TRANE

OPERATING AND SERVICE MANUAL

TRANE RAILWAY REFRIGERATION AND AIR CONDITIONING SYSTEMS

PRINTED IN THE UNITED STATES OF AMERICA BY
LA CROSSE PRINTING AND ENGRAVING COMPANY, LA CROSSE, WISC.

GENERAL INFORMATION

BASIC REFRIGERATION THEORY

Refrigeration is the process of removing heat from a substance and transferring this heat to another substance. Inasmuch as refrigeration deals entirely with heat transfer, it is well to have an understanding of the principles involved.

HEAT

Heat is a form of energy and, since it is not a substance, it can be dealt with only from its effects on other materials. Every substance on earth contains some heat, so that when a body is "cold," it means only that the heat which it contains is less concentrated or less intense than in another body.

ABSOLUTE ZERO

As we remove heat from a substance, its temperature drops. Since there must be some point at which no more heat can be extracted from a substance, a theoretical zero has been established. This point is known as absolute zero (459.6° below 0° Fahrenheit).

MEASUREMENT OF HEAT

In order to measure the heat in a substance, we must consider (1) the concentration of heat, and (2) the heat holding nature of that substance. The white hot filament of an electric light bulb may contain less heat units than a pail of water, but in the filament, the heat is more highly concentrated. Temperature expresses the concentration of heat in a body and this concentration of heat is determined by measuring its effects on some other material which has been agreed upon as a standard of measure. Mercury and alcohol thermometers are used to measure this effect, and the Fahrenheit scale is used almost entirely in refrigeration as a standard of measure.

HEAT FLOW

Heat flows from bodies of higher temperature to bodies of lower temperature just as water flows from higher to lower levels, and, like water, heat can be pumped uphill from which point it can flow away in a different direction. When two substances are brought into thermal contact (so that heat can flow), the heat flows from one into the other until they are both at the same temperature. The greater the temperature difference between the two bodies, the faster will be the heat flow. As the temperature difference approaches zero, the rate of heat flow approaches zero also.

Heat can flow from one substance to another in one of three ways or in a combination of these:

RADIATION, as heat from the sun, in which no material substance acts as a carrier. Radiant heat passes through transparent substances without warming them and is stopped or absorbed by opaque substances. Like light, radiant heat travels only in a straight line from its source and can be reflected from a polished surface.

CONDUCTION, as heat passing from one end of a bar or tube to the other. In this case heat is passed along from one particle of the material to the next one touching it. Flow of heat by conduction takes place at the surface of a metal.

CONVECTION, the most common method of refrigeration, is the transfer of heat from a warm body to a cold body by a fluid (liquid or gas) acting as a carrier between the two. The fluid picks up heat from the warm body by actual contact (conduction), becomes lighter and rises. The difference in temperature between the warm and cold bodies causes the carrier to circulate between the two, giving up its heat to the cold body. The circulation of the carrier stops when there is no longer a difference in temperature between the two bodies.

This method of heat transfer requires that consideration be given to the path of flow of the carrier between the warm and the cold bodies. Best heat transfer from one to the other is secured when the carrier fluid has a free and natural path with little obstruction.

UNIT OF HEAT

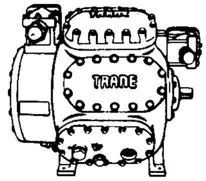
The amount of heat added to or subtracted from a body can be measured only by the rise or fall in temperature of a known weight of the substance. As a standard for all heat measurement, the unit of heat has been agreed upon as the heat required to raise the temperature of one pound of water one degree Fahrenheit at atmospheric pressure. This unit of heat is known as the British thermal unit or B.T.U.

SPECIFIC HEAT

The specific heat of a substance is the number of BTU required to raise the temperature of one pound one degree Fahrenheit. The specific heat of water is 1.0 by adoption as standard. The specific heat of another substance (solid, liquid, or gas) is determined experimentally by comparing it with water. Specific heat expresses the heat holding nature of a substance compared with that of water.

SENSIBLE HEAT

Heat added to (or subtracted from) a substance without causing a change of state will cause an increase (or decrease) in temperature. This heat is called sensible heat because its addition or subtraction is perceptible on the thermometer.



LATENT HEAT

When the temperature is reached at which heat added or subtracted does not cause further change in temperature (as the freezing or boiling points), a change in state takes place upon further addition or subtraction of heat. The heat necessary to cause one pound of a substance to change its state at the boiling or freezing temperature is known as latent heat. The heat required to change a liquid to a solid or vice versa is known as the latent heat of fusion. In changing a liquid to a gas, the heat necessary is known as the latent heat of evaporation, and in changing from a gas to a liquid, it is known as the latent heat of condensation. The latent heat of fusion in water at 32° F. is 144 BTU (freezing or melting), and the latent heat of evaporation (or condensation) at 212° F. is 970.4 BTU per pound. The latent heat of evaporation for one pound of Freon-12 at 33.43 pounds per square inch is 66.17 BTU. The latent heat of condensation at 124.3 pounds per square inch is 56.8 BTU per pound.

TOTAL HEAT

Since we cannot start at absolute zero to measure the total heat of a certain weight of a substance, we adopt a temperature at which we assume there is no heat to construct our tables of data as a basis for practical use. For data on the heat content of Freon-12, we start at 40° F. below zero (—40°) as the point of no heat. For water and steam, we start at 32° F. (32° F).

INSULATION

There would be little practical value in removing heat from a body if it were not possible to prevent heat from flowing back into it. Insulation and its effect is as important as the efficiency of heat removal.

Transfer of heat by convection requires that the fluid carrier circulate freely. It is inversely true that if the fluid carrier cannot circulate, little heat will be transferred from the warm to the cold body. Most types of insulation in use owe their value to the fact that they contain an infinite number of air cells. Air is a poor conductor and its circulation is reduced to a minimum by the smallness of each air cell. Air must be confined in very small cells to be effective as an insulator.

Should moisture from the air find its way into the air cells of insulation and freeze, the poor conducting air is replaced by a good conducting solid and insulation value is destroyed. For this reason, insulation should be well protected against infiltration of moisture.

MECHANICAL REFRIGERATION

Refrigeration is the process of lowering the temperature of a substance below that of the surrounding atmosphere. The heat absorbing body or refrigerant must be at a temperature lower than that of the substance to be cooled. Heat extracted from the body being cooled by the refrigerant must be carried away and delivered to the atmosphere whence it originated. If a lower temperature of the cool body is to be maintained, the body must be surrounded by insulating material so that the heat cannot return to it.

Ice is the most common refrigerant and in absorbing heat from a body higher than 32° F., absorbs this latent heat of fusion which changes to water at 32° F. Melting of the ice carries away the absorbed heat. If the process of refrigeration with ice is to be continued, the water must again be frozen.

The discovery of the properties of various liquids made possible a continuous process of refrigeration by mechanical means.

A liquid has different boiling temperatures for different pressures under which it is confined. The boiling point is also the condensation point for that pressure. This temperature-pressure-relation must be determined experimentally for each liquid. Water boils at 212° F. only at atmospheric pressure, (0 pounds gauge pressure). at 90° F. at 28.58" of vacuum and at 60° F. at 29.477" of vacuum. Under atmospheric pressure, Freon-12 boils at —21.8° F. Because of this low boiling point, it does not exist as a liquid at ordinary atmospheric temperatures and pressures. It can be changed to a liquid by confining it under pressure and cooling the gas to the boiling point for that pressure.

Liquids with low boiling points are used as refrigerants in mechanical refrigeration. Those liquids which change from a liquid to a gas after absorbing heat are known as primary refrigerants. Brine, air and cold water, which act only as heat carriers, are known as secondary refrigerants.

When the temperature of a liquid is raised to the boiling point corresponding to its pressure, both liquid and gas can exist together and the condition is said to be saturated. Gas, containing particles of liquid, is said to be "wet," but if it is at the boiling temperature with no liquid particles, it is "dry" and "saturated.." If the temperature of the gas is raised above its saturation temperature, it is "superheated." Strictly speaking, saturated gas, either wet or dry, is a vapor and not a gas until the vapor is highly superheated.

THE MECHANICAL REFRIGERATION SYSTEM

The mechanical refrigeration system is used more frequently today than any other means of refrigeration. The mechanical refrigeration system components are easily adapted to automatic control, and because of the many applications of these controls, different types of systems utilizing mechanical refrigeration equipment have been designed.

The mechanical refrigeration system has as its main components, a compressor, condenser, receiver, evaporator and a means of controlling the flow of refrigerant. Liquid refrigerant in the evaporator absorbs heat from

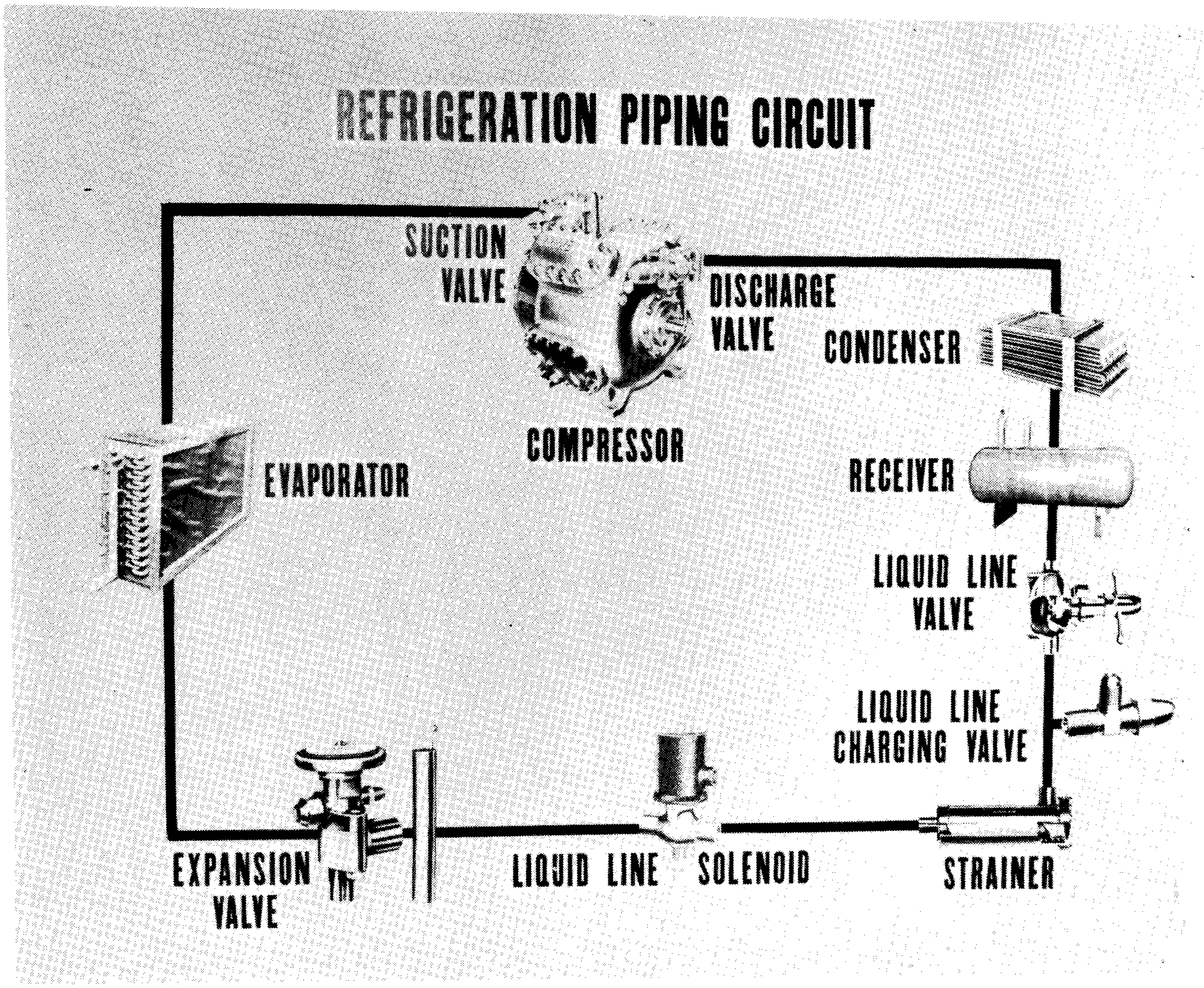


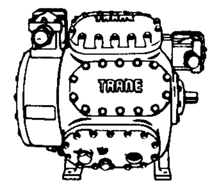
FIGURE 1

the medium being cooled because the liquid is held under a pressure at which its boiling temperature is below the temperature of the medium surrounding the evaporator. As the liquid refrigerant boils in the evaporator, it changes from a liquid state to a vapor by absorbing heat from the surrounding medium. This vapor or gas flows from the evaporator to the compressor where it is compressed to a higher pressure gas and then passes on to the condenser. Within the condenser, the heat of the compressed gas is transferred by conduction to the condenser cooling medium (usually air or water). This transfer of heat from the refrigerant to the cooling medium causes the refrigerant to condense into a liquid. Thus, the heat absorbed by the refrigerant in the evaporator is ultimately transferred to the condenser cooling medium. The refrigerant leaving the condenser is in a liquid state and is carried under pressure to the liquid receiver. From the liquid receiver, the refrigerant passes through the expansion valve where the pressure is reduced and then the liquid refrigerant enters the evaporator where it again absorbs heat from the surrounding medium and boils or changes into a vapor.

Figure 1 illustrates the basic refrigeration cycle.

GENERAL INFORMATION

PRINTED IN U.S.A.
SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN



SUPERSEDES

COMPRESSOR UNITS

Many operating conditions encountered in air conditioning railway cars are abnormal when compared with conditions encountered in the air conditioning of buildings. In developing the Trane Reciprocating Compressor, these typical railway conditions were carefully studied. The compressor was designed to absorb increased punishment of high head pressures, high hot gas temperatures, and high compression ratios which can result from dirty or clogged dry condensers, loss of water in the wet condensers, and improperly set or damaged high pressure switches. The result is a compressor which provides more refrigeration capacity than was ever available in the past from units of comparable size.

Trane Compressor Units are built in different sizes to provide full refrigeration capacity for any type of car. For conventional coaches, sleepers and diners, the units may be equipped with four-cylinder Trane Reciprocating Compressors having a nominal rating of ten tons capacity. Six-cylinder units of fifteen tons capacity, and eight-cylinder units of twenty tons capacity are available for special cars, such as domes, and unusual applications.

Maximum flexibility of installation below the car is permitted because of the compactness of the Trane Compressor Unit. Specifically designed for railway use, it may be suspended below the car either parallel to or at right angles to the center-sill. When motor size permits right angle mounting, the entire unit occupies approximately one-third the space required by most compressor units.

The entire compressor unit can be located at any point below the floor, regardless of occupied areas within the car, without special consideration for noise or vibration. The unit is quieter and smoother running than any installations of the past. It is entirely isolated from the car structure with large shock-absorbing rubber mounts. All refrigerant lines are equipped with a flexible hose to further isolate the car from transmission of sound and vibration. These features serve an important secondary function of protecting the equipment from damage caused by humping or rough handling.

Trane Compressor Units make use of standard electric motors. Because compressor is directly connected to the motor, V-belts and sheaves are completely eliminated, thereby avoiding problems of belt wear, failures and replacements caused by dirt, sand and flying ballast. All piping is of extra rugged construction. Because there are no belt drives or frail piping to be damaged, open construction of design is possible. Units with protective metal casings and screens are also available. These units have removable hinged front panels for complete accessibility. Figure 2 illustrates a complete open construction type of compressor unit. Figure 3 illustrates the enclosed type of unit.

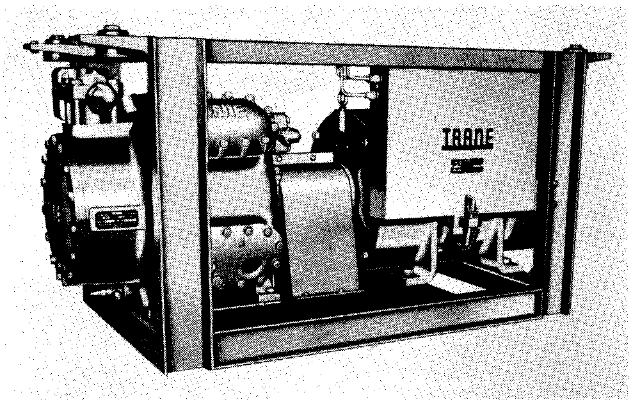


FIGURE 2

Typical Compressor Unit.

COMPRESSOR

All Trane Compressor Units are equipped with a modern design compressor. These units are of the V or W type and are four, six, or eight cylinders. These compressors are a direct-drive, constant speed unit incorporating unloaded starting, crankcase oil foam breaker, totally enclosed fully automatic capacity control, and a large suction separation chamber.

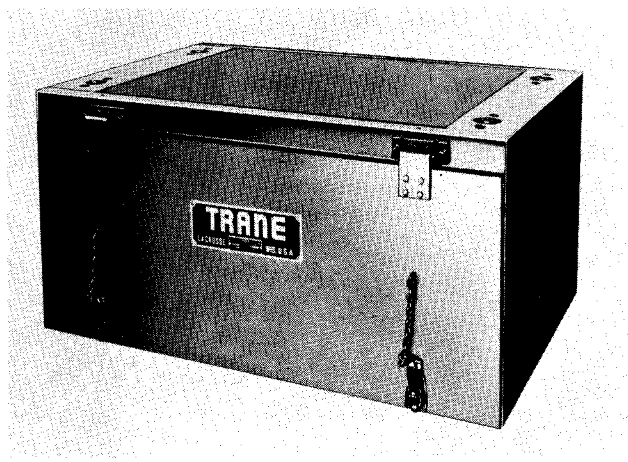


FIGURE 3

Completely Enclosed Compressor Unit.

Trane Railway Compressors have been designed to operate at 1750 rpm. Greater speed provides greater displacement, thus producing more capacity from a given bore and stroke. This has made it possible to reduce the size of the compressor. In most cases, the compressor is no larger than the motor that drives it. Fig. 4

Within the Trane Compressor are many features not found in other units. Among these are cam-ground pistons, lightweight reciprocating parts, compactness and aluminum bearings without inserts for accuracy of fit. Modern slip-fit internal assembly methods are employed, using lockrings where necessary. Serviceability has been built into the unit not one but many ways. One man with no special tools can disassemble and assemble a Trane Compressor in less than four hours. The number of parts has been minimized by limiting the number of internal bolts. The maximum use of sub-assemblies aids in the ease of serviceability.

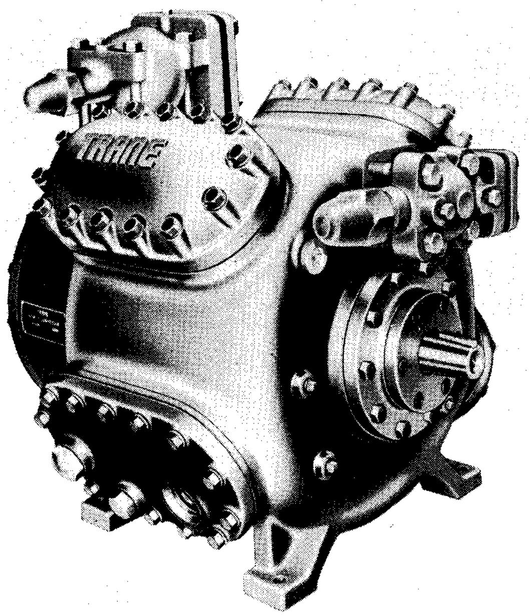


FIGURE 4
Four Cylinder Trane Compressor.

There are no preselective fits required with the Trane Compressor parts. A connecting rod can be replaced, for example, by any standard stock replacement connecting rod. No special fitting of connecting rod insert shims or other parts is necessary. Piston and connecting rod assemblies can be interchanged without measuring or adjusting for fit and clearances. Machining or special sizing is eliminated.

All Trane Compressors for railway application are furnished with hydraulically-operated, multi-stage cylinder unloaders which respond automatically to reduced cooling loads within the car. It is significant that power consumption is greatly reduced under moderate conditions as compared to the operation of conventional machines which must be stopped and started for temperature control but which use maximum power when operating under light load. The unloading feature also eliminates the need for expensive multi-speed motors and motor control for capacity modulation.

The capacity control feature greatly improves the performance of conventional split-coil evaporator systems because the unloaders can be adjusted to minimum coil temperatures under light loads and obtain lowest possible humidity in the car. Its features of capacity control make possible a practical "reheat" system for passenger cars where control of humidity is desired.

When the compressor is idle, cylinder unloaders hold their respective suction valves open upon starting, the suction valves remain open and vent the compression stroke until oil pressure is built up within the machine. The suction valves are then forced to close at different stages of oil pressure so there is no sudden load on the motor. This design permits the use of standard general purpose normal torque motors as compared with special motors of high torque starting capacity which are normally required.

CYLINDER UNLOADER

One of the most satisfactory systems of capacity control is one that employs cylinder unloaders. With this arrangement some method is provided that will hold open the suction valves of some of the cylinders.

With the suction valves held open, the piston will draw gas from the suction manifold on the down-stroke of the piston but will, on the up-stroke of the piston, return the gas, without compressing it, to the suction line.

In single step unloader systems, it is customary to unload one-half of the cylinders. In multi-step unloaders, the machines are unloaded in increments, depending upon the number of cylinders in the compressor. With cylinder unloading, the power requirements are decreased almost in direct proportion to the reduction in load.

HOW THE UNLOADER WORKS

To gain a full understanding of the complete operational cycle of the unloader mechanism, one should consider the mechanism as two distinct components: (1) capacity control actuator (see Figures 5 and 6 below the solid black line), (2) cylinder unloader mechanism—one for each controlled cylinder (Figures 5 and 6 above the solid black line).

(NOTE: Figures 5 and 6 are schematic drawings and show only the flow of operation.)

CAPACITY CONTROL ACTUATOR

The capacity control actuator reacts to variations in refrigeration load requirements and transmits them to the cylinder unloader mechanism, which acts to load and unload the compressor cylinders. To perform this dual function, the capacity control actuator consists of (1) a pressure sensing device (Figures 5 and 6, lower left quadrant) which is sensitive to variations in suction

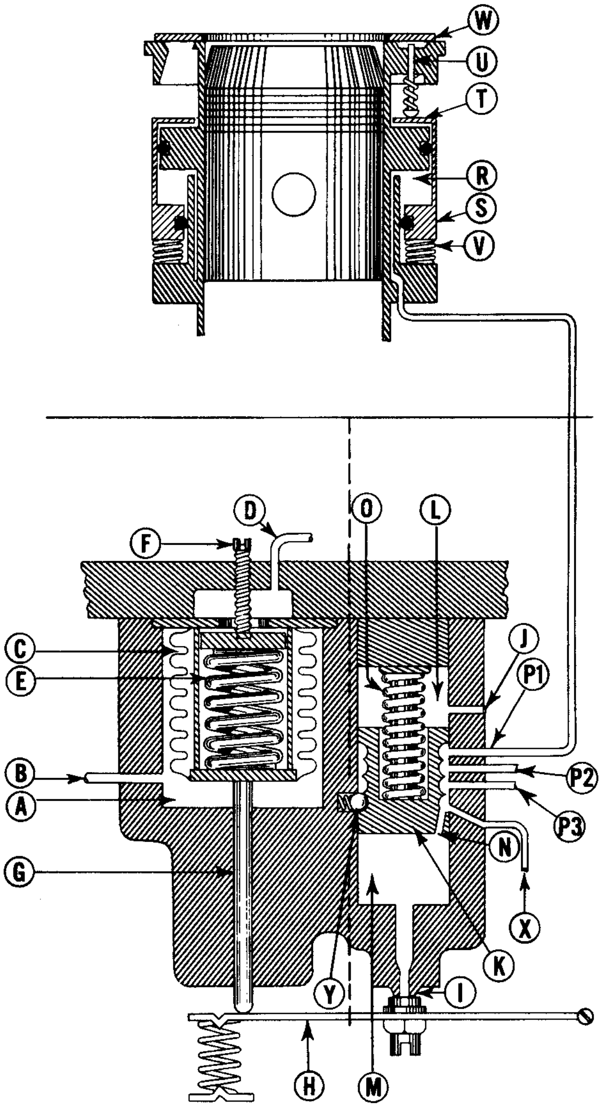


FIGURE 5
Schematic Drawing of Cylinder Unloading Mechanism (Loaded).

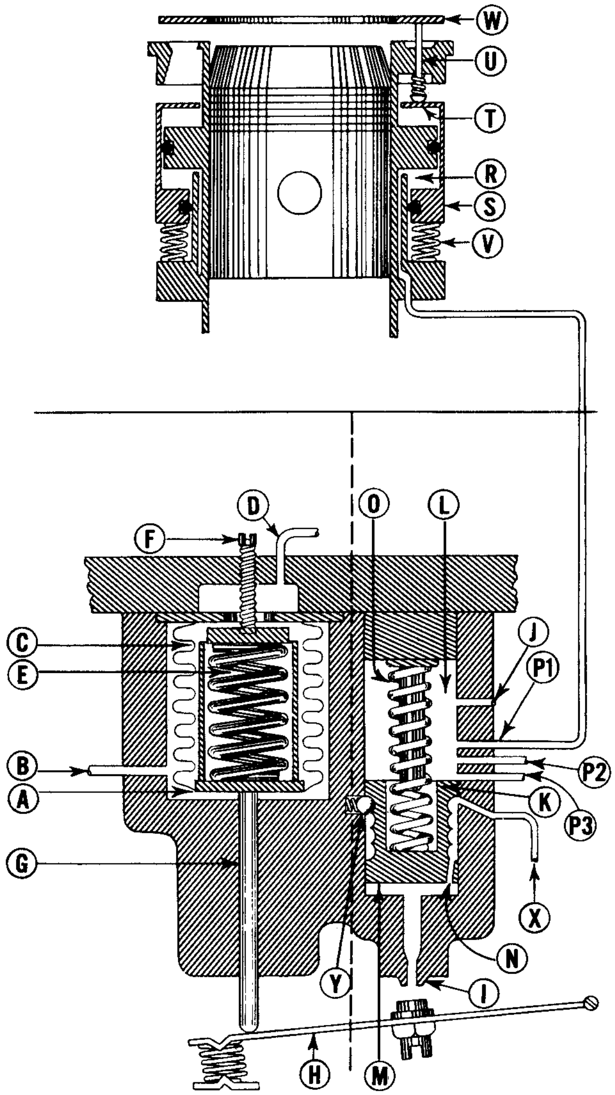


FIGURE 6
Schematic Drawing of Cylinder Unloading Mechanism (Unloaded).

pressure, (2) a valving mechanism (Figures 5 and 6, lower right quadrant) which regulates the oil pressure to the various cylinder unloader mechanisms.

PRESSURE SENSING DEVICE

This pressure sensing device consists of a chamber (A) which is connected to suction pressure through line (B) and a bellows (C), the inside of which is connected to atmospheric pressure through vent (D). The tendency of the pressure sensing device is to maintain as nearly as possible a predetermined suction pressure. This pressure is the maximum pressure required to satisfy the system and may range from 0 to 50 psi. The specific point is maintained by a balance of forces—suction pressure balanced against a combination of atmospheric pressure and force from spring (E). The amount of tension is adjustable by setscrew (F). When the system requires less than the full refrigeration load, the suction pressure will fall below the predetermined point, causing an unbalance within the device, and the unloading cycle will commence. The drop in suction pressure permits bellows (C) to expand, forcing plunger (G) against lever (H), moving it downward. The downward movement of this lever opens the regulated orifice (I). The opening and closing of this orifice controls the action of the valving mechanism.

VALVING MECHANISM

The function of the valving mechanism is to supply each of the cylinder unloaders with oil under pump pressure when full compressor capacity is required, and to relieve this pressure when cylinders are to operate unloaded. This valving mechanism consists of a hydraulic cylinder containing an annularly-grooved floating piston (K). The annular grooves are constantly connected to the oil pump pressure through line (X).

Above the piston is a chamber (L) which is vented to the crankcase through orifice (J). Below the piston is another chamber (M) connected to the annular grooves in the piston by orifice (N) and connected to the crankcase pressure through regulated orifice (I). Located within the hydraulic cylinder is a spring (O) which tends to move the floating piston toward the lower chamber.

Under full capacity operation, as shown in Figure 5, orifice (I) is shut off. Oil pressure in lower chamber (M) increases because oil under pump pressure is being supplied through line (X). This pressure overcomes the force of spring (O) and floating piston (K) rises in the cylinder. As it rises, the annular grooves in the floating piston coincide in sequence with lines P1, P2 and P3 to the cylinder unloaders providing them with full oil pressure and permitting them to operate at full capacity. To make Figures 5 and 6 as simple as possible, only line P1 is connected to a cylinder unloader mechanism. Lines P2 and P3 are in reality connected to identical mechanisms, and while this discussion is concerned with only one unloader mechanism, it can be extended to cover them all.

When full compressor capacity is not required, regulated orifice (I) is opened through movement of lever (H). Oil bleeds through it, and pressure within the lower chamber approaches crankcase pressure, as shown in Figure 6. Under these circumstances, the force of spring (O) overcomes the pressure in the lower chamber and floating piston (K) is moved downward so that the lines P1, P2 and P3 become connected in sequence to the crankcase pressure through orifice (J). The spring loaded ball (Y) permits the piston to move only in distinct increments, one groove at a time.

In this manner, the valving mechanism supplies or withdraws from each cylinder unloader the oil pressure that operates the unloader mechanism.

THE UNLOADER MECHANISM

When oil from the forced feed lubricating system flows through line T1 from the valving mechanism to the cylinder unloader, it enters annular chamber (R). The inner wall of unloader cylinder is firmly anchored to the cylinder liner. The unloader piston (S), however, is free to move. The up-and-down movement of this unloader piston raises and lowers takeup ring (T) which raises and lowers suction valve lift pin (U).

Under full capacity operation (Figure 5), oil flows into annular chamber (R) under pressure sufficient to contract the unloader piston spring (V). When oil pressure forces springs to contract, the unloader piston (S) moves down, and takeup ring (T) and the suction valve lift pins (U) move with it. This permits the suction valve (W) to function normally and the cylinder operates to full capacity. When the compressor is to operate at less than full capacity (Figure 6), oil line T1 from the cylinder unloader mechanism is connected to the crankcase pressure through orifice (J) which allows the pressure in the annular chamber (R) to dissipate. The cylinder unloader springs (V) expand, lifting the unloader piston (S). This raises the takeup ring (T), the valve lift pins (U), and holds the suction valve (W) open so that the controlled cylinder is operating in an unloaded condition.

AIR CONDITIONERS AND EVAPORATORS

Several variations of air conditioners with evaporators have been used with railway air conditioning equipment. In general, these can be classified as overhead air conditioners and floor-mounted air conditioners. Figures 7 and 8 illustrate two overhead units.

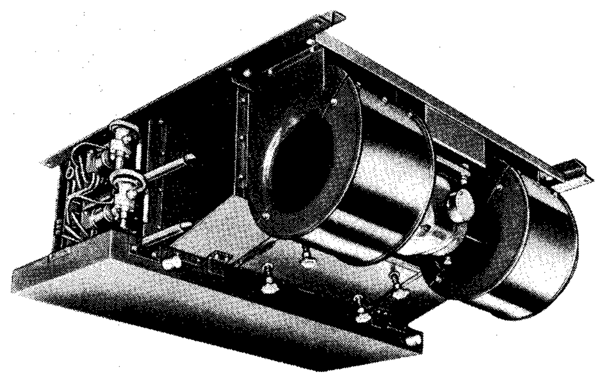


FIGURE 7

Typical Overhead Air Conditioner (Blow-Through).

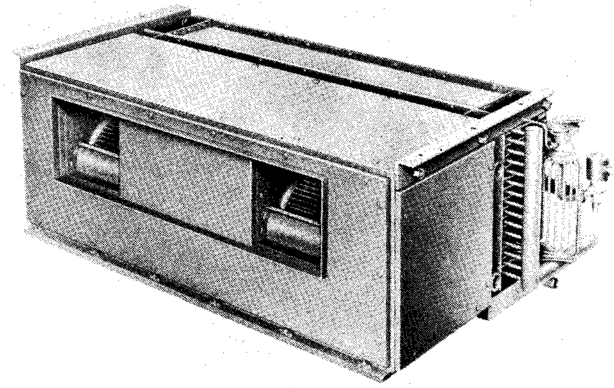


FIGURE 8

Typical Overhead Air Conditioner (Draw-Through).

Figure 7 shows a Trane standard overhead air conditioner unit. Greatest features of this versatile unit are its accessibility and flexibility in installation.

The fan section, consisting of motor and fans, and the coil assembly section with its heating coil, cooling coil and insulated drain pan, are mounted separately from the car ceiling. All parts of both sections are easily and quickly accessible since over-all casing has been eliminated. Yet, all parts are contained in a single, easy-to-install unit.

Both sections are interchangeable, thus making it possible to install the unit either for blow-through or draw-through operation. With this flexibility, it is possible to install the transition ducts between the fan outlets and the entering side of the coil section for blow-through operation, or the fan section can be suspended separately ahead of the unit for draw-through operation.

The compact unit, which is less than 30 inches long, can be furred in over vestibules, placed over smoking compartments or toilet spaces, or tucked in at the end of a car. No longer is it necessary for overhead air conditioners to project at great length into the car. No longer does the car designer have to work around bulky overhead equipment. Eliminated are the long tunnel-like spaces surrounding lengthy air conditioning units. Figure 9 shows the overhead air conditioner arranged for blow-through operation installed in the end of the car.

These units are available with outside and re-circulating air plenum chambers with dampers and filters. Damper adjustments control the pressure within the car. Since the plenum chambers with dampers are a part of the coiling unit, negative pressure is confined within the unit. Positive pressure is maintained elsewhere throughout the entire car. Thus, infiltration of air, water vapor, and dirt to the car proper is prevented. Figure 10 illustrates the overhead air conditioner arranged for draw-through operation and located in the end of the car.

CONDENSERS

In general, two types of condensers are used with railway air conditioning equipment. The first is a combination condenser which operates either as a dry condenser or as an evaporative condenser. The second is the dry-type condenser.

COMBINATION CONDENSER

Many railway air conditioning systems operate at less than peak load requirements about 90% of the time. Dry condensers are satisfactory for such operations, but when midsummer peak requirements must be met, a wet condenser is virtually a necessity.

The Trane Combination Condenser has ample dry condensing capacity for mild or moderate operating

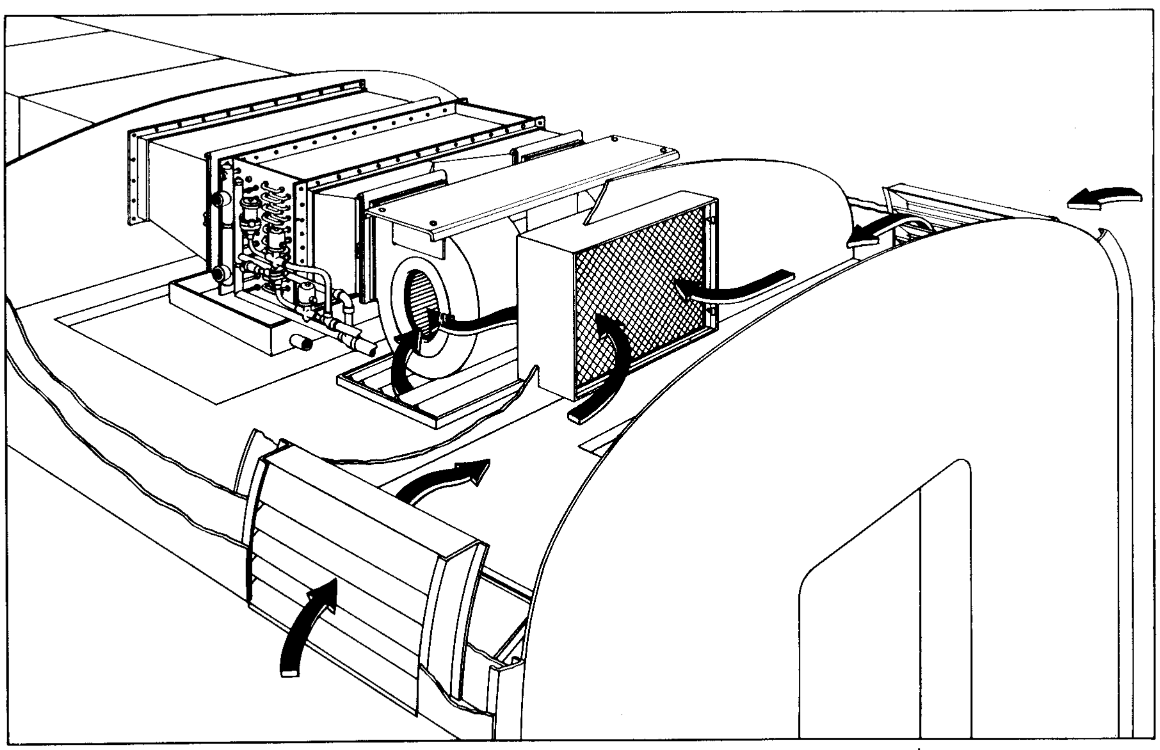


FIGURE 9
Installation of Overhead Air Conditioner (Blow-Through).

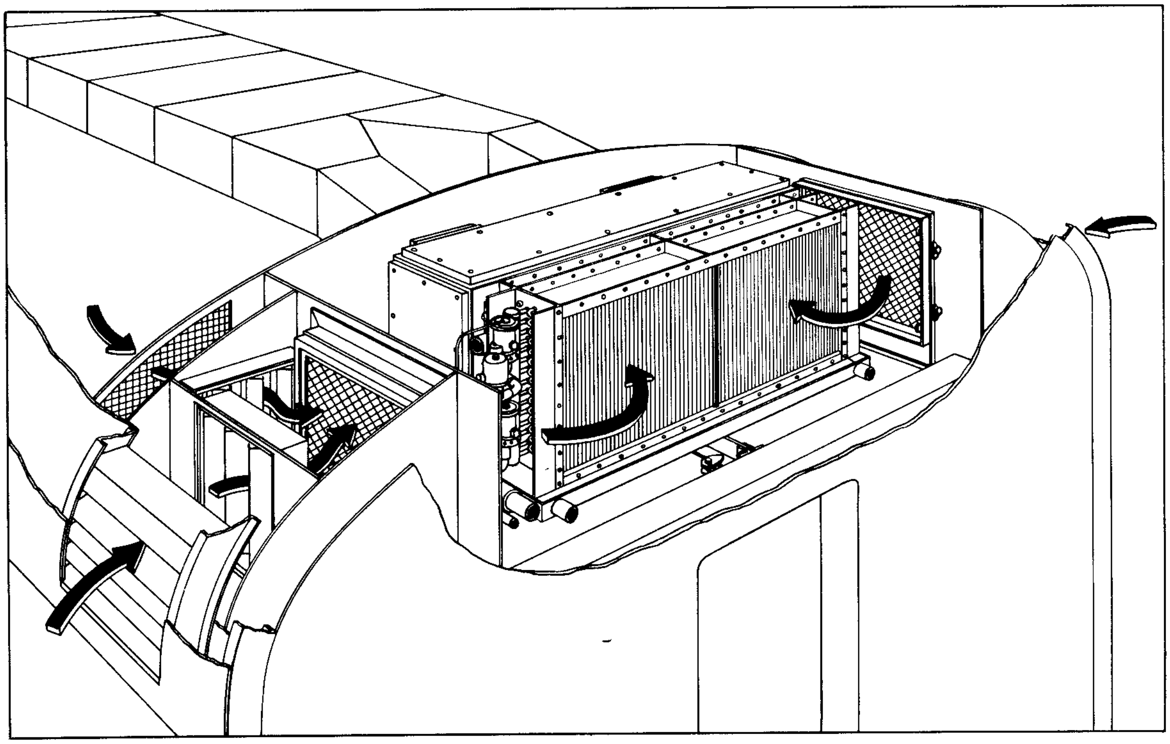


FIGURE 10
Installation of Overhead Air Conditioner (Draw-Through).

conditions encountered when outside temperatures range up to approximately 90° dry bulb. Under more severe operating conditions when maximum cooling capacity is needed, water is sprayed over the condensing coil and the unit functions as an evaporative condenser. Thus, during spring and fall months, the need for water is eliminated and the dangers of freeze-ups are avoided. Figure 11 illustrates a combination condenser.

DRY CONDENSER

The Trane Dry Condenser is ideal for use where only moderate outside temperatures are encountered. Its most outstanding feature is its low service and maintenance cost. This condenser consists of a single coil and axial flow fan. The entire unit is ruggedly constructed for undercar installation. A new coil of increased heat transfer efficiency is used because it provides greater capacity than regular coils of similar size. This makes possible a far more compact unit yet power requirements are not increased. Figure 12 illustrates a dry condenser with its liquid receiver attached. This unit is so arranged that the fan motor leads can be unplugged and the entire fan assembly swung away from the coil to make the coil completely accessible for cleaning.

TYPICAL REFRIGERATION PIPING DIAGRAM

A typical refrigeration piping diagram is illustrated in Figure 13. Included in this schematic piping arrangement are accessory devices which are generally required in railroad systems. The design is also based upon practices and standards established by the American Society of Refrigerating Engineers. Accessory items, such as line type liquid indicators, suction pressure regulators, relief valves, and self-sealing couplings, frequently require more maintenance than their value justifies. For this reason, accessories should be held to a minimum in railway air conditioning systems.

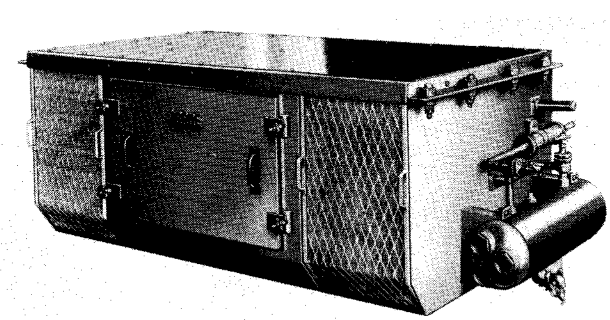


FIGURE 11
Combination Condenser Unit (Wet-Dry).

