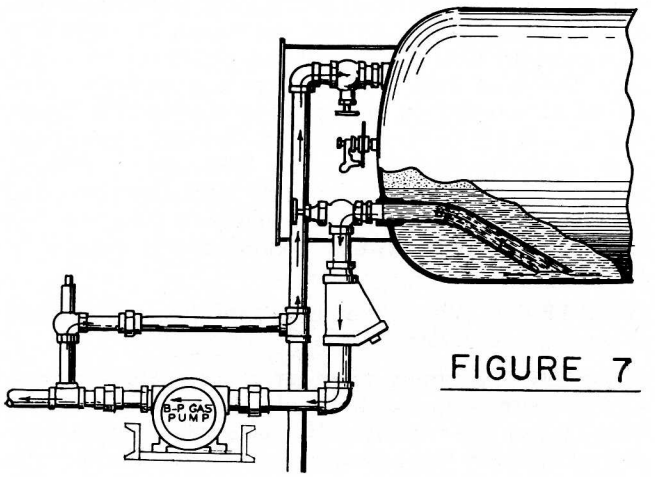


FIGURE 7

See Figure 7. Heat will cause some of the liquid between the pump and the tank to vaporize while the truck is on the road, and the vapor formed will collect at the high point of the dip-tube, where the liquid leaves the tank. The dip-tube acts as a vapor trap, because vapor will not run down hill through the dip-tube into the tank. When the truck reaches the delivery point, and the pump is started, the vapor that has collected in the dip-tube will be drawn into the pump, vapor-locking the pump and making it difficult to get the pumping action started. Storage tanks with liquid outlets in the bottom, as shown in Figures 1 and 2, are very much to be preferred. In this case, any vapor forming in the pump inlet line will rise into the tank and be dissipated in the vapor space of the tank, where it cannot cause trouble.

The second reason dip-tubes are bad in tank liquid outlets is that these make it impossible to use the new free-flowing excess-flow check valves. A further examination of Figures 3, 4, 5, and 6, with this in mind, will show you that if a dip-tube is attached to the inside end of either a half or full coupling, it has the effect of lengthening the coupling, so that the liquid can never easily enter the side holes on the free-flow excess-flow check valves. Having a truck with dip-tubes attached to the liquid outlets may cost as much as $1,000 per year, by making it impossible to use the new free-flow valves.

QUESTION: Your explanation about dip-tubes in the tank liquid outlets is well taken. What about dip-tubes on the bypass return outlet, or the vapor line? Are these bad also?

ANSWER: No, a dip-tube properly designed and made for these other places will not affect pump efficiency.

QUESTION: What about hand shut-off valves?

ANSWER: Use free-flow types such as the Okadee wherever possible, as this will also help the pump and speed deliveries. If a globe valve (which has more resistance-to-flow) is specified, try to use the angle type, as this may often eliminate a 90 degree elbow as well as reducing the resistance in the valve itself. The angle-type globe valve in the 2″ size has a pressure drop equal to the resistance-to-flow of only 25 feet of pipe. The straight-through globe valve equals 50 feet of pipe, so is twice as restrictive from a pumping standpoint.

QUESTION: What information do you have on pump strainers?

ANSWER: This is not a simple subject and we have a whole article just on this one item. We shall be glad to send reprints to anyone upon request. To sum up the important points we can say:

1. Use a strainer one pipe size larger than the other fittings in the pump inlet line.
2. Have the screen made of 40-mesh, or finer, wire cloth. Screens made of perforated metal having 1/16″ or 1/32″ holes will let quite a lot of foreign matter go through, as the holes are too big. In addition, screens of this type usually have more resistance-to-flow than wire cloth screens.
3. *Open* your strainer after the first load on your new truck has been pumped off. If the screen is badly clogged, keep opening the strainer at frequent intervals until the foreign matter from the new tank is all washed out. Since strainers on trucks sometimes have to be opened frequently for cleaning, it is wise to specify a make of strainer that has a bolted flange opening to the screen. This type of strainer can be easily opened with an 8″ crescent wrench. Some makes of strainers have a large threaded plug that requires the use of a 36″ pipe wrench, a tool that is difficult to apply under a truck.
4. Even when no dirt is normally found in a strainer, it would still be wise to inspect the screen at intervals as a safety precaution.
5. Order an extra screen for your strainer for use in case the other becomes damaged.

QUESTION: Your drawings do not show any flexible connections in the pipelines to and from the pumps. What do you have to say about these?

