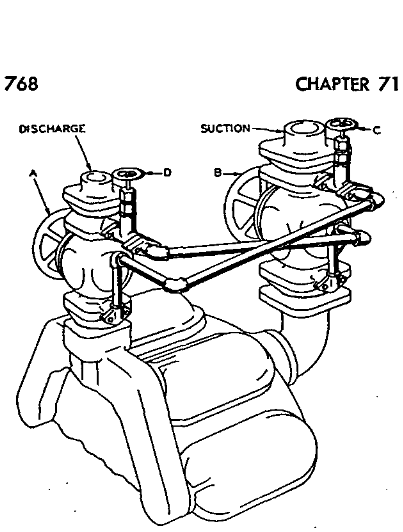

Fig. 3 .... Compressor with Crossover Connections

Crossover Connections

In general, high speed multiple cylinder compressors can be started against high differentials between the suction and discharge mains with normal torque motors, if the compressor is designed to start with some cylinders unloaded. However, if necessary, crossover connections can be provided so that the compressor can be started with minimum breakaway torque. Fig. 3 is a sketch of a compressor with crossover connections.

For manual starting with a *minimum* breakaway torque, valves *A* and *C* are opened wide, valve *B* is opened one-half turn. After the compressor has started, valve *C* is closed and valve *B* is gradually opened to fully open position.

The condenser can be pumped out into the low side by using the same connections. Valves *A* and *B* are closed, valves *C* and *D* are opened. The compressor is operated for a short period or until the suction pressure is down to 26 in. of vacuum.

Slow speed vertical and horizontal compressors with 2, 3, or 4 cylinders are equipped with manifolds incorporating starting bypass valves, because these compressors have to be unloaded due to the high starting torque required. A manifold with the necessary valves is shown in Fig. 4. When starting the compressor, valves *A* and *D* are closed and valve *C* is opened wide. Valve *B* is one-half turn open. After the compressor has started, the discharge valve *A* is opened, the bypass valve *C* is closed simultaneously, and then valve *B* is opened slowly.

Pipe Sizing

For proper sizing of suction mains and takeoffs from the mains to the compressors it is necessary to consider the effect of the pressure drop in the piping selected upon the size of compressor required. An economic study has to be made to determine whether it is more economical to buy additional compressor displacement (due to the lower suction pressure involved) if there is high suction line pressure drop, or whether it is better to select larger piping with consequent lower suction line pressure drop. In general, at higher temperature levels, higher pressure drops can be used.

Practical friction losses per 100 ft equivalent length of suction main are: 0.25 psi when operating at 5 psig suction pressure, 0.5 psi at 20 psig suction pressure, and 1.0 psi at 45 psig suction pressure. These are considered good practice but not an absolute limitation.

For discharge mains, a total friction loss of 3 to 5 psi is considered good design. Generally, a slightly oversized discharge line is desirable to hold down the discharge pressure and, consequently, the discharge temperature.

Tables showing ammonia line capacities, at typical conditions, are included in Chapter 69.

For proper protection of the compressor, the high-pressure and low-pressure cutout and gages should be installed on the compressor side of the stop valves.

Suction Gas Conditioning

Suction main piping should be insulated to limit the superheat at the compressor. For each 1 F deg increase in suction superheat, the discharge temperature will increase 1.5 to 2.0 F deg, depending upon the compression ratio involved. For each 10 F deg, the power requirements increase approximately 3 percent. It is, therefore, of importance to maintain proper conditioning of the suction gas, and one way to do this is to use a vertical desuperheater as shown in Fig. 5. The maintenance of low discharge temperatures in ammonia plants is very important because the compressor lubricating oil may carbonize at the higher temperatures. This can result in cylinder wall scoring and oil sludge throughout the system. Temperatures above 350 F should be avoided.