LIQUID RECEIVER

The liquid receiver is a storage tank or container for

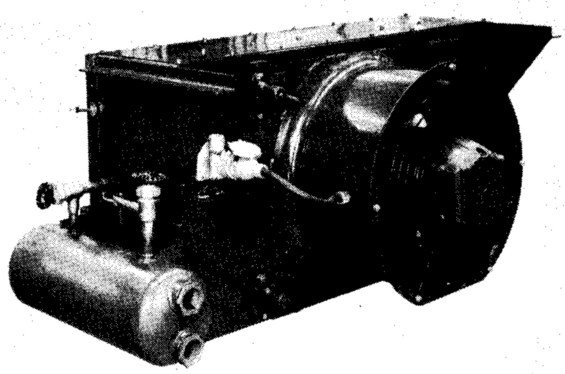


FIGURE 12
View of Dry Condenser with Receiver Mounted on Side.

storing the liquid refrigerant (Fig. 14). It includes two sight glasses at the end of the receiver which permit visual inspection of the liquid level. During normal operation of the cooling system, the liquid level will vary depending upon the cooling load. When outside temperatures are high and with the system operating at maximum capacity, the liquid level will be at the lowest point. For this reason the minimum quantity or charge should always be determined under these conditions. The liquid level in the receiver must be at least 2 inches above the bottom of the receiver. This will assure a solid stream of liquid refrigerant being supplied to the liquid line.

SHUT-OFF VALVES

The use of shut-off valves is recommended to enable general servicing and segregation of various sections of the refrigeration system. Specifically, each valve will perform the following functions:

1. Liquid Line Shut-Off Valve
   This valve, located at the outlet of the receiver, is a normally open valve. It is closed only when the system is to be pumped down and the refrigerant charge stored in the receiver.

2. Receiver Inlet Shut-Off Valve
   This valve, located between the condenser and receiver, is normally open and is closed only when the system refrigerant charge is to be stored in the receiver.

3. Charging Valve
   A charging valve is located in the liquid line beyond the liquid line valve. This valve permits charging the system with refrigerant.
   Additional data on valves may be found in the Trane Refrigeration Manual.

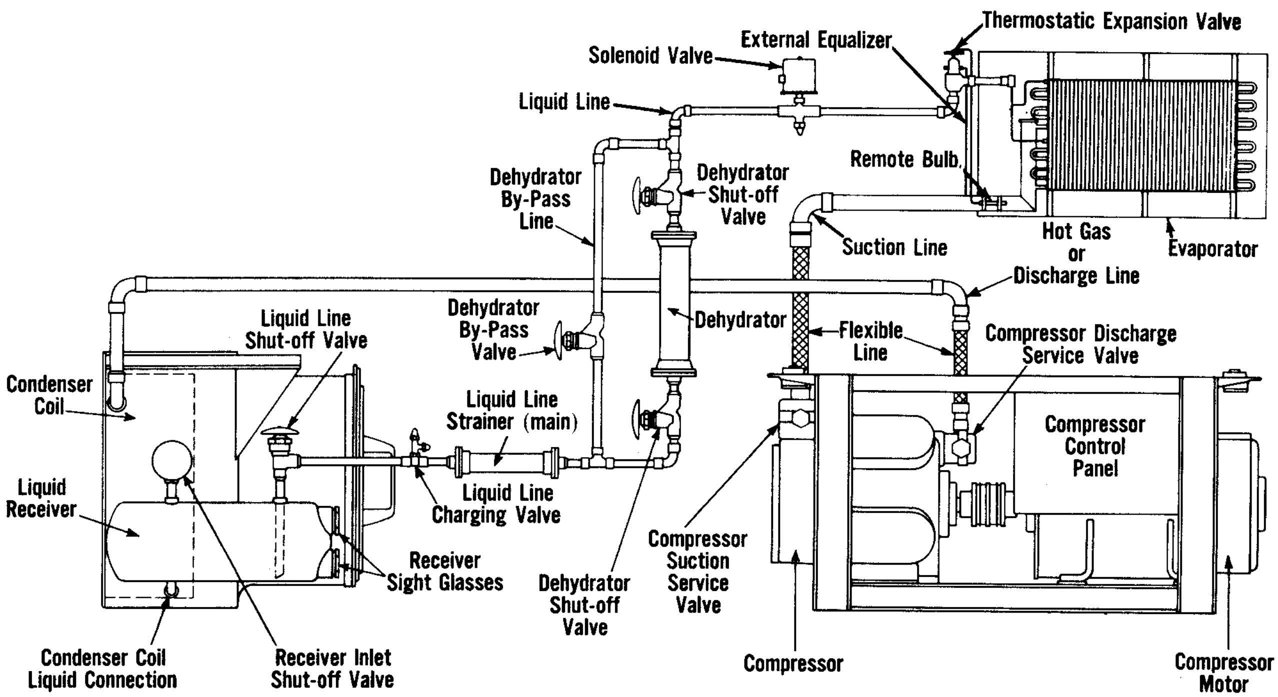


FIGURE 13
Piping Diagram.

STRAINERS

Two types of strainers are utilized in railway air conditioning work — the main line strainer and the auxiliary strainer. The main line strainer is a flanged type liquid strainer with 100 mesh screen. The main line strainer is installed in the liquid line near the liquid valve (Fig.15). Flanged connections permit removal of the screen for cleaning purposes without removing strainer unit from the system.

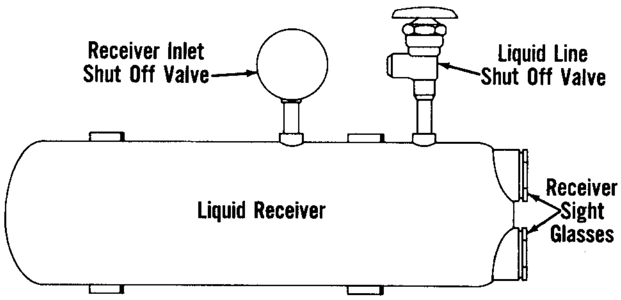


FIGURE 14

While the main line strainer is employed to remove dirt from the refrigerating system, small particles of solder, brazing material, etc., may obstruct or plug solenoid valves and expansion valve orifices during initial hours of operation. The auxiliary strainer is permanently installed in the line to prevent these difficulties.

DEHYDRATOR OR DRIER

A dehydrator can be used in the system to remove moisture. It is emphasized that this drier is used to remove only the very small amount of moisture which may not be removed by evacuation procedures; a drier or dehydrator should not be left in the line for continuous operation. For normal system operation, by-pass valves are provided to isolate the dehydrator from the system. In most cases a flanged type drier is utilized (Fig.16). This permits removal of the drying agent or desiccant without cutting the line or unsweating joints.

LIQUID SOLENOID VALVE

The liquid solenoid valve is located in the liquid line just ahead of the expansion valve and is controlled by the car thermostat. (Fig.17). This valve is normally closed and is energized or opened on demand of the car thermostat. When the car thermostat is satisfied, the solenoid valve is de-energized and closed.

THERMOSTATIC EXPANSION VALVE

A thermostatic expansion valve is installed in the liquid line ahead of the evaporator coil and regulates the flow of refrigerant into the evaporator coil according to changes in the superheat of the refrigerant suction gas leaving the evaporator (Fig.18). The refrigerant vapor is said to be superheated whenever its temperature is higher than the temperature corresponding to its pressure at saturation.

HEAT EXCHANGER

A heat exchanger (Fig.19) serves a dual purpose. The available cooling in the suction gas being returned to the compressor is used to cool the liquid being supplied to the cooling coil. This accomplishes a small degree of liquid sub-cooling and insures the evaporation of any small amount of liquid which might be present in the suction line caused by faulty expansion valve operation. On Trane systems, heat exchangers are normally used with dry condensers.

CONTROLS

Many different makes and types of controls are used with railway air conditioning and refrigeration equipment. To try to explain and illustrate all of the various controls within this manual would be impractical. Therefore, only the most commonly used controls are discussed in this section.

DUAL PRESSURE CONTROL

A number of different makes and styles or pressure controls are used with railway refrigeration equipment. Generally, most of these controls combine both the high and low pressure devices in one common unit.

The high pressure side of these controls usually has an adjustable cut-out point and sometimes has an adjustable differential. The high pressure portion of the con-

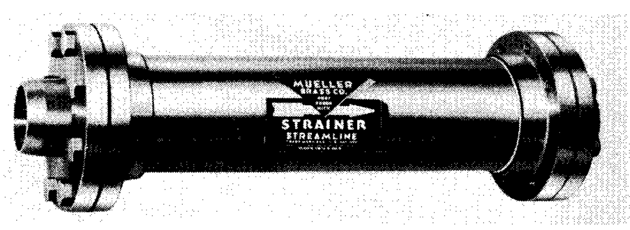


FIGURE 15 *Mueller Brass Co.*
Liquid Line Strainer.

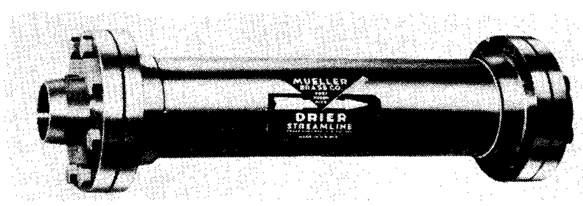


FIGURE 16 *Mueller Brass Co.*
Dehydrator or Drier.

trol functions to stop the operation of the compressor whenever a predetermined or set high pressure condition within the system is reached.

The low pressure side of these switches usually has an

Jackes - Evans

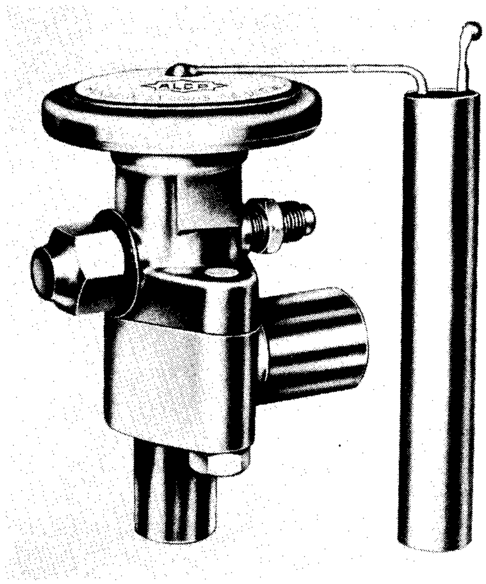
FIGURE 17
Liquid Solenoid Valve.

adjustable cut-out setting and an adjustable differential setting so that the controls can be set to meet specific installation requirements. The low pressure portion of these switches functions to stop the operation of the compressor whenever a predetermined or set low pressure condition exists within the system.

The operation and cut-in and cut-out points of both the high and the low side of the switch should be checked when placing the refrigeration system in operation. It may be necessary to reset or calibrate these switches in the field. Figure 20 illustrates a typical dual pressure control switch. The left-hand portion of this switch is the low pressure control and the right-hand portion of this switch is the high pressure control. Also shown in this illustration are the adjusting and calibrating screws.

TEST SWITCH

Many railway units are equipped with a test switch located in the control box of the compressor unit. This switch is a three-position switch with "MANUAL-OFF-AUTOMATIC." In the "OFF" position, the system will not operate. In the "MANUAL" position, the test switch will start the compressor and by-pass all safety devices. In the "AUTOMATIC" position, the compressor will operate under the control of the temperature control circuit and safety switches. This switch should be at the "AUTOMATIC" position at all times during the cooling cycle.



Alco Valve Co.

FIGURE 18
Thermostatic Expansion Valve.

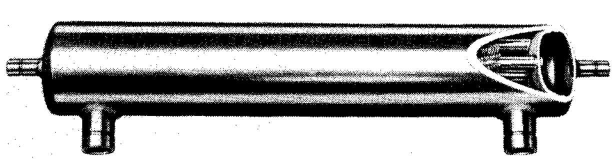
GAUGE MANIFOLD

Most railway refrigeration systems are furnished with a gauge manifold. The gauge manifold consists of a mounting bracket, evaporator pressure gauge, oil pressure gauge, condenser pressure gauge and three shut-off valves. This assembly is mounted on the compressor unit. On some railway refrigeration systems the gauge manifold assembly is installed in the control box, which is mounted on the compressor unit frame.

Shut-off valves on the gauge manifold should be opened only during system testing periods.

THERMOSTAT

Many different types of thermostats are used with railway air conditioning systems. In general, thermostats



Acme Industries, Inc.

FIGURE 19
Typical Heat Exchanger.

start and stop the refrigeration system on demand of car cooling requirements. Thermostats accomplish this either through direct or indirect action.

When the equipment has been properly selected, any railway air conditioning system can be made to maintain automatically, the exact condition desired. Much depends upon proper selection. Automatic controls can do very little to overcome the use of improper equipment no matter how elaborate the control system may be. Systems should be designed carefully and then provided with only as much control as is required.

TYPICAL SYSTEM CONTROL

An explanation of the use of typical controls with Trane Air Conditioning Systems follows.

Figure 22 shows an evaporator in a simple system. It provides the required cooling for peak loads at fixed operating conditions. With the operating conditions held constant, the correct amount of sensible and latent cooling can be obtained. The fans operate constantly to provide the necessary circulation of air to pick up the heat gained or accumulated in the car. The temperature controller, or thermostat (T), measures the dry bulb temperatures in the car and starts and stops the cooling system with changes in car temperature. The thermostat (OT) located in the outside air duct will cut off all refrigeration when outside air temperatures drop sufficiently low. Air used for ventilation then provides the necessary cooling effect to handle the heat load in the car. This control is the type generally used on air conditioning systems where the sensible or dry heat is the dominant heat gain and where latent or moisture load is very small. It is generally inadequate for railway cars because a wide variety of heat gains and operating conditions are normally encountered.

Figure 23 illustrates a modification which has become an acceptable method of evaporator coil and temperature control design for passenger air conditioning systems employing mechanical refrigeration. It is known as the Split Coil System. This system has advantages over the Simple System because it prevents frequent starting and stopping of the compressor and permits closer dry bulb temperature control by preventing the system from alternately supplying warm air and cold air to the car. This arrangement uses a divided coil and a compressor with cylinder unloaders for refrigerating capacity control. The thermostats T1 and T2 measuring dry bulb temperatures in the recirculating air stream operate to close solenoid valves SV1 and SV2 supplying refrigerant to each section of the cooling coil. Load

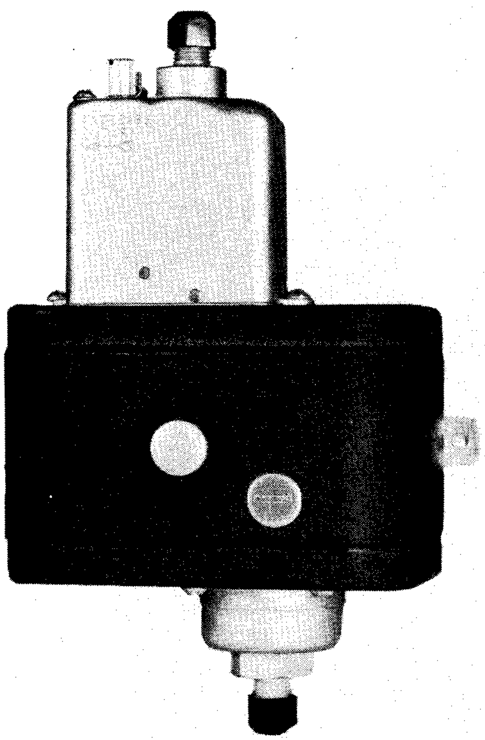


FIGURE 20 *Detroit Controls Corp.*
Dual Pressure Control

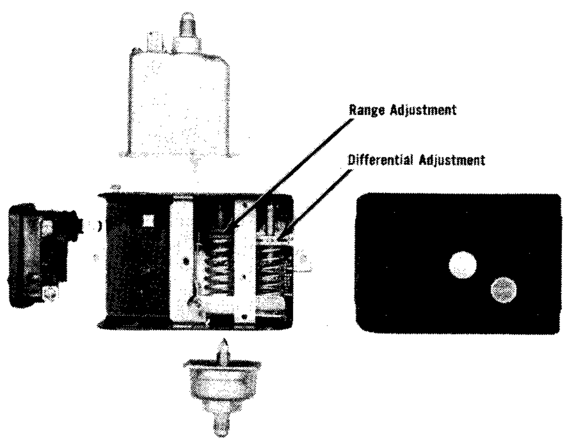


FIGURE 21 *Detroit Controls Corp.*
Exploded View of Dual Pressure Control Showing Range and Differential Adjusting Cams.

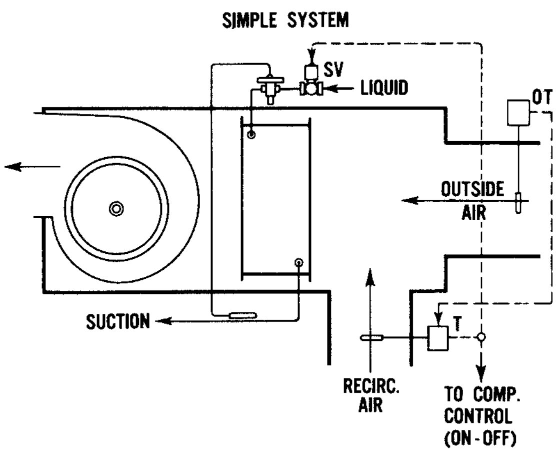


FIGURE 22

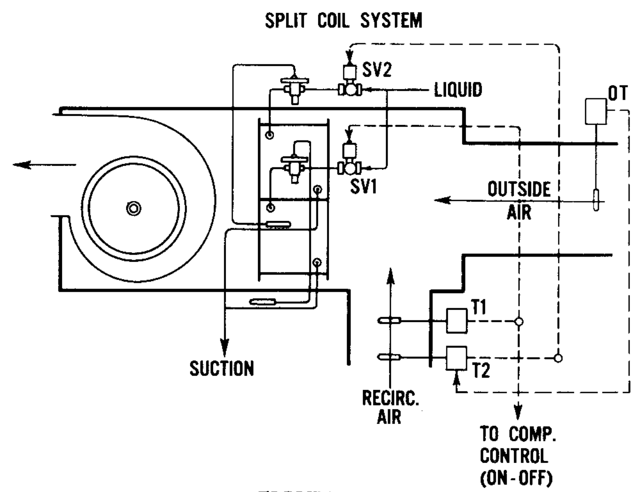


FIGURE 23

changes on the compressor resulting from cutting off one section of the coil will reflect in changes in suction pressure and the compressor will adjust automatically to the load through its cylinder unloaders.

REFRIGERATION PIPING DIAGRAM

NOTE: The dotted lines on the left hand cooling unit represent the second solenoid valve used on the Dome Coach, Dome Sleeper and Diner Car (Dining Section) Units. The Diner Car (Kitchen-Pantry Unit) has only one solenoid valve.

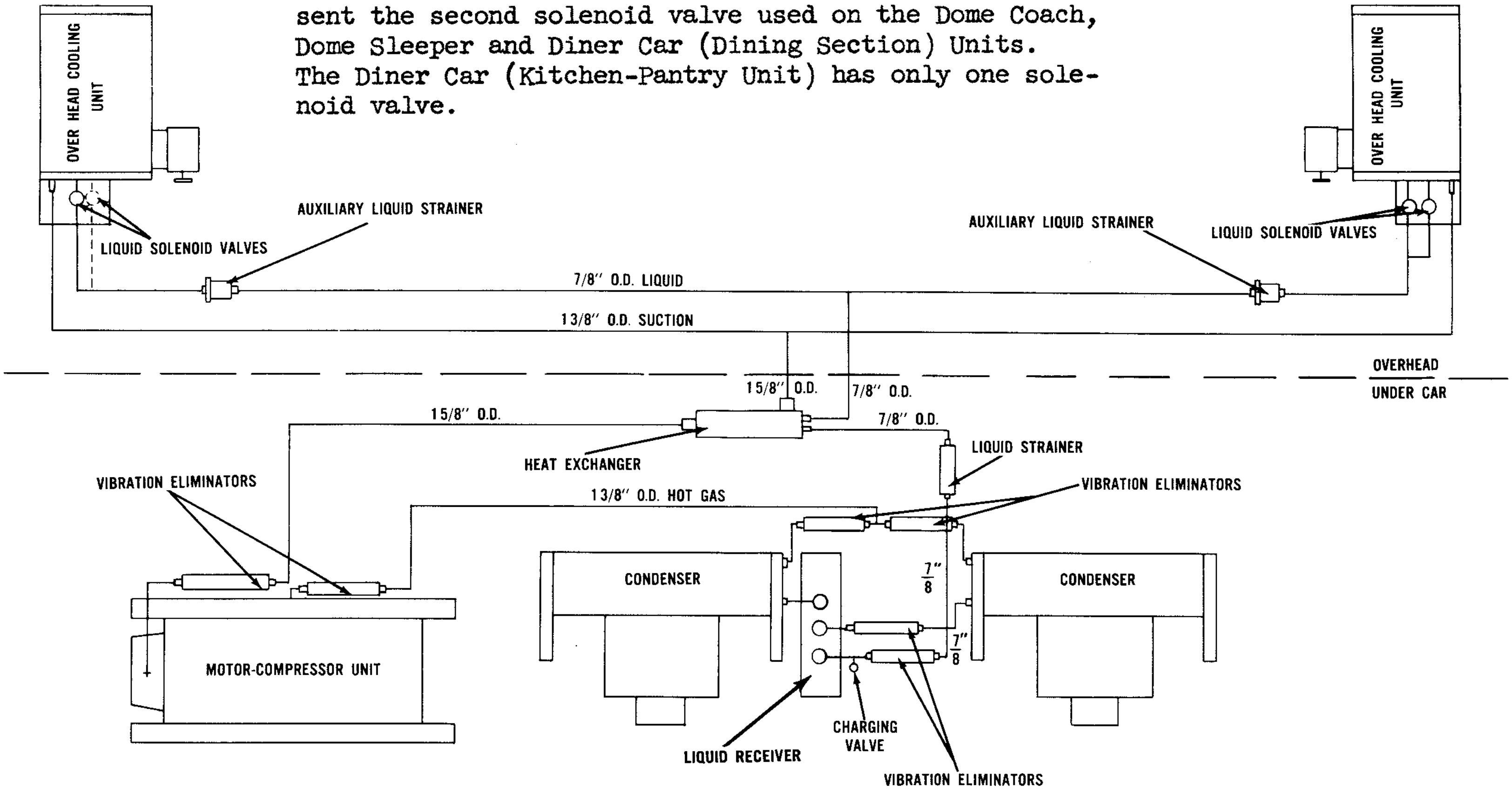


FIGURE 22

INSTALLATION

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN

INSTALLATION

The installation of refrigeration and air conditioning equipment requires careful planning. A system well laid out, correctly installed, and properly maintained will give many years of good service. A number of items must be given attention in the installation of the equipment.

ADEQUATE SPACE REQUIRED

Space around the compressor unit should be adequate to permit the installing crew, the maintenance man, or the serviceman to work without restrictions. Be sure to leave ample space in which to remove the various parts of the compressor unit. Also allow room to inspect the oil level of the compressor sight glass and to read the system pressure gauges. The unit should be located so as to have good ventilation. When running, both the compressor and the compressor motor liberate a considerable amount of heat to the surrounding air. If this is not removed, the temperature of the air passing over the motor will become so high that the motor cannot cool properly. This may result in a burned-out motor. In view of this, the compressor unit should never be located in a small, unventilated space. If such a space must be used, it is imperative that ventilation or cooling be provided.

INSTRUCTIONS FOR INSTALLING

After selecting the proper location and setting for the compressor unit, the actual installation of the unit should be made with considerable care. The following instructions should be issued to the installation crew and inspection made to insure that each point is carefully followed:

1. The hangers or base for the unit should be prepared to receive the base of the compressor unit in accordance with details on plan. The base of the compressor unit must be set level.
2. The compressor unit should be uncrated and prepared for setting.
3. Compressor unit should be set on base or attached to hangers. Only the steel compressor unit framework should be used for lifting. The unit should never be lifted by the compressor body, manifold, piping, shaft, drives, or motor. To do so will undoubtedly cause serious damage.
4. After the compressor unit is set or hung, but before it is anchored securely, it should be leveled carefully using shims or wedges between the base and compressor unit framework.
5. When leveling the unit, the level should be checked both lengthwise and widthwise by placing the level on the base of the compressor unit. Inasmuch as these are direct-drive units having a coupling between the motor and compressor, extreme care should be exercised in setting and leveling so as to prevent distortion of the base and resultant misalignment of the drive. If misalignment is suspected, it should be carefully checked before placing the compressor in operation.
6. Valves should not be opened nor protecting plugs removed until ready to attach the refrigerant piping.

RECEIVING AND SETTING UP EQUIPMENT

When equipment is received, it should be carefully checked for damage in transit and checked against the shipping list for shortages. Uncrate and handle the unit carefully when setting it up. Shipping skids are provided under the framework of the unit and should not be removed until the unit is ready to be placed in its final position.

REFRIGERANT PIPING

Many refrigeration systems having carefully selected, well-balanced equipment give continual trouble because of poorly designed or carelessly installed refrigerant piping. There is much more to the problem than merely conducting the liquid refrigerant to the evaporator and the refrigerant gas back to the compressor. For example, oil is one of the complicating factors in a refrigerant piping system. The very design of the reciprocating compressor results in mixing oil with refrigerant.

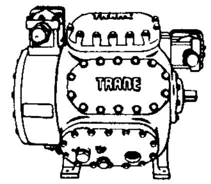
Because the compressor must be lubricated, the refrigerant gas comes in intimate contact with lubricating oil and the cylinder walls of the machine. Some of this oil is carried into the discharge line by the refrigerant and on to the condenser and receiver. To insure that the compressor does not run short of oil, the piping system must be designed to carry this oil with the refrigerant on through the evaporator back to the compressor. The lines must be properly pitched and oil loops must be provided where necessary.

If too much oil is carried away from the compressor, or if the oil is not returned satisfactorily, serious damage to the compressor may occur. It must also be remembered that the refrigerant undergoes various changes in the completion of the refrigeration cycle. In liquid state, fortunately, Freon-12 mixes readily with oil. Therefore, it is comparatively easy to carry oil with liquid refrigerant; but in a gaseous state, Freon-12 is a notoriously poor carrier of oil. Oil under pressure in hot gas discharge lines turns into a mist. The gaseous refrigerant and the oil mist will not mix. The oil will usually collect on the walls of the piping and then drain to low points in the system. However, if the velocity of the gaseous refrigerant is sufficiently high, the refrigerant will entrain the oil, carrying it along through the piping system.

INSTALLATION

PRINTED IN U.S.A. PM-400-1-254

THE TRANE COMPANY · LA CROSSE, WISCONSIN



The following general rule should always be observed in designing and installing a refrigeration piping system: Under conditions of minimum load, the gas velocity must not be less than 750 feet per minute through horizontal gas lines nor less than 1,500 feet per minute through vertical gas lines when the flow is upward.

The problem then in designing and installing refrigerant systems is to recognize the piping difficulties and how to carry the refrigerant and oil satisfactorily.

For a complete description of the layout and sizing of refrigerant lines, refer to the Trane Refrigeration Manual.

MATERIALS FOR PIPING SYSTEMS

The material used in piping the refrigerant system should be selected with care. For Freon-12, copper tubing is preferable. Type "K" or Type "L" should always be used since the wall of Type "M" tubing is too light for good practice. The use of hard tubing is recommended. Soft tubing is too easily damaged.

Forged or wrought copper fittings with sweat or soldered joints should always be used on liquid suction and discharge lines. Cast fittings should not be used on refrigeration work because the castings may be porous and allow the refrigerant to leak through the pores in the metal.

NECESSITY FOR CLEANLINESS

Freon-12 is an excellent solvent. It will dissolve grease and loosen dirt or scale. It will find its way through porous metal or bad joints in an amazing manner. Because of these characteristics, the refrigerant piping in the system must be absolutely clean and the piping joints must be well made.

Copper tubing, as it is received from the manufacturer, has a clean and bright appearance. However, it must be properly cleaned prior to use in the system. It is highly important that the inside surface of the system be absolutely clean if clogged strainers and other operating difficulties are to be avoided. The following procedure is recommended:

1. A clean lintless cloth should be drawn through the tubing by means of wire or an electrician's tape. This will remove all of the coarse particles of dirt and sand.
2. A clean lintless cloth saturated with carbon tetrachloride should be pulled through the pipe. This procedure is continued until the saturated cloth is not discolored by dirt.
3. A clean cloth saturated with compressor oil squeezed dry is drawn through the tubing again. This is to remove any lint. If possible, visual inspection should be made to see if the tubing is perfectly clean.
4. The cleaning job is completed by pulling through a clean, dry lintless cloth. This cloth must be lintless. An accumulation of lint will cause almost as much trouble as scale.

SWEAT JOINTS

Sweat joints in copper piping are not difficult to make, provided the proper material has been used, and the joint has been effectively cleaned and prepared before the actual sweating operation. The following procedure is recommended:

1. Tubing is cut so that the ends are perfectly square and will "bottom" in the fitting. There must be no gaps left through which solder can run into the line. If possible, a pipe-cutter should be used. If a hack-saw must be used, it should always be guided with a mitre box to insure a square even cut. Tubing should be reamed to remove burr, being careful not to expand tubing while reaming.

2. The outside of the copper pipe, and the inside of the fitting where solder will be applied, should be burnished. Fine crocus cloth or fitting brushes made for this type of work should be used. Surfaces should be burnished until all dirt and oxide are removed. Cleaned surfaces should not be touched with the hands or gloves.

3. A light coat of brazing flux can be applied to both pipe and fittings. An acid flux, such as muriatic (hydrochloric) acid, should never be used, as resulting corrosion can seriously affect the pipe and composition on brazing.

4. Joints should be heated to proper brazing temperature, being sure it is uniformly hot, so brazing material will flow to all parts of the joint. The brazing material should be fed through the joint until a uniform line of brazing material appears around the pipe at the end of the fitting.

5. An oxyacetylene torch is the most desirable means of heating the joints for brazing.

6. On some installations, a hard solder, such as silver solder or sil-fos, must be used. However, on some installations, the use of 95-5 solder is permitted. This solder is an alloy of 95 per cent tin and 5 per cent antimony. Where this is acceptable, it is a good solder to use because of its good mechanical strength.

7. When solenoid stop valves are being installed, the coil should be removed to prevent the heat of soldering from ruining the coil insulation. When sight-glasses are being installed, the glass should be removed to prevent cracking. No heat should be applied near the bulb of the expansion valve or any other place

INSTALLATION

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

where an excessive temperature may cause damage.

8. Pipe coverings should not be installed nor the piping anchored until testing is completed and all leaks have been properly eliminated.

WIRING AND CONTROLS

When the equipment has been properly selected, any refrigeration or air conditioning system can be made to maintain automatically the exact conditions desired. Much depends upon proper selection. Automatic controls can do very little to overcome the faults of improper equipment, no matter how elaborate the control system may be. Design the system carefully and then provide only as much control as is required. Never provide more control than is necessary. Over-control is far more troublesome than under-control.

PRESSURE TESTING, EVACUATING AND INITIAL CHARGING

The following discussion has been outlined for a typical piping system as shown in Section 7A2A. The following procedure is recommended for handling the systems installed in railway cars.

PRESSURE TESTING

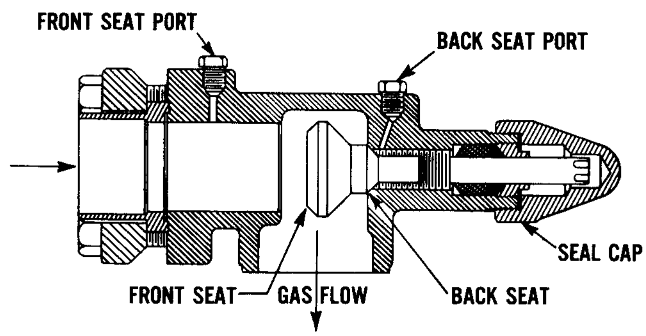
After the refrigeration piping and units have been completely assembled, the system must be checked and tested for piping and joint leaks.

The refrigeration system should be charged with carbon dioxide gas as a preliminary test for leaks. Carbon dioxide test pressure must not exceed 200 pounds per square inch. It should be noted that it is absolutely necessary to use a gauge and a regulator with the carbon dioxide drum, since the drum pressure may exceed 1,000 pounds per square inch and must be carefully controlled. Pressures exceeding 200 pounds per square inch may cause damage to the compressor or control devices.

> WARNING: Oxygen or acetylene should never be used in place of carbon dioxide for high pressure testing. A violent explosion may result. Installers are frequently tempted to substitute oxygen or acetylene which may be handy for anhydrous carbon dioxide. Free oxygen will explode violently when brought in contact with oil in the system. Acetylene may explode spontaneously when put under pressure unless dissolved in special holding agent such as is used in acetylene bottles.

The following procedure is recommended:

1. If the test pressure of 200 pounds per square inch will damage any of the bellows mechanisms on pressure controls or devices, remove the mechanisms before charging with carbon dioxide.
2. Close the shut-off valves to the pressure gauges in the compressor control panel.
3. Backseat the compressor suction and discharge service valves. Figure 1 illustrates the type of valves mounted on Trane Compressors. The valve illustrated is in the backseated position.
4. Remove the pipe plugs from the backseat ports.



COMPRESSOR SERVICE VALVE SHOWN IN BACK SEATED POSITION

FIGURE 1

5. For testing, evacuating and charging, it is recommended that a compressor service manifold be made up as illustrated in Figure 2.
6. Connect the compressor service manifold to the backseat ports of the compressor service valves.

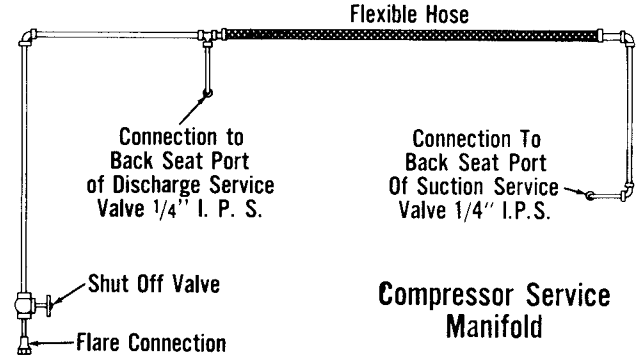
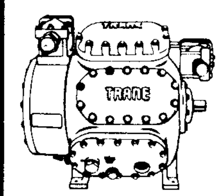


FIGURE 2



7. Connect the compressor service manifold to a carbon dioxide drum as shown in Figure 3.

8. Open the manual stems of the liquid line solenoid valves.

9. Open all liquid line shut-off and by-pass valves.

10. Turn the compressor suction and discharge service valve stems in (clock-wise) approximately three turns, so that the valve is off the backseat and the backseat port is open to the compressor service manifold.

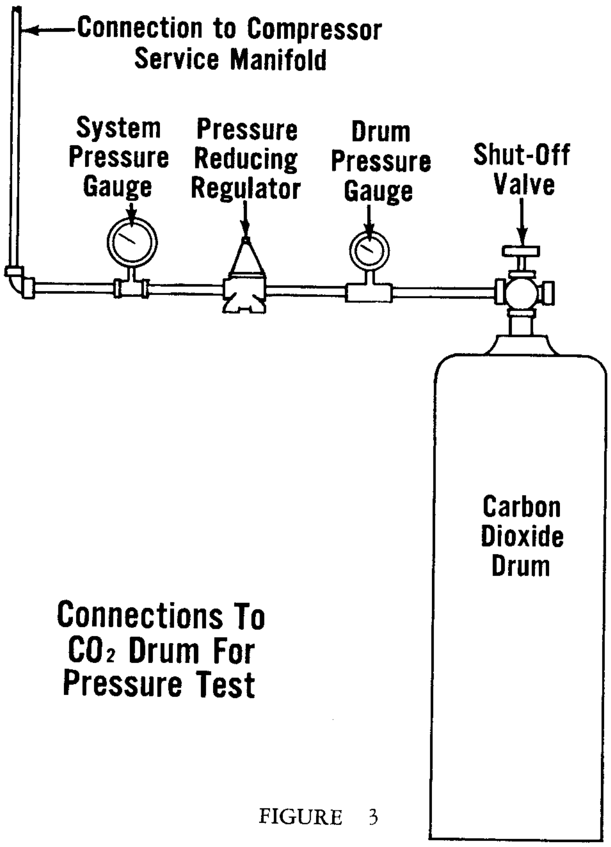


FIGURE 3

11. Open the valve on the carbon dioxide drum. Carbon dioxide should be admitted slowly until the pressure on the discharge gauge reads 200 pounds per square inch. When pressure in the system has been built up to 200 pounds, backseat the compressor service valves and close the valve on the carbon dioxide drum.

With pressure in the system, check the entire system for bad joints and leaks. The checking should be done as follows:

1. All solder or brazing connections should be tapped sharply with a rubber or rawhide mallet. They should not be struck hard enough to dent the pipe and fittings or break a sound connection, but sufficiently hard enough to detect any poor joints which may subsequently open due to expansion, contraction, vibration or the dislodgement of flux material.

2. All pipe joints should then be initially tested for leaks. First check the discharge gauge pressure. If presure has dropped (changes in ambient air considered) a major leak is present. Large leaks may be located by the noise of compressed gases leaking from the system. To detect smaller leaks, brush every possible point of leakage with soap solution and watch for telltale bubbles. Follow a definite sequence to be sure all joints are thoroughly covered, taking plenty of time, because of the importance of discovering leaks during this stage of testing.

The soap solution should be of such consistency that it will bubble easily. To insure good bubbling, a few drops of glycerin should be added to the solution. If ordinary tap water is too hard, soap will not dissolve well and the resulting scum is not suitable for testing. Wherever possible, use distilled or rain water. Use a small brush. Apply the solution, observe for bubbles, and wipe off solution joint by joint. Mark carefully any spots where leaks occur.

3. As soon as the entire system is properly tested, allow the carbon dioxide in the system to escape into the atmosphere. If any leak has been discovered, it should be repaired at this time. No attempt should be made to repair a leak while the system is under pressure. Neither should bad joints be repaired by remelting and adding more brazing material. The joint should be taken apart, thoroughly cleaned, and remade as a new joint. After the leaks have been repaired and the system is assumed to be free of leaks, a small quantity of Freon-12 should then be charged into both the high side and low side of the system through the compressor service manifold in a similar manner to that used for putting carbon dioxide into the system. Use the equivalent of 5 pounds of Freon for every 10 tons of capacity in the system. With Freon in the system and the pressure built up to 2 or 3 pounds within the system, backseat the compressor service valve and close the Freon drum. Disconnect the Freon drum and reconnect the carbon dioxide drum and then build up the pressure in the system to 200 psi as previously outlined above.

4. The entire system should now be checked with a halide leak detector. The exploring tube should be run over all sweat fittings, refrigeration accessories, coil headers, U-bends and the entire compressor body and compressor control box piping and controls. In fact, all parts of the system under Freon-12 pressure, should be slowly and very thoroughly tested. The presence of escaping Freon will color the flame of the halide torch green if the leak is small or a dense blue with a reddish tint if the leak is large. In fact, the flame may be extinguished by a very large leak. Since the halide torch is extremely sensitive, the presence of Freon in the air due to changing drums or making repairs may interfere with the test by coloring the flame regardless of the position of the exploring tube. In this case, it will be necessary to ventilate the room or area thoroughly.

If an open flame cannot be used, the soap bubble test should be used on all joints where leaks formerly occurred. This testing should be performed with extreme care to discover minute leaks.

If any leaks are discovered, the gas in the system must be exhausted to the atmosphere; the leaks repaired, the system again charged and tested as described above.

Once the system is found to be tight and free of leaks, it should be allowed to stand for 24 hours under refrigerant pressure. If after this period of time there is a change in the gauge reading (changes in ambient air temperature considered), a further test for leaks is necessary. It must be remembered that the pressure will rise and fall about 3 pounds for every 10° rise or fall of temperature surrounding the system.

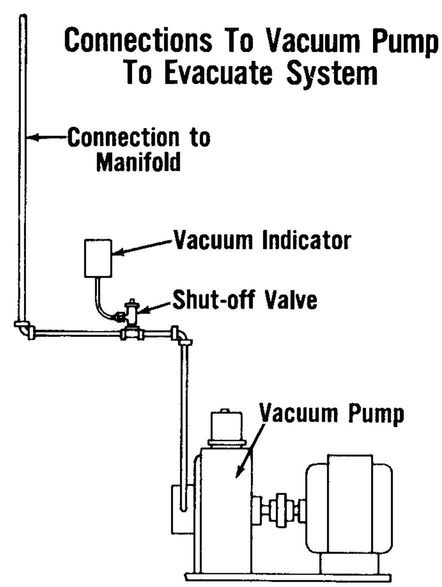


FIGURE 4

When the testing has been completed, relieve the pressure in the system to the atmosphere. Reassemble any parts which were removed from the system to prevent damage from the 200 pound test pressure. Reconnect all controls which were disconnected prior to testing. The system is now ready for final evacuation.

FINAL EVACUATION

After the system has been pressure-tested, evacuation of the system is required. Evacuating is done to remove air and moisture from the system. Figure 4 illustrates the recommended arrangement for connecting the auxiliary vacuum pump to the refrigeration system. Note that the piping is attached to the backseat ports of the compressor service valve using the same manifold as employed in the testing procedure. A vacuum pump capable of pulling an almost perfect vacuum must be used. Under no circumstances should the compressor be used to evacuate the system. A vacuum pump should be used with a reliable vacuum dehydration indicator. A vacuum indicator may be constructed similar to that shown in Figure 5. This is known as a wet bulb indicator.

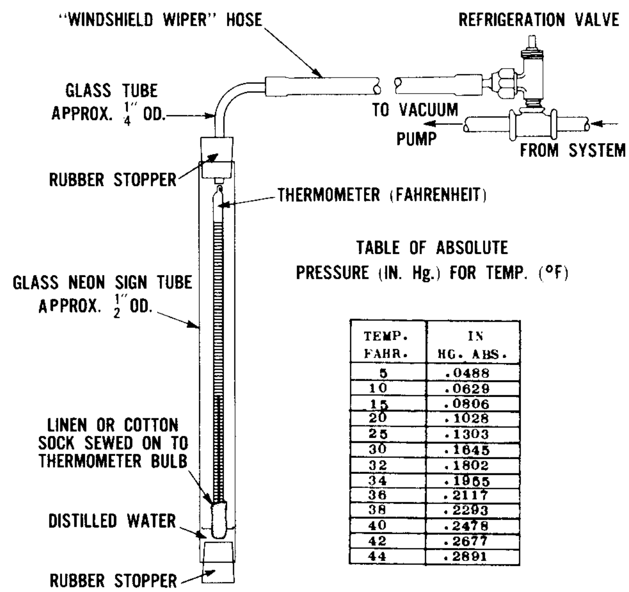


TABLE OF ABSOLUTE PRESSURE (IN. Hg.) FOR TEMP. (°F)

TEMP. FAHR.	IN HG. ABS.
5	.0488
10	.0629
15	.0806
20	.1028
25	.1303
30	.1645
32	.1802
34	.1965
36	.2117
38	.2293
40	.2478
42	.2677
44	.2891

FIGURE 5

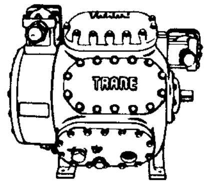
Water Vapor Pressure Method of Measuring Vacuum

Whenever the wet bulb indicator is used with a system being evacuated, make certain that the wet bulb indicator is connected with the vacuum pump between the wet bulb indicator in the system. Never attach the vacuum pump to one side of the system and the wet bulb indicator to the other side. If this were done, moisture would be drawn from the wet bulb indicator through the system to the vacuum pump.