ANSWER: We have had a few very good friends in the Industry who had serious accidents, some involving death, when hoses that appeared to be in good condition suddenly burst. I would feel much safer if I had all solid steel between me and "liquid dynamite." You will of course see other recommendations that flexible connections be installed to absorb strains that would otherwise damage pumps. However, Smith Pumps are built to take these strains. Their cases are unusually strong and rugged. Of course, it costs more to make them this way, but this is one of the reasons our pumps have been able to pass the rigid tests involved in Underwriters' Laboratories approval.

QUESTION: Since you recommend rigid steel piping connections, is there any way the pump can be mounted that will help reduce the strains imposed?

ANSWER: The major strains are caused by the movements of the truck frame with respect to the tank(s), while the truck is on rough roads. If the pump and meter supports can be attached to the tank(s) instead

of to the truck frame, as is more common, a large part of the strains will be eliminated.

QUESTION: Getting now to the pump itself, is there any special way it should be mounted?

ANSWER: Smith Pumps may be mounted in any position, upside-down, or sideways. Smith Pumps can be run equally well in either direction of shaft rotation. They have multiple outlets, for ease and convenience in piping. This can be a great advantage over other makes of pumps, and save money in piping.

QUESTION: Give examples on how to use these multiple outlets.

ANSWER: Please refer to Figures 1 and 2. These drawings show the pump piped for clockwise rotation, with the pump shaft turned toward the observer. If you decide to follow these drawings, be sure to get a power takeoff for the truck that will turn the pump shaft in this direction of rotation.

In Figure 1, we purposely show only one housing port being used. The majority of pumps have been installed this way. The pipe fitter has his choice of coming out of the right side, the top, or the left side, whichever is most convenient. This pump is mounted rightside up. If the pump had been mounted upside down or sideways, he would have had a choice of right, left, top, or even bottom porting.

Now, look at Figure 2, in which we show a pump with *all* ports in use. The left-hand port is piped to the meter, the bypass return line is connected to the top port, the truck filling connection is made in the right-hand port. By doing this, the piping system is simplified and the expense of two tees has been saved. Other arrangements are of course possible, and some are quite interesting.

QUESTION: Do you have anything to say about the pump drive shaft arrangement?

ANSWER: The power take-off with universal jointed shaft connection, shown in the drawings, is by far the most popular. Be sure this shaft has a splined joint, so no undue strain will be put on the pump by the drive. Also, be sure to observe the usual precaution of keeping the angles of the universal joints as straight as possible. There should be a universal joint at *each end* of the jack shaft. Otherwise, uniform rotating motion will not be transmitted to the pump, and its operation will be unsteady. A pump drive shaft with a universal joint on one end only can cause pump wear if the universal angle is great.

There are several other very successful types of drives that we have seen. Flexible shafts are sometimes used and are excellent where it is desirable to have the pump in a more accessible location, provided the flexible shafts are installed in accordance with their manufacturer's recommendations. However, modern pumps have trouble-free mechanical shaft seals, needing very little service attention, so an accessible mounting is not necessary now as it was several years ago, when many pumps had packing that had to be adjusted and lubricated frequently. V-belt and chain drives can be installed if the pump must run at a speed somewhat faster or slower than the power takeoff speed. Of these, we prefer the belts because if anything ever binds the pump, the belts will slip before major damage to the pump or power takeoff occurs.

QUESTION: What suggestions do you have about pump speed?

ANSWER: Large capacity pumps, such as our TC-2 (50 GPM), when properly installed on trucks, will often deliver fuel faster than the meter should take it, when the pumps are run at rated shaft speed. In such cases, the pump speed should be reduced by having the truck engine run at a slower speed. The meters most frequently used are rated at 30 gallons per minute, and drivers should not be allowed to run them faster than that. Human nature being what it is, many drivers have a natural tendency to race their pumps in an attempt to speed deliveries. Since the pump delivery rate is controlled in large measure by the amount of liquid that will flow through the pump inlet line and into the pump by gravity alone, overspeeding will usually improve the delivery very little. Instead, this speeding will cause the formation of large volumes of vapor in the pump and inlet line. The pump will be running partly dry. It will be noisy, and may wear fast. When a driver is known to have this tendency, you may be able to help him out by increasing the pressure setting of the bypass valve, as will be explained later. We also strongly recommend that the pipeline, somewhere between the pump and the meter, be tapped to take a copper tube line. This tube should run to a spot near the hose reel or meter, and a pressure gage should be screwed on the end of it. Remind the driver that he will get fastest delivery at the speed where the gage shows the highest pressure. This will be obvious to him, and a little experimenting will show him that overspeeding often *reduces* the delivery pressure, because of the vapor-locked condition this creates in the pump.

