OPERATING AIR POWERED DIAPHRAGM PUMPS

GENERAL

This section applies to standard types of double diaphragm pumps from various manufacturers which are in common use for a wide range of applications from fluid transfer, emptying sumps and drums, feeding filter presses etc.

OPERATING PRINCIPLES

Being powered by compressed air (normally a standard air supply of up to 100psi), they are portable, safe in flameproof areas, self-priming and their flow rate and pressure can be easily controlled.

Referring to the typical sectional arrangement drawing (Fig. 1) of a PATS **Centurion** diaphragm pump, you can see the two diaphragms (connected by a rod) which are caused to reciprocate by the compressed air, the air shuttle valve receiving a change-over signal at the end of each stroke.

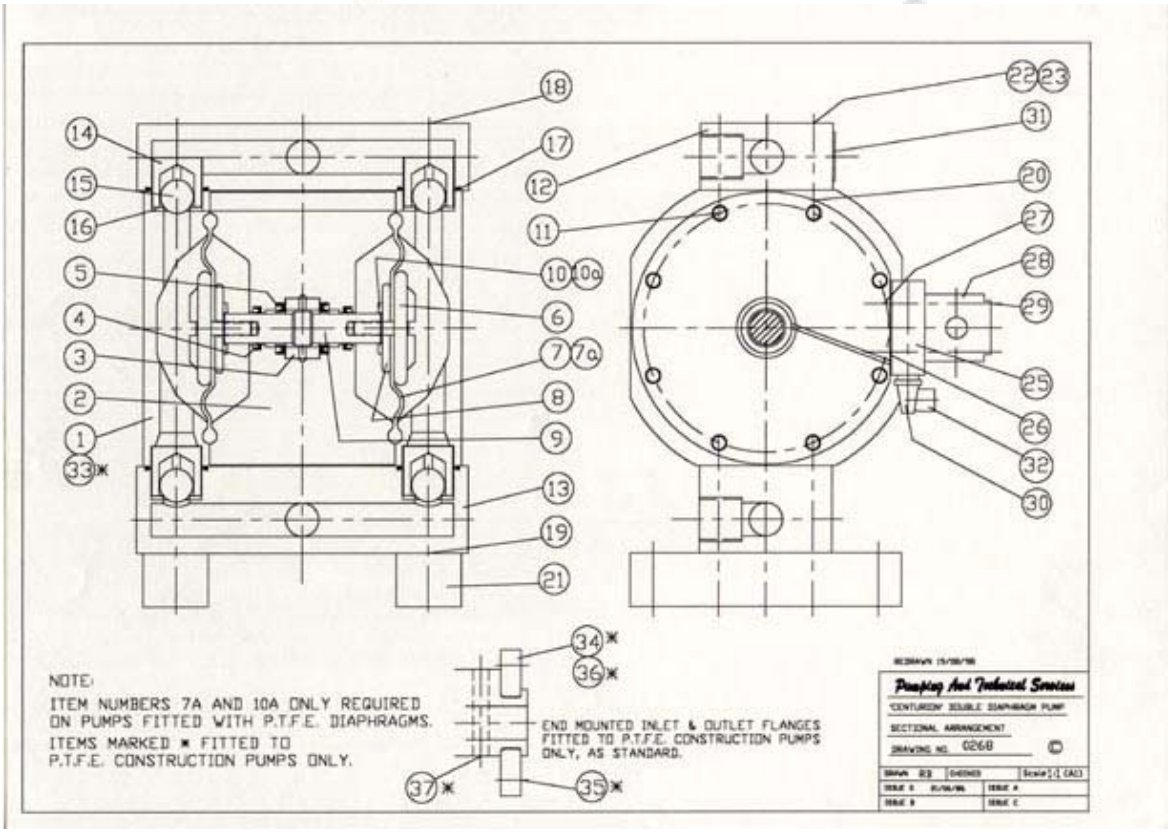

Fig 1

Typical Sectional Arrangement Drawing

Each diaphragm fluid chamber has an inlet and outlet non-return valve and manifolds to the respective common inlet and common outlet ports connect these.

Depending on the application, the non-return valves can be gravity-seated balls (as shown here) or other types such as flap valves.

PUMP CONTROL

The primary control of the pump flow rate and pressure is normally by means of a pressure regulation valve in the air supply line. Because the air acts directly on the fluid via the diaphragms, the maximum fluid pressure that can be generated at zero flow condition, is equal to the air pressure being applied.