INSTALLATION

PRINTED IN U.S.A. PM-400-1-254

THE TRANE COMPANY · LA CROSSE, WISCONSIN



SUPERSEDES

The wet bulb indicator is a testing device which is used solely to determine the amount of moisture remaining in the system. Whenever the wet bulb indicator is used, wet bulb temperatures within the indicator must be reduced to 35° or less before evacuation is completed. Never, under any circumstances, when using the wet bulb indicator, should the wet bulb indicator be opened when the vacuum pump is not in operation. Always provide a shut-off valve between the wet bulb indicator and the vacuum pump, so whenever the vacuum pump is to be shut down, the wet bulb indicator can be closed off from the system first.

In evacuating a system, it is necessary to reduce the pressure in the system to an almost perfect vacuum to remove water from the system. See Table I for the vacuum required to boil water at various temperatures. The importance of moisture removal cannot be overemphasized. Moisture in the system can result in freezing at the expansion valves or the formation of hydrochloric and hydrofluoric acid in the presence of Freon-12. Such acid is definitely detrimental to the compressor valves, bearings and seal. Moisture may also cause a gumming of the crankcase oil and copper plating of compressor parts.

Vacuum Required to Boil Water at Various Temperatures

TEMP.	VACUUM INCHES MERCURY
100 F	28.07
90	28.58
80	28.97
70	29.26
60	29.477

Note: FIGURES IN THIS TABLE ARE ESTABLISHED AGAINST A 30" COLUMN OF MERCURY. CORRECTIONS IN THIS TABLED TAKING INTO ACCOUNT THE TRUE BAROMETRIC PRESSURE PREVAILING AT THE TIME OF THE EVALUATIONS, SHOULD BE MADE.

TABLE 1

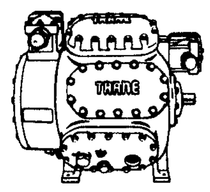
Before starting the vacuum pump, turn the valve stems of the compressor discharge and suction service valves in (clock-wise) three full turns, so that the valves are off the backseat, and the backseat ports are open to the vacuum pump. Be sure that the oil is in the compressor crankcase at the time the system is evacuated to remove any existing moisture from the oil. Make sure all stop valves are open. Open the solenoid stop valve by means of a manual lift stem.

Operate the pump until the vacuum is sufficiently low to evaporate moisture as shown on the vacuum indicator. The length of time required will vary with the amount of moisture in the system and the temperature of the air surrounding the car and system. Failure to reach a sufficiently low vacuum may be due to:

1. Presence of moisture in the system. This can only be removed by continued operation of the vacuum pump.
2. Inefficiency of the vacuum pump. This may be due to leaks within the pump proper or contaminated oil within the vacuum pump. This may be checked by valving off the system and operating the pump against the vacuum indicator only.
3. A leak in the system or in the vacuum pump or its connections. This is unlikely if testing with a halide torch was thoroughly and carefully done.
4. Defective vacuum indicator.

Never attempt to evacuate the system when the air temperature surrounding the system is below 70° F. After reaching a sufficiently low vacuum, allow the pump to continue operating for at least four hours.

When the system has been evacuated, backseat the compressor service valves. Be sure the valves are tightly closed before stopping the vacuum pump. Close the valve to the vacuum dehydration indicator and the vacuum pump. Disconnect the vacuum pump. Allow the system to stand a minimum of ten hours. At the end of this time, start the vacuum pump and recheck the dehydration indicator. If there is no noticeable loss of vacuum, the system is ready to be charged.



OPERATION

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

PLACING THE SYSTEM IN OPERATION

Once the system has been pressure-tested and properly evacuated, it is ready for charging and placing in operation. Never, under any circumstances, break the vacuum with air. Always break the vacuum with Freon.

INSPECTION BEFORE CHARGING

Since all parts of the system must function properly during the charging process, it is advisable for the entire system to be given a preliminary check before charging is started. It should be borne in mind that the evaporator must evaporate all the liquid entering the system. The compressor must remove the gaseous refrigerant from the evaporator and the condenser must condense gas discharge by the compressor. Unless each part of the system is operating properly, charging will be slow and laborious. Therefore, the following checks should be made:

Overhead cooling units should be checked for:

1. Proper location of thermostatic expansion valve remote bulb.
2. Proper attachment of thermostatic expansion valve bulb to suction line.
3. Filters installed and clean.
4. Free rotation of the fan shafts.
5. Proper belt alignment and tension.
6. Adequate lubrication of fan and motor bearings.
7. Correct fan rotation
8. Drives properly aligned and all set-screws tight.

Compressor units should be checked for:

1. Adequate motor bearing lubrication.
2. Proper oil level in the compressor.
3. Suction discharge valves open and gauge valves open.
4. Proper voltages to compressor motor.
5. Proper overloads or fuses in compressor motor starter.
6. Motor coupling tight and properly aligned.
7. Check sequence of controls in interlocks. To do this, disconnect the motor leads at the motor starter to prevent the motor from running and then operate all of the controls including actuation of the safety devices.

Condenser air cooled, should be checked to assure:

1. Proper fan rotation.
2. Liquid valves open.
3. Drives properly aligned and set-screws tight.

Condenser evaporative, should be checked for:

1. Adequate water fill.
2. Proper operation of float valve.
3. Proper spray-pump operation.
4. Free rotation of fan shaft.
5. Proper fan alignment.
6. Adequate lubrication of pump, fan and motor bearings.
7. Correct fan rotation.

Controls should be checked for:

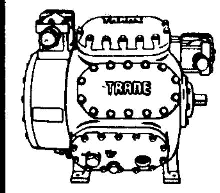
1. Electrical circuit to all electrical controls.
2. Opening of solenoid stop valve with thermostat actuated or set in the manual position.

PRECAUTIONS BEFORE OPERATION

Before operating the air conditioning system for the first time, the entire system and components should be given a preliminary check and inspection. All refrigeration temperature controls and electrical control devices should be put through their complete cycle of operation.

The following specific checks are recommended:

1. Pressure Gauge. Pressure gauge shut-off valves should be open.
2. The Dual Pressure Control. The high pressure cut-out point of the dual pressure control switch should be set to stop the compressor at 240 pounds per square inch with a differential of approximately 40 pounds. The low pressure side of this switch should be adjusted to stop the compressor at approximately 15 pounds per square inch gauge and set to cut in at approximately 42 pounds per square inch gauge.
3. The Test Switch. The test switch located in the control box of the compressor should be in an "AUTOMATIC" position. This switch is a three-position switch, "MANUAL-OFF-AUTOMATIC." In the "OFF" position, the system will not operate. In the "MANUAL" position, the test switch will start the compressor and by-pass all safety devices in them. In the "AUTOMATIC" position, the compressor

PRINTED IN U.S.A.
PM-400-1-254
THE TRANE COMPANY · LA CROSSE, WISCONSIN


will operate under the control of the temperature control circuit and safety switches. This switch should be in the "AUTOMATIC" position at all times during the cooling cycle.

4. Thermostatic Expansion Valve. Preparations should be made to accurately check the thermostatic expansion valve for proper superheat adjustment after the car is in operation. Thermometers or contact-type thermocouples should be placed adjacent to the thermostatic expansion valve remote bulb so that the temperature readings can be made with the system in operation.

If an excessive suction line pressure drop is anticipated, the pressure should be measured leaving the evaporator coil and the superheat determined as the temperature rise above the temperature corresponding to the pressure leaving the evaporator coil. As an example:

It is necessary to maintain 10° superheat at suction line leaving the coil.

Suction Pressure at Coil..37.0 psig.
Suction Pressure Corresponding to 37.0 psig. .... 40°F.
Superheat Required .... 10°

Suction Gas Temperature in Suction Line .... 50°F.

NOTE: To determine pressure drop in suction line, determine the difference in pressure between the point leaving the coil and the suction pressure reading in the compressor control box. For example:

Suction Pressure at Coil 37.0 psig
Suction Pressure at Control Box ....35.5 psig

Pressure Drop .... 1.5 psig

Setting the superheat of the expansion valve cannot be determined without measuring the suction pressure of the coil. Only by knowing the actual pressure drop at maximum or peak load, and compensating for this pressure drop, can the superheat be set accurately. The pressure drop may be determined by using a pressure gauge which may be installed in a tee in the external equalizer line connection to the expansion valve. (For complete information on how to measure superheat, refer to the Trane Refrigeration Manual.)

5. Solenoid Valve. The manual stem of the solenoid valve should be in the "AUTOMATIC" (open) position. Current should be applied to each valve to make sure valves are functioning properly.

6. Compressor Suction and Discharge Service Valves. Compressor suction and discharge service valves should be opened fully and the valve stems turned out (counter-clockwise) so that the valve is closed against the backseat port.

7. Compressor Oil Level. The oil level in the compressor should be ⅞ of the way up on the bull's-eye sight-glass in the crankcase of the compressor.

8. Compressor. Turn the compressor over several times by hand to be sure there is free movement of all parts and that oil is not retained in the head of the compressor as a result of being installed on the car body floor in an inverted position during car construction. All shut-off valves should be in the "open" position.

If a drier is used in the system, the by-pass valve should be closed. Start and stop the compressor several times at 10 second intervals and observe the general compressor performance. Check pressure gauges. The discharge pressure will rise rapidly. The suction pressure reading will be reduced to approximately 30-40 psig. Observe oil pressure.

NOTE: When these checks have been completed, the system should be allowed to run normally for a period of four hours before a final check is made either by the car builder or the railroad.

Careful inspection observation should be made during the initial four hours of operation. During this period, the temperature of the various parts — compressor, motor, bearings, and so forth — will rise to equilibrium or stable temperatures. It should be borne in mind during the first hour of operation the system is being stabilized that normal oil and liquid levels have not been reached in the compressor crankcase and liquid receiver.

9. Oil Pressure. During the initial period of operation, or whenever the suction pressure is changed rapidly (or when a part of the cooling coil is shut off), oil in the crankcase will be observed to foam. This is caused by liquid refrigerant in the oil being evaporated or boiled off rapidly. This is normal performance, and after the system is operated for a short time, a clear and stable oil level will usually be restored.

During any initial starting period, or after a prolonged period of idleness, the compressor oil pressure must be observed. Under usual conditions, a large quantity of liquid refrigerant may collect in the compressor crankcase on the off cycle.

The oil pressure gauge must be observed constantly under these unusual conditions. It is important to understand that the pressure indicated on the oil pressure gauge is not total oil pressure. It is the oil pressure at the discharge side of the oil pump. To determine the total operating oil pressure, subtract the suction pressure gauge reading from the oil pressure gauge reading. Example:

Oil Pressure Gauge (pump discharge pressure)	70 psig
Suction Pressure Gauge	30 psig
Total Operating Oil Pressure	40 psig

If operating oil pressure has failed during any period, operate the compressor for no more than 2 minutes. Then, shut the compressor down. After the compressor has been idle for 5 minutes, restart the compressor and operate again for 2 minutes. Normally, several starts and stops will eliminate the liquid refrigerant from the crankcase and satisfactory oil pressure will be obtained. If oil pressure is not obtained after repeated tests, and with adequate oil in the crankcase, stop the system and determine the cause of the failure.

10. General. All controls should be checked for satisfactory operation, reset if necessary, and calibrated. All operating pressures and temperatures should be observed and recorded. The superheat setting of the thermostatic expansion valves should be checked and adjusted if necessary. The compressor capacity control system should be adjusted and set. Even though the compressor unloaders are pre-set at the factory, it is always necessary to check them and adjust them to fit the particular system used on the cars.

CHARGING THE SYSTEM

After all of these control circuits have been put through their sequence of operation, and the operator is satisfied that all of the electrical control circuits are properly connected, properly wired and operating correctly, the system is ready for charging. Initial charging of the system is accomplished through the liquid line charging valve as shown in Figure 1 following the procedure as described below:

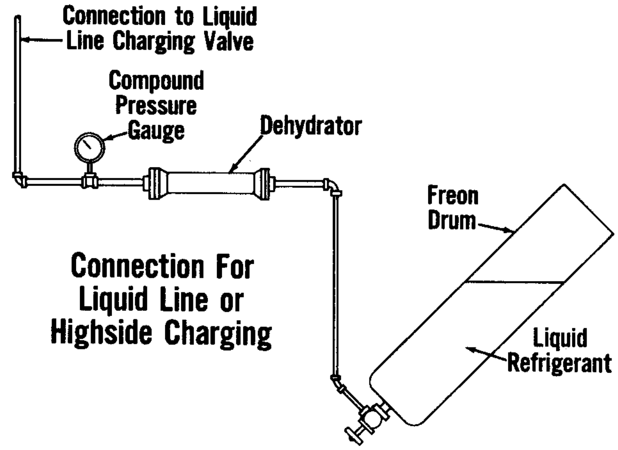
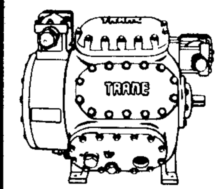


FIGURE 1

1. Place the test switch located in the compressor control panel, in the "OFF" position.
2. The liquid line charging valve must remain closed during the preparation of the system for charging. If accidentally opened, vacuum in the system will draw air and moisture into the system.
3. Connect the drum of clean, dry Freon-12 to the liquid line charging valve, using a flexible charging line and a dehydrator between the drum and the charging valve. A dehydrator with ¼" flare connections and about 5 to 8 cubic inches effective volume of desiccant is recommended. With the flare connection on the charging valve loose, the valve on the refrigerant drum should be cracked open and enough gas allowed to escape through the loose connection of the liquid line charging valve to purge the charging line. When the air has been forced out of the charging line, and only gas remains, the loose flare connection of the liquid line valve should be tightened up so that no more gas can escape. Place the Freon drum in an inverted position so that only liquid refrigerant will be charged into the system.
4. Open the suction and discharge service valves on the compressor.
5. Close the liquid line valve and the shut-off valve in the by-pass line around the drier (when used).
6. Open the shut-off valves located before and after the liquid line dehydrator.
7. Open the liquid solenoid valves by means of the manual lift stem.



PRINTED IN U.S.A. PM-400-1-254
THE TRANE COMPANY · LA CROSSE, WISCONSIN
SUPERSEDES

The system is now ready to be charged and operated. Freon will be supplied from the drum, circulated through the evaporator coil, compressed in the compressor, condensed in the condenser, and stored in the receiver.

8. Open the liquid line shut-off valve. Vacuum in the system will draw considerable refrigerant into the system permitting the low pressure contact of the dual pressure control switch to close, placing the controls of the refrigeration system in a position ready for starting.

9. When the vacuum in the system has been broken by the Freon and pressure within the system is built up to approximately 30 to 40 pounds per square inch gauge, place the test switch in the "AUTOMATIC" position.

The system should be operated in a normal manner at peak cooling load if possible. A quantity of Freon sufficient to cover the inlet opening of the liquid line at the bottom of the receiver by at least 2" should be added. If the required minimum quantity of refrigerant is not charged into the system during the initial charging procedure, additional Freon must be added later.

It is frequently necessary to change refrigerant drums during the charging process. When an empty drum is to be removed, the liquid line charging valve should be closed tightly and the entire charging line transferred to a new drum. Connections of the drum should be tightened after which the charging line should be placed loosely in position on the liquid line valve connection. Air should then be purged from the charging line as described previously. Initial charging should be continued until a sufficient quantity of refrigerant is added or charged into the system.

During the charging process, the compressor may tend to cycle or cut off due to the action of the low pressure control switch. Do not, under any circumstances, block this switch in a closed position or operate the system with the test switch in the "MANUAL" position. As long as the pressure within the Freon drum exceeds the pressure within the system, Freon will flow from the drum into the system. Whenever the compressor runs, it will tend to pull the system pressure down below that which exists in the drum. If the low pressure control switch were to be blocked, or the test switch placed in the "MANUAL" position, it would be possible for the compressor to draw the system down into a vacuum and perhaps admit air through some small leak in the system. This air leakage into the system would destroy all of the good work which has been accomplished during the evacuation process.

When the system has been fully charged, the liquid charging valve should be closed, the Freon drum closed off and the charging line dehydrator and drum should be disconnected and removed from the system.

After the charging drum is removed, the liquid line charging valve is closed, the liquid line shut-off valve from the receiver to the system should be opened and the system permitted to operate in its normal fashion.

LOW SIDE CHARGING

After the system has been placed in operation, it may be determined that a small quantity of additional Freon must be added to the system. Generally, the addition of small amounts of refrigerant is more conveniently accomplished by the low side charging method, using gaseous refrigerant rather than liquid refrigerant. The general arrangement of system piping for low side charging is shown in Figure 2 . The Freon drum is placed in upright position and connected to the suction service

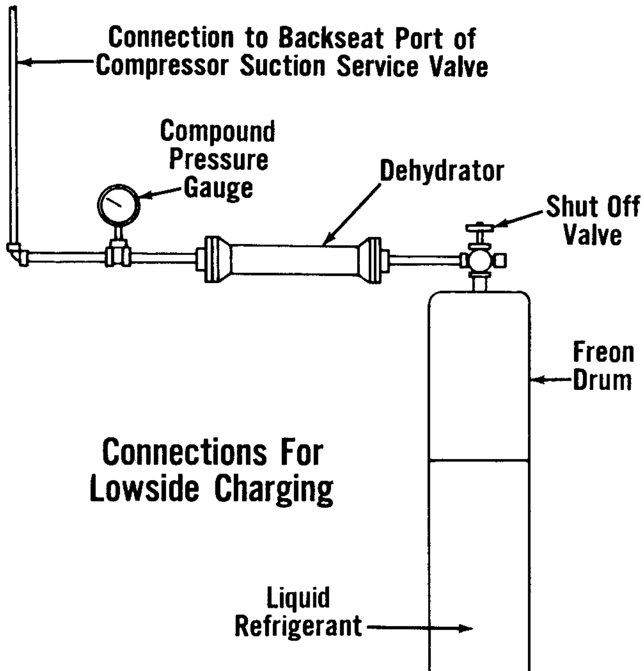


FIGURE 2

valve, permitting the refrigerant to be drawn from the Freon drum into the system. Always use a clean, new dehydrator between the drum and the system. The following procedure describes the method for low side charging:

1. Connect the charging line including the Freon drum.
2. Wind the valve stem of the suction service valve out all the way (counter-clockwise) to close the backseat port of the valve.
3. Connect the charging line to the backseat port of the compressor valve. Purge the charging line.
4. Wind the suction valve stem in (clockwise) to open the backseat port on the valve.

5. Open the Freon drum valve and permit refrigerant gas to enter the system.

With the system in operation and the pressure in the low side less than the pressure in the drum, refrigerant will flow from the drum into the system. After a period of time, the boiling refrigerant in the Freon drum may reduce the pressure in the drum to a point where the pressure within the drum is less than the pressure within the system. Whenever this happens, the charging process must be stopped until the drum warms up and the refrigerant pressure within the drum again exceeds the pressure within the system.

PRE-SERVICE CHECK

The pre-service check and inspection cannot be made until the system has operated continuously for at least four hours. During this initial period, oil will have time to collect in any low spots or tubes of evaporators. Thus, the amount of oil remaining in the system outside the compressor will more or less be stabilized and oil can be added if necessary with the assurance that the compressor oil level will remain relatively constant. Any scale or foreign matter in the refrigerant lines will have become loosened and will have found its way to strainers. The belts on the air handling equipment will have taken their initial stretch and may be ready for final adjustment. All in all, the system will have settled down and any improper or potential troubles should become immediately apparent. For the pre-service check, the following checks and adjustments should be made:

1. Compressor. The compressor oil level should be checked. If the oil level within the compressor has dropped below the recommended level (7/8 of the way up on the bull's-eye sight-glass) additional oil can be added to the compressor. When adding oil to the compressor, always use the recommended oils (see lubrication tables). If the oil is at the proper level on starting, a frequent check should be made during the four hour initial run to see if the level remains constant. This can be done while the balance of the checking is done.

2. Refrigerant. The quantity of refrigerant should be checked in the sight-glasses of the receiver. There should be a sufficient quantity of refrigerant within the system so that when it is operating at full load the liquid level within the receiver, as viewed through the bottom bull's-eye sight-glass, stands approximately 2" from the bottom of the receiver, and when the system is operating at minimum capacity, the liquid level as viewed through the top bull's-eye sight-glass of the receiver, stands at approximately ½ of the way up on the top sight-glass. If these levels are maintained, gas will be prevented from entering.the liquid line and a liquid seal will be maintained at all expansion valves.

3. Liquid Line. The liquid line from the receiver to the expansion valves should be checked to see that there is no appreciable change in temperature over the length of the line. If a strainer, stop valve or drier has a warm inlet and a cold outlet, there is evidence of a restricted liquid flow through the device. If any restrictions are present, the system should be pumped down and the obstructions removed from the system.

4. Superheat. The superheat setting of the thermostatic expansion valve should be checked and adjusted, if necessary.

5. Compressor Oil Pressure. Compressor oil pressure should be checked.

6. Refrigerant Leaks. The entire system should be gone over during this initial period of operation and every joint within the system should be checked for refrigerant leaks. When making these checks for refrigerant leaks, all flanges and gasket joints on the refrigeration compressor as well as all joints within the system, should be carefully checked. If any leaks are detected, the system must be pumped down and the leaks repaired.

7. Motors. Check all motors to see that they are operating at the proper amperage. Also check the motors for adequate lubrication. Do not overlubricate the motors. Consult the motor lubrication chart for proper motor lubricants.

8. Air Handling Units. The air handling units should be checked. The belts driving the fans should be adjusted for proper tension and alignment. Check lubrication of blower and motor bearings. Air filters, where used, should be checked to be sure that they are clean.

9. Compressor Coupling. During the initial run, the compressor drive coupling bolts may become loose. After approximately two hours of continuous operation, the compressor should be stopped and all bolts and nuts in the coupling should be drawn up tight. If the coupling is permitted to run with the bolts loose, damage to the coupling laminations may result.

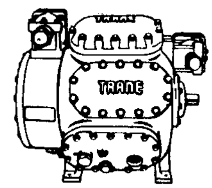
FINAL CHECK

After the system has been in full operation for approximately 200 hours, a check of the equipment should be made as follows:

1. Compressor. All external bolts of the compressor should be re-torqued in accordance with data shown in the compressor servicing section.

OPERATION

PRINTED IN U.S.A. PM-400-1-254
THE TRANE COMPANY - LA CROSSE, WISCONSIN



2. Coupling. The bolts in the coupling between the compressor and motor should be tightened. The set-screws in the coupling should be checked to see if they are tight and the bolt in the compressor hub portion of the coupling should be checked for tightness.

3. Refrigerant Line Filters. All filters in the entire refrigeration system, both in the compressor and the liquid lines, should be removed, cleaned and reinstalled.

4. Shut-Off Valves. The shut-off valves to the drier, where used, should be closed and the valve in the by-pass line opened.

   NOTE: The drier should be placed in operation only in the event new refrigerant is added to the system where the refrigeration system is open for repairs.

5. Compressor Oil. The compressor oil of the compressor should be drained. The compressor handhole cover should be removed and the compressor swabbed out thoroughly with clean carbon tetrachloride or equal solvent. When cleaning the compressor, be sure to use clean, dry lintless wiping cloths. Never under any circumstances use a cloth with lint in it or waste material. After the compressor crankcase has been thoroughly swabbed and cleaned out, new oil taken from sealed cans and of the specifications outlined in the lubrication chart, should be added to the compressor crankcase.

   WARNING: This oil must be the exact specifications outlined by The Trane Company and no substitutions or mixing of oils of different specifications should be made.

PERIODIC INSPECTIONS

Round Trip or 100 Hour Inspection.

1. The oil level in the compressor should be checked. If the oil level appears to be low, the cause of loss of oil should be determined and remedied. After this, if necessary, additional oil may be added to the compressor. If the oil in the crankcase appears to be dirty, it should be changed.

2. The oil pressure gauge and evaporator pressure gauge should be checked to determine that the compressor is operating with adequate lubricating oil pressure.

3. The entire system should be checked for refrigerant leaks and repairs made as required. The entire compressor, as well as every joint in the system, should be tested with a halide leak detector.

4. The conditions of the filters in the air handling equipment should be checked. If the filters are dirty, they should be cleaned or replaced.

5. A check of the quantity of refrigerant and the liquid in the receiver, when the system is in continuous operation, should be made.

6. Any evidence of improper operation, if found, should be investigated and corrected.

Once a Month or 500 Hour Inspection. (Items 1 through 6 above should be inspected, plus the following.)

7. All motor and fan shaft bearings should be checked for adequate lubrication. Over lubrication should be avoided.

8. Drive belts should be checked for proper tension, alignment and wear.

9. Pulleys and sheaves should be checked for tightness on shafts. If pulleys are found to be loose they should be removed and the bore of the pulley and the periphery of the shaft should be checked for wear. Worn parts should be replaced. If no wear is found, the pulleys should be replaced on the shafts and tightened in position. After replacing pulleys, the alignment of the pulley and the adjustment of the belts should be checked and adjusted.

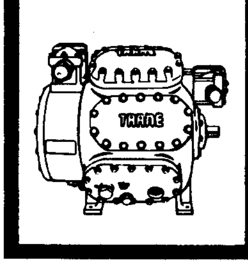
10. Operating pressures of the refrigeration system, suction discharge and oil pressure should be observed. If head pressure is higher than normal, the cause should be determined and corrected. Purging of air or other non-condensible gases from the system may be necessary.

11. The condition of the spray pump suction screens and the water tank on the evaporative condenser should be checked. If filled with sludge, dirt, gravel, and so forth, the entire system should be cleaned. It is essential that water strainers, pumps and spray heads be in good operating condition to assure proper system performance.

12. Check the cleanliness of the overhead cooling unit coil and fans. If excessive dirt is present, the coil and fans should be cleaned. Check the condensate drain and if drain is dirty or obstructed, flush the dirt from the line.

Annual Inspection. (Items 1 through 12 above should be inspected plus the following.)

13. A careful and complete inspection of the con-



OPERATION

PRINTED IN U.S.A.

SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN

denser should be made. Coils must be thoroughly cleaned.

14. All motors and shaft bearings should be checked for evidence of wear.

15. All frayed or worn belts should be replaced.

16. The drain pans and drain pipe connections of all cooling units should be checked. They should be clean and free to carry away water.

17. All equipment should be checked for evidence of rust conditions. Where rust is accumulating, thoroughly wire-brush the affected surfaces and repaint or seal to prevent further rusting.

18. Controls, contacts and wiring should be inspected for evidence of wear and damage.

MAINTAINING SYSTEM

SEASONAL SHUT-DOWN

The refrigeration system should not be allowed to stand for months unused with a full refrigerant pressure in the lines and equipment. When cooling is not required for several months the system should be pumped down, valved off, and refrigerant stored in the receiver until the equipment is to be placed in service.

The following shutdown procedure is recommended:

1. Open the shut-off valves in the gauge lines to permit suction, discharge and oil pressure readings to be taken.

2. Close the liquid valve on the receiver to retain all the liquid refrigerant in the receiver.

3. The solenoid stop valve should be manually opened or the thermostat should be set to hold the valve open so that all liquid refrigerant can be withdrawn from the liquid line.

4. The entire system should then be placed into operation. The fans in the air conditioning unit should be running in the normal manner. If an evaporative condenser is used, it should operate in its usual manner. The compressor will then draw the refrigerant out of the liquid line, evaporator coil and suction line, and discharge it into the condenser or receiver. The low pressure setting of the high-low pressure cut-out switch in the compressor motor control panel must be closed manually or readjusted to stop the compressor at 2 psig.

5. After the compressor has been operated several times and a pressure of 2 psi is maintained on the suction pressure gauge, close the compressor suction service valve. When the compressor has stopped, close the compressor discharge service valve and the shut-off valve between the condenser coil and receiver.

6. After the system is pumped down, and with all shut-off valves in the closed position, the liquid receiver and condenser coil and discharge line should be checked for Freon leaks. Repair leaks if necessary. Unless this is done, Freon may be lost during the shutdown period.

With the refrigerating system shut down for the season, instructions should be placed on the master cooling switch indicating that the system must not be operated.

It is recommended that a tag reading as follows be placed on the master switch to prevent possible damage to the system as a result of premature start-up.

> WARNING: This system must not be operated until placed in readiness by authorized persons. Serious damage will result if this switch is closed before that time.

STARTING AFTER SEASONAL SHUT-DOWN

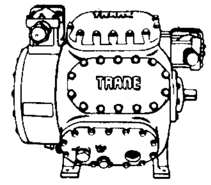
In general, the instructions with respect to placing the system in operation as outlined under Section should be followed. It is advisable that all equipment be inspected. The air handling equipment should be in readiness and the filters clean. Of particular importance is the fact that all lines should be checked for leakage prior to opening shut-off valves. The supply of lubricant in all bearings should be checked. All shafts should turn freely and be free of rust. Having completed this inspection, the system may be placed into operation as follows:

1. The compressor service valves should be opened, allowing the pressure in the liquid and suction line to be raised to approximately 40 psig pressure. A thorough leak test should be made with a halide torch to be sure that no leaks have developed.

2. The compressor should be turned by hand to make sure that the compressor and motor operate freely. Start and stop the machine by opening and closing the test switch. The seal should be inspected for evidence of excessive oil or refrigerant leakage.

3. Check the solenoid stop valve to be sure that the valve has not been opened manually and allowed to remain in that position. The valve must close when de-energized.

4. The liquid shut-off valve should be opened and the liquid allowed to enter the liquid line from the condenser. The entire system should be checked with a halide torch. The cooling switch may be closed, allowing the compressor motor starter and condenser to operate.



5. The compressor oil pressure should be checked carefully during the initial period of operation. After the system is run for approximately 15 to 20 minutes, the oil level in the compressor should be checked. The sight glasses in the receiver should be checked to assure proper quantity of refrigerant.

With the proper function of controls and with sufficient charge of compressor oil and refrigerant, the system is ready for normal operation.

REFRIGERANT PUMP-DOWN

To pump down the system:

1. The liquid shut-off valve located on the receiver should be closed to retain the liquid refrigerant in the receiver.
2. Open the liquid solenoid valves by means of the manual stem.
3. Start the compressor and allow it to run. It may be necessary to remove the cover from the dual pressure control and hold the low pressure contacts closed manually as the suction pressure will be pumped down below the normal cutout setting of the switch. Never block the switch in the closed position.
4. Observe the suction pressure gauge. When the suction pressure has been reduced to 2 psig, the compressor must be stopped. Turn the test switch to the "OFF" position.
5. Front seat the compressor discharge service valve.
6. Close the shut-off valve located in the receiver inlet line. This will trap practically all the refrigerant in the receiver. The slight pressure remaining in the lines should be allowed to remain until the system is opened, as this will prevent air and moisture from being drawn into the piping.

The system should never be pumped down to a vacuum, then opened to the atmosphere. Air and moisture will be admitted to the system if refrigerant lines are opened under vacuum conditions.

> WARNING: If the refrigerant lines to be opened to the atmosphere are colder than the ambient air temperatures, a considerable amount of sweating will take place on the inside as well as on the outside surface of the piping. It is well, therefore, to permit the refrigerant piping to warm up to ambient air temperature before opening the system to the atmosphere.

REMOVING EXCESS REFRIGERANT

Refrigerant can be removed from the system and stored in refrigerant drums.

There are two general methods for accomplishing the removal:

1. The use of an auxiliary pump-out condensing unit.
2. Chilling the refrigerant drums by packing the drums in an ice bath.

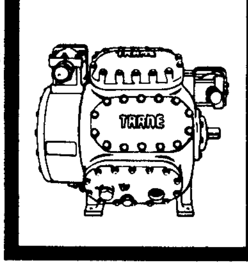
If the latter method is used, proceed as follows:

1. An empty or partly empty refrigerant drum should be connected to the charging connection on the liquid line, and the charging line purged to remove air and moisture.
2. Pack the refrigerant drum in cracked ice and salt until the temperature of the drum is sharply reduced and the pressure within the drum is well below the pressure in the high side of the system.
3. Open the valve on the refrigerant drum and the liquid charging valve, allowing the refrigerant to flow into the drum.
4. The liquid level in the receiver should be checked. If the level is less than 2" from the bottom of the receiver, too much liquid has been removed. If some refrigerant must be returned to the system, the ice should be removed from around the drum and the drum allowed to warm up. When pressure is restored to the refrigerant drum, refrigerant may be added as outlined under "LOW SIDE CHARGING." When at least 2" of liquid is shown above the bottom of the receiver, the system should be considered charged.
5. Close drum and liquid line charging valves and disconnect the charging line.

ADDING OIL TO COMPRESSOR

It will be found that some systems require the addition of oil before the correct level in the crankcase can be maintained. This is due to the fact that oil is entrained with the refrigerant being circulated and it takes an amount of oil to "wet" the system. For the purpose of calculating additional oil requirements, it may be assumed that the system will require the addition of approximately 1 pint of oil for every ten pounds of refrigerant charged into the system.

Oil may be added by charging it into the crankcase with a suitable oil pump while the compressor is in operation. The pump should be attached loosely to the oil charging valve connection. With the charging valve closed, the pump should be operated sufficiently to purge air from the oil line to the valve, or until oil ap-



pears at the connection. Then the connection should be tightened and the oil charging valve opened. Sufficient oil should be pumped into the crankcase to bring the oil to the correct level as indicated in the sight glass. Oil should be charged into the system through a suitable dehydrator. After oil is added, the oil charging valve should be closed tightly and the oil pump disconnected.

REMOVING OIL FROM COMPRESSOR

Excess oil can be removed from the crankcase of Trane Reciprocating Compressors at the oil charging valve, which is located beneath the oil level of the compressor. To remove oil, pump down the compressor to approximately 2 psig. Connect a flexible tube to the oil charging valve connection and open the valve slowly, allowing oil to run into a suitable container.

When sufficient oil has been drained, the oil charging valve should be closed tightly and the compressor started. The compressor should be allowed to run for some time after which the oil level should be rechecked.

AIR IN SYSTEM, PURGING

If air or other non-condensible gases are present in the system, they will tend to move toward and collect at the condenser. The head pressure will rise to a point above the pressure corresponding to the temperature at which the vapor is condensing. In extreme cases, the pressure may rise to a point where either the high pressure cut-out or the thermal overload elements in the starter may stop the compressor.

To determine whether or not there is air in the system, the compressor must be allowed to stand idle long enough for the entire system to cool down to the temperature of the surrounding air. After the entire system has attained the same temperature at the surrounding room air, the reading of the head pressure gauge should not be more than 10 lbs. above the saturation pressure corresponding to the surrounding air temperature.

IF PURGING IS REQUIRED

1. Stop operation of compressor.
2. Front seat compressor service valve.
3. Close liquid line valve between condenser and receiver.
4. Loosen but do not remove plug in front seat port of compressor discharge service valve.
5. Purge gas from condenser and discharge line until pressure of escaping gas tends to drop off.
6. Tighten plug in front seat port of discharge service valve.
7. Open compressor service valve and liquid line valve.
8. Operate system.
9. Recheck for non-condensible gases.
10. Repeat purging procedure if necessary.

BROKEN VALVES IN COMPRESSOR

Broken or leaky discharge valves in a compressor are generally indicated by the suction pressure rising rapidly as soon as the machine is stopped. If the suction pressure rises faster than 5 lbs. per minute, it is an indication that the compressor discharge valves are not holding. Before the compressor is opened, however, it should be determined that the pressure rise is not due to other causes such as leaky expansion or solenoid stop valve.

REPLACING PARTS

After the system has been pumped down, the system may be opened and defective parts may be removed or necessary repairs made. If a defective part is to be removed from the system, open lines within the system should be capped or plugged until the new part is installed.

When a new part is being installed, the joint or connection should be first made on the liquid side of the system. The liquid valve should then be cracked for an instant and the gas from the system allowed to purge the air from the new component. After the air has been purged from the new part, remaining joints can be made.

STARTING UP AFTER REPAIRS

1. When the system has been properly repaired, and joints have been tested and found tight and when properly purged or evacuated, the system is ready to start.
2. The compressor discharge and suction service valves should be opened. Open the discharge service valve first and then open the suction service valve. The receiver shut-off valve should also be opened. The liquid shut-off valves should be slowly opened and the liquid allowed to enter the system. If the solenoid liquid valve was manually opened, it should now be reset for automatic operation. The pressure in the system should now cause the low pressure switch to function and start the compressor.
3. If a drier is used, the by-pass line around the drier should be closed permitting refrigerant to pass through the drier.
4. The oil level in the crankcase and the quantity of refrigerant in the system should be checked.

COUPLING

Trane compressors, due to their unloaded starting, are equipped with standard torque motors and drive is accomplished through a flexible coupling. This coupling is very flexible as far as longitudinal travel or angular movement is concerned. Rotationally it is extremely rigid. A guard is installed over the coupling to prevent accidental contact with the mechanism during operation.

TO REMOVE:

1. Remove the coupling guard.
2. Loosen, but do not remove all nuts and bolts within the coupling.

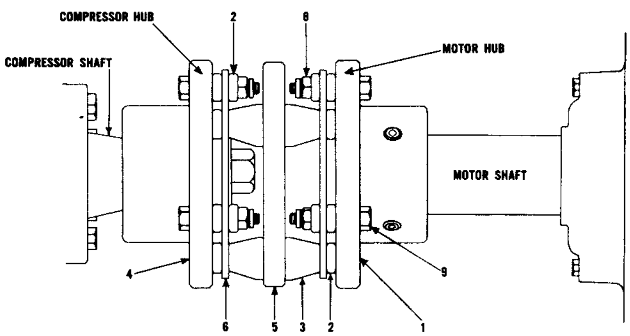


FIGURE 3
Illustration of Thomas Flexible Coupling.

3. With reference to Fig. 3, remove nuts (Ref. No. 4) from long through bolts (Ref. No. 1) and draw bolts through openings in the flange of the motor hub. As through bolts are being removed, use care to prevent loss of bevel washers (Ref. No. 2) and spacers (Ref. No. 3). As the last long through bolt together with its bevel washers and spacers is removed, the center flange (Ref. No. 5) is freed and removed.
4. Remove the nuts (Ref. No. 3) from the short bolts (Ref. No. 9) and remove bevel washers (Ref. No. 2) and laminations (Ref. No. 6) from the bolt.
5. Remove the short bolts from the flange of the motor hub.
6. Remove nuts, bevel washers and laminations from the short bolts in the hub of the compressor flange.
7. Remove the short bolts from the hub of the compressor flange.
8. Remove compressor hub, mounting bolt and washer. Compressor hub has a tapered bore and this hub can usually be freed and removed by tapping lightly with a rawhide mallet. DO NOT STRIKE FLANGE OF COMPRESSOR HUB WITH A STEEL HAMMER. DISTORTION WILL PERMANENTLY DAMAGE THE FLANGE. If the flange cannot be freed by tapping with a leather mallet, it will be necessary to use a wheel-puller. In using a wheel-puller, grip the compressor hub behind the hub and not behind the flange. Be sure to place the hub mounting bolt spacer between the jack screw of the wheel-puller and the end of the compressor shaft so as not to damage the threads in the end of the shaft.
9. Loosen set screws in motor hub and slide motor hub off motor shaft. If hub is tight on shaft, it may be necessary to use a wheel-puller to remove the hub. When using a wheel-puller on the motor hub, be sure to grip the motor hub behind the hub. Do not grip the puller on the flange of the hub. DO NOT STRIKE FLANGE OF MOTOR HUB WITH A STEEL HAMMER. DISTORTION WILL PERMANENTLY DAMAGE THE HUB FLANGE.

TO INSTALL:

1. Align motor and compressor shafts.
2. Insert compressor shaft key in place and position compressor hub on shaft. Be sure that hub and shaft are clean so that hub will draw onto shaft evenly. If hub does not draw onto shaft evenly and fully, it will work loose while in operation and will cause noisy operation and possible damage to the coupling assembly.
3. Install hub washer and mounting screw in shaft end and tighten screw.
4. Place key in position on motor shaft and install motor hub on motor shaft. DO NOT TIGHTEN SET SCREWS IN MOTOR HUB.
5. Position the motor shaft midway between its limits of end-play and adjust the motor hub so that the distance between the innermost faces of the compressor hub flange and the motor hub flange is 2-7/16". Tighten motor flange set screws.
6. Insert short screws in hub flanges. Place bevel washers, laminated shims and nuts on short screws. Tighten all nuts on the short screws.
7. Insert long through bolt from motor end through flange of motor hub and feed bevel washers, spacers and center section onto the through bolt as it is pushed forward and through the flange of the compressor hub. Place nut on through bolt but do not tighten. Insert remaining through bolts in a similar manner. When all through bolts have been inserted, tighten nuts on the through bolts.
8. Coupling bolts and set screws must be main-

tained tight at all times. Loose bolts and set screws cause noisy operation and may result in damage to the coupling, motor shaft or compressor shaft. After four or five hours of operation check coupling bolts and set screws to be sure that they are tight.

9. Install coupling guard.

If either the motor or the compressor is removed from the base, it will be necessary to carefully realign the shaft before installing the drive coupling. If the base is twisted during shipment or distorted during installation, it will also be necessary to realign the shaft before the coupling is operated. Misalignment of the shaft and coupling assembly will cause noisy operation of the coupling and promote rapid wear of the parts of the coupling and possibly cause breakage and severe damage to the coupling parts. It is possible to make a rough check of the coupling alignment with a straight edge placed over the outer edges of the flanges of the compressor and motor hubs and measuring the distances between the parallel faces of the two hubs. Another rough check against coupling misalignment is to observe the laminations in the coupling while the coupling is rotating at full motor speed. If the laminations appear fuzzy or fanned out, the coupling is misaligned. If the coupling is properly aligned, the laminations will appear to be a solid piece with the same thickness all the way around. The two preceding checks are rough measurements of the alignment of the coupling and accurate alignment can be made only with the use of a dial indicator. The following instructions describe coupling alignment using dial indicating equipment.