QUESTION: What about increasing the pump speed as the unit wears out?

ANSWER: As pumps wear out, it is sometimes necessary to increase the shaft speed somewhat in order to keep up fast delivery rates. However, try to make your drivers see that this overspeeding only accelerates the pump wear. Keep the speeding within reasonable bounds. We are sure from personal inspection of many pumps in our repair division that some have been seriously damaged by terrific overspeeding during the last few days of use. Repair bills could sometimes be cut almost in half if pumps were replaced a few weeks sooner, so they would not be subjected to this type of abuse.

QUESTION: The next item in the piping is the bypass valve. This has always been hard to understand because different pump manufacturers seem to recommend different bypassing setups.

ANSWER: One of the things that may make pump bypassing systems diffiicult to understand is that there are at least four different names commonly applied to the bypass valve. We frequently hear the terms "relief valve," "safety valve," and "differential valve" used in place of the proper wording "bypass valve." The type of bypassing system that is correct depends upon the working principles of the pump you are using. If you install a different make of pump in an installation meant for another, be sure to read the pump manufacturer's installation instructions and make any small changes necessary.

The most troublesome *and dangerous* situation occurs when there is *no* bypass valve in the lines. The second most troublesome installation is where the bypass valve is piped to discharge to the pump inlet line, or where the pump has a "built-in" bypass valve discharging within the pump. This is the so-called "merry-go-round" system. We have a complete article on this one subject alone, and reprints are available. For sat-

isfactory results, the bypass valve *must be piped so it discharges back to the tank from which the pump is drawing liquid*. The drawings in Figures 1 and 2 show the bypass valve properly piped to discharge back to the tanks. Note in Figure 1 (showing twin-tank system) how the bypass return line is manifolded so it can be directed back to either tank, by opening valves C or D. If both tanks are left open to the pump inlet line, valves C and D should both be left open.

QUESTION: What spring setting do you recommend for a bypass valve?

ANSWER: The higher the setting, the faster the delivery rate, particularly when filling cylinders and larger tanks without making a vapor return connection. On the other hand, higher settings also cause pumps to wear a little faster, so a compromise must be made between fast delivery and pump upkeep costs. Usually, a reasonably fast delivery rate can save much more in driver labor time than the cost of pump repairs. We therefore recommend a bypass valve setting of at least 75 pounds for normal service. More and more of our customers, particularly those who make deliveries in rugged areas where the delivery hose has to be longer than usual, are setting their valves higher, up to 125 pounds, with very good results.

When one recalls that only a few years ago the maximum recommended bypass valve setting was 40 to 50 pounds, it is easy to see that considerable good work has been done by pump manufacturers to improve the wear resistance of their products. In the case of our own Smith Pumps, this improvement has come about through a costly program involving long factory and field tests of all promising new developments in gear and bearing materials. With the extensive research being carried on in local government-sponsored laboratories working with difficult problems in connection with supersonic jet aircraft and rockets of various types, improved materials are constantly being made available to us. Extensive testing of these improvements in our LPG pumps is still being carried on, and we anticipate even further improvements in pump wearing qualities as time passes.

QUESTION: What size bypass valve do you recommend?

ANSWER: The 1″ size is usually adequate for most delivery trucks, although the 1¼″ size will probably wear longer when used with 50 GPM pumps such as our Model TC-2.

QUESTION: What construction is best for a bypass valve?

ANSWER: A simple spring-loaded valve such as the Bailey No. 119 does a good job as far as the pump and the rest of the system is concerned, and is quite inexpensive. However, these valves will often chatter and increase the truck noise appreciably. In such cases, you may consider a more expensive diaphragm-type bypass valve, such as made under different numbers by the Bailey, Fisher, Reliance, and other companies.

QUESTION: What is the valve numbered E in both Figures 1 and 2?

ANSWER: This is the *hand bypass valve*. It is an ordinary globe or angle valve having the same pipe size as the spring-loaded bypass valve.

QUESTION: What is the hand bypass valve used for?

ANSWER: This valve has three very important functions. We strongly recommend that it be included in the piping system on any delivery truck.