It follows that to make the pump operate at a useful flow rate, the driving air pressure must be higher than the fluid delivery pressure of the pump. For example, when pumping fluid at a pressure of say 30psi, the optimum flow rate will be achieved with a driving air pressure of about 60psi.

It should be appreciated that the maintenance interval for these pumps is normally determined by the life of the diaphragms. The length of diaphragm life is dependent on the total number of operating cycles and degree of stress that they encounter. To maximise diaphragm life, remember the following: -

- Set the driving air pressure at the minimum level required to achieve the duty.
- Avoid continuous operation at the maximum flow rate - it is best to slow the pump to a steady rate, even if takes longer to finish the job.
- Avoid allowing the pump to run without fluid for long periods. When emptying a tank or sump, if there is no operator standing by, consider fitting an automatic cut-out device. A valve or similar restriction device can also control the pump but these must be installed in the pump delivery line. If the delivery line is closed completely, the pump will 'stall' and remain stopped (consuming no air). When the delivery line is re-opened, the pump should automatically start pumping again.

INSTALLATION CONSIDERATIONS

Because of the reciprocating pumping action, pulsations are generated which can cause vibration in the pump and pipework, particularly at higher flow rates and pressures. This effect can be reduced or eliminated by: -

- reducing the flow rate and/or operating pressure
- using flexible inlet and outlet hoses
- fitting a pulsation damper in the pump discharge line
- fitting an additional pulsation damper in the pump suction line

Note: A simple form of pulsation damper may be created by fitting a 'tee' in the line with a vertical (rising) branch pipe which is sealed at the top, creating a bubble of air which compresses and expands to absorb the pulsations.

On permanent installations, the pump can be bolted down.

On portable applications, the pump may be freestanding, subject to limiting the pulsations as discussed above, or particularly for larger units, mounted on a skid or trolley. The latter arrangement may also make provision for carrying any flexible hoses etc.

SELF-PRIMING

Most diaphragm pumps are capable of self-priming even when 'dry', from depths of up to about 8 metres. However, the practical depth possible depends on several factors, the main ones being: -

- vapour pressure of the liquid and operating temperature
- type and condition of the pump non-return valves
- volumetric efficiency of pump
- total length and route of the suction pipework
- avoidance of any leaks in suction pipework

The pump should be located as close as possible to the liquid source and the suction pipework should rise steadily from the liquid source to the pump suction.

It is also important to realise that when priming, the pump can only empty air from the suction line into the delivery line at low pressure. Therefore, there must be a vent or free exit for the air arriving in the delivery line.

LIQUIDS CONTAINING SOLIDS

Diaphragm pumps can be suitable for handling a certain degree of solids and sludge etc. Some models are available which, when equipped with flap type non-return valve, will pass any size solid that fits into the suction port.

Normal units will be rated for passing solids of a certain size and if necessary, should be fitted with a suction strainer to restrict entry accordingly. Liquids containing abrasive solids may cause wear, particularly in the non- return valves, and may damage the diaphragms. Special materials may be used for the vulnerable parts to achieve a satisfactory life.

MATERIALS OF CONSTRUCTION

For handling water and other harmless liquids, cast iron or aluminium are the normal materials for diaphragm pump chambers and manifolds.

Stainless steel versions are readily available for handing chemicals, solvents and for ultra clean duties.
For the more extreme corrosive chemicals, versions are available in plastics such as polypropylene, polyethylene, P.V.D.F. and for ultimate resistance in P.T.F.E.

Many of the lower priced polypropylene plastic pumps are of moulded construction and are not as robust as those with solid plastic components.

Refer to PATS' **Centurion** range of machined from solid plastic diaphragm pumps.

DIAPHRAGMS

For water and other normal fluids, the common diaphragm materials are Nitrile, Neoprene and Ethylene Propylene synthetic rubbers.

For some chemicals and solvents, Viton synthetic rubber will be suitable although more expensive.

For extreme chemicals, P.T.F.E diaphragms will be specified (often as an over-lay on a synthetic rubber backing).

As a general rule, P.T.F.E. diaphragms (being less flexible) will have a shorter mechanical life and on some makes of pump will require modification to shorten the operating stroke when converting from rubber diaphragms.