1. Mount dial indicator on the motor shaft with the stem of the dial indicator riding on the circumference of the compressor shaft just behind the keyway. (Fig. 4).

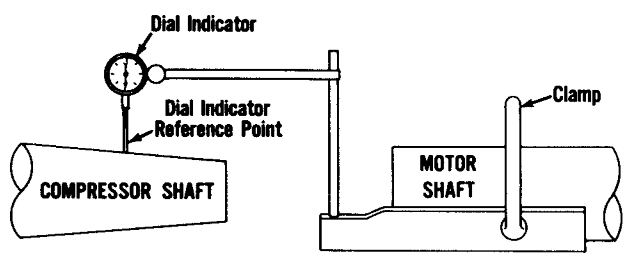


FIGURE 4

Method of Mounting Dial Indicator for Aligning Coupling.

2. The refrigerating unit bases are so constructed that the plane of the bosses that support the motor are lower than the plane of the bosses that support the compressor. Shims must be placed between the feet of the motor and the motor mounting bosses to elevate the motor so that the axes of the motor shaft and the compressor shaft are in the same horizontal plane.

3. In positioning the motor with reference to the compressor, it is necessary to have the axis of the motor shaft parallel with the axis of the compressor shaft and both axes must be in the same perpendicular and the same horizontal plane.

4. With the dial indicator in position and the motor mounting screws through the feet of the motor but not drawn down tight, rotate the dial indicator and shift the motor on the base until the axes of the motor shaft and the compressor shaft are aligned as far as vertical plane is concerned.

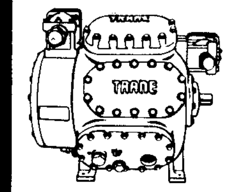
5. With the motor in this position, draw the motor mounting screws down tight. Rotate the dial indicator about the compressor shaft and take a reading at the top of the motor shaft and a reading at the bottom of the motor shaft. This reading will indicate how much the motor will have to be elevated so that the axes of the motor shaft and compressor shaft are in the same horizontal plane.

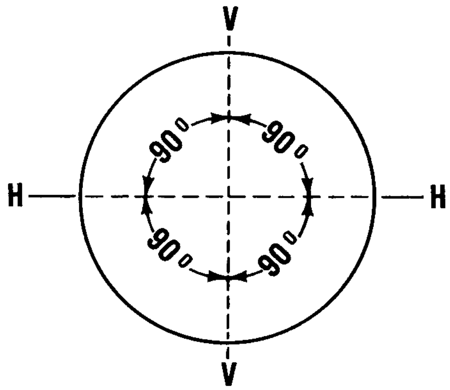
6. In elevating the motor with shim stock, only one side of the motor is raised at a time and the other side of the motor is held tight to the base. This will allow the motor to be elevated and at the same time prevent the motor from shifting on the base. In shimming under the motor, a shim of equal thickness is placed under each of the two feet on one side of the motor at a time. By alternately raising one side of the motor and then the other with the opposite side held tightly to the base, proper elevation of the motor can be obtained without the motor shifting about on the base.

7. Loosen the two motor mounting bolts in the feet of the motor on one side of the motor shaft. With a pinch bar raise the motor on this side and insert a shim of equal thickness under each foot of the motor. Draw the motor mounting bolt down tight. Start with a reading at the top of the shaft and take succeeding readings around the shaft at points approximately 90° apart. (see Fig. 5).

8. Loosen the two motor mounting bolts on the opposite side of the motor; raise this side of the motor and insert a shim of equal thickness under each foot of the motor on this side. Draw the motor mounting bolts down tight and check alignment around the compressor shaft with the dial indicator. Start with a read-

PRINTED IN U.S.A. PM-400-1-254
THE TRANE COMPANY · LA CROSSE, WISCONSIN





Positions On Compressor Shaft At Which Dial Indicator Readings Are Taken

FIGURE 5

ing at the top of the shaft and take succeeding readings around the shaft approximately 90° apart. (see Fig. 5).

9. Repeat steps 7 and 8 until the best possible alignment of the shafts is obtained. When Trane refrigerating units are assembled prior to shipment, the shafts are aligned to a tolerance of plus or minus .005". Due to the design of the coupling, it will operate successfully with misalignment as great as .025". However, for best operation and long life, it is recommended that the best possible alignment be obtained on the unit in the field.
Figures 7, and 8 illustrate coupling misalignment

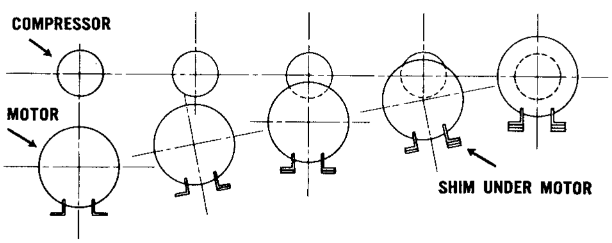


FIGURE 6
Motor Shimming Procedure.

10. When the shafts are properly aligned, install coupling.

THERMOSTATIC EXPANSION VALVE

To inspect, clean or replace parts, remove the two cap screws and lift off the power assembly.

Valve cage assembly may be withdrawn from the valve body. Check the action of the valve cage assembly to make sure it operates freely. Check equalizer lines for obstructions. Be sure to replace gaskets in their proper positions when reassembling valve. The two lugs on the valve cage fit into grooves in the power assembly. Do not force valve together; make the cage fit properly before tightening body flange.

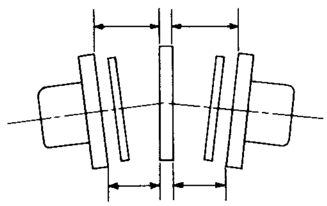


FIGURE 7

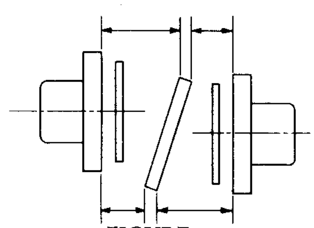


FIGURE 8

Examples of Coupling Misalignment.

To adjust the superheat of the thermostatic expansion valve, remove seal cap on side of valve and turn adjusting stem. Turning stem to the right decreases refrigerant flow and raises superheat. Turning stem to the left increases refrigerant flow and lowers superheat. Two turns of the stem equals approximately (1°F).

Adjust each valve separately and wait between adjustments to observe results.

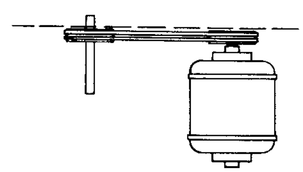
SOLENOID VALVE

Liquid solenoid valves should be disassembled once a year and diaphragm and rubber seat on the plunger inspected. Foreign material interfering with the action of the plunger or diaphragm may have caused damage to these parts.

Replace any damaged parts or worn parts.

BELTS

Belts may be installed by loosening the belt tension adjusting device until the belts slip easily into the grooves. Tighten the belt tension adjusting device until the belt slack has been taken up. Line up motor and drive using a straight edge. Motor shaft and drive shaft should be parallel and sheave belt grooves should be in the same plane. Correct belt alignment is illustrated in Fig. 9. Angular misalignment and parallel misalignment are shown in Fig. 10.



Correct Fan Belt Alignment

FIGURE 9

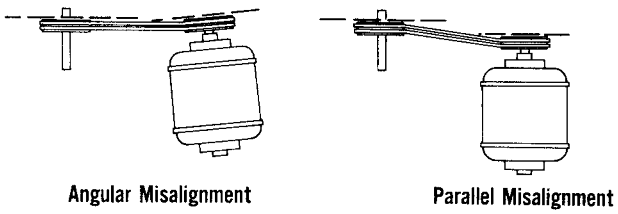


FIGURE 10

Be sure belt tension is properly adjusted before placing the unit in operation. Proper tension will permit ½ to ¾ inch depression of the belt when pressed with one finger midway between the two pulleys.

COMBINATION CONDENSER COMPONENTS (Wet-Dry)

Combination condensers are designed to operate "wet" when the compressor head pressure exceeds 200 psig. Operation of the spray pump is controlled by the automatic pressure switches mounted on the side of the condenser.

It is recommended that the condenser be operated dry during the late fall, winter, and early spring to prevent possible damage to the unit due to freezing. During these periods of the year the spray pump disconnect plugs should be removed from the disconnect plug receptacle, and water drained from the tank.

1. Coils: Excessive deposits of lime and scale may be removed by circulating a commercial type inhibited acid coil cleaner through the spray system. Be sure to follow the instructions in using such a solution. After cleaning with an inhibited acid solution, flush system thoroughly.
2. Spray Pump: Spray pump shaft should turn freely. Packing gland nuts should be finger tight, allowing a slight leakage of water for lubrication of the packing.
   A petcock permits bleeding in the event the pump becomes airbound.
3. Hoses: Replace rubber hoses upon evidence of deterioration or excessive cracking.
4. Strainers: Spray pump strainers may be removed and cleaned by removing the flanged cover and withdrawing the screen from the body of the strainer.
5. Spray Nozzles: Spray nozzles may be removed from the spray tree assembly and cleaned individually. Unscrew head of spray nozzle from body and remove orifice plate. Clean interior of spray nozzle body and spray nozzle head.

MOTORS

The bearing chambers of motors installed on the various refrigeration components are properly packed with grease before shipment. Clean, fresh mineral grease should be added to each bearing chamber from time to time at intervals depending upon the speed of the motor, number of hours per day in service and whether the motor is open or totally enclosed. Grease should be added sparingly, as too much grease results in hot bearings and excess is forced out around the shaft. Avoid the use of a pressure greasing system which tends to fill the chambers completely. A most satisfactory means of adding grease is by means of a small plunger-type gun which will not fit the bearing plug hole too tightly, thus preventing forcing too much grease into the chamber. Before inserting any grease into the chamber, remove the second plug from the chamber which provides a grease relief vent. With motor at standstill, it is a good precaution to insert a clean wire or clean rod into this grease relief vent to make sure it is not plugged or sealed by a deposit of "spent" grease. Fresh grease then can be inserted through the upper port. The motor should be run for a few minutes before reinstalling either plug in order to permit bearing to distribute the grease and drive any excess out through the vents. The plugs may then be replaced. If there is evidence of grease working out around the shaft, less grease should be added and the greasing periods lengthened slightly. Motors should be disassembled annually, the bearings and bearing chambers thoroughly cleaned out and repacked with fresh, clean grease. Kerosene, gasoline or carbon tetrachloride are excellent agents for washing out the bearings and bearing chambers. Upon reassembling the motor after cleaning out the old grease and dirt, smear a little clean grease over all the balls and bearings and then fill the remaining space in the bearing chamber only half full of clean grease. Take every precaution to keep dirt and grit out of the bearings and bearing chamber.

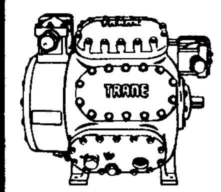
COMPRESSOR CAPACITY MODULATION

In many air conditioning systems multiple air conditioners or multiple evaporators are used. In these systems, the controls function to cut in and out the evaporators in the air conditioners to meet the varying system load conditions. The evaporators are usually fed or controlled by liquid line solenoid valves.

In many systems face-and-by-pass dampers are installed in the air conditioners. On these systems, air is directed through the evaporator or by-passed around the evaporator, the air movement being controlled by the dampers.

In either case, the suction temperature and suction pressure in the refrigeration system tend to vary in accordance with the load on the evaporators or with the number of evaporators in operation.

If the compressor were to operate at a fixed capacity, the suction temperature and pressure would, at times of minimum system load, be so low that the moisture on



the surface of the evaporators would freeze. In addition, the suction pressure might even drop below zero pounds gauge pressure. If the low pressure cut-out switch was properly set, at the low suction pressures, the compressor would short-cycle.

In order to balance out such a system, some sort of compressor capacity modulation is required.

CYLINDER UNLOADER

One of the most satisfactory systems of capacity control is one that employs cylinder unloaders. With this arrangement some method is provided that will hold open the suction valves of some of the cylinders.

With the suction valves held open, the piston will draw gas from the suction manifold on the down-stroke of the piston but will, on the up-stroke of the piston, return the gas, without compressing it, to the suction line.

In single step unloader systems, it is customary to unload one-half of the cylinders. In multi-step unloaders, the machines are unloaded in increments, depending upon the number of cylinders in the compressor. With cylinder unloading, the power requirements are decreased almost in direct proportion to the reduction in load.

HOW THE UNLOADER WORKS·

To gain a full understanding of the complete operational cycle of the unloader mechanism, one should consider the mechanism as two distinct components: (1) capacity control actuator (see Figures 11 and 12 below the solid black line), (2) cylinder unloader mechanism—one for each controlled cylinder (Figures 11 and 12 above the solid black line).

(NOTE: Figures 11 and 12 are schematic drawings and show only the flow of operation.)

CAPACITY CONTROL ACTUATOR

The capacity control actuator reacts to variations in refrigeration load requirements and transmits them to the cylinder unloader mechanism, which acts to load and unload the compressor cylinders. To perform this dual function, the capacity control actuator consists of (1) a pressure sensing device (Figures 11 and 12, lower left quadrant) which is sensitive to variations in suction pressure, (2) a valving mechanism (Figures 11 and 12, lower right quadrant) which regulates the oil pressure to the various cylinder unloader mechanisms.

PRESSURE SENSING DEVICE

This pressure sensing device consists of a chamber (A) which is connected to suction pressure through line (B) and a bellows (C), the inside of which is connected to atmospheric pressure through vent (D). The tendency of the pressure sensing device is to maintain as nearly as possible a predetermined suction pressure. This pressure is the maximum pressure required to satisfy the system and may range from 0 to 50 psi. The specific point is maintained by a balance of forces—suction pressure balanced against a combination of atmospheric pressure and force from spring (E). The amount of tension is adjustable by setscrew (F). When the system requires less than the full refrigeration load, the suction pressure will fall below the predetermined point, causing an unbalance within the device, and the unloading cycle will commence. The drop in suction pressure permits bellows (C) to expand, forcing plunger (G) against lever (H), moving it downward. The downward movement of this lever opens the regulated orifice (I). The opening and closing of this orifice controls the action of the valving mechanism.

VALVING MECHANISM

The function of the valving mechanism is to supply each of the cylinder unloaders with oil under pump pressure when full compressor capacity is required, and to relieve this pressure when cylinders are to operate unloaded. This valving mechanism consists of a hydraulic cylinder containing an annularly-grooved floating piston (K). The annular grooves are constantly connected to the oil pump pressure through line (X).

Above the piston is a chamber (L) which is vented to the crankcase through orifice (J). Below the piston is another chamber (M) connected to the annular grooves in the piston by orifice (N) and connected to the crankcase pressure through regulated orifice (I). Located within the hydraulic cylinder is a spring (O) which tends to move the floating piston toward the lower chamber.

Under full capacity operation, as shown in Figure 11 orifice (I) is shut off. Oil pressure in lower chamber (M) increases because oil under pump pressure is being supplied through line (X). This pressure overcomes the force of spring (O) and floating piston (K) rises in the cylinder. As it rises, the annular grooves in the floating piston coincide in sequence with lines P1, P2 and P3 to the cylinder unloaders providing them with full oil pressure and permitting them to operate at full capacity. To make Figures 11 and 12 as simple as possible, only line P1 is connected to a cylinder unloader mechanism. Lines P2 and P3 are in reality connected to identical mechanisms, and while this discussion is concerned with only one unloader mechanism, it can be extended to cover them all.

When full compressor capacity is not required, regulated orifice (I) is opened through movement of lever (H). Oil bleeds through it, and pressure within the lower chamber approaches crankcase pressure, as shown in Figure 12 Under these circumstances, the force of spring (O) overcomes the pressure in the lower chamber and floating piston (K) is moved downward so that the lines P1, P2 and P3 become connected in sequence to the crankcase pressure through orifice (J). The spring loaded

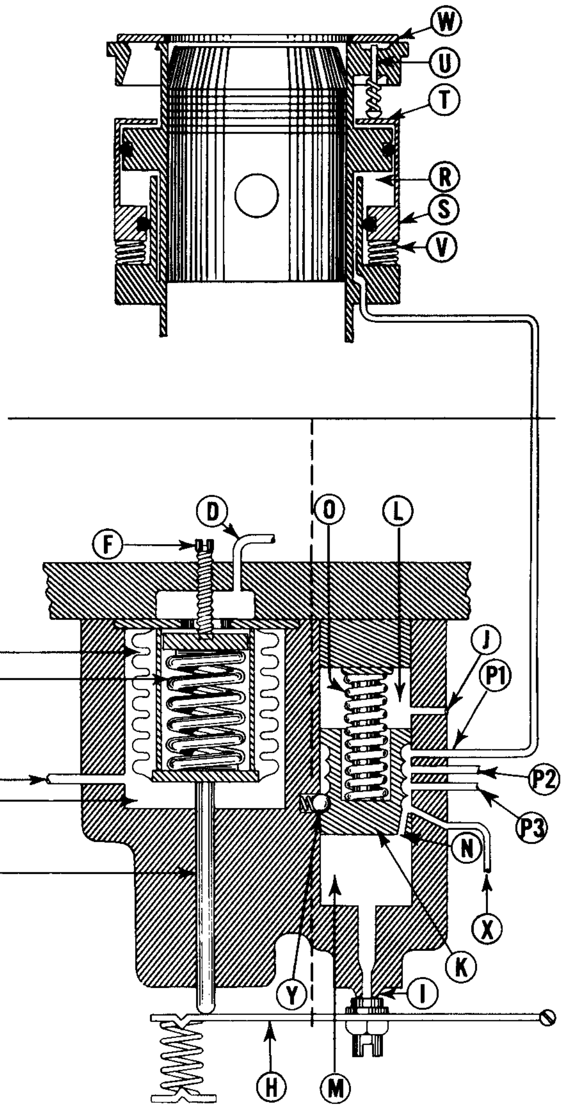


FIGURE 11
Schematic Drawing of Cylinder Unloading Mechanism (Loaded).

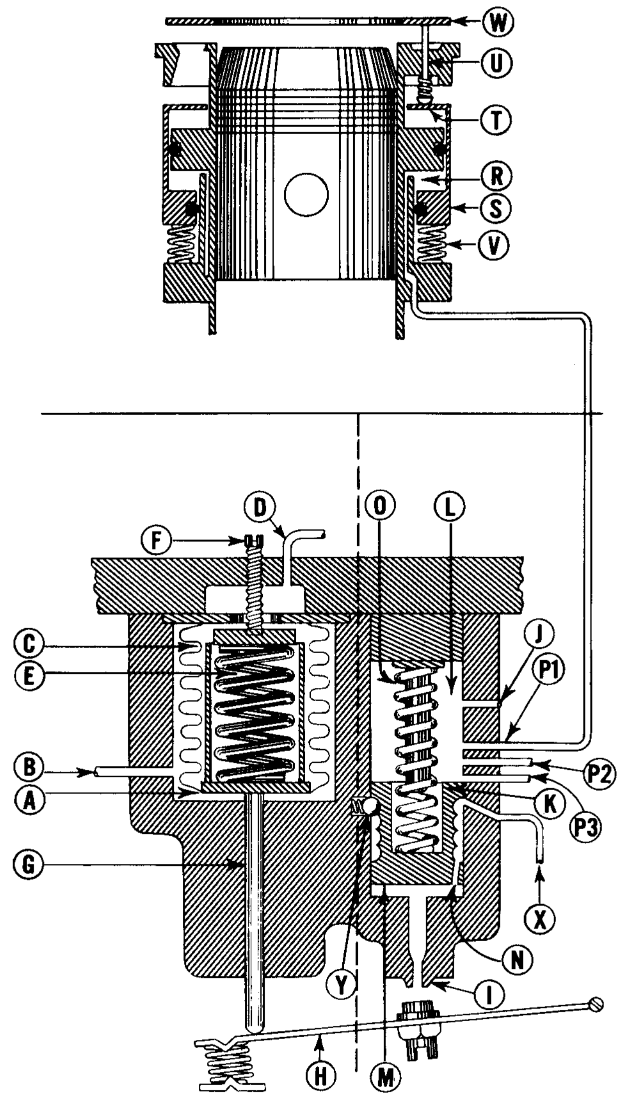


FIGURE 12
Schematic Drawing of Cylinder Unloading Mechanism (Unloaded).

ball (Y) permits the piston to move only in distinct increments, one groove at a time.

In this manner, the valving mechanism supplies or withdraws from each cylinder unloader the oil pressure that operates the unloader mechanism.

THE UNLOADER MECHANISM

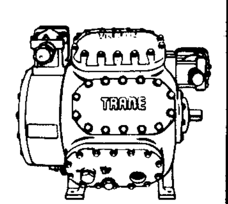
When oil from the forced feed lubricating system flows through line P1 from the valving mechanism to the cylinder unloader, it enters annular chamber (R). The inner wall of unloader cylinder is firmly anchored to the cylinder liner. The unloader piston (S), however, is free to move. The up-and-down movement of this unloader piston raises and lowers takeup ring (T) which raises and lowers suction valve lift pin (U).

Under full capacity operation (Figure 11), oil flows into annular chamber (R) under pressure sufficient to contract the unloader piston spring (V). When oil pressure forces springs to contract, the unloader piston (S) moves down, and takeup ring (T) and the suction valve lift pins (U) move with it. This permits the suction valve (W) to function normally and the cylinder operates to full capacity. When the compressor is to operate at less than full capacity (Figure 12), oil line P1 from the cylinder unloader mechanism is connected to the crankcase pressure through orifice (J) which allows the pressure in the annular chamber (R) to dissipate. The cylinder unloader springs (V) expand, lifting the unloader piston (S). This raises the takeup ring (T), the valve lift pins (U), and holds the suction valve (W) open so that the controlled cylinder is operating in an unloaded condition.

REFRIGERATION SERVICE MANUAL

OPERATION

PRINTED IN U.S.A. SM-400-1-553
THE TRANE COMPANY - LA CROSSE, WISCONSIN



SUPERSEDES

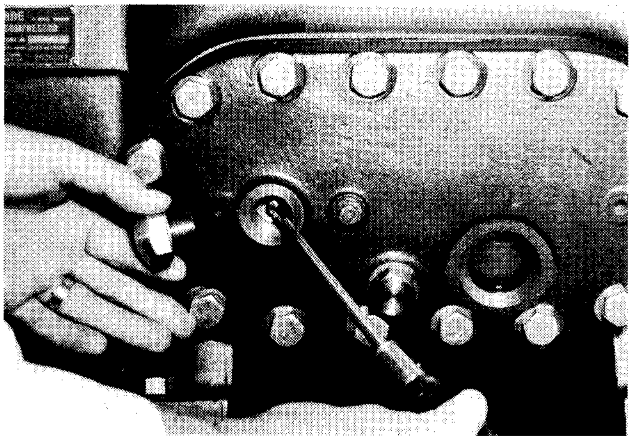


FIGURE 13 Capacity Control Adjusting Screw.

CAPACITY CONTROL ACTUATOR

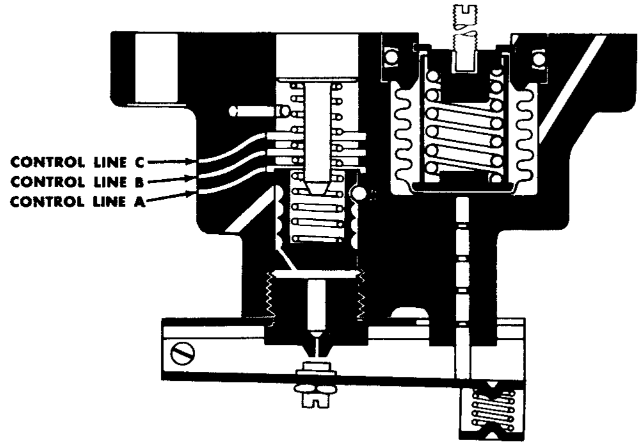


FIGURE 14 Capacity Control Actuator

CAPACITY CONTROL LOADER AND UNLOADER SEQUENCE

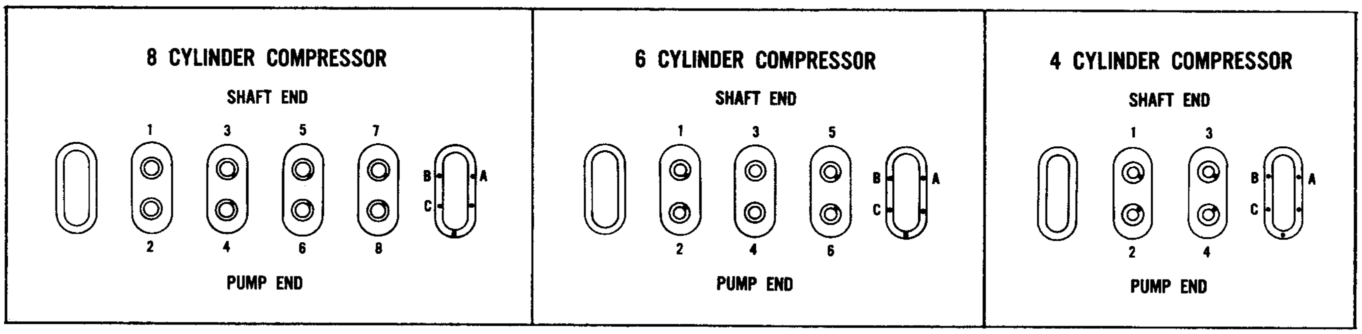


FIGURE 15 Cylinder Designation

		8 CYLINDER	6 CYLINDER	4 CYLINDER
	INCREASING			
STEP 0		6 CYLS. OUT 25%	4 CYLS. OUT 33%	3 CYLS. OUT 25%
STEP 1	CONTROL LINE "A"	CYLS. NO. 5 & 6 IN - 4 CYLS. OUT 50%	CYL. NO. 5 IN - 3 CYLS. OUT 50%	CYL. NO. 1 IN - 2 CYLS. OUT 50%
STEP 2	CONTROL LINE "B"	CYLS. NO. 7 & 8 IN - 2 CYLS. OUT 75%	CYL. NO. 6 IN - 2 CYLS. OUT 66%	CYL. NO. 3 IN - 1 CYL. OUT 75%
STEP 3	CONTROL LINE "C"	CYLS. NO. 3 & 4 IN - 0 CYLS. OUT 100%	CYLS. NO. 1 & 2 IN - 0 CYLS. OUT 100%	CYL. NO. 4 IN - 0 CYLS. OUT 100%
	DECREASING			
STEP 0		0 CYLS. OUT 100%	0 CYLS. OUT 100%	0 CYLS. OUT 100%
STEP 1	CONTROL LINE "C"	CYLS. NO. 3 & 4 OUT - 2 CYLS. OUT 75%	CYLS. NO. 1 & 2 OUT - 2 CYLS. OUT 66%	CYL. NO. 4 OUT - 1 CYL. OUT 75%
STEP 2	CONTROL LINE "B"	CYLS. NO. 7 & 8 OUT - 4 CYLS. OUT 50%	CYL. NO. 6 OUT - 3 CYLS. OUT 50%	CYL. NO. 3 OUT - 2 CYLS. OUT 50%
STEP 3	CONTROL LINE "A"	CYLS. NO. 5 & 6 OUT - 6 CYLS. OUT 25%	CYL. NO. 5 OUT - 4 CYLS. OUT 33%	CYL. NO. 1 OUT - 3 CYLS. OUT 25%

TABLE 1. Loading and Unloading Sequence

OPERATION

PRINTED IN U.S.A. SM-400-1-553

THE TRANE COMPANY - LA CROSSE, WISCONSIN

ADJUSTING THE CAPACITY CONTROL

After the system has been placed in operation, the compressor capacity modulation control should be checked and adjusted to meet the requirements of the specific installation.

Figure 13 shows the adjusting screw of the capacity control mechanism located in the handhole cover assembly. The protecting cover plug has been removed.

Turning the adjusting screw clockwise raises the setting of the control range and turning the screw counter-clockwise lowers the setting of the control range.

If the compressor is in operation and a constant suction pressure is being maintained by the system, turning the adjusting screw clockwise will cause the compressor to unload, while turning the screw counter-clockwise will cause the compressor to load.

SETTING THE CAPACITY CONTROL

Figure 15 illustrates the sequence of capacity control. The chart shows which cylinders load and unload in response to the action of the valving mechanism.

In most systems it is desirable to maintain a certain minimum suction pressure whether the system is operating at maximum load or at minimum load. In addition, the capacity modulation of the compressor should be set so that the compressor is operating at minimum capacity when the system is at minimum capacity. In some cases, certain compromises must be made to effect a balance during operation.

In some systems it may be just a matter of adjusting the capacity control to begin unloading when a certain suction pressure is reached.

In other systems it will be a matter of setting the capacity control so that the compressor is operating fully unloaded when the system is at minimum load.

The capacity control mechanism has an approximate range of 9 to 10 pounds. With three steps of capacity modulation, this means that there will be approximately 3 to 3½ pounds between steps. The range or differential between steps cannot be changed in the field. However, the point at which the unloading commences can be varied and set at the desired point.

COMPRESSOR CAPACITY

When adjusting the capacity control, it is often necessary to determine how many cylinders are loaded or at what per cent of full capacity the compressor is operating.

The only true indication of the number of cylinders that are loaded at a given time is horsepower required to operate the compressor at that capacity. This can be checked readily by using a clamp-on volt-ammeter on one leg or phase of the motor leads. With the use of the volt-ammeter, each step of loading or unloading can be checked or determined. Table 2 shows the percentage

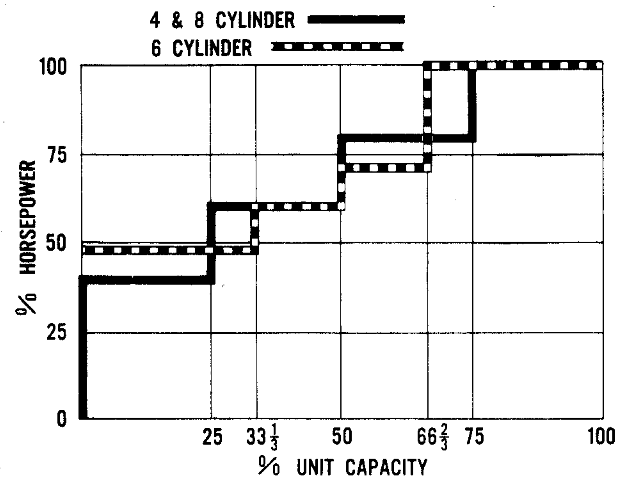


Table 2.

of horsepower required for the different percentages of capacity.

With the volt-ammeter clamped on, compare the amperage reading on the meter with the full load amperage rating of the compressor motor. With reference to Table 2 , the percentage of compressor capacity can then be determined.

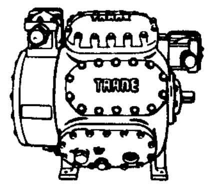
If the ammeter reading falls between two of the horsepower per cent lines on the table, it may be that the compressor is modulating between steps of capacity.

With a constant load on the compressor and with the volt-ammeter clamped on the motor lead, if the capacity control adjusting screw is turned, the compressor will load and unload and this can be checked by the readings on the meter. As the compressor loads up, step-by-step, the amperage readings will also go up in definite steps as shown in Table I.

TROUBLE ANALYSIS - ALTERNATING CURRENT UNITS

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
A. Compressor fails to start.	1. Failure of A.C. generator.	1. No A.C. power.	1. Check generator.	
	2. Comp. or cond. fan O.L. relays tripped out.	2. Sol. ref. valves and control relays operate but Comp. fails to start.	2. Reset O.L. relays on motor control panel.	
	3. Comp. test switch in "OFF" position.		3. Place switch in "AUTO" position.	
	4. Faulty or badly adjusted refrigeration pressure control.		4. Check and adjust ref. press. cont.	
	5. Faulty compressor motor or broken leads.	5. Magnetic starters on motor control panel operate and cond. fan runs but comp. motor does not.	5. Check motor and connections.	
	6. Blown control circuit fuse on cars with A.C. solenoid valves.	6. D.C. equipment on air cond. control panel operates but neither sol. valves nor control relays on motor panel operate.	6. Replace fuse on motor control panel.	
B. Compressor "Short Cycles"	1. Intermittent contact in electrical control circuit.	1. Normal operation except too frequent cycling.	1. Repair or replace faulty electrical control.	
	2. Low pressure controller differential set too close.	2. Normal operation except too frequent stopping and starting.	2. Reset differential in accordance with proper job conditions.	
	3. High pressure controller differential too close.	3. Normal operation except too frequent stopping and starting.	3. Replace faulty control.	
	4. Leaky liquid line solenoid valve.	4. Valve may hiss when closed. Also temperature change in refrigerant line through valve.	4. Repair or replace.	
	5. Dirty or iced evap.	5. Reduced air flow: a. Dirty air filters. b. Broken fan belt. c. Fan belt tension improperly adjusted. d. Defective motor on direct drive units.	5. Clean or defrost evaporator. Check filters and fan drive.	

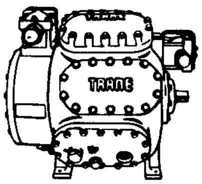
PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN



SUPERSEDES

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
	6. Faulty condensing.	6. Excessively high discharge pressure.	6. Check for condenser trouble.	
	7. Overcharge of refrigerant or non condensible gas.	7. High discharge press.	7. Remove excess refrigerant or purge non-condensible gas.	13
	8. Lack of refrigerant.	8. Normal operation except frequent stopping and starting of compressor.	8. Repair refrigerant leak and recharge.	12
	9. Restricted liquid line strainer.	9. Suction pressure too low and frosting at strainer.	9. Clean strainer.	
	10. Faulty motor.	10. Motor starts and stops rapidly.	10. Repair or replace faulty motor.	
	11. Faulty operation of evaporative condenser.	11. Compressor starts and stops frequently. a. No water b. Spray nozzles clogged. c. Water pump not operating. d. Coil surface dirty. e. Air inlet or oulet obstructed. f. Fan not operating.	11. a. Fill with water. b. Clean spray nozzles. c. Repair faulty pump. d. Clean oil. e. Remove obstruction. f. Repair.	
	12. Faulty operation of dry condenser.	12. Compressor starts and stops frequently. a. Fan not operating. b. Air inlet or outlet obstructed. c. Coil surface dirty.	12. a. Repair. b. Remove obstruction. c. Clean coil.	
C. Compressor Runs Continuously	1. Excessive load.	1. High temp. in conditioned area.	1. Check for excessive fresh air or infiltration.	
	2. Thermostat controlling at too low a temp.	2. Low temp. in conditioned area.	2. Reset or repair thermostat.	
	3. "Welded" contacts on elec. control in motor starter circuit.	3. Low temp. in conditioned space.	3. Repair or replace control.	
	4. Lack of refrigerant.	4. Low level in receiver.	4. Repair leak and charge.	12
	5. Overcharge of ref.	5. High discharge pressure.	5. Purge or remove excess.	13
	6. Leaky valves in compressor.	6. Compressor noisy or operating at abnormally low discharge pressure or abnormally high suction pressure.	6. Overhaul comp.	15

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
	7. Solenoid stop valve stuck open or held open by manual lift stem.	7. Air conditioned space too cold.	7. Repair valve or restore to auto. operation.	
D. Compressor Loses Oil.	1. Insufficient oil charge.	1. Oil level too low.	1. Add sufficient amount of proper comp. oil.	
	2. Traps in hot gas and suction lines.	2. Oil level gradually drops.	2. Repitch lines and provide lift loops. (See sect. on ref. piping.)	
	3. Low velocity in risers.	3. Oil level gradually drops.	3. Resize vertical lines or provide oil ret. traps.	
	4. Clogged strainers or valves.	4. Oil level gradually drops.	4. Clean or repair and replace.	1, 9, 11
	5. Loose expansion valve thermal bulb.	5. Excessively cold suction line.	5. Provide good contact between remote bulb and suction line.	4
	6. Liquid flooding back to compressor.	6. Excessively cold suction. Noisy compressor operation.	6. Readjust superheat setting or check remote bulb contact.	4, 6
	7. Short cycling.	7. Too frequent starting and stopping of compressor.	7. See items under Complaint "B."	
	8. Crankcase fittings leak oil.	8. Oil around comp. base and low crankcase oil level.	8. Repair oil leak and add proper refrig. oil.	
E. Compressor is noisy.	1. Loose compressor drive coupling.	1. Coupling bolts loose.	1. Tighten coupling and check alignment.	
	2. Lack of oil.	2. Low pressure gauge reading.	2. Add oil.	
	3. Dry or scored seal.	3. Squeak or squeal when comp. runs.	3. Check oil level.	
	4. Internal parts of compressor broken.	4. Comp. knocks.	4. Overhaul compressor.	15
	5. Liquid "flood back."	5. Abnormally cold suction line. Comp. knocks. Foaming in oil sight glass.	5. Check and adjust superheat. Valve may be too large or remote bulb loose on suction line. Air entering evaporator too cold for complete evaporation of liquid. Or see B-5.	6, 7
	6. Expansion valve stuck in open position.	6. Abnormally cold suction line. Compressor knocks.	6. Repair or replace.	4



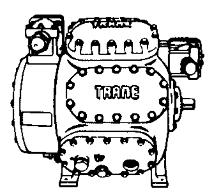
COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
	7. Compressor or motor loose on base.	7. Compressor or motor jumps on base.	7. Tighten motor or compressor hold-down bolts.	
F. System Short of Capacity	1. Flash gas in liquid line.	1. Expansion valve hisses.	1. Add refrigerant.	12
	2. Clogged strainer or solenoid stop valve.	2. Temperature change in refrigerant line thru strainer or sol. stop valve.	2. Clean or replace.	1, 10, 11
	3. Ice or dirt on evaporator.	3. Reduced air flow.	3. Clean coil and defrost. See B-5.	
	4. Expansion valve stuck or obstructed.	4. Short cycling or continuous running.	4. Repair or replace expansion valve.	4, 5, 9
	5. Excess pressure drop in evaporator.	5. Superheat too high.	5. Check superheat and reset thermostatic expansion valve.	6
	6. Improper superheat adjustment.	6. Short cycling or continuous running.	6. Adjust expansion valve. Check superheat and reset thermostatic expansion valve.	6
G. Discharge Pressure Too High	1. Improper operation of evaporative condenser.	1. Low air or spray water volume. Scaled surface.	1. Correct air or water flow. Clean coil surface.	
	2. Air or non-condensible gas in system.	2. Exceptionally hot condenser and excessive discharge pressure.	2. Purge.	14
	3. Overcharge of ref.	3. Exceptionally hot condenser and excessive discharge pressure.	3. Remove excess or purge.	13
	4. Evaporative condenser too small.	4. Condenser appears to be operating satisfactorily yet excessive discharge press. exists.	4. Recheck condenser rating table for correct size selection.	
H. Discharge Pressure Too Low	1. Lack of refrigerant.	1. Low level in receiver.	1. Repair leak and charge.	12
	2. If refrigerant circuit is provided with oil separator, separator may operate improperly. Leaky oil return valve.	2. Continuous flow of oil through oil return valve.	2. Repair or replace as necessary.	
	3. Broken or leaky compressor discharge valves.	3. Suction pressure rises faster than 5 lbs. per minute after shut-down.	3. Remove head, examine valves and replace those found to be operating improperly.	15
	4. Leaky relief by-pass valve.	4. Low discharge pressure and high suction pressure.	4. Inspect valve to determine if replacement is necessary.	

TROUBLE ANALYSIS - DIRECT CURRENT UNITS

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
A. Compressor fails to start.	1. L.V. relay tripped out.	1. Sol. valves and control relays inoperative.	1. Reset L.V. relay by "reset" button on air conditioning panel.	
	2. Main battery fuse blown.	2. L.V. relay does not pick up when reset button is pressed.	2. Replace fuse on motor control panel.	
	3. Low battery.	3. L.V. relay trips out as soon as comp. motor comes up to speed stopping compressor.	3. Recharge battery.	
	4. Compressor or condenser fan O.L. relays tripped out.	4. Refrigerant sol. valves and control relays operate but comp. fails to start.	4. Reset O.L. relays on motor control panel.	
	5. Compressor test switch in "OFF" position.		5. Place switch in "AUTO" position.	
	6. Faulty or badly adjusted refrigeration pressure control.		6. Check and adjust ref. pressure control.	
	7. Faulty motor or broken armature lead wire.	7. Motor control panel operates properly and condenser fan motor runs but comp. fails to start.	7. Check motor and connections.	
	8. Faulty motor control panel.	8. Sol. valves and control relays operate but main and accelerating contactors on panel inoperative.	8. Check and replace defective components on motor control panel.	
B. Condenser fan inoperative.	1. Blown cond. motor fuse.	1. Comp. runs but cond. fan does not.	1. Replace cond. motor fuse in motor control panel.	
	2. Defective cond. fan motor, disconnected plug or broken leads.		2. Check motor connections and wiring.	
	3. Faulty or badly adjusted refrigeration pressure control.		3. Check and adjust ref. press. cont.	
	4. Faulty compressor motor or broken leads.	2. Magnetic starters on motor control panel operate and cond. fan runs but comp. motor does not.	4. Check motor and connections.	

OPERATION

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN

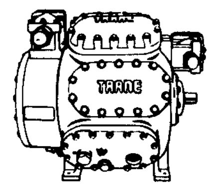


COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
C. COMPRESSOR "SHORT CYCLES"	1. Intermittent contact in electrical control circuit.	1. Normal operation except too frequent cycling.	1. Repair or replace faulty electrical control.	
	2. Low pressure controller differential set too close.	2. Normal operation except too frequent stopping and starting.	2. Reset differential in accordance with proper job conditions.	
	3. High pressure controller differential too close.	3. Normal operation except too frequent stopping and starting.	3. Replace faulty control.	
	4. Leaky liquid line solenoid valve.	4. Valve may hiss when closed. Also temperature change in refrigerant line through valve.	4. Repair or replace.	
	5. Dirty or iced evap.	5. Reduced air flow: a. Dirty air filters. b. Broken fan belt. c. Fan belt tension improperly adjusted. d. Defective motor on direct drive units.	5. Clean or defrost evaporator. Check filters and fan drive.	
	6. Faulty condensing.	6. Excessively high discharge pressure.	6. Check for condenser trouble.	
	7. Overcharge of refrigerant or non condensible gas.	7. High discharge press.	7. Remove excess refrigerant or purge non-condensible gas.	13
	8. Lack of refrigerant.	8. Normal operation except frequent stopping and starting of compressor.	8. Repair refrigerant leak and recharge.	12
	9. Restricted liquid line strainer.	9. Suction pressure too low and frosting at strainer.	9. Clean strainer.	
	10. Faulty motor.	10. Motor starts and stops rapidly.	10. Repair or replace faulty motor.	
	11. Faulty operation of evaporative condenser.	11. Compressor starts and stops frequently. a. No water b. Spray nozzles clogged. c. Water pump not operating. d. Coil surface dirty. e. Air inlet or oulet obstructed. f. Fan not operating.	11. a. Fill with water. b. Clean spray nozzles. c. Repair faulty pump. d. Clean oil. e. Remove obstruction. f. Repair.	
	12. Faulty operation of dry condenser.	12. Compressor starts and stops frequently. a. Fan not operating.	12. a. Repair. b. Remove obstruction.	