The three uses are:

1. To give the operator a better control over the filling rate.
2. To enable him to purge the pumping system of vapor, should this ever be necessary.
3. To simplify the loading of the delivery truck tanks either with an outside pump or with the delivery truck pump.

Taking these three uses in order, suppose (1) the driver is given a 20 lb. trailer bottle to fill. At the normal bypass valve setting of 75 lbs. or higher, this bottle would fill so fast that it would be difficult to turn the filler valves fast enough to prevent overfilling. But, if the hand bypass valve is opened 1 or 2 turns before the pump is started, enough liquid will be bypassed to reduce the pressure to the point where this type of filling operation can be controlled nicely. The hand bypass valve can also be used to control meter speed when filling large tanks. If the meter runs too fast, it can be slowed down to its maximum rating by opening this valve. Of course, pumping speeds can also be reduced by throttling the truck engine, but a hand bypass valve has other uses as well.

Suppose (2) that the truck driver is having trouble with vapor lock in the pumping system. This may occur on hot days even in well-designed layouts, possibly due to heat reflected from the roads, or heat transferred to LPG lines by heated air that has blown past the truck engine or engine exhaust system. Vapor lock is particularly common on twin-tank trucks where propane is carried in one tank, and butane or LPG mix in the other. Whenever the pumping system is changed over from a high pressure liquid to a low pressure liquid, the high pressure liquid left in the pipes will "flash" into vapor and vapor lock the pump. When vapor lock occurs, all the driver has to do is open the hand bypass valve with the pump running. This will open a direct pipeline back to the tank, and enable the pump to flow the vapor through this line without having to build up any pressures. In just a few seconds, all the vapor will be purged, and the lines will be full of solid liquid. The hand bypass valve can then be closed, and the pump will work properly.

The hand bypass valve can also be used to advantage for fast loading of the delivery truck (3). Quite frequently, delivery trucks have been equipped with loading connections containing the same 1¼″ filler valve commonly used in filling domestic tanks. These 1¼″ valves are very small for truck loading, and they make it difficult to load trucks at flow rates greater than 30 to 40 gallons per minute. Considerable time can be saved by using another larger connection, if the loading pump has a greater capacity (as is usual). Figure 1 shows two possible loading connections in dotted lines. Loading line "X" can be connected at a cross (F) or at a separate tee in the pump inlet line. The bulk plant pump can force liquid into this connection, and it will enter either one or both tanks through the tank liquid outlets, depending which of valves A and B are opened or closed. With a loading line such as "X," the truck pump can be used in an emergency to load its own tank, by opening either or both of valves C and D, opening the hand bypass valve (E), and closing valves A and B. This can be very handy in the event of an electric power failure.

If it is difficult to find the space for an extra tee, or difficult to pipe to a cross in the pump inlet line, a Smith LPG Pump can be used with a loading connection like "Z" on the drawing, Figure 1. The two or

three ports in the pump housing act like a built-in tee, and liquid can flow through "Z" and the pump case, and into the pump discharge line, without having to run through any of the pump working parts. This type of connection may be used with an outside bulk plant pump, without having to run the truck pump. However, it will not allow the use of the truck pump to fill its own tank unless the power takeoff can be reversed. Reversing is not necessary with the "X" type hookup.

The loading connection shown in Figure 2 is also of the "Z" type. The truck pump cannot load its own tank here, either, unless the p.t.o. can be reversed.

Use of the bypass return line or the pump inlet line for loading makes it unnecessary to have a special loading connection on the tank, and we all recognize that the more tank outlets that can be eliminated, the better the truck is from a safety standpoint. This design also may make the tank a little cheaper, as well as assuring faster loading.

QUESTION: We hear that larger meters for delivery trucks are being developed, and that a few companies have experimental trucks that are making deliveries at flow rates up to 50 GPM. Have you heard anything about this?

ANSWER: Large meters are indeed being made available. However, the only trucks that we know of so far that have filled consumer tanks at a 50 GPM rate have used larger-sized liquid and vapor delivery hoses than are commonly specified. In other words, this is nothing really new. They are just making the delivery truck piping and connecting hoses as much like the loading and unloading systems in bulk plants as possible. We all know we can load or unload truck transports or railroad tank cars at our plants at flow rates of 50 or even 100 GPM, so if we want to rig up delivery trucks with the same high-flow piping, and use big connecting hoses, deliveries can certainly be speeded considerably. It is as simple as that.