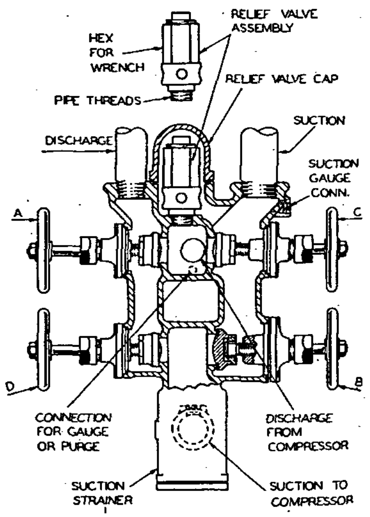

Fig. 4 .... Manifold and Bypass Valves for Unloading Compressor

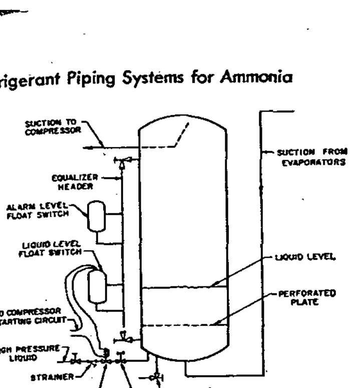

Fig. 5 .... Vertical Gas Desuperheater

Oil Receivers

Fig. 6 is an illustration of two compressors on the same suction line and with one discharge line oil separator. The oil separator float drains into an oil receiver which maintains a reserve supply of oil for the compressors. The compressors should be equipped with crankcase floats to regulate the flow of oil to the crankcase.

AMMONIA COMPRESSOR COOLING

Ammonia compressors are generally constructed with internally cast cooling passages along the cylinders or in the top heads. The purpose of these passages is to provide space for circulating a heat transfer medium to minimize conduction of heat from the hot discharge gas to the incoming suction gas and the oil in the crankcase of the compressor. Water is usually the medium circulated through these passages, commonly termed water jackets. Approximately 0.1 gpm per ton of refrigeration is circulated. The oil in the crankcase (depending on type of construction) is approximately 120 F. Temperatures above this reduce the lubricating properties of the oil.

For compressors operating above 32 F, the water flow is sometimes controlled entirely by hand valves, although a solenoid valve in the inlet line is desirable to make the system automatic. An illustration of this type of cooling is found in Fig. 7.

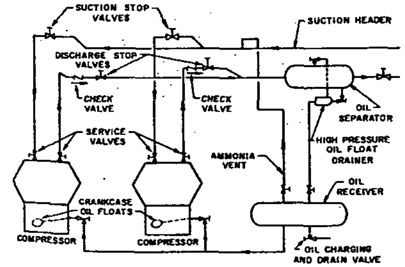

Fig. 6 .... Parallel Compressors with Common Oil Separator

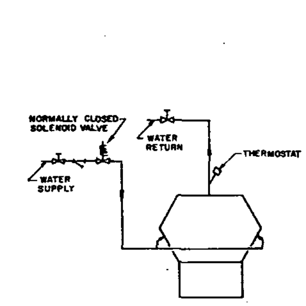

Fig. 7 .... Jacket Cooling for Suction Temperature above 32 F

The thermostat in the water line leaving the jacket is used as a safety cutout to stop the compressor if the temperature becomes too high. To be effective, the thermostatic element should be in the water leaving the compressor.

For compressors operating below 32 F evaporator temperature, or installed where temperatures below 32 F may exist, it is essential to provide means for draining the jacket on shutdown. One method is shown in Fig. 8. The normal water flow is through the normally closed solenoid valve which is energized when the compressor is started. The water then circulates through the jacket and out through the water return line which contains a check valve. When the compressor is stopped, the solenoid valve in the water inlet line is de-energized and stops the flow of water to the compressor. At the same time, the normally open solenoid valve is opened to drain the water out of the low point of the jacket to sewer. There is a check valve in the air vent line that opens when pressure is relieved and allows the jacket to be drained. This flapper type check valve is installed at a slight angle so that water pressure will close it, but absence of water pressure allows it to swing open.

Occasionally, for installations of compressors in spaces below 32 F, the cooling is best handled by using an anti-freeze solution in the jackets and cooling this by a secondary heat exchanger.

Another method of cooling the compressor on systems operating below 32 F evaporator temperature is to expand ammonia through the jacket at temperatures above 32 F and to control this temperature by use of a back pressure regulator. Some systems employ a thermal expansion valve for controlling the liquid flow through the jacket and others employ a hand valve. In either case, a solenoid valve opens in the liquid line when the compressor is started. For the method using a thermal expansion valve, the suction gas from

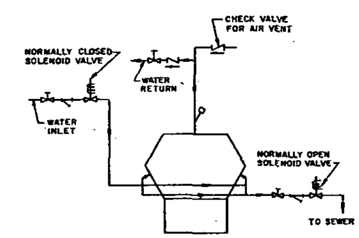

Fig. 8 .... Jacket Cooling for Suction Temperature below 32 F