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
		b. Air inlet or outlet obstructed. c. Coil surface dirty.	c. Clean coil.	
D. Compressor Runs Continuously	1. Excessive load.	1. High temp. in conditioned area.	1. Check for excessive fresh air or infiltration.	
	2. Thermostat controlling at too low a temp.	2. Low temp. in conditioned area.	2. Reset or repair thermostat.	
	3. "Welded" contacts on elec. control in motor starter circuit.	3. Low temp. in conditioned space.	3. Repair or replace control.	
	4. Lack of refrigerant.	4. Low level in receiver.	4. Repair leak and charge.	12
	5. Overcharge of ref.	5. High discharge pressure.	5. Purge or remove excess.	13
	6. Leaky valves in compressor.	6. Compressor noisy or operating at abnormally low discharge pressure or abnormally high suction pressure.	6. Overhaul comp.	15
	7. Solenoid stop valve stuck open or held open by manual lift stem.	7. Air conditioned space too cold.	7. Repair valve or restore to auto. operation.	
E. Compressor Loses Oil.	1. Insufficient oil charge.	1. Oil level too low.	1. Add sufficient amount of proper comp. oil.	
	2. Traps in hot gas and suction lines.	2. Oil level gradually drops.	2. Repitch lines and provide lift loops. (See sect. on ref. piping.)	
	3. Low velocity in risers.	3. Oil level gradually drops.	3. Resize vertical lines or provide oil ret. traps.	
	4. Clogged strainers or valves.	4. Oil level gradually drops.	4. Clean or repair and replace.	1, 9, 11
	5. Loose expansion valve thermal bulb.	5. Excessively cold suction line.	5. Provide good contact between remote bulb and suction line.	4
	6. Liquid flooding back to compressor.	6. Excessively cold suction. Noisy compressor operation.	6. Readjust superheat setting or check remote bulb contact.	4, 6
	7. Short cycling.	7. Too frequent starting and stopping of compressor.	7. See items under Complaint "B."	
	8. Crankcase fittings leak oil.	8. Oil around comp. base and low crankcase oil level.	8. Repair oil leak and add proper refrig. oil.	

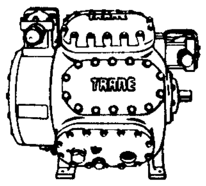
OPERATION

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY · LA CROSSE, WISCONSIN



SUPERSEDES

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
F. Compressor is noisy.	1. Loose compressor drive coupling.	1. Coupling bolts loose.	1. Tighten coupling and check alignment.	
	2. Lack of oil.	2. Low pressure gauge reading.	2. Add oil.	
	3. Dry or scored seal.	3. Squeak or squeal when comp. runs.	3. Check oil level.	
	4. Internal parts of compressor broken.	4. Comp. knocks.	4. Overhaul compressor.	15
	5. Liquid "flood back."	5. Abnormally cold suction line. Comp. knocks. Foaming in oil sight glass.	5. Check and adjust superheat. Valve may be too large or remote bulb loose on suction line. Air entering evaporator too cold for complete evaporation of liquid. Or see B-5.	6, 7
	6. Expansion valve stuck in open position.	6. Abnormally cold suction line. Compressor knocks.	6. Repair or replace.	4
	7. Compressor or motor loose on base.	7. Compressor or motor jumps on base.	7. Tighten motor or compressor hold-down bolts.	
G. System Short of Capacity	1. Flash gas in liquid line.	1. Expansion valve hisses.	1. Add refrigerant.	12
	2. Clogged strainer or solenoid stop valve.	2. Temperature change in refrigerant line thru strainer or sol. stop valve.	2. Clean or replace.	1, 10, 11
	3. Ice or dirt on evaporator.	3. Reduced air flow.	3. Clean coil and defrost. See B-5.	
	4. Expansion valve stuck or obstructed.	4. Short cycling or continuous running.	4. Repair or replace expansion valve.	4, 5, 9
	5. Excess pressure drop in evaporator.	5. Superheat too high.	5. Check superheat and reset thermostatic expansion valve.	6
	6. Improper superheat adjustment.	6. Short cycling or continuous running.	6. Adjust expansion valve. Check superheat and reset thermostatic expansion valve.	6
H. Discharge Pressure Too High	1. Improper operation of evaporative condenser.	1. Low air or spray water volume. Scaled surface.	1. Correct air or water flow. Clean coil surface.	
	2. Air or non-condensible gas in system.	2. Exceptionally hot condenser and excessive discharge pressure.	2. Purge.	14



OPERATION

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

COMPLAINT	POSSIBLE CAUSE	SYMPTOMS	RECOMMENDED ACTION	Ref. Note
	3. Overcharge of ref.	3. Exceptionally hot condenser and excessive discharge pressure.	3. Remove excess or purge.	13
	4. Evaporative condenser too small.	4. Condenser appears to be operating satisfactorily yet excessive discharge press. exists.	4. Recheck condenser rating table for correct size selection.	
J. Discharge Pressure Too Low	1. Lack of refrigerant.	1. Low level in receiver.	1. Repair leak and charge.	12
	2. If refrigerant circuit is provided with oil separator, separator may operate improperly. Leaky oil return valve.	2. Continuous flow of oil through oil return valve.	2. Repair or replace as necessary.	
	3. Broken or leaky compressor discharge valves.	3. Suction pressure rises faster than 5 lbs. per minute after shut-down.	3. Remove head, examine valves and replace those found to be operating improperly.	15
	4. Leaky relief by-pass valve.	4. Low discharge pressure and high suction pressure.	4. Inspect valve to determine if replacement is necessary.	

TROUBLE ANALYSIS CHART NOTES

1. CLOGGED STRAINER OR FILTER

Occasionally the strainer or filter in the liquid line may become clogged with dirt or other foreign material left in the system during erection. When this happens, the liquid line leaving the strainer will feel cooler than the entering line. If the strainer is badly clogged, some sweat or frost may appear at the outlet.

2. THERMOSTATIC EXPANSION VALVE LEAKS

Thermostatic expansion valves do not close tight to give positive shut-off to the flow of refrigerant through the valve on the off cycle of the condensing unit. As a result, large quantities of liquid refrigerant may pass through the low side and into the compressor on the off cycle. This causes liquid slugging to the compressor at start-up, which is definitely harmful to the machine.

3. METHOD FOR PREVENTING DIFFICULTIES CAUSED BY THERMOSTATIC EXPANSION VALVE LEAKS

Therefore, rather than relying on the expansion valve to hold back the flow of refrigerant on the off cycle, the installation of thermostatically controlled solenoid valves in the liquid line ahead of the expansion valves is used. They should be wired to operate on a non-recycling pump-down circuit. This means that the thermostats, when satisfied and not calling for cooling, will de-energize the liquid line solenoid valve coil and the holding coil of the non-recycling relay. This action will cause the compressor to pump out the low side of the refrigerant system and shut it off from the action of the low pressure cut-out switch.

The compressor may also knock, due to liquid flood back. The remote bulb of the thermostatic expansion valve should be checked for improper contact with the suction line.

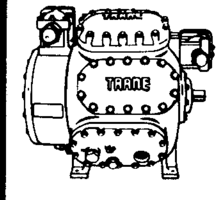
4. THERMOSTATIC EXPANSION VALVE STUCK IN OPEN POSITION

If the expansion valve is stuck in an open position, there will be an excessive amount of sweating on the suction line and compressor crankcase due to the large amount of liquid being passed into the suction line.

5. THERMOSTATIC EXPANSION VALVE HAS LOST CHARGE

The power element of an expansion valve consists of the remote bulb, capillary tube and the bellows or diaphragm, which actuates the valve cage. If this power element is inoperative or has lost its charge, the valve will either maintain an almost closed position or may

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY · LA CROSSE, WISCONSIN



SUPERSEDES

close completely. To test for an inoperative power element.:

1. Stop compressor.
2. Remove remote bulb from contact with suction line.
3. Place bulb in ice water.
4. Start compressor.
5. Remove bulb from ice water and warm in hand. At the same time check suction line for rapid temperature change which indicates flood through of liquid refrigerant. If refrigerant floods through valve, power assembly operates properly.

   WARNING: Do not flood back through suction line for too long a period because excessive liquid flood back can cause severe damage to the compressor.

6. THERMOSTATIC EXPANSION VALVE IMPROPERLY ADJUSTED

If the expansion valve is adjusted for too low a superheat, too much liquid will be passed to the evaporator. The suction line will be abnormally cold and liquid may slug back to the compressor. If the expansion valve is adjusted for too high a superheat, too little liquid will be passed to the evaporator and the suction line will be abnormally warm. Superheat must always be adjusted carefully using thermometer and suction gauge.

7. THERMOSTATIC EXPANSION VALVE TOO LARGE

If the thermostatic expansion valve has been improperly selected, and its capacity is too great for the system, the valve will not maintain a consistently level suction pressure. The remote bulb will attempt to control the flow of liquid at its superheat setting, but the oversized valve port will pass liquid too rapidly. The presence of liquid near the remote bulb will close the valve and the pressure in the evaporator will drop until the valve opens to pass another slug of liquid. This "hunting" will cause a suction pressure variation noticeable on the suction pressure gauge. On the usual air conditioning application, this variation is usually 10 to 15 psig.

8. THERMOSTATIC EXPANSION VALVE TOO SMALL

If the thermostatic expansion valve is too small, it cannot pass a sufficient amount of liquid to satisfy the evaporator. Under conditions of heavy load, the superheat will be excessive and the system will lose capacity. Under conditions of light load, the system may function properly. Too small expansion valves usually result in abnormally low suction pressure.

9. THERMOSTATIC EXPANSION VALVE IS OBSTRUCTED

Unless the expansion valve is properly protected by a strainer or filter, foreign matter may obstruct the valve port. If the obstruction is small, the resulting operation will be much the same as though the valve were undersized as described in Note 7. If the obstruction is large and only a small trickle of liquid can pass, the compressor will short cycle. If the obstruction holds the valve open during shut-down, the operation will be as described in Notes 2 and 3. An obstructed expansion valve is usually indicated by a partly warm evaporator and frosting at the evaporator inlet.

10. SOLENOID STOP VALVE LEAKS

If the solenoid stop valve leaks while in a closed position, and the compressor motor is controlled from a low pressure switch, the compressor will usually short cycle, that is, stop and start at frequent intervals. The liquid line leaving the magnetic stop valve will feel cooler than the inlet side, and in some cases, there may be evidence of sweat or frost on the solenoid stop valve outlet.

11. SOLENOID STOP VALVE OBSTRUCTED

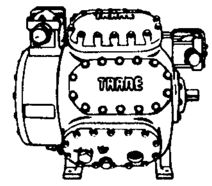
If the solenoid stop valve is obstructed, the resulting operation will be much the same as though the thermostatic expansion valve was obstructed or too small. See Notes 7 and 8. An obstructed solenoid stop valve can usually be detected by a temperature change in the refrigerant line through the valve. The liquid line leaving the valve will be colder than the liquid line entering and may even sweat or frost. If the solenoid stop valve is so obstructed that it cannot close, the operation will be as described in Note 9.

12. SHORTAGE OF REFRIGERANT

There should always be sufficient liquid in the receiver to completely submerge the inlet to the liquid line pipe. If there is a shortage of refrigerant, the liquid level will fall below the inlet to the liquid line and a mixture of gas and liquid will pass into the liquid line. When this occurs, there will be a hissing at the expansion valve. The coil and suction line will be relatively warm while the suction pressure will be low due to little or no liquid being supplied to the evaporator if the shortage is severe.

13. OVERCHARGE OF REFRIGERANT

An overcharge of refrigerant will cause high head pressure. Liquid will back up in the condenser and decrease the amount of surface available for condensing and as a result the head pressure will rise. In extreme cases, it may rise to the point where the thermal overload elements in the motor starter or the high pressure cut-out will stop the compressor. This may also result in short cycling.



OPERATION

PRINTED IN U.S.A. SM-400-1-154

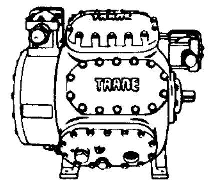
THE TRANE COMPANY - LA CROSSE, WISCONSIN

TROUBLE ANALYSIS

The information in this section includes a compilation of difficulties or troubles which may be encountered in the operation of motors together with a listing of possible causes and remedies. In general when a motor shows signs of improper operation, check all possible causes of the difficulty beginning with the most probable, until the actual causes are discovered. Many difficulties may be corrected by checking first for loose connections or shorts. In any event, do not disassemble parts of the unit unnecessarily. USE ACCURATE INSTRUMENTS TO CHECK ELECTRICAL CHARACTERISTICS.

TROUBLE	CAUSE	REMEDIES
Motor will not start.	Overload control trip.	Wait for overload to cool. Try starting again. If motor still does not start, check all causes outlined below.
	Power not connected.	Connect power to control, and control to motor. Check contacts.
	Faulty (open) fuses.	Test fuses.
	Low voltage.	Check generator power supply. Also check voltage at motor terminals with motor under load.
	Wrong control connections.	Check connections with control wiring diagram.
	Loose terminal lead connection.	Tighten connections.
	Driven machine locked.	Disconnect motor from load. If motor starts satisfactorily, check driven machine.
	Open circuit in stator or rotor winding.	Check for open circuits.
	Short circuit in stator winding.	Check for shorted coil.
	Winding grounded.	Test for grounded winding.
	Bearings stiff.	Free or replace bearings.
	Grease too stiff.	Use proper lubricant.
	Faulty control.	Check, correct or replace faulty device.

TROUBLE	CAUSE	REMEDIES
Motor noisy.	Motor running single phase.	Stop motor, then try to start. It will not start on single phase. Check for open circuit in one o fthe lines or circuits.
	Electrical load unbalanced.	Check current balance.
	Vibration.	Remove motor from load. If motor is still noisy, rebalance rotor.
	Air gap not uniform.	Center rotor and replace bearings if necessary.
	Noisy ball bearings.	Check lubrication. Replace bearings if noise continues and is excessive.
	Loose punchings or loose rotor on shaft.	Tighten holding bolts.



	Rotor rubbing on stator.	Center rotor, replace bearings if necessary.
	Motor loose on mounting brackets.	Tighten hold-down bolts. Re-align motor if necessary.
Motor at higher than normal temperature or motor smoking.	Overload.	Measure motor loading with ammeter.
	Electrical load unbalanced.	Check for voltage unbalance or single phasing.
	Fuse blown, faulty control, etc.	Check for open circuit in one of the lines or circuit.
	Restricted ventilation.	Clean air passages and windings.
	Incorrect voltage and frequency.	Check motor nameplate values with power supply. Also check voltages at motor terminals with motor under full load.
	Rotor winding with loose connections.	Tighten if possible or replace rotor.
	Belt too tight.	Remove excessive pressure on bearings.
Bearings hot.	Bent shaft.	Replace shaft.
	Too much grease.	Remove relief plug and let motor run. If excess grease is not drawn off, flush and relubricate.

TROUBLE	CAUSE	REMEDIES
Bearings hot.	Wrong grade of grease.	Add proper grease.
	Insufficient grease.	Remove relief plug and re-grease bearing.
	Foreign material in grease.	Flush bearings; relubricate, making sure grease supply is clean.
	Bearing mis-aligned.	Align motor and check fan shaft bearing assemblies. See that the races are exactly 90° with shaft.

COMPRESSOR LUBRICATION

It may occasionally be necessary to replace compressor oil which has been lost through a leak in the system. Oil capacity of the compressor crankcase is 7-1/2 quarts, and with the compressor operating, the oil level should be maintained to 7/8 full on the oil sight glass.

USE ONLY THE FOLLOWING APPROVED OILS IN THE COMPRESSOR:
Ansul #300 new non-foaming oil, Texaco Capella "D" wax-free oil.

DUAL PRESSURE CONTROL SETTINGS

TABLE 3

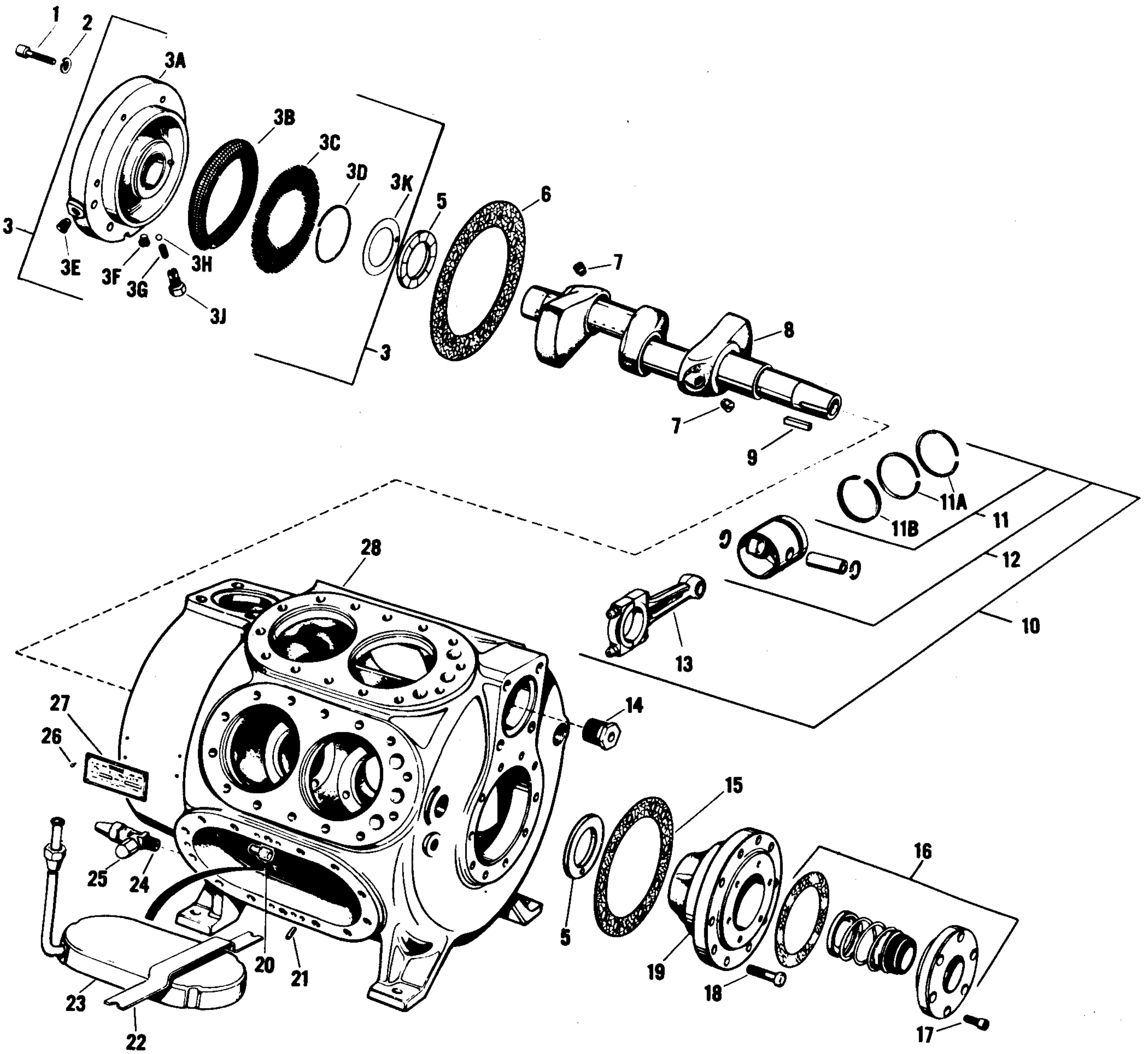
CONTROL	CUT OUT	CUT IN
High Pressure	290 psi	240 psi
Low Pressure	7-1/2 psi	25 psi

COMPRESSOR

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

MODEL B



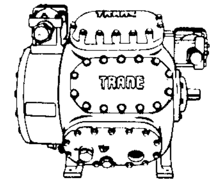
See Following Pages for Parts List

Figure 4-1

REFRIGERATION PARTS MANUAL

COMPRESSOR

PRINTED IN U.S.A.
PM-400-1-254
THE TRANE COMPANY - LA CROSSE, WISCONSIN



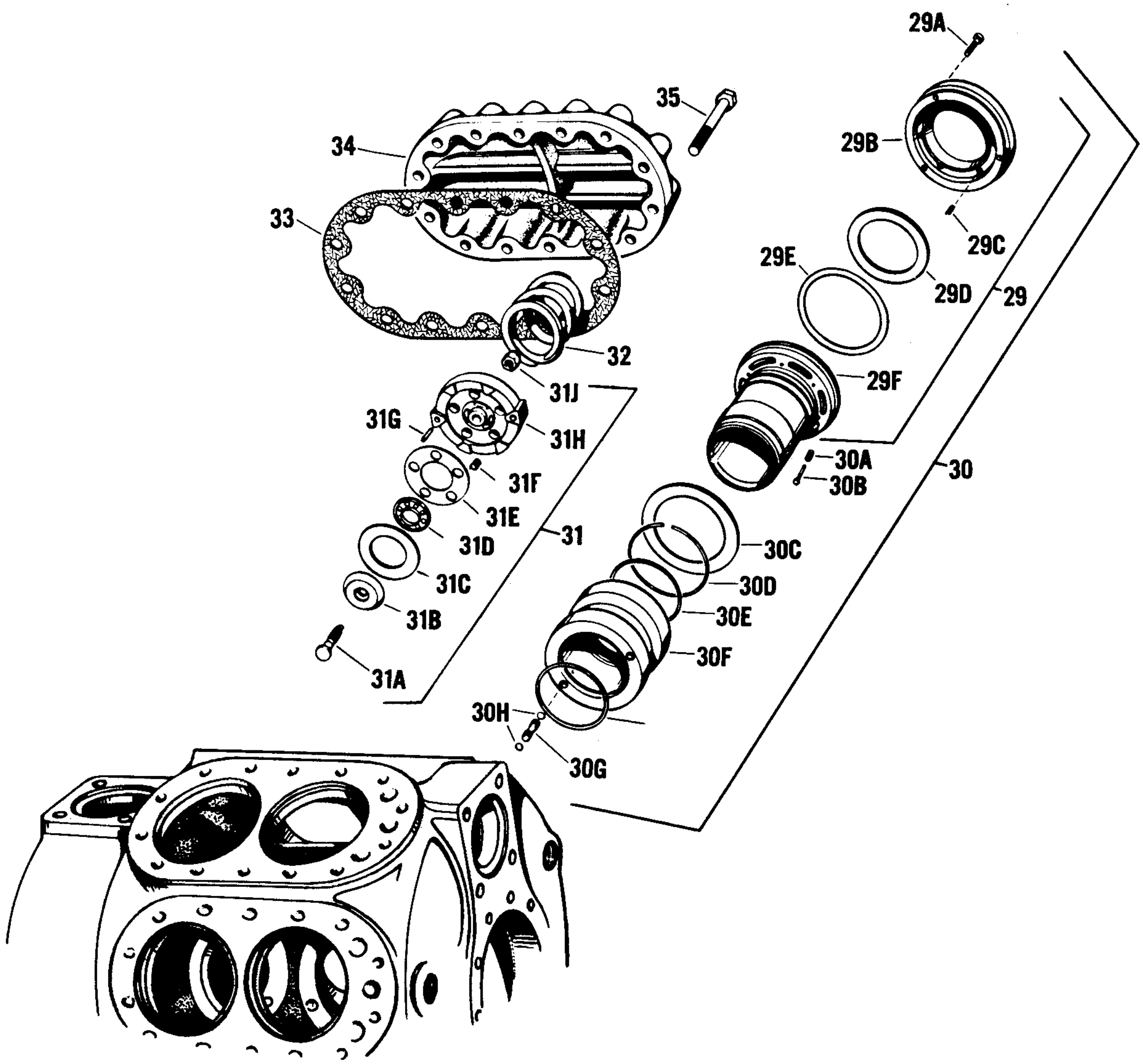
SUPERSEDES

MODEL B

REF NO.	PART NAME AND DESCRIPTION	PART NUMBER	NUMBER REQUIRED B-514	B-516	B-518
1	Screw - Socket Head Cap, 3/8" - 24 x 1-1/2"	SCR - 40	6	6	6
2	Lockwasher - 3/8" x .156" x .094"	WAS - 13	6	6	6
3	Bearing Head and Main Bearing Assembly (Pump End) Consisting of: 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3J, 3K(2)	BRG - 1	1	1	1
3A	Bearing Head With Bearing	BRG - 2	1	1	1
3B	Breaker-Foam	BKR - 1	1	1	1
3C	Ring-End	RNG - 1	1	1	1
3D	Ring - Retaining	RNG - 2	1	1	1
3E	Plug - Magnetic Pipe, 1/4" I.P.S.	PLU - 10	1	1	1
3F	Plug - Square Head Pipe, 1/4" I.P.S.	PLU - 1	1	1	1
3G	Spring - Relief Valve	SPG - 1	1	1	1
3H	Ball - Relief Valve	BAL - 1	1	1	1
3J	Cap - Relief Valve	CAP - 2	1	1	1
3K	Shim	SHM - 1	*	*	*
5	Bearing-Thrust	BRG - 3	2	2	2
6	Gasket - Bearing Head, Pump End	GKT - 19	1	1	1
6A**	Gasket - Bearing Head (Shim), Pump End	GKT - 20	*	*	*
7	Plug - Magnetic Pipe 1/4" I.P.S.	PLU - 10	2	2	2
8	Crankshaft - 4 Cylinder	CSF - 1	1		
8	Crankshaft - 6 Cylinder	CSF - 2		1	
8	Crankshaft - 8 Cylinder	CSF - 3			1
9	Key	KEY - 2	1	1	1
10	Piston and Connecting Rod Assembly Consisting of 12 and 13	PST - 2	4	6	8
11	Piston Ring Kit Consisting of 11A(2), 11(B)1	RNG - 3	4	6	8
11A	Ring-Compression	RNG - 4	8	12	16
11B	Ring-Oil	RNG - 5	4	6	8
12	Piston Assembly with Pin and Piston Rings	PST - 1	4	6	8
13	Connecting Rod Assembly	ROD - 1	4	6	8
14	Valve - Pressure Relief, 300#	VAL - 53	1	1	1
15	Gasket - Bearing Head, Seal End	GKT - 21	1	1	1
16	Seal Assembly	SEL - 1	1	1	1
17	Screw - Socket Head Cap, 3/8" - 24 x 3/4"	SCR - 41	6	6	6
18	Screw - Hex Head Cap, 7/16" - 14 x 1-1/4"	SCR - 42	10	10	10
19	Bearing Head and Main Bearing Assembly (Seal End)	BRG - 4	1	1	1
20	Valve Assembly - Oil Check	VAL - 30	3	3	3
21	Pin - Roll, 5/16" x 1-1/4"	PIN - 1	2	2	2
22	Hold Down Strip - Screen Assembly	STR - 1	1	1	1
23	Screen Assembly - Oil Strainer	SRN - 1	1	1	1
24	Valve - Angle, 3/8"	VAL - 31	1	1	1
25	Nut - Seal, Brass, 3/8" Flare	NUT - 16	1	1	1
26	Screw - Nameplate	SCR - 1	4	4	4
27	Nameplate	PLT - 9	1	1	1
28	Housing - 4 Cylinder	HUS - 1	1		
28	Housing - 6 Cylinder	HUS - 2		1	
28	Housing - 8 Cylinder	HUS - 3			1
28	Housing - 4 Cylinder, R.H.	HUS - 13	1		
28	Housing - 6 Cylinder, R.H.	HUS - 14		1	
28	Housing - 8 Cylinder, R.H.	HUS - 15			1

*As Required
**Not Illustrated

Illustration Precedes This List



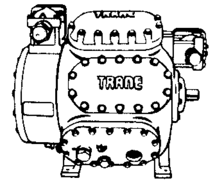
See Following Pages for Parts List

Figure 4-3

COMPRESSOR

PRINTED IN U.S.A. PM-400-1-254

THE TRANE COMPANY - LA CROSSE, WISCONSIN



SUPERSEDES

MODEL B

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NUMBER REQUIRED B-514	B-516	B-518
29	Liner Assembly - Without Unloader Consisting of: 29A, 29B, 29C, 29D, 29E, 29F	LNR - 1	1	2	2
29A	Screw - Socket Head Cap, 1/4" - 28 x 5/8"	SCR - 43	12	18	24
29B	Valve Plate	PLT - 10	4	6	8
29C	Spring - Suction Valve	SPG - 2	24	36	48
29D	Valve - Suction	VAL - 32	4	6	8
29E	"O" Ring	RNG - 6	4	6	8
29F	Liner-Cylinder	LNR - 2	4	6	8
30	Liner-Assembly - With Unloader Consisting of: 29, 30A, 30B, 30C, 30D, 30E, 30F, 30G, and 30H	LNR - 3	3	4	6
30A	Spring - Lift Pin	SPG - 3	24	36	48
30B	Pin - Lift	PIN - 2	24	36	48
30C	Ring - Takeup	RNG - 7	4	6	8
30D	Ring - Retaining	RNG - 8	4	6	8
30E	"O" Ring	RNG - 9	8	12	16
30F	Unloader Assembly	UNL - 1	3	4	6
30G	Connector - Oil	CON - 1	3	4	6
30H	"O" Ring	RNG - 10	6	8	12
31	Valve Assembly - Discharge Consisting of 31A, 31B, 31C, 31D, 31E, 31F, 31G, 31H, 31J, 31K	VAL - 33	4	6	8
31A	Bolt - Discharge Valve Cage	BLT - 1	4	6	8
31B	Seat - Discharge Valve	SET - 1	4	6	8
31C	Valve - Discharge	VAL - 34	4	6	8
31D	Retainer - Valve Cushion	RTR - 1	4	6	8
31E	Cushion - Valve	CUS - 1	4	6	8
31F	Spring - Discharge Valve	SPG - 4	20	30	40
31G	Pin - Dowel, 1/4" x 3/4" Long	PIN - 3	8	12	16
31H	Cage - Discharge Valve	CAG - 1	4	6	8
31J	Locknut - Discharge Valve Bolt	NUT - 17	4	6	8
32	Spring - Cylinder	SPG - 5	4	6	8
33	Gasket - Cylinder Head	GKT - 23	2	3	4
34	Head - Cylinder	HD - 1	2	3	4
35	Screw - Hex Head, 7/16" - 14 x 2-1/2"	SCR - 44	28	42	56

Illustration Precedes This List

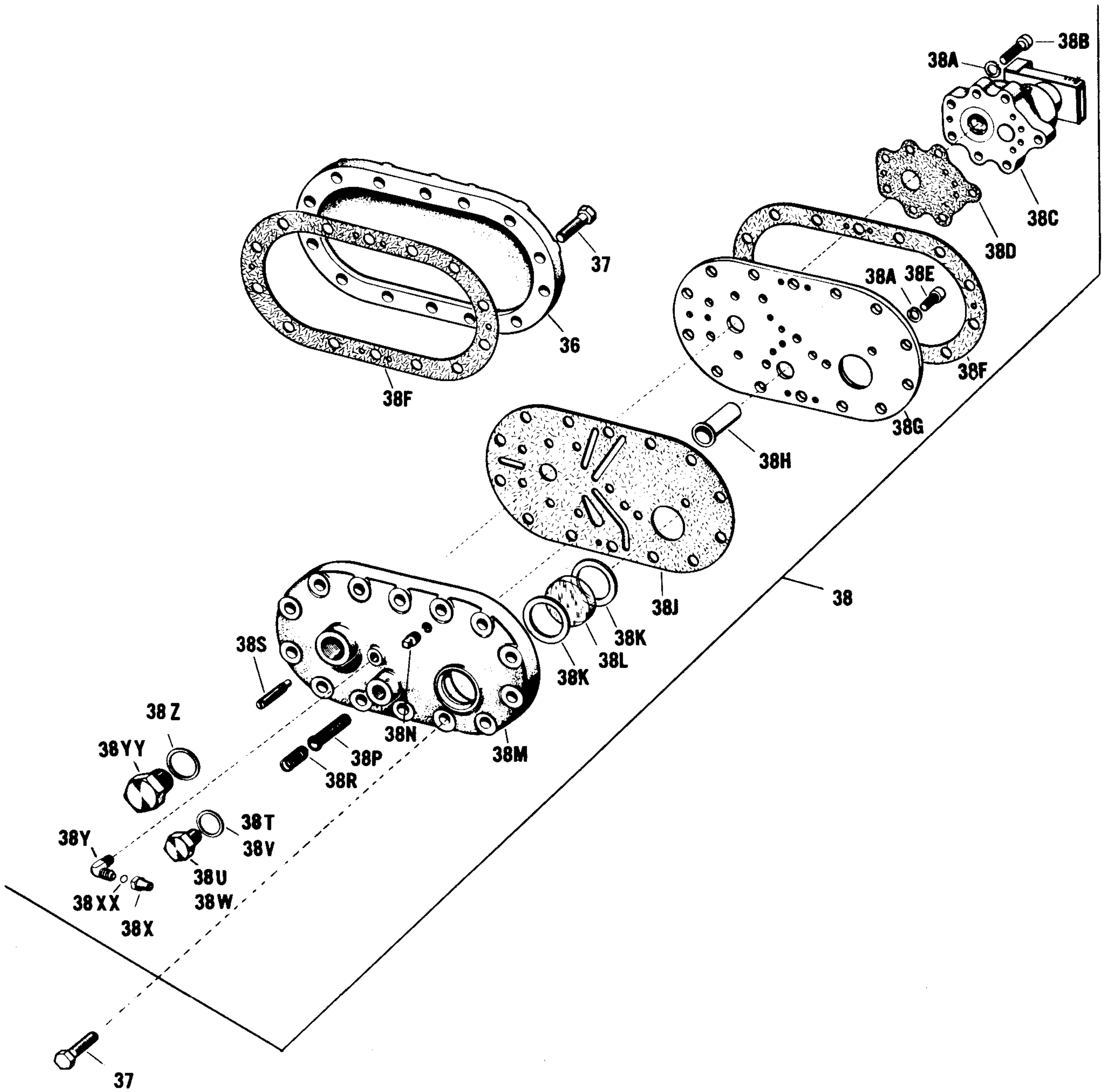
COMPRESSOR

PRINTED IN U.S.A.

SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

MODEL B



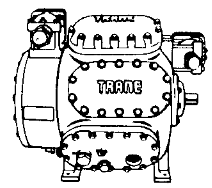
See Following Pages for Parts List

Figure 4-5

REFRIGERATION PARTS MANUAL

COMPRESSOR

PRINTED IN U.S.A. PM-400-1-254
THE TRANE COMPANY - LA CROSSE, WISCONSIN

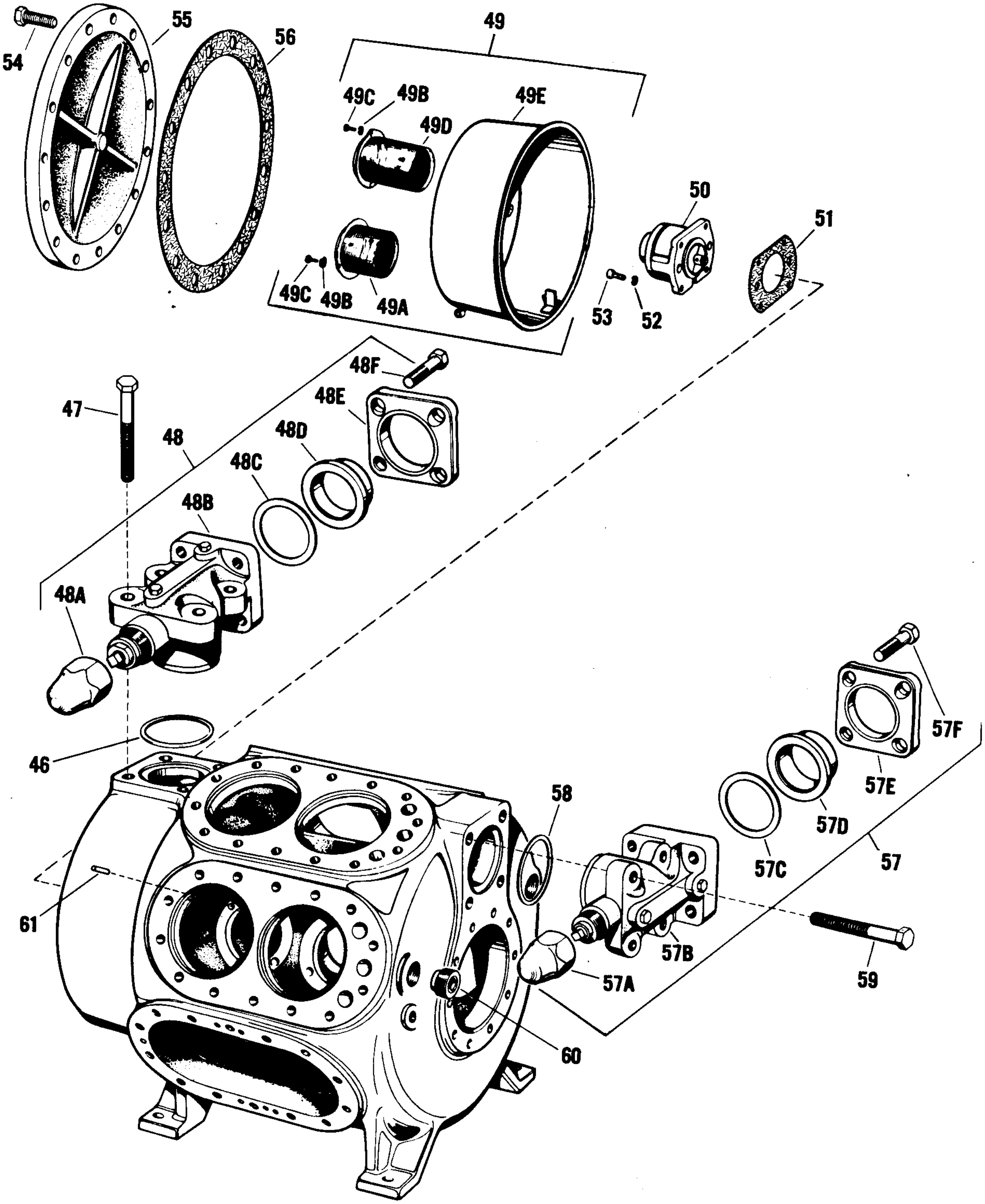


SUPERSEDES

MODEL B

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NUMBER REQUIRED B-514	B-516	B-518
36	Cover - Handhole	COV - 2	1	1	1
37	Screw - Hex Head Cap, 7/16" - 14 x 1-3/4"	SCR - 45	28	28	28
38	Handhole Cover With Capacity Control Assembly (With Oil Pressure Switch Tappings) Consisting of: 38A, 38B, 38C, 38D, 38E, 38F, 38G, 38H, 38J, 38K, 38L, 38M, 38N, 38P, 38R, 38S, 38V, 38W, 38X, 38XX, 38Y, 38YY, 38Z	COV - 3	1	1	1
38	Handhole Cover With Capacity Control Assembly (Without Oil Pressure Switch Tappings) Consisting of: 38A, 38B, 38C, 38D, 38E, 38F, 38G, 38H, 38J, 38K, 38L, 38M, 38P, 38R, 38S, 38V, 38W, 38YY, 38Z	COV - 18	1	1	1
38A	Lockwasher - 3/8" x .078" x .125"	WAS - 17	10	10	10
38B	Screw - Socket Head Cap, 3/8" - 24 x 1-3/4"	SCR - 46	7	7	7
38C	Capacity Control Assembly	CNT - 4	1	1	1
38D	Gasket - Capacity Control Assembly	GKT - 24	1	1	1
38E	Screw - Socket Head Cap, 3/8" - 24 x 1"	SCR - 45	3	3	3
38F	Gasket - Handhole Cover	GKT - 25	2	2	2
38G	Plate - Steel Back	PLT - 11	1	1	1
38H	Cover - Strainer Screen	COV - 4	1	1	1
38J	Gasket - Distributor	GKT - 26	1	1	1
38K	Gasket - Sight Glass	GKT - 27	2	2	2
38L	Glass - Sight	GLS - 4	1	1	1
38M	Cover - Control Handhole (With Oil Pressure Switch Tappings)	COV - 5	1	1	1
38M	Cover - Control Handhole (Without Oil Pressure Switch Tappings)	COV - 20	1	1	1
38N	Plug - Hex Head Pipe, Steel, 1/8" I.P.S.	PLU - 11	1	1	1
38P	Screen - Strainer	SRN - 2	1	1	1
38R	Spring - Strainer Screen	SPG - 6	1	1	1
38S	Screw - Bellows Adjusting	SCR - 47	1	1	1
38T	Gasket - Strainer Screen Plug, Asbestos, Copper Sheathed (Use With PLU-12)	GKT - 28	1	1	1
38U	Plug - Strainer Screen (Use with GKT-28)	PLU - 12	1	1	1
38V	"O" Ring - Strainer Screen Plug (Use With PLU-22)	RNG - 34	1	1	1
38W	Plug - Strainer Screen (Use with RNG-34)	PLU - 22	1	1	1
38X	Nut - Flare, 1/4" S.A.E.	NUT - 1	1	1	1
38XX	Bonnet - Flare, 1/4" S.A.E.	BON - 1	1	1	1
38Y	Elbow - 90°, 1/4" S.A.E. x 1/8" M.P.S.	ELL - 2	1	1	1
38YY	Plug - Bellows Adjusting Screw Cover	PLU - 13	1	1	1
38Z	Gasket - Bellows Adjusting Screw Cover Plug	GKT - 29	1	1	1

Illustration Precedes This List



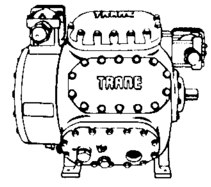
See Following Pages for Parts List

Figure 4-7

COMPRESSOR

PRINTED IN U.S.A. PM-400-1-254

THE TRANE COMPANY - LA CROSSE, WISCONSIN



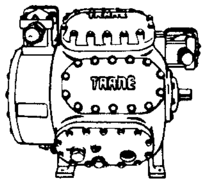
SUPERSEDES

MODEL B

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NUMBER REQUIRED B-514	B-516	B-518
46	Gasket - Suction Stop Valve	GKT - 15	1	1	1
47	Screw - Hex Head Cap, 5/8" - 11 x 4"	SCR - 14	4	4	4
48	Valve - Suction Stop, 2-5/8"	VAL - 35			1
	Consisting of: 48A, 48B, 48C, 48D, 48E, 48F				
48A	Cap	CAP - 3			1
48B	Body	BOD - 1			1
48C	Gasket	GKT - 31			1
48D	Adapter	ADP - 7			1
48E	Flange	FLG - 2			1
48F	Screw	SCR - 48			4
48	Valve - Suction Stop, 2-1/8"	VAL - 36	1	1	
	Consisting of: 48A, 48B, 48C, 48D, 48E, 48F				
48A	Cap	CAP - 4	1	1	
48B	Body	BOD - 2	1	1	
48C	Gasket	GKT - 32	1	1	
48D	Adapter	ADP - 8	1	1	
48E	Flange	FLG - 3	1	1	
48F	Screw	SCR - 49	4	4	
49	Suction Strainer Assembly 4 Cylinder	SRA - 6	1		
	Consisting of: 49A, 49B, 49C, 49D, 49E				
49	Suction Strainer Assembly, 6 Cylinder	SRA - 7		1	
	Consisting of: 49A, 49B, 49C, 49D, 49E				
49	Suction Strainer Assembly, 8 Cylinder	SRA - 8			1
	Consisting of: 49A, 49B, 49C, 49D, 49E				
49A	Filter - Oil	FLR - 6	1	1	1
49B	Lockwasher - No. 10	WAS - 18	10	10	10
49C	Screw - Round Head, No. 10 - 32 x 3/8"	SCR - 9	10	10	10
49D	Screen - Suction Strainer	SRN - 3	2	3	4
49E	Pan - Suction Strainer	PAN - 3	1	1	1
50	Pump Assembly - Oil	PMP - 1	1	1	1
51	Gasket - Oil Pump	GKT - 34	1	1	1
52	Lockwasher - 5/16" x .130" x .097"	WAS - 14	4	4	4
53	Screw - Hex Head, 5/16" - 24 x 3/4"	SCR - 50	4	4	4
54	Screw - Hex Head, 1/2" - 13 x 1-1/2"	SCR - 51	15	15	15
55	Cover - Suction	COV - 6	1	1	1
56	Gasket - Suction Cover	GKT - 30	1	1	1
57	Valve-Discharge Stop, 2-1/8"	VAL - 36		1	1
	Consisting of: 57A, 57B, 57C, 57D, 57E, 57F				
57A	Cap	CAP - 4		1	1
57B	Body	BOD - 2		1	1
57C	Gasket	GKT - 32		1	1
57D	Adapter	ADP - 8		1	1
57E	Flange	FLG - 3		1	1
57F	Screw	SCR - 49		4	4
57	Valve - Discharge Stop, 1-5/8"	VAL - 37	1		
	Consisting of: 57A, 57B, 57C, 57D, 57E, 57F				
57A	Cap	CAP - 5	1		
57B	Body	BOD - 3	1		
57C	Gasket	GKT - 33	1		
57D	Adapter	ADP - 9	1		
57E	Flange	FLG - 4	1		
57F	Screw	SCR - 52	4		
58	Gasket - Discharge Stop Valve	GKT - 14	1		
58	Gasket - Discharge Stop Valve	GKT - 15		1	1
59	Screw - Hex Head Cap, 1/2" - 13 x 3-1/4"	SCR - 13	4		
59	Screw - Hex Head Cap, 5/8" - 11 x 4	SCR - 14		4	4
60	Plug - Socket Head Pipe, 1" I.P.S.	PLU - 14	2	2	2
61	Pin - Roll, 3/16" x 1"	PIN - 4	3	4	6
62**	Kit - Gasket, B Compresser	KIT - 2	1	1	1

**Not Illustrated

Illustration Precedes This List



SERVICING THE COMPRESSOR

MODEL B

The design of the Trane Model B-514 Compressor is such that it can be repaired without removing the compressor from the base. However, major repairs may be facilitated by performing the work with the compressor set up on a workbench or table (see "To REMOVE COMPRESSOR").