QUESTION: What about the 1¼" filler valves in the consumer tanks we fill? Will they take flow rates this fast without damage?

ANSWER: Manufacturers of this equipment have been working on new-model filler valves that will take 50 GPM or higher with very low pressure drop. They recommend their new models very highly. With the older style 1¼" filler valves that are installed in most consumer tanks at present, there is a difference of opinion. The consensus seems to be that the older filler valves will take the high flow rates without excessive wear, but will develop higher pressure drop, putting a greater strain on the pumping equipment, as the pump bypass valve would have to be set at a higher pressure.

QUESTION: Would it be possible to get these high flow rates through a ¾" delivery hose 50 to 100 feet long, like our drivers are used to using? It would just be a matter of setting the pump pressures high enough, wouldn't it?

ANSWER: Pump bypass valves would have to be set to at least 200 lbs. to do a good job on this, particularly with propane in the warmer months. We believe we should inject some words of warning here. A 200 lb. differential pressure, added to the already high tank pressures found in propane systems, would make the total pressure far exceed the working pressures that the various parts of the pumping system were designed to take. For instance, the relief valve in the tank being filled would be likely to pop, because of the pressure buildup. The hoses would be carrying almost twice the strain they carry now. Pumps available at the present time would wear excessively under this high pumping load. Hand valves and filling nozzles should be strengthened. Ideally, such a system is possible, but it could be made safe only if we had better equipment, including a device on the truck that would sense the pressure in the tank being filled, and automatically stop the pumping when this got to the danger point at, say, 240 p.s.i. (The relief valve on the tank would blow at 250 p.s.i.). The hoses would have to be designed to take a working pressure of at least 400 p.s.i., and of course all pumps used would have to be building up at least twice today's pressures without excessive wear. We recognize these future problems and have had our experimental department working on a pressure-sensing device and a high-pressure pump. However, developments such as these require time. It should be several years before this equipment is available for general use. Until then, *don't boost your pump pressures over 100 to 125 lbs.*, as this would be very unsafe and probably cause many accidents.

QUESTION: What about the spray-fill type filler valves now being made available for consumer tanks? Do they help with pumping speed?

ANSWER: In case the tanks you fill have dip-tubes on the filler valves, and you also do not make a vapor return connection, then spray-fill valves will be a big help in attaining fastest possible flow rates. However, if your tanks do not have dip tubes, or if your driver is used to making a vapor connection, you should not expect much improvement through their use.

QUESTION: Do you have any other points to make in connection with delivery truck pumping systems?

ANSWER: It is not practical to cover everything in one booklet. The reader is referred to our article "How to Speed-Up Fuel Deliveries" in the January 1953 issue of the Butane-Propane News, for details on items like the meter, meter back-pressure valve, delivery hose, etc., which have not been mentioned here. Reprints of this article are also available. Remember, too, that we are glad to answer your special questions on LPG pumping at any time. If you are planning to have a truck assembled by one of the large tank companies who specialize in this type of work, we shall be glad to cooperate in any way that we can, by reviewing pump piping drawings and approving them for you, etc., without charge or obligation of any kind.

QUESTION: Will you please sum up what you consider to be the most important points to remember about delivery truck pumping systems?

ANSWER: 1. Of all the 2" excess-flow check valves available on today's market, the only one we can recommend for large-capacity pumps designed for fastest deliveries is the free-flow type such as A7537FL (Rego).

2. The pump strainer should be one that can be opened for cleaning easily, and should have a screen made of 40-mesh, or finer, wire cloth.

3. Truck pumps should not be greatly overspeeded. If overspeeding is necessary to get good delivery from a worn pump, replace the pump immediately. Overspeeding the pump for a few weeks or a month may double the repair bill.

4. Do not use a "merry-go-round" bypass arrangement. Have an outside bypass valve piped to discharge back to the tank. Set this at 75 lbs. or a little higher.

5. A hand bypass valve is a valuable and inexpensive driver aid.

WHY YOU SHOULD MAKE YOUR NEXT PUMP A SMITH

1. BEST DESIGN

Smith Pumps have been designed through the cooperation of qualified LPG engineers, competent production men with long experience in the field, and LPG distributors. Our multiple gear design has been proven best over the years. Other types cannot match Smith Pumps for their ability to pump against high differential pressures, or their ability to overcome vapor-lock conditions.

2. LONG WEARING

Smith Pumps are the longest-wearing positive pumps in the field. No expense is spared to build these units of the finest materials available. Continual improvements are being made as better materials are developed.