There are two general groups that compressor service repairs can come into. The first is the replacement of a single component such as a discharge valve cage assembly. The second is a complete disassembly of the entire compressor for major overhaul.

Many of the components of the compressor are combined as sub-assemblies. These sub-assemblies consist of a number of parts which can be removed and replaced as a unit. These units or sub-assemblies can be taken apart and in most cases, individual parts can be replaced. There are several major advantages to the sub-assembly type of design. A compressor which consists of a number of sub-assemblies can be taken apart, repaired, and re-assembled in a minimum amount of time. When rebuilding a compressor where sub-assemblies are involved, it will, in most cases, be to the serviceman's advantage to replace complete sub-assemblies.

The design of the Trane Model B-514 Compressor permits the replacement of many of these components or sub-assemblies without disassembly of the rest of the compressor. For instance, a cylinder liner may be removed and replaced without the removal of the piston or rod, without the removal of the oil from the crankcase or without the removal of the handhole cover.

There is no pre-selective fit with Trane compressor parts. This means that a connecting rod within a compressor can be replaced by any standard stock replacement rod without tedious special fitting of connecting rod inserts, shims, and so forth. Piston and rod assemblies can be interchanged without the necessity of measuring and adjusting piston clearances. No machining or special sizing is required.

Wherever bolts or nut and bolt combinations are drawn up, a torque wrench should be used to insure evenness and proper fit. This is essential as some fits such as the connecting rod assembly on the crankshaft can be badly distorted and cause premature wear or complete failure. So that the serviceman will know the proper torque to be applied to the various bolts and nut and bolt combinations, torques are set forth throughout the manual.

Before beginning repairs, the compressor must be pumped down. If repairs require the removal of suction or handhole covers, the crankcase oil must be drained from the compressor (see OPERATION, "TO DRAIN CRANKCASE").

Freon-12 is similar to carbon tetrachloride with regard to its cleaning and oil removal properties. Because of the good cleaning properties of the refrigerant used with the Trane Model B-514 Compressor, all parts being removed from the compressor must be handled carefully and protected against rusting immediately upon removal from the compressor.

It is recommended that as each part is removed it be oiled well with clean compressor oil. When reinstalling original parts or installing new parts, it is recommended that all parts be washed clean with a refrigeration compressor parts cleaner and oiled with clean new compressor oil before they are placed in the unit. CAUTION: Thoroughly lubricate all bearing surfaces within the unit when these parts are being installed. This lubrication will enable the compressor to run without seizure when it is started up for the first time and before the oil pump pressure builds up.

The number given in parentheses following a part is a reference number of that part. An illustration of the part may be found in Model B Compressor parts list commencing on Page 1, Section 7A6A.

The following disassembly procedure details the method of removing each assembly and its components individually. The sequence is also correct for complete compressor disassembly.

CYLINDER HEAD

The cylinder heads are cast of close-grain, pressure tight, nickel alloy iron with high physical strength. The two heads are interchangeable.

TO REMOVE:

Loosen and remove all but two cylinder head bolts (Fig. 1). Back off the remaining two bolts two or three full turns. Examine cylinder head to see whether or not head is following the bolts. If it is not, jar the head with a lead hammer until gasket breaks loose. Slowly and alternately loosen the two remaining bolts to dissipate the energy of the safety head springs (Fig. 2). As an aid in determining how far the bolts must be turned until they are freed of the tapped hole, a third bolt can be inserted through the head and turned into the tapped hole approximately two or three full turns. As the other two bolts are loosened and the head rises, the third bolt will serve as a measure of the amount of thread still engaged by the other two bolts. This third bolt will also hold the head in place on the cylinder and prevent it from falling when the other two bolts clear the tapped holes. Slowly and alternately loosen the two bolts, dissipate the energy of the safety head springs (Fig. 2), remove bolts, withdraw head (Fig. 3), and remove safety head springs (Fig. 4).

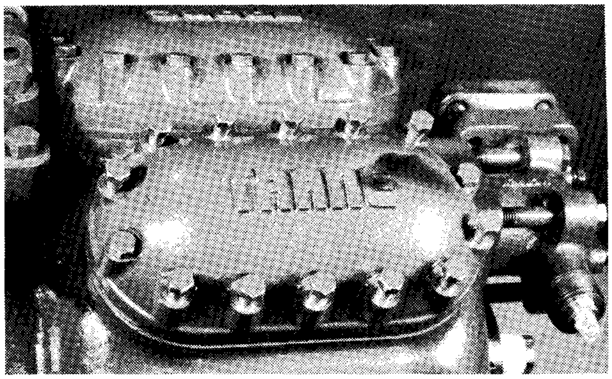


Figure No. 1

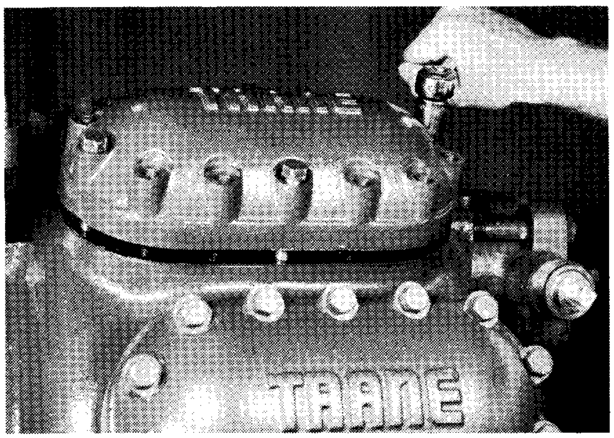


Figure No. 2

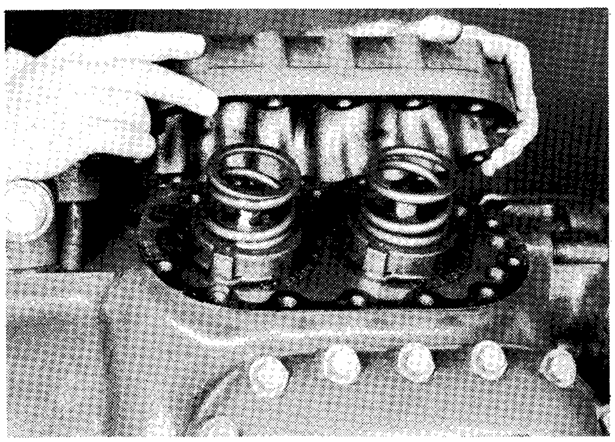


Figure No. 3

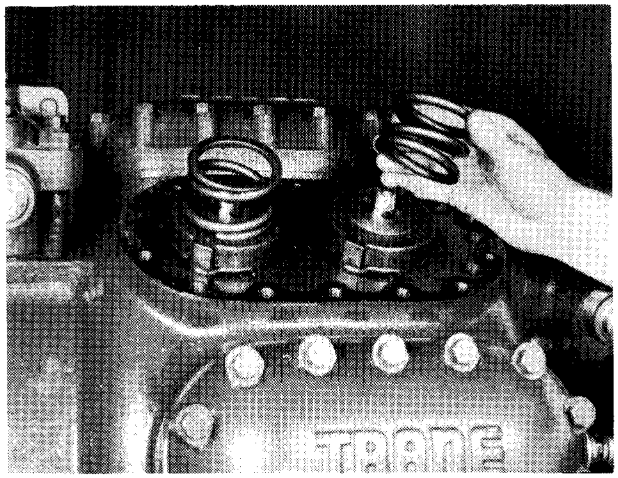


Figure No. 4

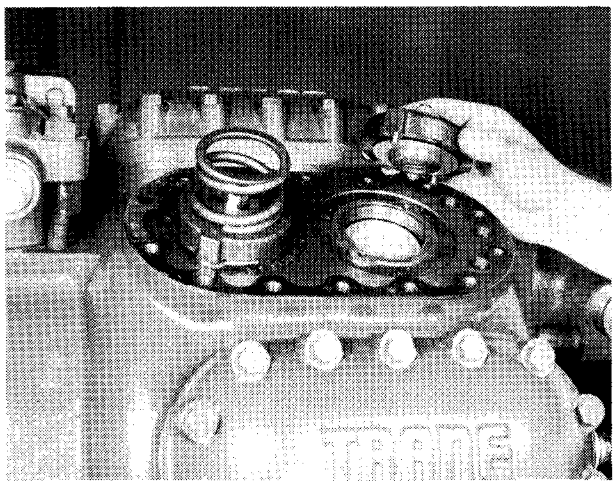


Figure No. 5

TO INSTALL:

Make sure safety head springs are centered properly on the discharge valve cage assemblies (Fig. 4). Put two bolts (on opposite sides) through the cylinder head. Oil the head gasket (Ref. No. 33) with compressor oil and center on cylinder head bolts. Position cylinder head, gasket and two cylinder head bolts on cylinder. Turn the two bolts in until their threads catch. The length of the bolts is such that the bolts will engage about two or three threads before compression of the safety head springs begins. Draw the head down evenly by alternate tightening of the two bolts. Insert and tighten remaining head bolts. Tighten bolts to final torque.
TORQUE — 37 foot pounds.

DISCHARGE VALVE

Trane compressor discharge valves are a highly efficient ring type with large valve area. This large area requires only a minimum of valve movement. These non-flexing type valve rings are surface treated for extra long life. The entire discharge valve mechanism is a sub-assembly and can be replaced as a complete unit (Fig. 5) or dis-assembled (Fig. 6) and worn or broken pieces replaced.

TO REMOVE:

Remove cylinder head (see "TO REMOVE CYLINDER HEAD"). Lift off safety head springs (Fig. 4). Lift off discharge valve cage (Fig. 5).

TO INSTALL:

Center valve cage assembly over cylinder. Locate dowel pins (Ref. No. 31) in the suction valve plate (Ref. No. 29). Press valve assembly into place being certain that valve assembly seats properly. If fit is proper, the dowel pins should slide easily into the holes in the valve plate. Do not force.

TO DISASSEMBLE DISCHARGE VALVE:

Loosen locknut on discharge valve bolt. Remove discharge valve bolt (Ref. No. 31A) and discharge valve seat (Ref. No. 31C). Remove valve ring (Ref. No. 31D), springs (Ref. No. 31G), valve cushion retainer (Ref. No. 31E) and valve cushion (Ref. No. 31F).

TO ASSEMBLE DISCHARGE VALVE:

Place valve cushion (Ref. No. 31F) into the discharge valve cage (Ref. No. 31J) making sure that the outer edge of the cushion is tucked into the undercut slot in the valve cage (Fig. 7). The holes in the cushion must line up with the spring pockets in the valve cage. Press valve cushion retainer (Ref. No. 31E) into place. This is a hand press fit (Fig. 8). Place discharge valve springs (Ref. No. 31G) into the spring pockets in discharge valve cage (Fig. 9). Lay the discharge valve (Ref. No. 31D) in place over springs (Fig. 10) and insert discharge valve seat (Ref. No. 31C) and discharge valve cage bolt (Ref. No. 31A) into the cage assembly (Fig. 11). On earlier style assemblies, a gasket was used between discharge valve cage bolt and discharge valve seat. It has been found that this gasket is not necessary and in present design assembly it is being omitted. It can be omitted when reassembling earlier design discharge valve cages. Before assembling and tightening locknut (Ref. No. 31K), make sure the discharge valve ring registers in the valve guide (Fig. 12). Assemble locknut (Fig. 13) and tighten in place. Recheck valve ring movement to make sure that its movement is not restricted by the valve guide (Fig. 12).
TORQUE — 15 foot pounds.

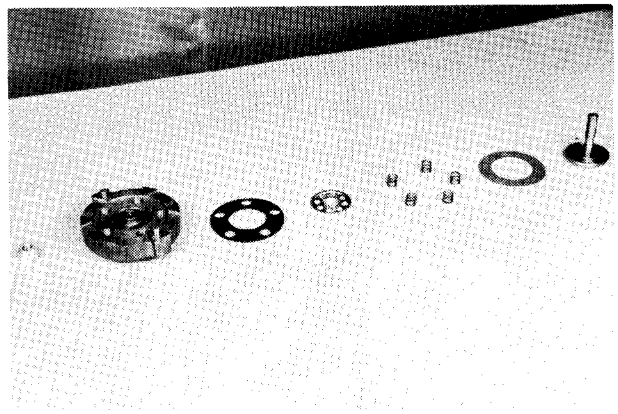


Figure No. 6

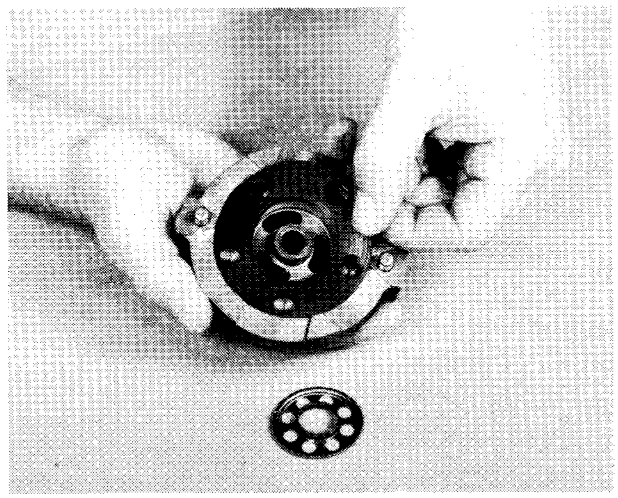


Figure No. 7

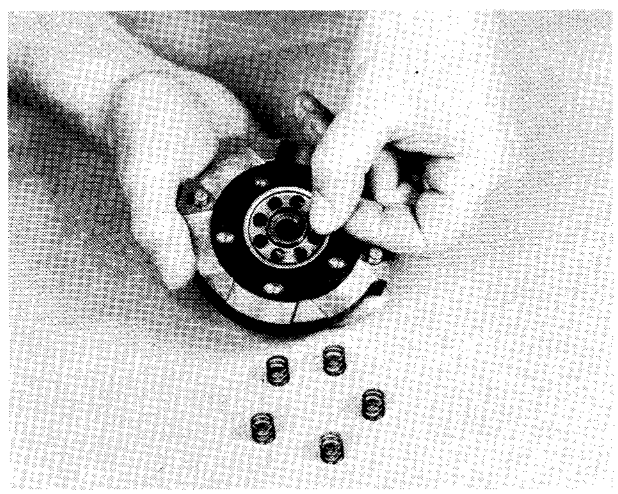
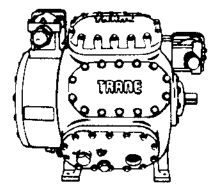


Figure No. 8



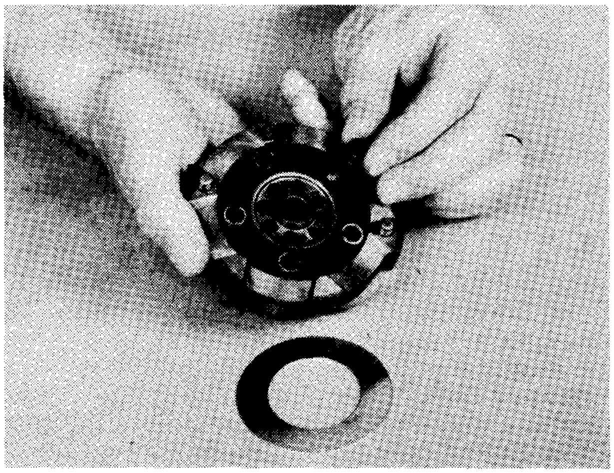


Figure No. 9

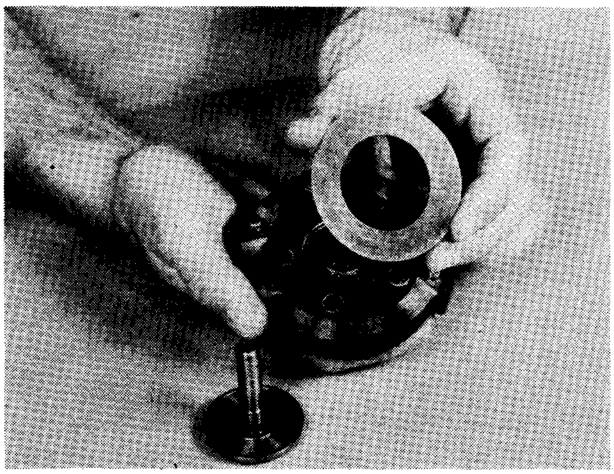


Figure No. 10

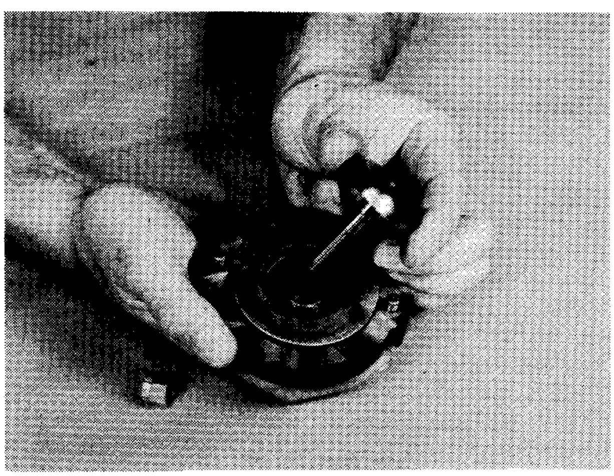


Figure No. 11

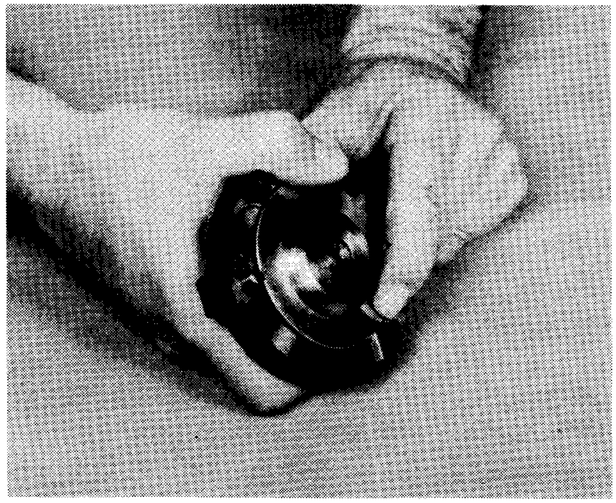


Figure No. 12

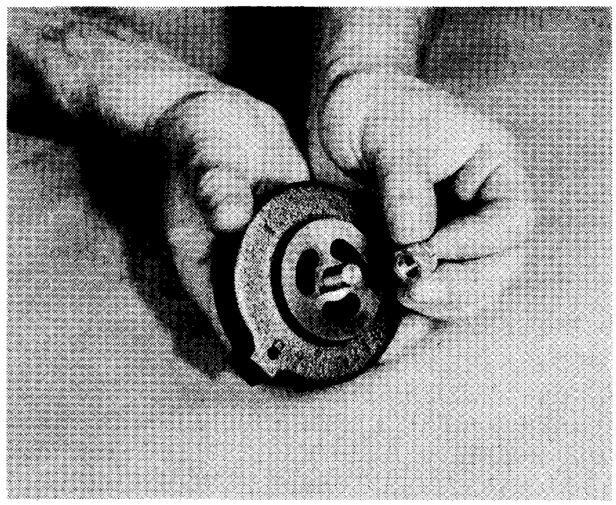


Figure No. 13

CYLINDER LINERS

The Trane Model B-514 Compressor is equipped with cylinder liners. These liners, which form the wearing surface for the piston rings, can be readily removed and replaced in the field without removal of the piston and connecting rod from the crankshaft. Three of the four cylinder liners are equipped with unloader assemblies. The removal of cylinder liners, with or without unloaders, is the same. The installation of the liners with or without unloaders is different, however, and will be discussed later.

TO REMOVE:

Remove cylinder head, safety head spring, and discharge valve cage assembly from above the cylinder liner to be removed (See "TO REMOVE CYLINDER HEAD"). The suction valve plate (Ref. No. 29D) which is mounted on the top of the cylinder liner (Ref. No. 29F) is tapered in toward the top. A block of soft wood should be cut and shaped to fit into this taper (Figures 14 and 15). Rotate the crankshaft until piston head is down about two inches from the top surface of the valve plate. Place wood block in cylinder so that tapered ends fit inside of valve plate and hold in position. Rotate the crankshaft until piston head contacts puller block and continue to rotate shaft so that piston forces cylinder liner out of housing. When rotating shaft, provide an even pressure. Do not bump. After cylinder assembly is forced out beyond the "O" ring seal (Fig. 15) it can be withdrawn by hand. On cylinder liners equipped with unloaders, the unloader mechanism will come out with the cylinder liner. While the liner is being withdrawn, support the piston through the liner so that the piston does not bump against the compressor housing when the liner comes off.

In some cases, while disassembling the compressor, it may be impossible to rotate the crankshaft or to run the pistons up and down within the cylinders. Thus the cylinder liner can not be removed by using the piston to drive the liner out of the cylinder. In such cases it will be necessary to remove the hand hole covers from the compressor (see "TO REMOVE HAND HOLE COVERS"), and drive the cylinder liners out by hand. This can be accomplished by placing a small block of hard wood against the skirt or bottom of the cylinder liner and by tapping against this block of wood with a light hammer. In this fashion, drive the cylinder liner up within the cylinder until the "O" ring clears the top of the cylinder. The liner can then be removed by hand.

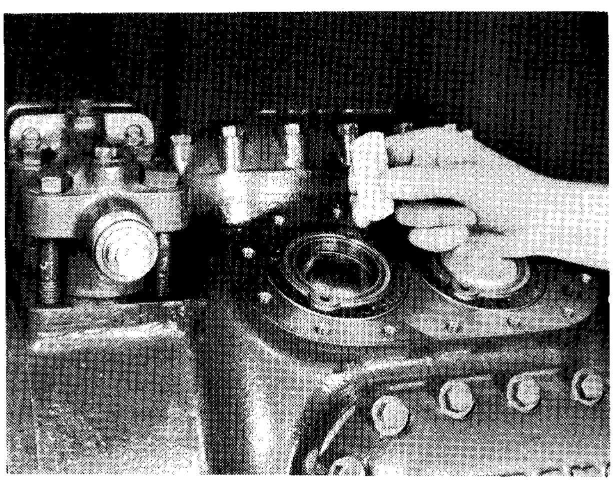


Figure No. 14

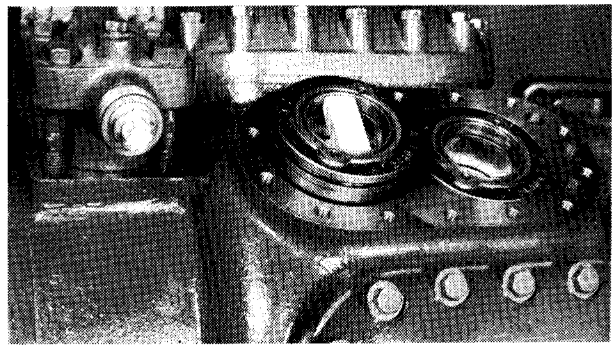


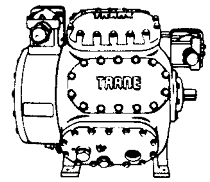
Figure No. 15

TO INSTALL: (CYLINDER LINER ASSEMBLY WITHOUT UNLOADER)

The bottom of the cylinder liner assembly is tapered for entry of the piston and piston rings. Before placing the liner over the piston, rotate the piston rings on the piston to stagger the gap of the rings. Rotate the crankshaft so that the piston is near the bottom of its stroke. While rotating the shaft and moving the piston, guide the piston so that it does not become wedged in the cylinder hole. Place the liner in the hole in the crankcase until the liner is against the top of the piston. Reach through the liner and center the head of the piston in the bottom of the liner. Push the liner down over the the piston so that it does not become wedged in the cylinder hole. Place the liner in the hole in the crankcase until the liner is against the top of the piston. Reach through the liner and center the head of the piston in the bottom of the liner. Push the liner down over the piston until the first ring is contacted. Rock and rotate the liner on the piston, and at the same time press it down firmly against the ring. The rocking and rotating motion will guide the ring into the tapered cylinder liner.

CAUTION: Do not hammer or attempt to force the liner over the ring. Sudden shock can cause ring breakage.

After the first ring is picked up, push the liner down to contact with the second ring. Rotate the crankshaft and raise the head of the piston about 1/2". Rock and rotate the cylinder liner, pressing down as before until the second ring is guided into the liner. Repeat the operation until the third ring is guided into the liner. When all rings are in the liner, push the liner all the way down into the cylinder housing. Never use a hammer or try to drive cylinder liner in place after "O" ring makes contact with the housing. Cylinder liner should be pushed into place. This can be done by hand. If the liner assembly will not go all the way, it may be that the suction valve plate is not properly centered on the top of the liner. Loosen the three socket head cap screws (Ref. No. 29A) while pushing the liner into place (Fig. 16). When liner is in place, tighten the socket head cap screws.


PRINTED IN U.S.A. SM-400-1-154
THE TRANTE COMPANY - LA CROSSE, WISCONSIN

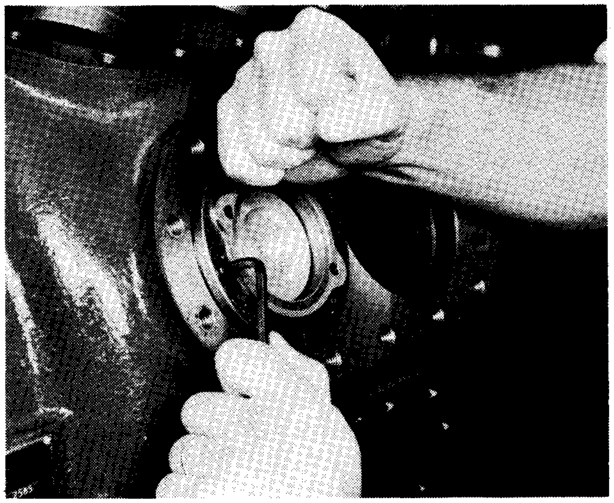


Figure No. 16

TO INSTALL: (CYLINDER LINER ASSEMBLY WITH UNLOADER)

The installation of the cylinder liner assembly with unloader is the same as the installation of the plain liner above as far as entry of the piston and rings is concerned. The main difference, however, is in the proper positioning of the unloader assembly in the housing. The unloader cylinder housing is fitted with a roll pin (Ref. No. 6) and an oil connector (Ref. No. 30G) as shown in Figure 17. The under side of the unloader assembly has two holes which correspond to the above. The holes are 180° apart. The roll pin dowell protrudes further from the face of the housing than does the oil connector. The roll pin serves as a guide for the unloader assembly and permits proper registration of the oil connector. Before inserting the cylinder liner with unloader assembly into the housing, make sure that the holes of the unloader are positioned so that the dowel and oil connector will register properly.

CAUTION: The dowel pin hole in the unloader assembly is smaller than the oil connector hole. The oil connector hole will pass over the dowel, but the dowel hole will not go over the oil connector. Forcing the unloader assembly down when unloader assembly is improperly positioned by 180° will cause excessive damage to the oil connector.

The cylinder liner assembly with unloader should be pushed down into the housing the same as described above. When unloader comes in contact with the roll pin dowel, slowly rotate assembly back and forth until roll pin registers in unloader. Push liner assembly into housing. Do not try to force down as small unloader hole may be registering with the oil connector. If liner does not go in readily, remove from housing and check position of holes with respect to the dowel and oil connector. If an attempt has been made to force unloader down while positioned incorrectly, check the oil connector for possible damage. A damaged oil connector "O" ring can cause erratic functioning of the unloader mechanism. If, after the roll pin dowel and oil connector have registered, the cylinder liner will not go all the way into the housing, check alignment of suction valve (Fig. 16) as described in "TO INSTALL CYLINDER LINER WITHOUT UNLOADER."

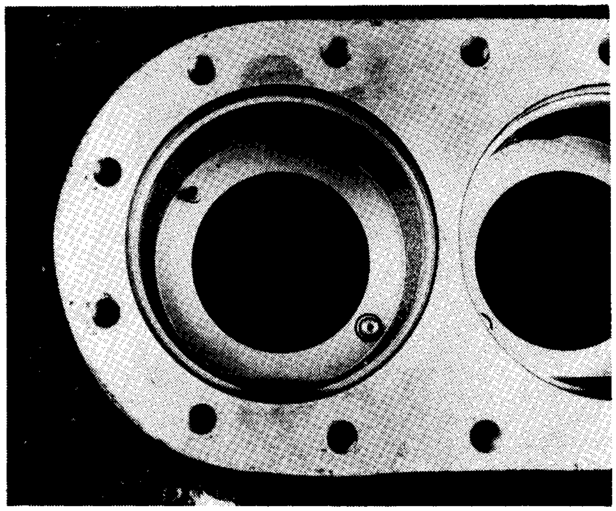


Figure No. 17

CYLINDER UNLOADER ASSEMBLY

Three of the four cylinder liners in the Model B-514 Compressors are equipped with an unloader mechanism. This mechanism acts to load or unload the compressor cylinder by controlling the seating of the suction valves. The unloader mechanism slips into place over the cylinder liner and seals against the liner with "O" rings. No bolts are required to fasten the unloader mechanism to the cylinder liner. The unloader mechanism is a subassembly which is not to be serviced in the field. Should the unloader become inoperative, the entire unloader sub-assembly must be replaced.

TO REMOVE:

The unloader mechanism is removed from the cylinder liner by gripping the unloader assembly in the hands and striking the skirt or bottom of the cylinder liner against a soft wood surface (Fig. 18). Be sure that the unloader mechanism is held firmly between the two hands and that the bottom of the cylinder liner strikes evenly against the wood surface. Also be sure that the wood surface is soft and free of any hard metal particles or tools that would damage the bottom of the liner assembly when it strikes the wood surface.

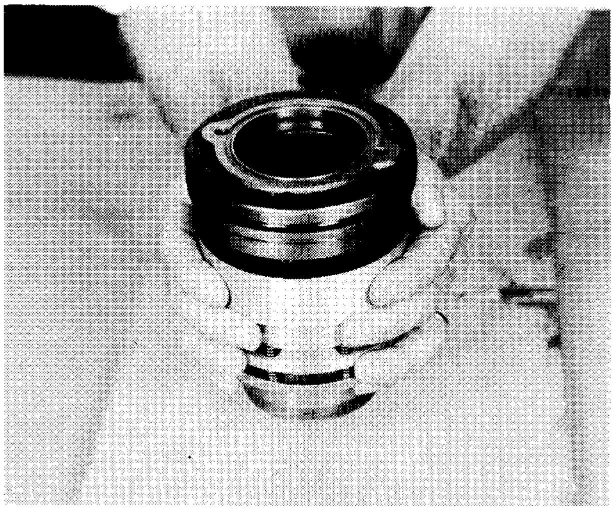


Figure No. 18

TO INSTALL:

The unloader mechanism slides on to the cylinder liner and is sealed in position by two "O" rings. Before placing the unloader mechanism on the cylinder liner, oil the external surfaces of the cylinder liner and the internal surfaces of the unloader with clean compressor oil. Be sure the "O" rings are well lubricated. Invert the cylinder liner on the table or bench. Be sure that the work surface on which the cylinder liner assembly is resting is clean and free of hard metal particles which would damage the valve seat on the top of the cylinder liner (Fig. 18). With the cylinder liner inverted on the bench, place the unloader mechanism squarely in position on the skirt or bottom of the cylinder liner (Fig. 19). Slowly and evenly with a firm pressure, push the cylinder unloader mechanism down on the cylinder liner.

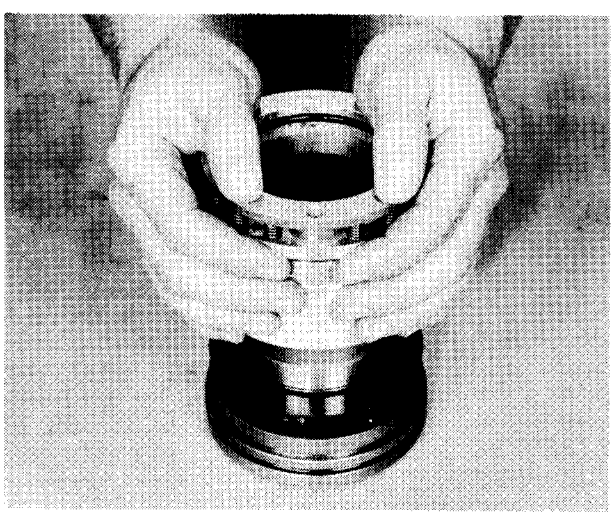


Figure No. 19

CAUTION: Be sure that fingers are free and do not get pinched between the cylinder unloader mechanism and the take-up ring on the cylinder liner.

When the unloader mechanism is finally in place, the unloader mechanism should be touching the surface of the take-up ring (Ref. No. 30C). Be sure that retaining ring (Ref. No. 30D) is properly in place in the slot in the cylinder liner so that unloader mechanism and take-up ring will operate correctly.

SUCTION VALVE ASSEMBLY

In the Trane Model B-514 Compressor, the discharge valve cage assembly is mounted on the top of the cylinder liner and a part of its valve seat is formed by the valve plate which holds the suction valve mechanism in place on top of the cylinder liner. The top surface of the cylinder liner forms the seat for the suction valve. The discharge valve assembly, the suction valve assembly and cylinder liner assembly are all held in place within the cylinder by the safety head spring which is compressed against the discharge cage by the cylinder head. The compression chamber is isolated from the crankcase by an "O" ring seal around the liner against the cylinder wall.

This type of valve and seat design differs from the type of design which incorporates a valve plate assembly wherein the suction and discharge valves are bolted to a single plate which covers two cylinders. The valve design of the Model B-514 Compressor eliminates the extra bolts and gaskets which are a necessary part of the valve plate assembly type of design.

TO REMOVE:

The suction valve assembly is located on top of the cylinder liner and is held in place by a valve plate (Ref. No. 29B) and three socket head cap screws (Ref. No. 29A). The entire suction valve assembly can be removed and replaced as a unit or it can be disassembled and broken or worn pieces replaced. When the entire suction valve assembly is replaced, the liner and valve plate assembly is replaced as a unit. If parts of the suction valve are to be replaced, stand the cylinder liner in upright position and remove the three socket head cap screws (Ref. No. 29A). When the three screws are removed, be careful not to move the valve plate around on the top of the cylinder liner (Fig. 20). With the screws removed, carefully invert the cylinder liner and valve assembly, being careful not to separate the valve assembly from the cylinder liner. With the cylinder liner and valve assembly set up in inverted position, the liner can be drawn away from the valve assembly (Fig. 21) without the component parts of the valve assembly falling out. With the cylinder liner separated from the valve assembly, the valve ring (Ref. No. 29B) and the valve springs (Ref. No. 29C) and the "O" ring (Ref. No. 29E) can be removed (Fig. 22).

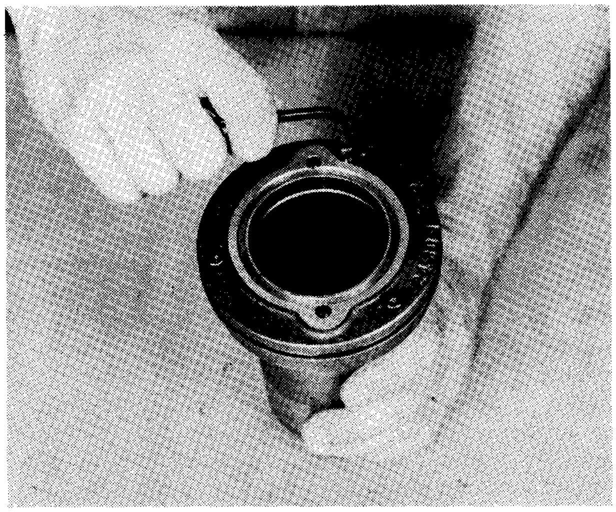


Figure No. 20

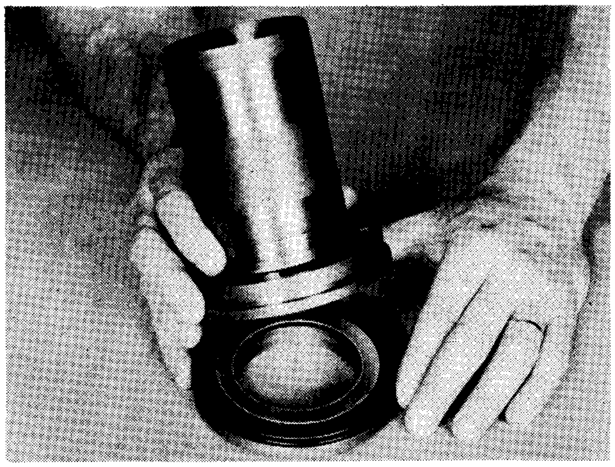


Figure No. 21

TO ASSEMBLE:

With the suction valve plate (Ref. No. 29B) in an inverted position, place the "O" ring (Ref. No. 29E) in place on the valve plate. Place the springs (Ref. No. 29C) in position in the spring pockets (Fig. 23). Place the valve ring (Ref. No. 29B) in position in the valve plate (Fig. 24). Be sure the valve ring is centered so that the valve movement is not restricted. Place the valve plate assembly in an inverted position on the work table and carefully locate the cylinder liner on the valve plate (Fig. 21). Holding the valve plate against the cylinder liner, invert the liner and valve assembly and set in upright position on the table. Insert the socket head cap screws but do not tighten in place (Fig. 20). With the socket head cap screws snug but not fully tightened, invert the cylinder liner and check the movement of the valve to see that it is not restricted or "pinched" within the assembly (Fig. 25). The socket head cap screws can now be tightened down as the valve ring is in its proper position.

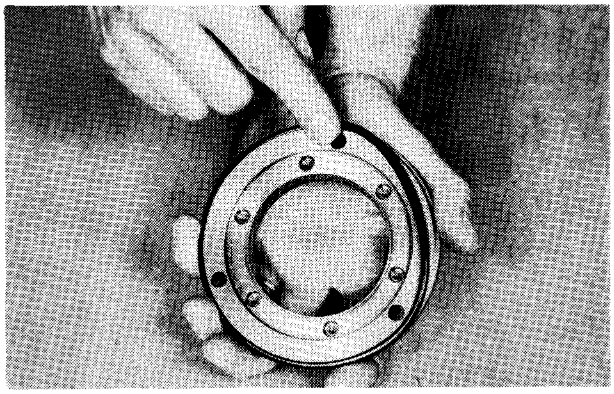


Figure No. 22

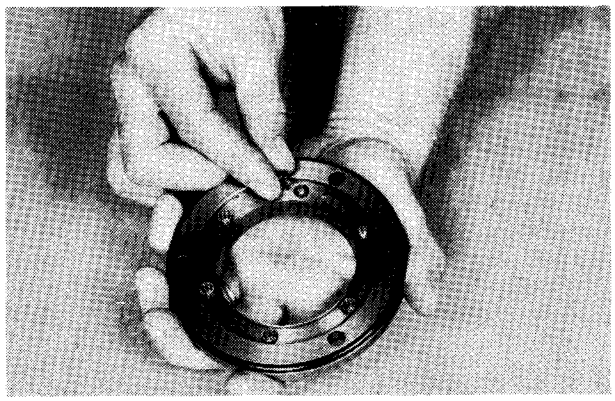


Figure No. 23

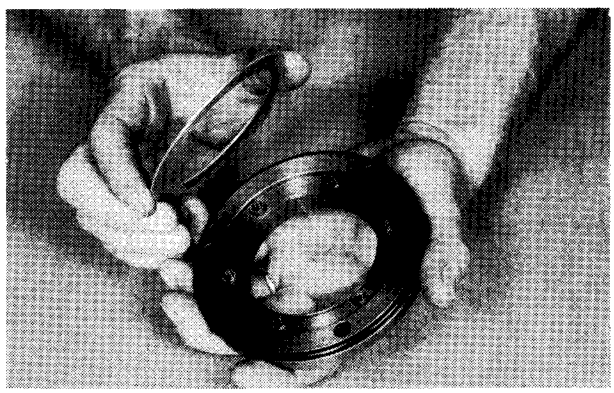


Figure No. 24

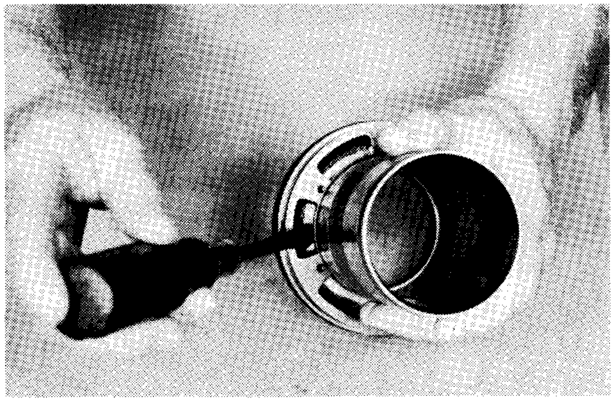


Figure No. 25

TAKE-UP RING AND LIFT PINS

The cylinder liner which is used in the cylinder without unloading mechanism and the cylinder liner which is used with the unloader are the same and the two are interchangeable. The cylinder liner with the unloading feature includes, besides the unloader mechanism, a take-up ring and lift pins. When the unloader is in the "loaded" position, the take-up ring and lift pins are down and the suction valve is free to operate in a normal fashion. When the unloader mechanism is in the "unloaded" position, the take-up ring and the lift pins are up and the lift pins register against the underneath surface of the suction valve ring and hold the valve off its seat.

TO DISASSEMBLE:

Place cylinder liner on work area in an inverted position. Release retaining ring (Ref. No. 30B) and slide off cylinder liner. Slide take-up ring (Ref. No. 30C) off the cylinder liner. Remove lift pins (Ref. No. 30B) and lift pin springs (Ref. No. 30A).

TO ASSEMBLE:

Place cylinder liner on work area in an inverted position. Place springs (Ref. 30A) on lift pins and insert lift pins in holes on underside of cylinder liner (Fig. 26). After each pin is inserted, push the pin in and out to see that it operates freely. Push take-up ring (Ref. No. 30B) over and down on cylinder liner (Fig. 27). Slide retaining ring (Ref. 30D) over cylinder liner and snap into position in ring groove. With retaining ring in position, work the take-up ring up and down to see that the lift pins move freely and can raise and lower the suction valve ring. Be sure that lift pins do not bind. The cylinder liner is now ready for the assembly of the unloader mechanism to the cylinder liner (see "TO INSTALL UNLOADER ASSEMBLY").

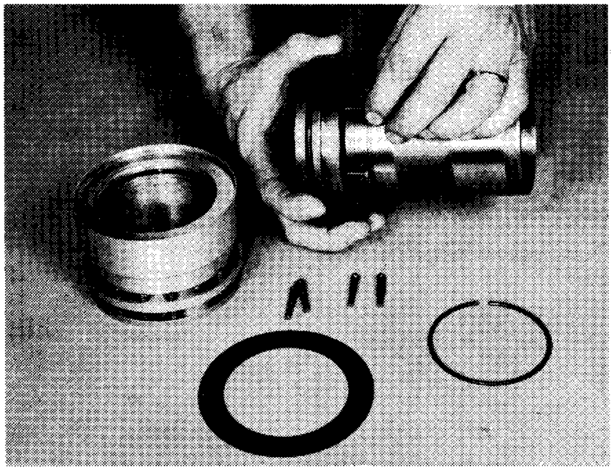


Figure No. 26

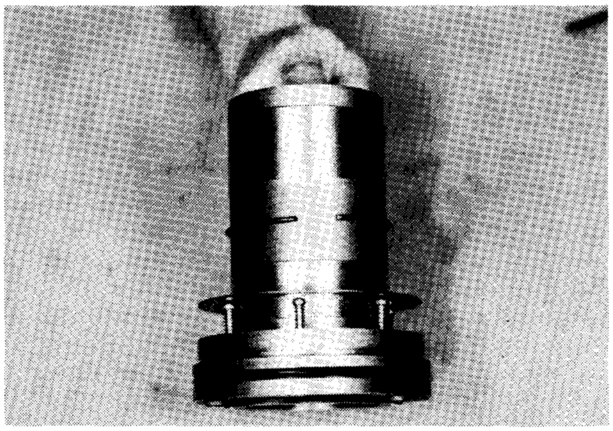


Figure No. 27

CRANKCASE HANDHOLE COVER PLATES

The Trane Model B-514 Compressor crankcase incorporates two large handholes for maximum accesibility with one hole on either side of the crankcase. These handholes are closed off with handhole covers. The handhole cover on the back side of the compressor is fitted with two tappings, one for a crankcase oil equalizing line and the other for a crankcase oil heater, should such a heater be required with a compressor installation.

The handhole on the front side of the compressor contains the oil level sight glass and the complete compressor capacity control actuator. This capacity control actuator is self-contained and its range is adjustable by a screw located in the front side of the cover assembly. The handhole cover also contains a cleanable oil strainer. Figure 28 shows the face or front side of the handhole cover assembly.

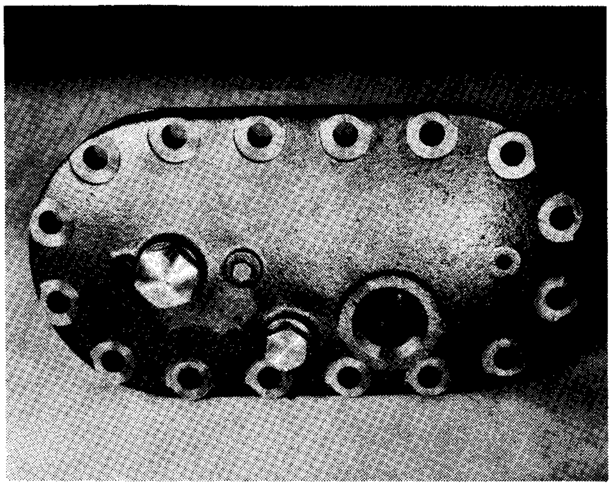


Figure No. 28

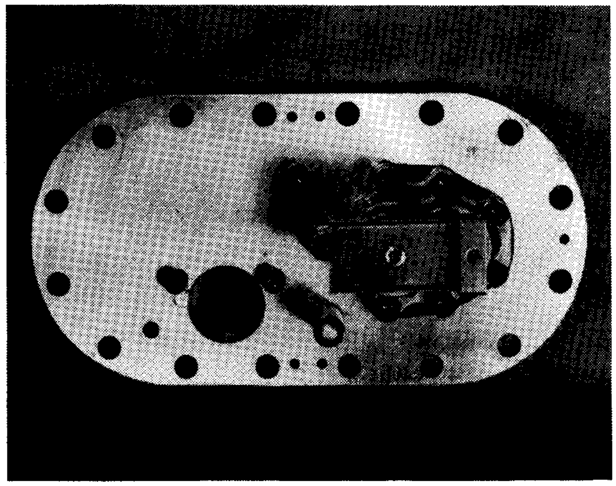


Figure No. 29

Figure 29 shows the reverse side of the handhole cover assembly with the capacity control mechanism. This capacity control mechanism is a complete assembly and can be removed as a unit with the handhole cover. The capacity control mechanism is a sub-assembly which is not to be serviced in the field. If the capacity control mechanism becomes inoperative, the entire handhole cover assembly and capacity control actuator should be replaced as a unit.

The capacity control mechanism can operate as a self-contained device, which is dependent upon suction pressure variations to load and unload the machine or the mechanism can be fitted with an external electric or pneumatic control. For adjustments to the capacity control mechanism and explanations of the external connections to this control together with information as to the operation of this device, see OPERATION, "COMPRESSOR CAPACITY CONTROL."

TO REMOVE:

Before removing the handhole covers, the oil must be drained from the compressor (see OPERATION, "TO DRAIN OIL"). When the oil has been drained from the compressor, either handhole cover may be removed without breaking any internal connections. However, on the handhole cover with the sight glass and capacity control mechanism, all pressure control tubing must be removed from the connections on the face of the handhole cover. On the present Model B-514 Compressor the control tubing is connected to the crankcase housing proper and is not connected to the face of the handhole cover.

Loosen and remove all but the top center cap screw on the handhole cover. The top screw should be backed out approximately 8 to 10 turns but should be left in the compressor housing to support the weight of the handhole cover when it breaks loose from the gasket which seals the opening. With all but one of the screws removed, lightly tap around the rim of the handhole cover to break it loose from the gasket. When the gasket seal behind the crankcase handhole cover is broken, support the cover with the hand at the bottom of the cover and remove the remaining cap screw. The cover can then be drawn away from the compressor as there are no internal connections behind the cover to disconnect.

The blank handhole cover on the back side of the compressor can be removed in a similar fashion. Always leave the top center bolt in place to support the weight of the cover while breaking the gasket seal behind the cover.

TO INSTALL:

Before placing the crankcase cover in position against the compressor housing, make sure that the cover is free of dirt. Place two cap screws through the cover. Oil the gasket with clean compressor oil and place the gasket against the two cap screws and against the cover plate. Position the cover gasket and two bolts against the opening in the crankcase and draw up the two bolts, hand tight. Insert the remaining cap screws and pull them up hand tight. When the handhole cover is in position with all cap screws hand tight, the screws can be tightened to final torque. After bolts are torqued up, recheck all bolts to see that the torque is proper. TORQUE — 37 foot pounds.

PISTON AND WRIST PIN ASSEMBLY

Pistons of the Trane Compressor are of the automotive type, lightweight, cast aluminum. The flexible cam ground skirts of the piston assure close fit under low or normal piston temperatures and prevent seizure under high piston temperatures. Piston pins are of floating type and are held in position by snap rings. The pistons are fitted with two compression rings and one oil control ring. Since the suction valve is not located in the piston, reciprocating weight is held to an absolute minimum.

TO REMOVE:

With a Tru-Arc wrench remove the two snap rings that hold the wrist pin in place in the piston. The wrist pin can now be removed from the piston by driving the pin out through the wrist pin hole, using a wood block or a brass driving rod. Use care not to nick the surface of the piston or distort the shape of the hole.

TO INSTALL:

Position the connecting rod in the piston and drive the wrist pin through the wrist pin hole in the piston and through the connecting rod. The wrist pin is driven into position by tapping lightly with a rawhide mallet and brass driving rod. When the wrist pin is in its final position, insert with a Tru-Arc wrench the two wrist pin locking rings.

PISTON RINGS

The three piston rings when replaced should be replaced as a set. A set consists of two compression rings and one oil control ring. These rings should be carefully fitted into the grooves in the piston and should be clean and free from dirt and burrs after assembly on the piston.

TO REMOVE:

The piston rings can be removed from the piston by using shim stock between the rings and the piston. Carefully work the rings out of the groove and slide them over the shim stock and off the piston. Care should be used in removing the rings as they are easily broken.

TO INSTALL:

To install the rings, work them carefully down over the piston to their proper groove using shim stock to aid the rings into position. The oil control ring goes in the bottom groove on the piston and the two compression rings go in the upper two grooves. When the rings are in final position, check to see that they move freely on the piston in the grooves.

When installing new rings on the piston, be sure that the grooves in the piston do not have any burrs and that the grooves are free of dirt. Before placing the piston rings in the grooves on the piston, check to see that the rings fit the grooves freely. The back edge of the ring can be rolled around the circumference of the piston to see that it fits freely (see Fig. 30).

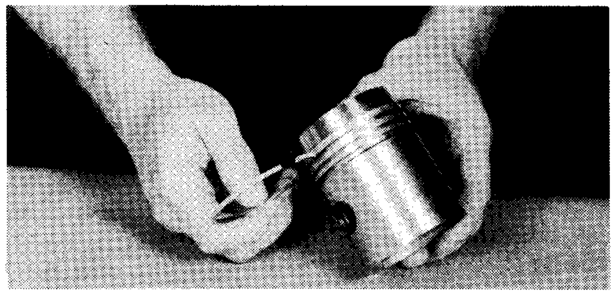


Figure No. 30

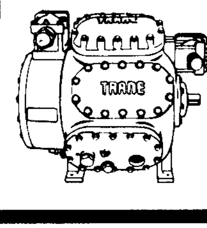
CONNECTING ROD AND PISTON ASSEMBLY

The connecting rods are heat-treated aluminum alloy having a good bearing quality, high mechanical strength and light weight. No bearing inserts are used, permitting good tolerance control and maximum heat transfer from bearing surfaces. The bearing surface is treated with graphitic material for longer life. Connecting rods are oval-bored at both ends. This oval fit insures good bearing contact at both high and low operating temperatures. When the compressor chills down rapidly, the rod shrinks faster in size than the crankshaft due to the difference of materials in the connecting rod and the crankshaft. With the oval type bore, seizure is prevented as the rod and shaft temperature is decreased.

The connecting rod bolts are undercut for increased strength (see Fig. 31).

TO REMOVE:

Remove cylinder head (see "TO REMOVE CYLINDER HEAD"). Remove discharge valve cage (see "TO REMOVE DISCHARGE VALVE CAGE"). Remove cylinder liner (see "TO REMOVE CYLINDER LINER"). Remove handhole covers. Rotate the crankshaft until the connecting rod nuts are accessible through the handhole cover. With a box or socket wrench, loosen and remove the two nuts from the connecting rod bolts. These nuts are crimped and must be run all the way off with a wrench. Remove connecting rod washers. Connecting rod bolts are body bound in the connecting rod and rod cap and must be driven out of the connecting rod cap.



With a block of wood or lightweight mallet, slowly and alternately drive the connecting rod bolts up through connecting rod. When body bound section of the bolt is free of the connecting rod cap, the cap can be removed. After the cap has been removed, the piston and connecting rod assembly can be drawn out through the top of the cylinder.

TO INSTALL:

Before installing the connecting rods on the crankshaft be sure that the bearing surfaces of the shaft and the connecting rod are clean and free of dirt. Lubricate the bearing surfaces on the rod and shaft with clean compressor oil. Inasmuch as connecting rod bolts are body-bound, they must be driven into place with a lightweight mallet or hammer (see Fig. 32). Be sure that the flat side of the head of the connecting rod bolt is properly positioned with respect to the metal keeper and the shank of the connecting rod. All connecting rods have two match marks which identify the rod and cap as a unit. THESE TWO MATCH MARKS MUST BE ASSEMBLED SO THAT THEY ARE ON THE SAME SIDE OF THE ROD and when assembling the rods on the shaft, the match marks are always assembled with the match marks facing the seal end of the compressor (see Fig. 33).

Invert cylinder liner assembly on clean work surface using care not to mar the valve seat on the top side of the liner assembly. Rotate the piston rings on the piston to stagger the gap in the piston rings. Start the head of the piston down into the cylinder liner. The cylinder liner skirt is tapered as is the top of the piston to assist the entry of the piston and ring into the liner. With the piston started into the liner, rotate and rock the piston and at the same time press down firmly on the skirt of the piston (see Fig. 34). The rocking and the cylinder liner. After all rings have passed the bottom of the liner skirt, push the piston down into the liner until the bottom of the piston is even with the bottom of the cylinder liner. With the piston inserted into the liner, rotate the liner with reference to the connecting rod so that when the side of the rod with the match rotating motion will cause the piston and rings to enter mark is facing the seal end of the compressor, the register pin hole and oil connector hole are properly aligned for entry and location within the cylinder (see "TO INSTALL CYLINDER LINER ASSEMBLY WITH UNLOADER"). With the rod and liner in this position (Fig. 35), rotate the crankshaft until the shaft journal is in position to accept the connecting rod. Push the entire assembly down into the cylinder and with the locating pin and connecting rod in position in the cylinder liner unloader assembly, press the liner into final position (see "TO INSTALL CYLINDER LINER WITH UNLOADER"). With the rod in position against the shaft, place the cap on to the connecting rod bolts. Be sure that the match marks on the cap faces the seal end of the compressor. The connecting rod cap will not go all the way on to the connecting rod bolts due to the fact that the bolt is of the body bound type. The rod cap must be drawn into final position by the connecting rod bolt nuts. With the cap in position and as far on the bolt as it will go, place the connecting rod bolt, washers and nuts in place and tighten the connecting rod nuts on the bolts. When drawing up the connecting rod nuts, do so alternately so as not to pull the cap up against the rod unevenly. If the cap is pulled on the bolts unevenly, it can be badly distorted and will be damaged when the compressor is placed in operation. The connecting rod nuts should be drawn up hand tight and their final tightening should be done with a torque wrench. It is essential that these nuts be finally drawn up with a torque wrench as improper tension on these rods will cause distortion of the fit of the rod and will result in premature wear and possibly complete failure of the

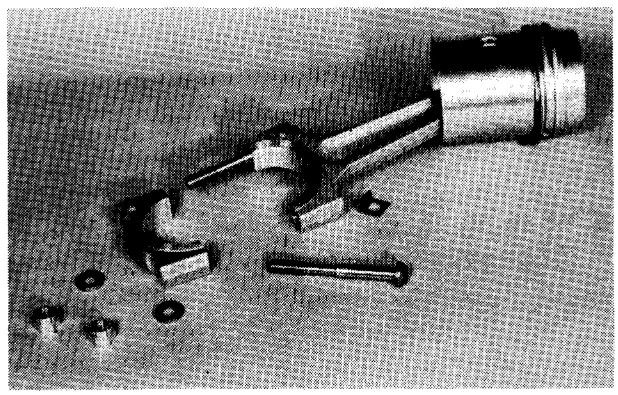


Figure No. 31

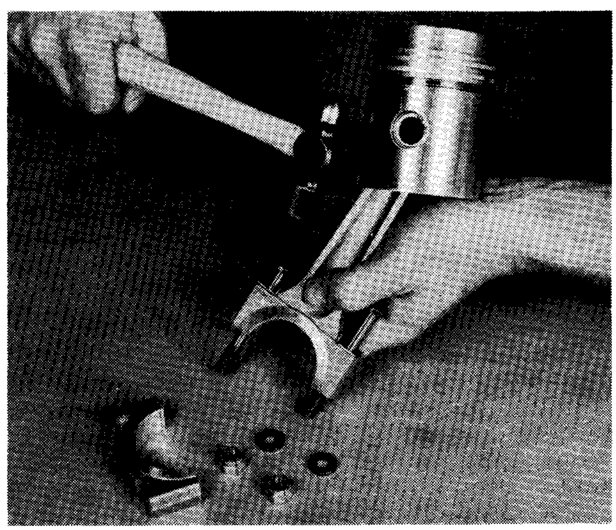


Figure No. 32

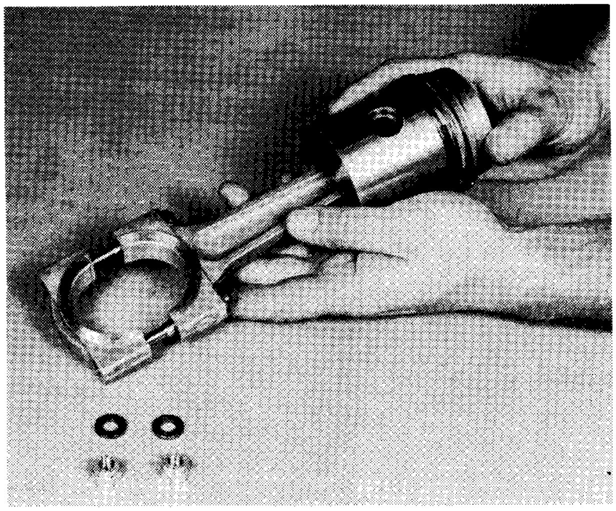


Figure No. 33

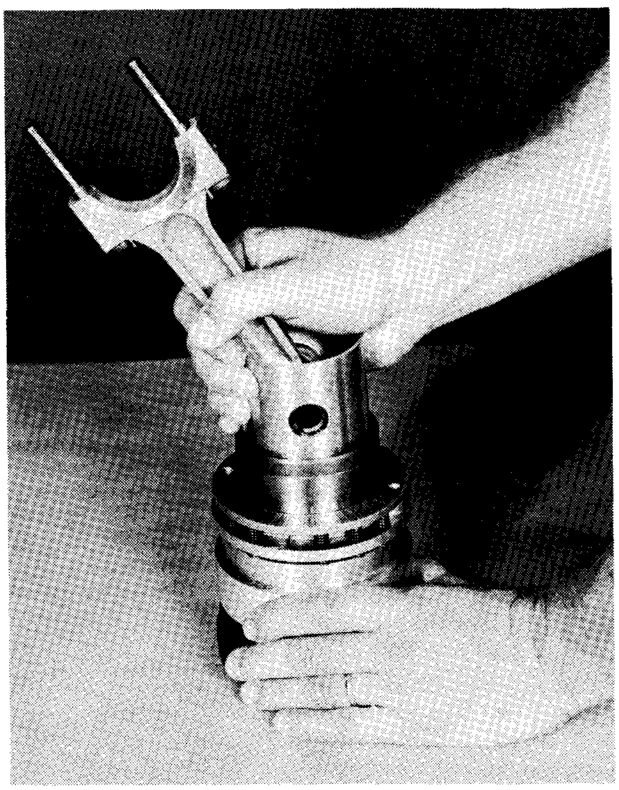


Figure No. 34

connecting rod bearing. The proper torque for the connecting rod bolts and nuts on the Model B-514 Compressor is 15 foot pounds. After torqueing the nuts, recheck to make sure that the torque is correct.
TORQUE — 15 foot pounds.

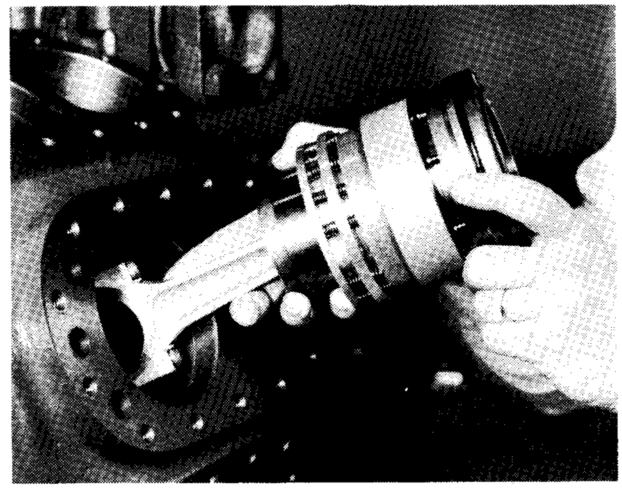


Figure No. 35

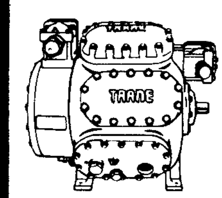
CAUTION: After a connecting rod has been tightened up to proper torque, rotate the crankshaft to make sure that the rod turns freely. Repeat as each rod is installed.

COMPRESSOR SHAFT SEAL

The compressor shaft seal is of the standard rotary type. One piece construction on seal cover plate permits fast removal of heat from the sealing surface, thereby providing longer life.

TO REMOVE:

Remove compressor drive coupling (see COUPLING, "TO REMOVE"). Loosen and remove all but two of the socket head cap screws that hold the valve plate against the bearing housing. Slowly and alternately back out the two remaining cap screws (Fig. 36). The seal plate should be forced away from the bearing housing by the tension of the shaft seal spring. However, if the plate does not follow the two cap screws, lightly tap around the outer rim of the cover plate until it is free from the gasket seal on the housing. Carefully back out the two cap screws so that the plate follows the screws. Be sure that the plate is removed evenly so as not to distort the seal and cause breakage of the carbon ring within the seal. When the plate has been removed, the seal assembly can be drawn out of the compressor. In some cases



the Neoprene ring will adhere to the crankshaft. If the seal spring pressure does not force the carbon nose ring and retaining flange clear of the seal housing, it can be loosened from the shaft by the use of a seal puller or hooking small Allen wrenches behind the Neoprene ring and forcing the ring off the shaft shoulder. Use extreme care in handling the seal assembly as the carbon nose ring can be broken or cracked very easily.

TO INSTALL:

In some instances it may be possible to reuse the shaft seal assembly. However, if the seal has had excessive wear or is damaged, it should be replaced with a complete new seal assembly. Never attempt to replace any of the single components of the seal assembly. The seal must always be replaced as a complete unit consisting of spring, Neoprene ring, retainer, carbon nose ring, gasket and seal cover face plate. Before inserting the seal in the bearing housing and on the shaft, make sure that the shaft is smooth and free of dirt (Fig. 37). To assist the entry of the Neoprene ring into the seal housing, lubricate the crankshaft with clean compressor oil or clean white petroleum jelly. After the shaft is cleaned and lubricated, do not touch the surface again with the fingers.

Position seal spring on shaft (Fig. 38). Place Neoprene ring and retainer ring in position on shaft and slide onto shaft as far as the ring will go. Use care not to cut Neoprene on sharp edges of shaft keyway. Thoroughly clean carbon nose ring with a suitable refrigeration compressor parts cleaner. Examine face of carbon nose ring to see that it is free of dirt and is not cracked or chipped. After carbon nose ring has been cleaned, do not touch the sealing surfaces again with the fingers.

Wet the face of the carbon nose ring with clean compressor oil before putting it in position on the shaft. Place the carbon nose ring into the ring retainer making sure that the notches in the retainer are properly aligned with the notches in the carbon nose ring (Fig. 40). Carefully clean and lubricate the face of the seal housing cover plate. Insert two socket head cap screws through holes on opposite sides of the plate (Fig. 36). Lubricate gasket with clean compressor oil and place it over cap screws and against flange on cover plate. Position the cover plate and bolts against the compressor housing. Press the seal assembly into the housing evenly and engage both socket screws in the bearing head. Do not pull one screw down more than the other as distortion at this point may cause breakage of the delicate carbon nose ring. Slowly and alternately draw the seal housing cover plate against the seal housing until the two socket head screws are hand tight. Insert and tighten the remaining screws. After all the screws are in place, they should be tightened into final tension with a torque wrench.

TORQUE — 20 foot pounds.

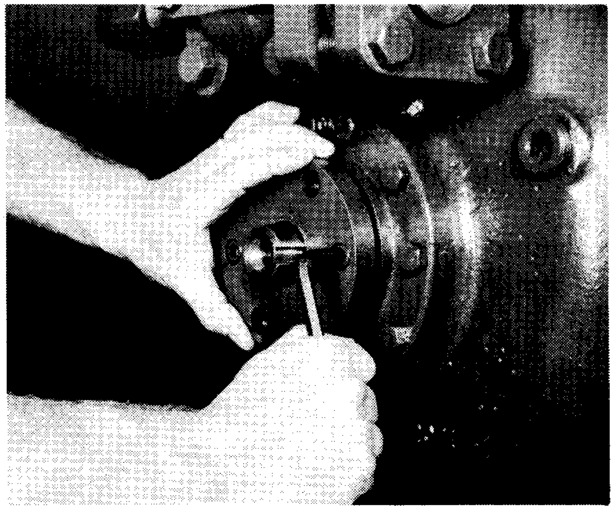


Figure No. 36

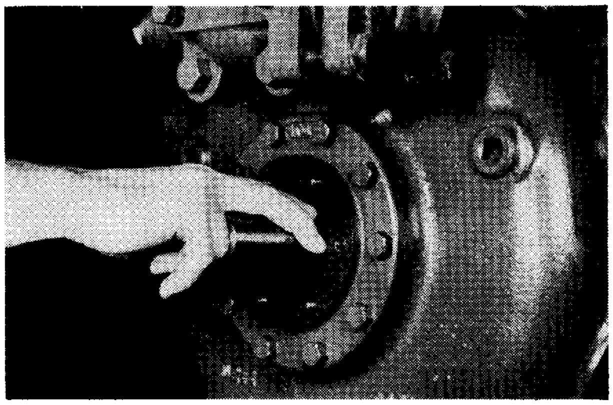


Figure No. 37

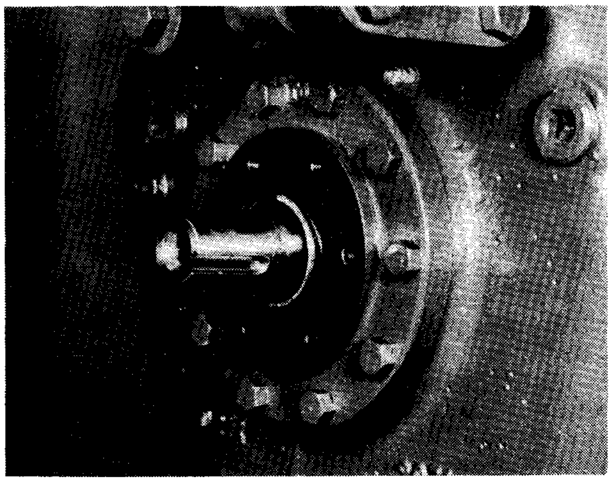


Figure No. 38

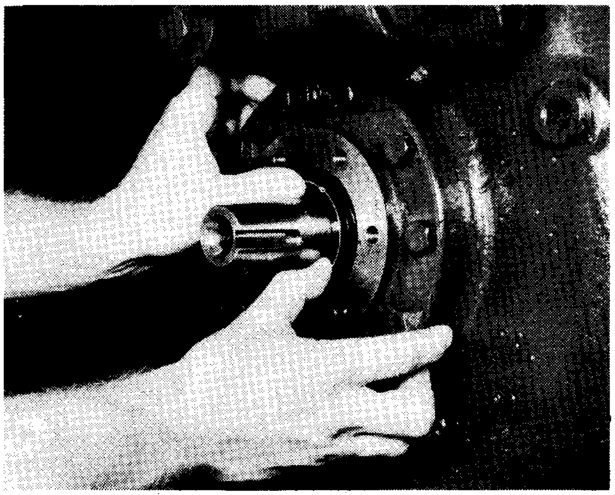


Figure No. 39

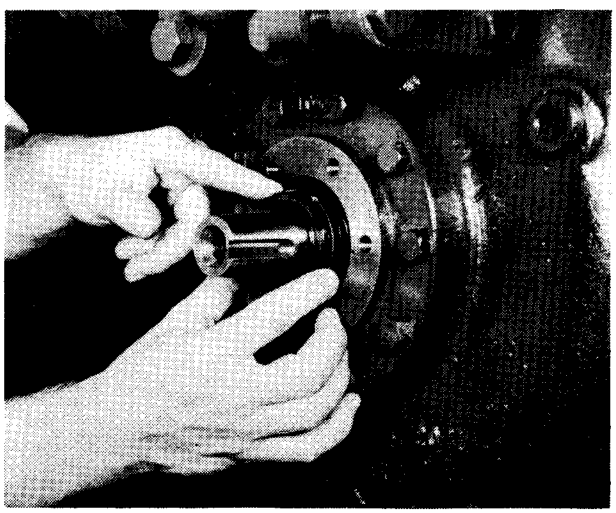


Figure No. 40

SUCTION STRAINER ASSEMBLY

In operation, the suction gas enters the large volume separation chamber of the compressor from the top. Immediately upon entry, the gas strikes the rounded surface of a large circular suction strainer pan. At this point, heavy foreign particles, droplets of oil or liquid refrigerant, if present, are separated from the refrigerant by a combination of gas velocity and gravity and drop to the bottom of the suction chamber.

The suction gas is then deflected at right angles from the suction strainer pan and again by the suction end cover. Changes in direction of gas flow effectively separate foreign particles before they can damage the suction strainer screens.

Heat from the compressor tends to vaporize any slugs of refrigerant into dry gas. This insures maximum dry gas return to the cylinders.

The large suction chamber also insures the delivery of uncontaminated gas to the cylinders. Its size makes it possible to collect oil, metal shavings or liquid refrigerant slugs and hold them for proper disposal.

One suction strainer screen is provided for every two cylinders. These strainers are in a horizontal position, protected by the suction strainer screen.

An uninterrupted flow of refrigerant is conducted to the suction valves through the gas passages in the compressor housing.

The small amount of oil returning with the suction gas collects in the suction chamber. After a certain level is reached, the oil flows back into the crankcase through a fiber wool filter and an oil check valve.

TO REMOVE:

Remove all of the suction cover cap screws (Ref. No. 54) with the exception of the top screw. Back out this top screw 10 or 12 full turns. The screw is left engaged in the threads to support the weight of the suction cover plate when the gasket seal is broken between the cover plate and the crankcase housing. The cover plate is provided with jack screw holes and two of the cap screws (Ref. 54) should be inserted into these jack screw holes to assist in breaking the gasket seal. Run the jack screws in through the cover plate until the seal is broken. Remove the top cap screw and at the same time support the weight of the cover with the hand at the bottom of the cover plate.

After the cover plate has been removed, the strainer pan can be removed from the suction chamber. The suction strainer screens can now be cleaned and if the oil filter at the bottom of the strainer assembly is badly contaminated, it can be replaced. This oil filter is a sealed assembly and cannot be cleaned. If it is dirty, it must be replaced. If it is found necessary to replace this filter, remove the two screws and lock washers and replace filter and reinsert the screws and lockwashers.

TO INSTALL:

When the strainer pan is inserted in the suction chamber, the guide post must register in the slot in the bottom of the bearing head (Fig. 41). The strainer pan, when in proper position, is supported by the two legs on the underneath surface of the strainer pan assembly. The strainer pan is held firmly in position by a spring action of the housing cover pressed against the face of the strainer pan. As the cover cap screws are drawn into place, the inner face of the cover will depress the face of the pan and hold it securely in place. Before placing the cover in position, insert a cap screw in the top and bottom of the cover, lubricate the surface of the gasket with clean compressor oil and position the gasket on the two cap screws and against the cover plate.

Position the cover plate against the face of the suction chamber and tighten the two cap screws. Insert the remaining cap screws and draw them up hand tight. When all of the cap screws are hand tight, final tightening should be made with a torque wrench. After the bolts have been drawn up to the proper torque, recheck the torque to insure that it is correct.
TORQUE — 55 foot pounds.

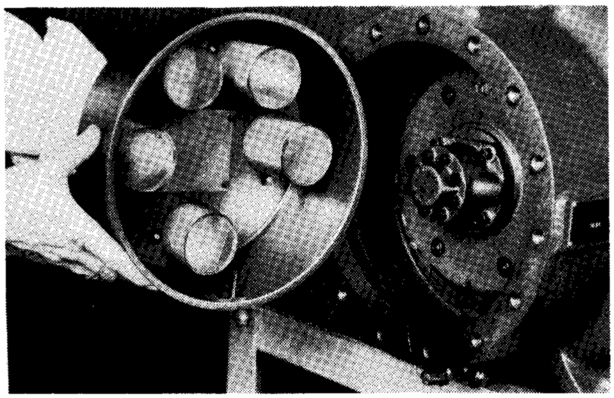


Figure No. 41

OIL PUMP ASSEMBLY

The oil pump used in the Model B-514 Compressor is a force feed, direct drive, positive displacement pump which is self-reversing in operation. The pump will operate regardless of the direction of rotation of the compressor; thus, even though the electric line phasing is accidently reversed, the compressor will still operate properly. The oil pump is a complete assembly and should not be serviced in the field. If the oil pump becomes inoperative, the complete oil pump assembly should be replaced.

TO REMOVE:

The oil pump assembly is held in position on the bearing head and against the end of the crankshaft by four socket head cap screws. Loosen and remove the four cap screws and lockwashers (Ref. Nos. 52 and 53). Rock the oil pump assembly up and down to break the gasket seal. Do not strike the oil pump assembly with a hammer.

TO INSTALL:

Before placing oil pump in position on the bearing head, be sure that the face of the bearing head and the face of the oil pump flange are clean and free of dirt. Place two cap screws through the holes in the flange of the oil pump. Lubricate the gasket with clean compressor oil and position gasket over screws against the flange of the oil pump assembly. Be sure that the holes in the gasket register with the holes in the bearing head. The drain slot in the oil pump assembly must be at the bottom (Fig. 42). Oil pump drive key must be turned to the position required to fit properly in the slot in the end of the crankshaft. Assemble oil pump with the four bolts and lockwashers, pulling up the bolts to the required torque.
TORQUE — 12 foot pounds.

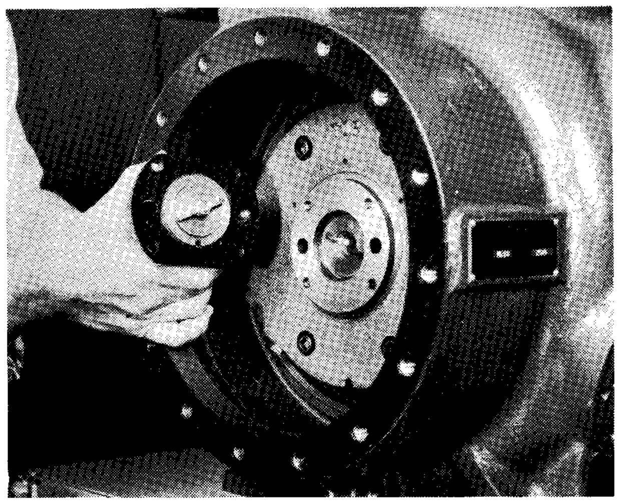


Figure No. 42

MAIN BEARINGS

The main bearings in the compressor are sleeve type, steel backed babbitt. The bearings are pressed into bearing heads and cannot be replaced in the field. If the bearings become damaged or worn, the entire bearing head assembly must be replaced.

The bearing head on the pump end of the compressor contains the foam-breaker.

Within the pump end bearing head is a magnetic plug to filter steel particles out of the oil before the oil passes into the crankshaft and bearings.

The bearing head also contains a pressure relief valve. This valve is a spring-loaded ball seating type valve (Fig. 43). Whenever the crankshaft or main bearings are replaced, adjustment of the crankshaft end play must be made.

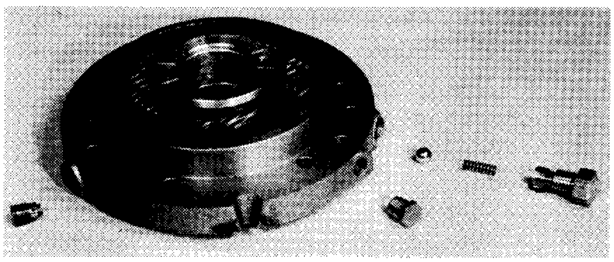


Figure No. 43

CRANKSHAFT

The crankshaft of the Model B-514 Compressor is made of high-strength ductile cast iron. Carbon forms nodules or round particles instead of flakes. These nodules materially increase metal strength by eliminating flaking fractures, making smaller, stronger shafts possible. Further size reduction of the crankshaft was possible since lightweight aluminum rotating parts require less counterweight. The crankshaft can easily be slipped in and out of the large opening in the compressor suction chamber. Because of the compactness and weight of the shaft, no blocking is necessary when the shaft is removed. The crankshaft is built in one piece and does not have detachable counterweights. Because of this feature, shaft balance is always maintained.

The crankshaft is one of the main parts of the compressor lubricating system. Separate oil feed lines to bearings and other wearing parts of the compressor have been eliminated. Crankshaft oil passages are scientifically arranged to feed from the inside of the crankshaft throw. Centrifugal force thus keeps any dirt particles that have escaped previous cleanings away from the bearings. Two magnetic plugs in the oil passage in the shaft trap steel particles. Because of this feature, the bearings run dirt free, aiding in long compressor life.

Oil escapes between the connecting rod bearings and is converted into a mist to lubricate wrist pins and cylinder walls. A tapered hole at the top of the connecting rod collects the oil mist and allows it to feed down into the wrist pin bearing surfaces.

TO REMOVE PUMP END BEARING:

Remove shaft seal assembly (see "TO REMOVE SHAFT SEAL ASSEMBLY). Remove suction cover (see "TO REMOVE SUCTION COVER"). Remove oil pump (see "TO REMOVE OIL PUMP). Remove handhole covers (see "TO REMOVE HANDHOLE COVERS"). Remove piston and connecting rod assemblies (see "TO REMOVE PISTON AND CONNECTING ROD ASSEMBLIES"). Remove bearing head cap screws and lockwashers (Ref. Nos. 1 and 2) from pump end bearing. Insert cap screws in jack screw holes and break gasket seal between face of bearing and compressor housing. If the shaft is frozen within the bearing on the pump end but not on the seal end, the shaft may follow the pump end bearing as it is withdrawn from the housing. While withdrawing the pump end bearing, watch the shaft and if it is following the bearing head, support the shaft with hand through the handhole cover in the crankcase. However, if the shaft does not follow the bearing head, back the bearing head out and support the bearing head with the hand at the bottom. The bearing head has a lip which fits into the compressor housing (see Fig. 43). When the lip of the bearing head is free of the housing, it can be removed from the end of the shaft. The shaft does not have to be supported, for it will balance in the seal end bearing housing without damage to the seal end bearing.