The balanced-gear principle, unique with Smith Pumps, eliminates bearing loads on the main shaft and allows the idler gears to be *self-adjusting for wear.* The original high pumping efficiency is maintained for a large part of the life of the pump. As a matter of fact, worn Smith Pumps may have slightly better efficiency than new pumps.

3. SAFE

Smith Pumps were the first LPG units to receive the approval of the Underwriters' Laboratories. They have a perfect safety record.

4. TROUBLE FREE

Smith Pumps are carefully tested to be sure they are in perfect condition when leaving the factory.

5. ACCURATE, TOP-QUALITY WORKMANSHIP

Smith Pumps are built by precision machinists having long experience in specialized work on LPG pumps. Most of our employees have been with us for more than ten years. There is no substitute for the quality of such fine workmanship.

6. GOOD SERVICE

Our business has been founded on good service. Old customers will be pleased to tell you how we have helped them by making same-day shipments of urgent requirements. Part of this reputation for good service is due to the cooperation we get from freight forwarders. Our factory is in one of the few areas served directly by all the major transcontinental truck lines, air lines and railroads. In many cases, we can give faster service than can factories or branches located in smaller manufacturing centers, even though we may be farther from your plant.

7. LEAK-PROOF MECHANICAL SHAFT SEAL

Incorporated in a shaft-packing assembly, as a complete unit including the shaft. Designed and patented by our own engineers (Patent No. 2,554,595), and built in our own factory especially for use with Smith Pumps. Experience with regular production since 1948 shows that in 95% of all cases, the shaft seal outlasts the rest of the pump. However, if a replacement has to be made, this can be done in a *few minutes* using only a wrench, without removing the pump from the piping, and without opening the pump's working section. The overall cost is a very few dollars, as good credit can usually be allowed for used shaft packing assemblies.

8. EXCHANGE PUMP PLAN

When a pump needs replacement, it is only necessary to advise the factory of the *model number* and the *serial number.* An identical unit in new condition will be shipped immediately. You return the old pump for credit after the new pump is received, and the charge amounts to only that required to repair the old pump plus freight. This plan includes the possibility of turning your old pumps in on larger or smaller units, should your requirements change.

9. LARGE STOCKS OF PUMPS AND PARTS

We maintain large stocks at all times, and are in a position to make immediate shipment on new pumps, replacement pumps, and parts. All of our operations are under one roof. We are able to give better service, as production planinng is made easier, and this results in a saving in costs to the user.

10. FACTORY REPAIRS

A repair division is maintained at the factory for the convenience of all Smith Pump users. We have several men who specialize in repair work and who can return a pump to new condition in a few hours, at less than half the cost of a new pump. Factory repairs include the full test procedure followed when making new pumps.

11. LPG PUMP SPECIALISTS

Most LPG pump manufacturers have other interests. In many cases, LPG pumps are only a sideline to them. This is not true with Smith Pumps. The LPG units we make are our bread-and-butter and all our energy is directed towards the continual improvement of this already-excellent product.

12. COST

The old maxim "you get what you pay for" is true with LPG pumps. Smith Pumps cost more than most *because they are better.* We make them this way because *better pumps pay for themselves many times over* by speeding deliveries and reducing maintenance expense.

OTHER INSTALLATION SUGGESTIONS AVAILABLE

Reprints of many of the Pump Installation articles that we have contributed to the *Butane-Propane News* and the *LP-Gas Magazine* are available free of charge at our factory office. Almost every common type of LPG installation is covered in one or more of these articles. Write for any that may help you in your own work. Those listed below are the most widely used:

REPRINT 1—The Inlet Line and Pump Starvation.

REPRINT 2—Filling Cylinders on a Manifold.

REPRINT 3—Bulk-Plant Design.

REPRINT 4—Strainers.

REPRINT 5—Bypass Valves.

REPRINT 6—Principles in Accurate Metering.

REPRINT 7—Unloading Railroad Tank Cars
(Series of 3 articles, 10 pages).

BOOKLET A—Transferring LP-Gas with Liquid Pumps (24 pages).

BOOKLET B—Proper Design of Discharge Line (20 pages).

BOOKLET C—Dollars and Sense (16 pages).

Many special reprints, articles, blueprints, etc., in addition to those listed, are available. If you have an unusual or special problem, write, giving all details, and we will be glad to send any available information without obligation.

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