TO REMOVE CRANKSHAFT:

The crankshaft is removed from the compressor through the suction end of the compressor. Before removing the crankshaft remove the connecting rods and piston assemblies (see HANDHOLE COVER, "TO REMOVE"). Remove the shaft seal (see SHAFT SEAL, "TO REMOVE") and the pump end bearing (see PUMP END BEARING, "TO REMOVE"). Grip the crankshaft at the center and at the pump end of the shaft. One hand is through the handhole opening and the other at the end of the shaft (see Fig. 44). Slowly and carefully draw shaft out of seal end bearing. Do not bump bearing with shaft end. When shaft end is clear of bearing, rest counterweight of shaft on bearing housing of compressor (see Fig. 45). Shift hands so that shaft is gripped through suction end of compressor. Draw shaft out of compressor housing.

TO REMOVE SEAL END BEARING:

If the seal end bearing is to be removed, the pump end bearing and the crankshaft must first be removed (see "TO REMOVE PUMP END BEARING" and "TO REMOVE CRANKSHAFT"). The main bearing on the seal end is removed from the housing by first removing the cap screws (Ref. No. 18) from the bearing housing (Ref. No. 19) and inserting the cap screws into the jack screw holes in the bearing housing. Run the cap screws into the jack screw holes and break the gasket seal between the bearing head and the crankcase housing. The bearing housing has a lip which fits into the crankcase housing.

TO INSTALL MAIN BEARINGS AND CRANKSHAFT:

Cover smooth face of bearing thrust collar (Ref. No. 5) with clean compressor oil. Place thrust collar against bearing head with smooth face against bearing head and groove side toward crankcase. Be sure thrust collar is properly located on bearing head register pin.

Lubicate all bearing surfaces on crankshaft. Insert crankshaft into compressor housing and support the weight of the shaft counterweight on the compressor housing (see Fig. 45). With the shaft in this position, shift grip on shaft so that one hand is supporting the crankshaft through the handhole in the crankcase and the other hand is supporting the end of the crankshaft at the suction chamber end of the crankcase (see Fig. 44). Carefully guide the seal end of the shaft into the main bearing on the seal end of the compressor. Do not bump bearing with the end of the shaft as the bearing surface is very soft and can become badly scratched or raised if struck by the end of the shaft. When the end of the shaft is started into the bearing, carefully push the shaft all the way into the bearing until the shoulder of the shaft is against the thrust collar.

When the shaft has been positioned as above, it can be released and does not need to be supported or blocked from the underside.

Cover smooth face of pump end bearing and smooth face of thrust collar with clean compressor oil and position thrust collar on bearing head register pin. Smooth face of thrust collar is toward the bearing head and the grooved side of the thrust collar is toward the shaft and crankcase.

Before placing shims in position on bearing head, be sure that face of flange on bearing head is clean and free of dirt. Also be sure that base of crankshaft is free of dirt. Lubricate end of crankshaft.

When reinstalling the main bearings, the seal end bearing is first placed into the housing and then the shaft is installed, then the pump end bearing is installed. Before installing the seal end bearing, make sure that the crankcase housing bearing face is clean and free of dirt and the flange on the bearing housing is clean and free of dirt. Place two of the bearing head cap screws (Ref. No. 18) into the seal end bearing housing. Lubricate the bearing gasket with clean compressor oil and position the gasket over the cap screws against the face of the flange on the bearing head. Position the bearing head, making sure that the marking "Top" on the face of the bearing head is in the proper position.

Slide the bearing head into position in the crankcase and insert all cap screws in the bearing housing. Tighten cap screws to the proper torque with a torque wrench. TORQUE — 37 foot pounds.

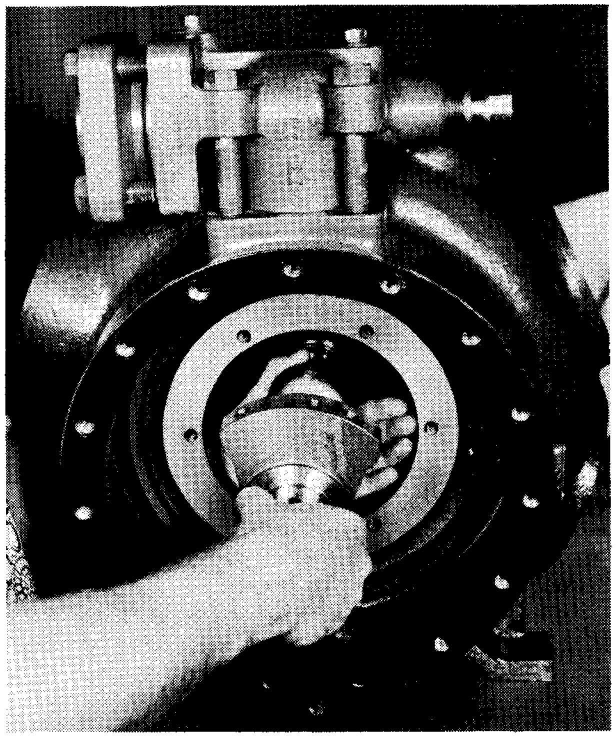


Figure No. 44

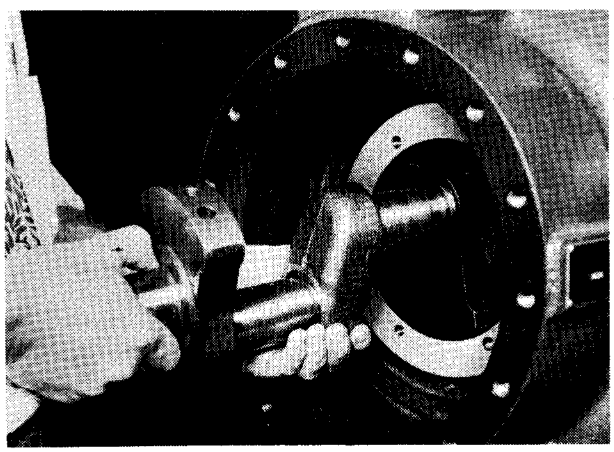
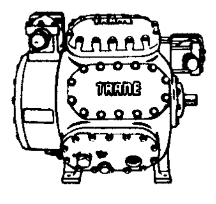


Figure No. 45



COMPRESSOR

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

PUMP END BEARING HEAD AND END PLAY ADJUSTMENT

Included with each replacement pump end bearing head is a set of paper spacer shims. These shims are of .010" and .015" thickness. Select three .015" shims and place these three shims over the cap screws and against the flange of the bearing head. Do not lubricate these shims and do not lubricate the face of the flange of the bearing head and the face of the crankcase. These shims are to be installed dry. With the shims in place, and the thrust collar properly located on the bearing head register pin, carefully place the bearing head assembly on to the end of the crankshaft. When the lip of the bearing head comes in contact with the hole in the crankcase, raise the bearing head assembly and crankshaft slightly to relieve the weight of the shaft and to properly position bearing head for entry into crankcase. When the bearing head is in the correct position, the lip on the bearing head will slide easily into the crankcase housing. With the bearing head over the shaft and entered into the housing, be sure to locate the "Top" mark on the casting in the proper position. Tighten the two cap screws hand tight. Install remaining cap screws and tighten all bolts to proper torque.
TORQUE — 37 foot pounds.

Crankshaft end play measurement and adjustment is to be made without the shaft seal or connecting rods installed. It cannot be regulated with rods or seal installed.

Push crankshaft against pump end bearing thrust collar. With feeler gauge, measure distance between end of shaft and face of seal end thrust collar. Push shaft against seal end bearing thrust collar and with feeler gauge measure distance between shaft and pump end thrust collar. This measurement should be the same on both ends of the shaft. When taking this measurement, measure around the entire circumference of the shaft to take into account any small burrs that may be present on the thrust collars. A second method of measuring end play utilizes the dial indicator as illustrated in Figure 46. The reference point on the dial indicator is placed against the shaft. The shaft is first pushed against the seal end and then back against the pump end. The difference in dial readings gives total end play clearance.

Crankshaft end play clearance on Model B Compressors should be .008" to .015". Crankcase end play is adjusted by the number and thickness of gaskets installed between the pump end bearing flange and the housing. If end play as measured above is greater than the top allowance, decrease the thickness of the shims. If the end play is below the minimum, increase the thickness of the shims. Final end play should be between the limits of .008" and .015". Enclosed with the bearing head are three shims of .010" thickness and three shims of .015" thickness. A combination of shims should be selected to give proper end play clearance.

When final selection of shims have been placed between pump end bearing and crankcase housing, insert torque.
TORQUE — 37 foot pounds.

Recheck end play measurements with feeler gauge.

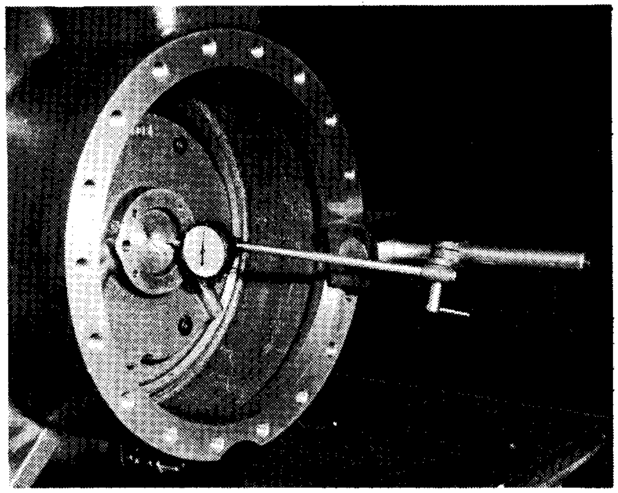
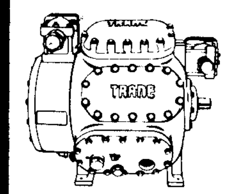


Figure No. 46

FOAM-BREAKER

When a compressor is shut down or during the off period, Freon pressure within the crankcase tends to build up. When the compressor starts up, the pressure within the crankcase is quickly reduced. As the pressure within the crankcase is lowered, Freon is leaving the crankcase rapidly. The crankcase oil also tends to leave the compressor and be entrained with the refrigerant. The result is foaming within the compressor oil. The bearing head on the pump end of the Model B-514 Compressor contains a foam-breaker which separates the oil from the Freon and returns this trapped oil to the crankcase while allowing free passage of the gas into the suction chamber. This reduces the amount of foaming and loss of oil from the crankcase at startup.

The foam-breaker is not a filter or strainer to remove dirt from the crankcase oil. All straining and cleaning of the oil is done by the filter in the suction strainer



pan assembly and the filter in the sump of the compressor. Therefore, the foam-breaker should not require any servicing in the field. However, in some instances the oil within the compressor may become excessively dirty or gummed and it may be necessary to take the foam-breaker assembly apart for cleaning.

TO REMOVE:

If it becomes necessary to clean the foam-breaker assembly within the pump end bearing head, remove retaining ring (Ref. No. 3D) and end ring (Ref. No. 3C). This operation is illustrated in Figure 47 and Figure 48. With the end ring removed, the foam-breaker screen (Ref. No. 3B) can be removed. This is illustrated by Figure 49. The screen and bearing housing can now be cleaned.

It may be necessary to remove the magnetic plug (Ref. No. 3E) and the pressure relief valve (Ref. Nos. 3G, 3H and 3J) from the bearing head to clean the passages within the bearing head assembly. This entire assembly can be washed with a suitable refrigeration compressor parts cleaner.

TO INSTALL:

Carefully roll foam-breaker screen (Ref. No. 3B) into approximate shape and insert into bearing head (Fig. 49 and Fig. 48). Replace end ring (Ref. No. 3C) and retaining ring (Ref. No. 3D). This is shown in Figures 48 and 47. Replace magnetic plug (Ref. No. 3E) and relief valve (Ref. Nos. 3G, 3H and 3J).

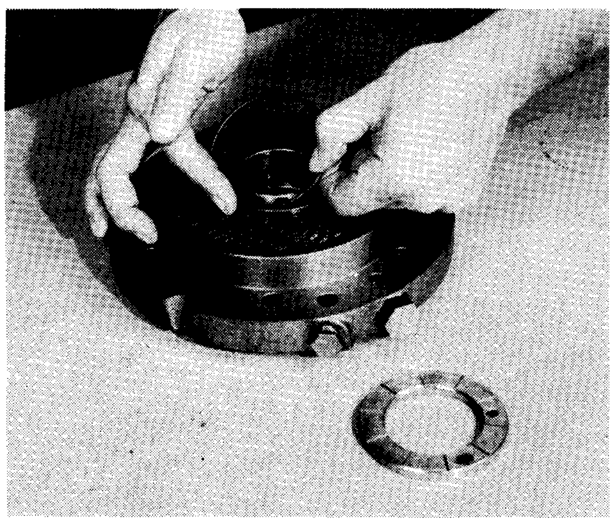


Figure No. 47

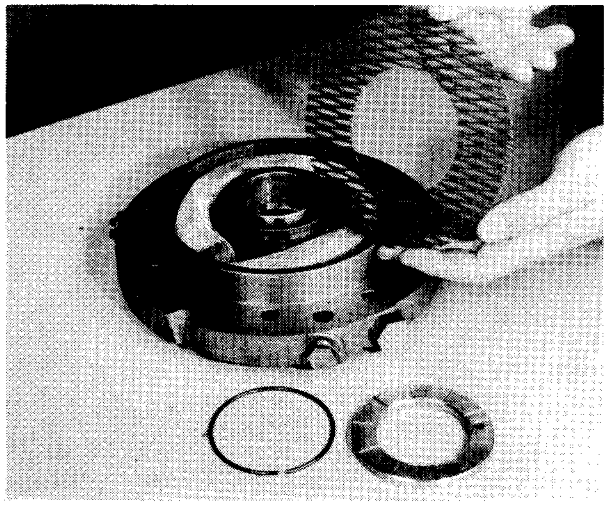


Figure No. 48

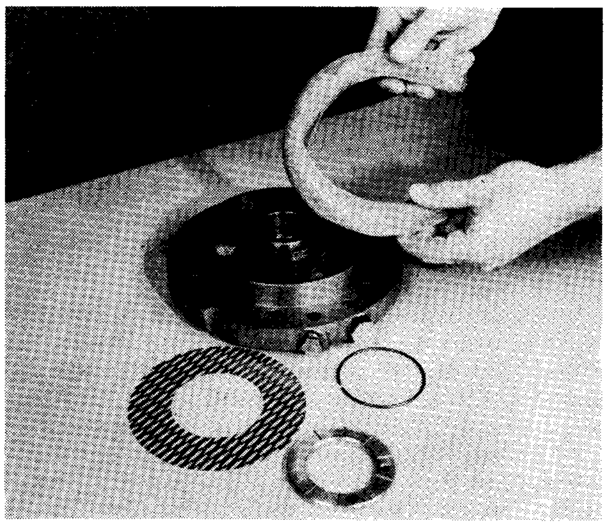


Figure No. 49

CRANKCASE OIL STRAINER ASSEMBLY

Located in the base of the compressor crankcase is an oil strainer screen assembly. This strainer assembly is connected to the lubricating system through a tube and flare nut attached to the inside wall of the compressor housing.

Oil that returns to the crankcase enters the crankcase suction chamber and filters into the crankcase through the oil filter in the suction strainer pan assembly. Oil enters the crankcase proper through a check valve (Ref. No. 20) located in the wall of the compressor housing. The main oil reservoir is located in the crankcase of the compressor housing.

Lubricating oil is drawn from the crankcase through the strainer assembly at the bottom of the crankcase. This strainer, a fine mesh screen covered by an inverted pan, allows a narrow slot between the lip of the pan and the bottom of the crankcase to insure suction to the oil pump even when the oil level is excessively low.

The force-feed positive displacement type oil pump draws the oil from the crankcase through the strainer screen assembly.

Whenever a compressor is opened up for repair and cleaning, the strainer pan should be removed and the face of the strainer screen cleaned with a suitable refrigeration compressor parts cleaner.

TO REMOVE:

The strainer screen assembly is held in position in the bottom of the crankcase by a hold-down strip (Ref. No. 22) and this hold-down strip is positioned and locked in place by two roll pins (Ref. No. 21). The connection to the crankcase is made by a tube and a flare nut. Loosen but do not disconnect the flare nut connection. Grip the hold-down strip with the fingers on one side of the strainer pan assembly. Rotate the hold-down strip in a circular motion toward the seal end of the compressor. By carefully rolling or rotating the strip, it will turn over and spring free of the roll pins.

When the hold-down strip has been removed, the flare nut is disconnected from the housing and the pan can be removed from the crankcase housing through the handhole opening in the crankcase.

TO INSTALL:

Before installing strainer assembly, be sure that strainer assembly is clean and that the inside of the crankcase is also clean.

Place strainer assembly in position and connect flare nut and tube to crankcase housing. Do not tighten flare nut at this time. Leave the connection loose so that the pan can be shifted and positioned within the crankcase.

Place the ends of the hold-down strip against the roll pins in the crankcase housing. The strip should be arched upward at this point. Place the palms of the two hands against the top arch of the hold-down strip, and with a waving motion, press firmly down with first one hand and then the other against the hold-down strip (Fig. 50). This waving motion will depress the arched strip and snap it into position against the top of the strainer pan. Be careful not to pinch the fingers between the strip and the pan as it snaps into position (see Fig. 51). After the hold-down strip has snapped into position, shift the strainer pan so that it is centered under the hold-down strip. With the pan in position under the strip, tighten flare nut connection to crankcase.

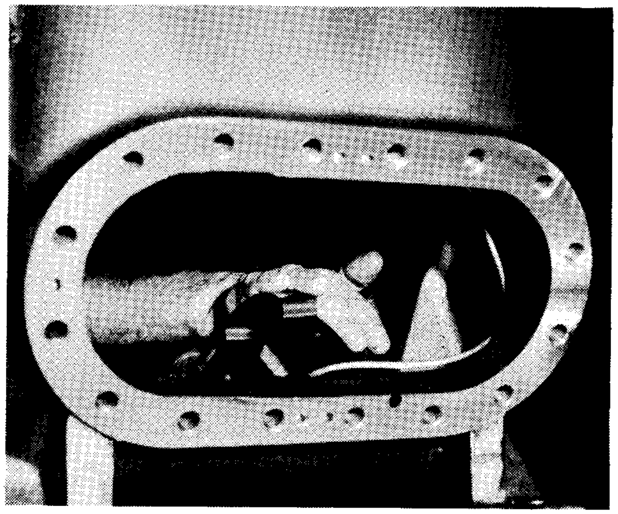


Figure No. 50

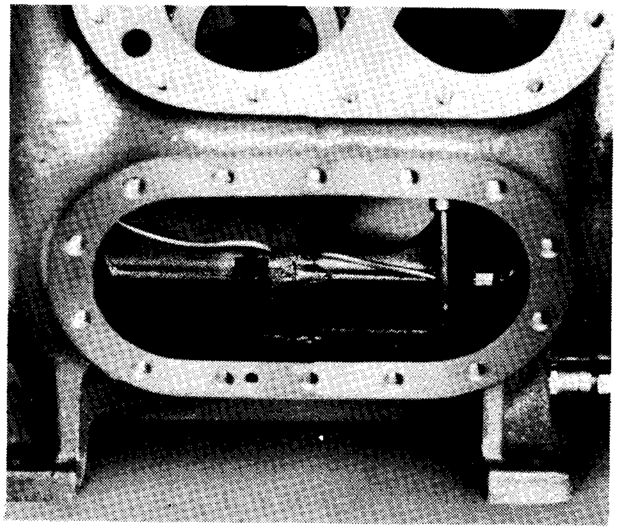


Figure No. 51

The following pages are from a Trane manual covering the following Northern Pacific cars:

- Dome Coaches 550-559
- Dome Sleepers 304-314
- Sleepers 367-372
- Coaches 586-587
- Diners 456-457
- Parlor-Bar-Lounge 492-492

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN

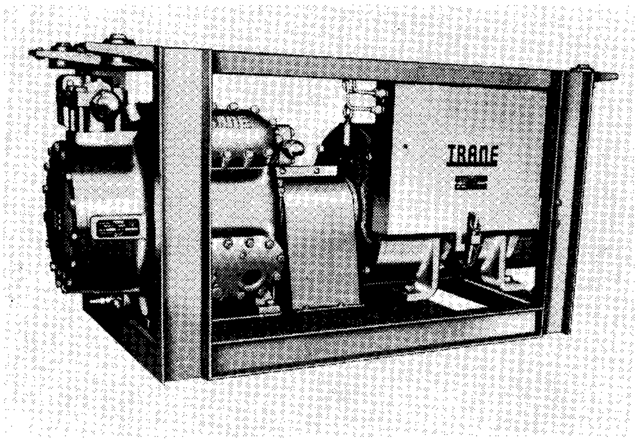


FIGURE 1

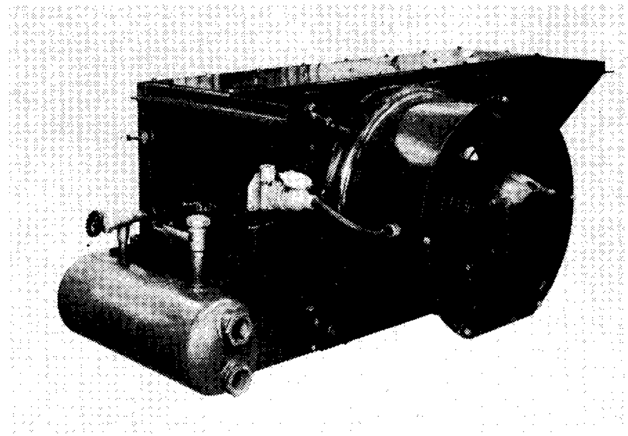


FIGURE 2

A. Compressor Unit (Fig. 1)

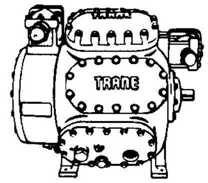
Compressor - Reciprocating, Trane Model B-514C, 10 Ton. 2-1/2" Bore x 2" stroke, 4 cylinder.
Motor - Electric, Reliance, Frame T-326Y12 28 to 42 volt DC, Trane Spec. 5230-5232
Dome Cars - 14.5 HP, 2000 RPM
Standard Cars - 12.5 HP, 1800 RPM

Note: Motors are the same on all cars. Motors used on dome cars operate at 2000 RPM by means of a field weakening resistor mounted in the electrical locker on the motor starting control panel. Motors are drip proof protected, and have ball bearings.

B. Dry Condenser Unit (Fig. 2)

Note: The condensers are identical for all cars. Two units are used on the dome cars. A single unit is used on the coaches, sleepers and diners.

Motor - Electric, Reliance, Frame CT-204, 1 HP, 28 to 42 volt, 1750 RPM. To-totally enclosed, non ventilated, ball bearings, Trane Spec. 5234
Coil - Trane, 24" x 42", 8 row condenser coil.
Fan - 21" diameter, 7 blade, direct connected.
Liquid Receiver - Drawn steel shell with two liquid sight glasses and inlet and outlet refrigerant valves.
Dome Cars - 8" x 30"
Standard Cars - 8" x 24"



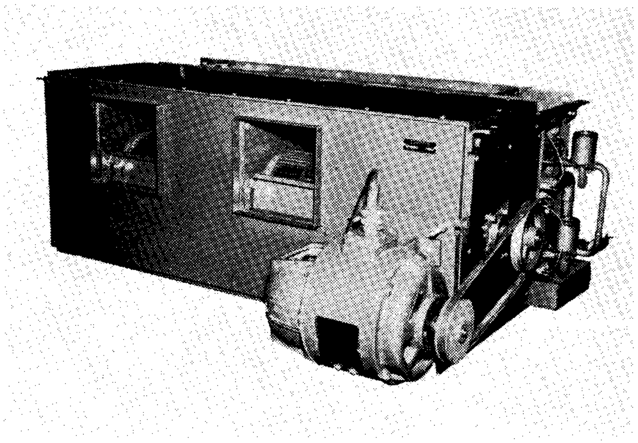


FIGURE 3

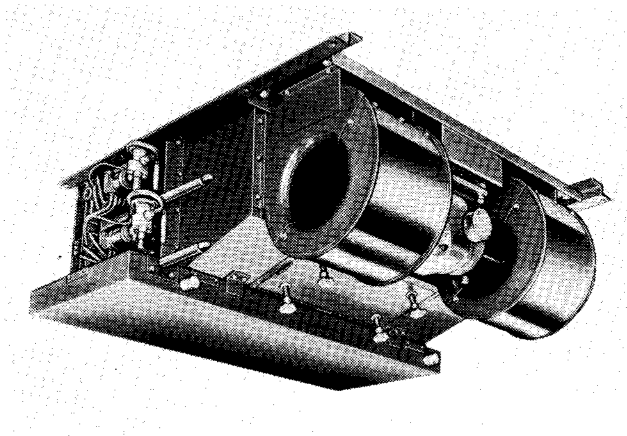


FIGURE 4

C. Cooling Units -- Dome cars and sleepers (Fig. 3)

The cooling units used on these cars are the draw-thru type. Two 6 ton units are used on each dome car and one 8 ton unit on the coaches and sleepers.

Motor - Electric, Reliance, Frame CT-203, 1 HP, 28 to 42 volt DC, 1750 RPM, open, with ball bearings, Trane Spec. 5236.
Cooling Coils -
Dome Cars - Trane, 15" x 36", 8 row DE
Sleepers - Trane, 15" x 41", 8 row DE
Heating Coils -
Dome Cars - Trane, 15" x 36", 1 row steam
Sleepers - Trane, 15" x 41", 1 row steam
Expansion Valves - Two per unit. Alco TO 300FG
Solenoid Valves - Two per unit. Jackes-Evans, Type 70, 36 volt.
Fans - Two per unit. Trane 8", FC, 3/4 DWDI, belt driven

C. Cooling Unit -- Diners (Fig. 4)

The cooling units used on these cars are the blow-thru type.

Motor - Electric, Louis Allis Frame 204, 32 volt DC, 1 HP, 1200 RPM, open casing, with ball bearings.

Cooling Coil - Trane 15" x 41", 6 row DE
Heating Coil - Trane 15" x 41", 1 row steam
Expansion Valves - Two per unit, Alco TDL-2F
Solenoid Valves - Two per unit, Jackes-Evans, Type 70, 36 volt.
Fans - Two per unit, Trane 10", FC, 3/4 DWD1, direct driven

CONTROL DISCUSSION

NORTHERN PACIFIC RAILROAD

On standard cars such as coaches, sleepers and diners, the air conditioning system consists of an overhead cooling unit with the cooling coil split into two equal sections, a dry condenser and a motor compressor unit. On the partial-dome coaches and partial-dome sleepers, the air conditioning system consists of two overhead cooling units with each coil split into two equal sections, two dry-type condensers, and a single motor compressor unit.

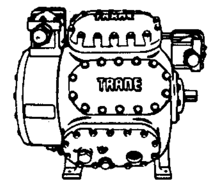
TEMPERATURE CONTROL

All of the overhead cooling coils on Trane equipment cars are split into two equal sections for capacity control. Each of these sections is furnished with an expansion valve and solenoid valve. When the car thermostat calls for cooling, the solenoid valve under the control of that thermostat opens admitting refrigerant to the coil section. When the thermostat is satisfied, the solenoid valve closes.

On the standard cars such as the coaches, sleepers, and diners, two thermostats on the vapor control system control the two coil sections. The low-temperature thermostat or the first-stage thermostat controls the lower section of the cooling coil. The high-temperature thermostat or the second-stage thermostat controls the upper section of the cooling coil. On the partial dome cars, two cooling coils are used--one for the body of the car, the other for the dome. Each of these coils is also split into two equal sections and are under the control of individual thermostats similar to the standard cars.

When the car temperature rises to a point requiring cooling, the first-stage thermostat or low-temperature thermostat opens the solenoid of the lower half of the cooling coil and starts the compressor. Further rise in car temperature will cause the second-stage thermostat to open a solenoid valve on the remaining top half of the coil providing full cooling capacity.

As the car temperature falls, the thermostat will close the solenoid valve on the top half of the cooling coil first and the solenoid valve on the bottom half of the cooling coil last. The compressor will continue to operate until it shuts down on low suction pressure through the action of the dual refrigerant pressure controller. This is called a pumpdown cycle, wherein all of the refrigerant remaining in the cooling coils is pumped into the receiver to prevent liquid slugging the next time the thermostat calls for cooling and the solenoid valve opens.



CAPACITY CONTROL

The capacity of the compressor automatically adjusts to changes in load through the action of the cylinder unloaders. These compressor cylinder unloaders are actuated by the compressor oil pump pressure and respond automatically to changes in suction pressure. The compressor will unload on decreasing suction pressure and will load on increasing suction pressure. Three of the four cylinders of the compressors are provided with these cylinder unloaders.

When all the cooling coil sections are in operation, the suction pressure is normal and all cylinders of the compressor are loaded. When one section of the cooling coil is shut off, the suction pressure will drop and the compressor will unload. Conversely, with one cooling coil section operating, the suction pressure will rise when the other section is energized, loading the compressor. On standard cars, using only one cooling unit, all compressor cylinders will be loaded when both sections of the coil are in operation. When one half of the coil is shut off, the compressor unloaders are adjusted so that two of the four or one half of the compressor is unloaded. Therefore, the unloaders match the cooling capacity. When 100% cooling is required, all the cylinders are loaded. When 50% cooling is required, two of the four cylinders or 50% will unload.

On dome cars, two cooling units are used, each split into two equal sections, the compressor unloaders are adjusted so that one of the four cylinders unload each time a coil section is shut off. With all four coil sections operating, all four compressor cylinder unloaders are loaded. When one coil section is shut off, leaving three in operation, one of the four cylinders unloads. When two sections are shut off, two cylinders will unload and when three sections are shut off, three cylinders will be unloaded. When the last section of the cooling coil is shut off, the compressor will continue to operate on the remaining cylinder which does not have an unloader until the system is pumped down and the compressor will shut off on low suction pressure.

CONTROL PANEL AND CONTROL CIRCUIT

The motor starting control panel located in the electrical locker in conjunction with the vapor control panel and other components operates the compressor motor and the condenser fan motors. In the following discussion refer to figure 7 and 8 on pages 8 & 9.

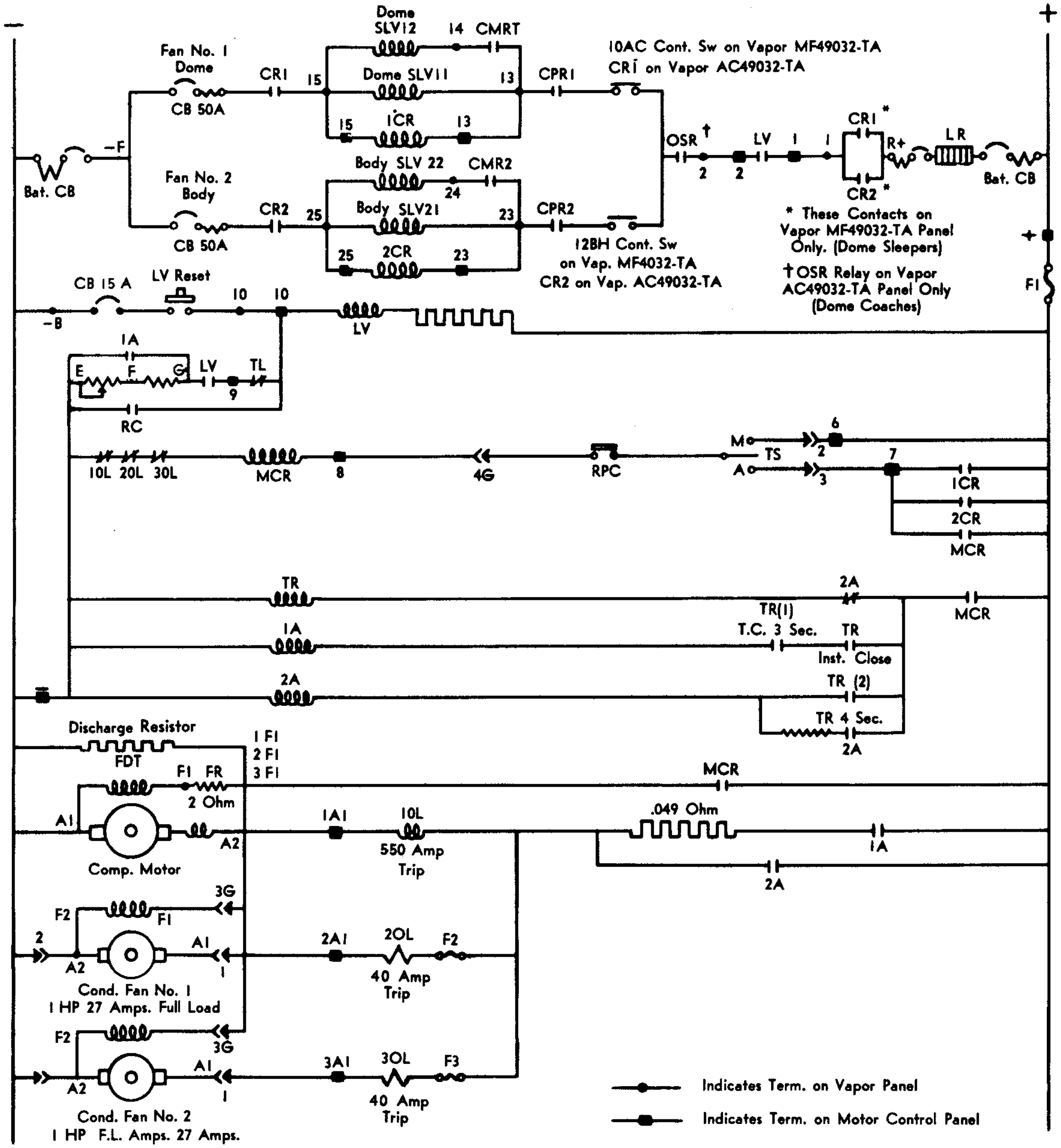
In automatic operation, the Vapor control panel through the action of the first stage cooling thermostat* energizes the #1 control relay (1-CR) on the motor control panel which closes and energizes the main control relay (MCR). MCR closes and maintains itself energizing a timing relay (TR) and energizes the compressor and condenser fan motor field. After a time delay, contactor #1A closes and connects the compressor and condenser fan motors to the power source through the starting resistor. After an additional time delay, contactor #2A closes and short circuits this resistor connecting the motors directly across the line. As 2A operates, it drops out TR and 1A.

The condenser fan motors and compressor motors are stopped by dropping out the main control relay (MCR) which opens 2A. The main control relay (MCR) drops out when the refrigeration dual pressure control switch opens, when an overload contact opens, or when the system test switch is in the off position. The system test switch (TS) is located on the compressor unit. When this system test switch is in the "automatic" position, the compressor is under the control of the temperature control panel. When it is in the manual position, it bypasses the temperature controls and will close the main control relay (MCR) and the motor starting sequence proceeds as described above. Since the test switch is a spring return to the off position when it is released from the manual position it will shut off all of the equipment. This switch should always be kept in the automatic position.

A low-voltage relay (LV) is provided on the motor starting control panel for protection of the battery. The low-voltage relay (LV) is closed by pressing the low-voltage reset button on the vapor panel. Relay LV is then maintained through a resistor as long as the voltage does not fall below the specified minimum. A contact on the #1 accelerating contactor 1A shorts out this resistor to prevent the low-voltage relay (LV) from dropping out when all of the motors are started, even if the voltage falls below the minimum setting. A contact on the reverse current relay prevents the low-voltage relay (LV) from dropping out as long as power is being drawn from the car generator, and resets the LV relay automatically when the generator operates. A contact on the low voltage relay (LV) is connected in the thermostat circuits to prevent operation of the liquid solenoid valves or automatic starting of the refrigeration equipment if the low-voltage relay is not closed.

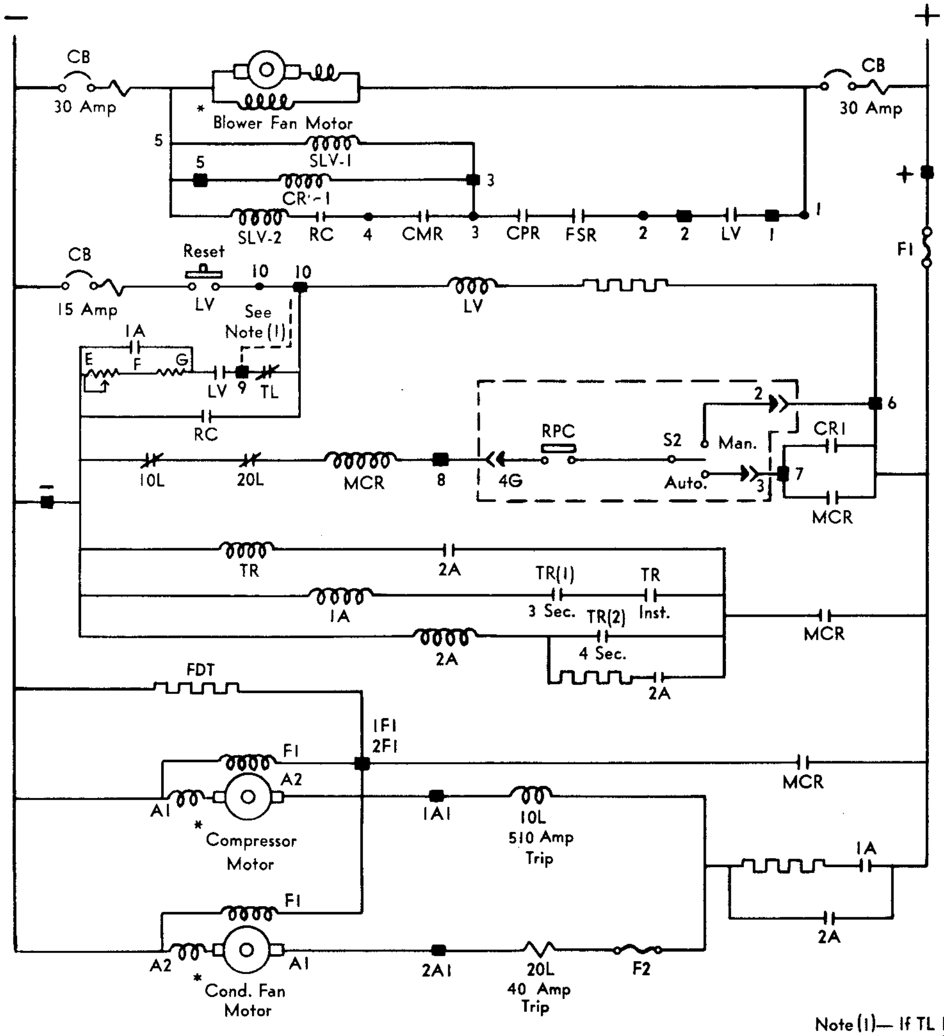
The condenser fan motors are protected by thermal overload devices. The compressor motor is protected by an overload relay. The main fuse, the condenser fan motor fuse are for short circuit protection only.

* On partial-dome cars each of the first-stage cooling thermostats (body or dome) has its own control relay (1CR and 2CR). The contacts of these relays are in parallel so either will energize MCR and start the system.



VAPOR PANEL 53D326 (coaches) 58F127 (sleepers) Lot No. 8959-12 Lot No. 8959-13	CR1	— Control Relay — Dome System
	CR2	— Control Relay — Body System
	CPR1	— CLG. Pilot Relay — Dome Unit
	CPR2	— CLG. Pilot Relay — Body Unit
	CMR1	— CLG. Mod. Relay — Dome Unit
	CMR2	— CLG. Mod Relay — Body Unit
	OSR	— Outside Therm. Relay
MOTOR CONTROL PANEL	LV	— Low Voltage Relay
	1CR	— Control Relay
	2CR	— Control Relay
	MCR	— Main Control Relay
	TR	— Time Relay
	1A	— First Accel. Contactor
	2A	— Second Accel. Contactor
	10L	— Comp. Motor O.L. Relay (Mag. Man. Reset)
	20L	— Cond. Motor O.L. Relay (Thermal)
	30L	— Cond. Motor O.L. Relay (Thermal)
	F1	— Main Fuse 600 Amp. Fuse Tron
	F2	— Cond. Fan Motor Fuse 45 Amp.
	F3	— Cond. Fan Motor Fuse 45 Amp.
COMPRESSOR UNIT	RPC	— Dual Ref. Pres. Control
	TS	— Comp. Test Switch
EVAP. UNITS	SLV11	— First Stage Sol. Liq. Valve — Dome
	SLV12	— 2nd Stage Sol. Liq. Valve — Dome
	SLV21	— First Stage Sol. Liq. Valve — Body
	SLV22	— 2nd Stage Sol. Liq. Valve — Body
SEPARATELY MOUNTED	FR	— Comp. Motor Fld. Res., 1.5 Ohm - 100 Watt
	FDF	— Field Discharge Resistor
BY OTHERS	RC	— Relay Operated By Aux. Contacts On Car LTG. Gen. Rev. Current Relay
	TL	— Train Lino Relay

FIGURE 5
Schematic Wiring Diagram For Dome Coaches & Sleepers
12 Ton System



VAPOR PANEL	CB	Circuit Breaker
	CPR	CLG. Pilot Relay—First Stage Thermostat
	CMR	CLG. Mod. Relay—2nd Stage Thermostat
	LV	RESET Reset Button
	OSR	Outside Temp. Relay
MOTOR CONTROL PANEL	CR1	Control Relay
	LV	Low Voltage Relay
	TR	Timing Relay
	1A	1st Accel. Contactor
	2A	2nd Accel. Contactor
	10L	Compressor Motor Overload Relay
	20L	Condenser Fan Motor Overload
	F1	Main Fuse
	F2	Condenser Fan Motor Fuse
	MCR	Main Control Relay
COMPRESSOR UNIT	RPC	Dual Refrigeration Pressure Control
	S2	Compressor Test Switch
EVAP. UNIT	SLV-1	1st Solenoid Liquid Valve (2 Amp. Aprox.)
	SLV-2	2nd Solenoid Liquid Valve (2 Amp. Aprox.)
	FDT	Field Discharge Resistor
	RC	Auxiliary Contacts on Car Lighting Generator R.C. Relay
	TL	Train Line Relay — (Contacts Open When Train-Lined)

Note (1)— If TL Relay Is Not Used, Jumper 9 & 10 As Shown By Dotted Line

—●— Terminal on Vapor Panel
—■— Terminal on Motor Control Panel
* See Interconnection Diagram For Actual Motor Wiring

FIGURE 6
Schematic Wiring Diagram For Coaches, Diners & Sleepers
8 Ton System

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN

SUPERSEDES

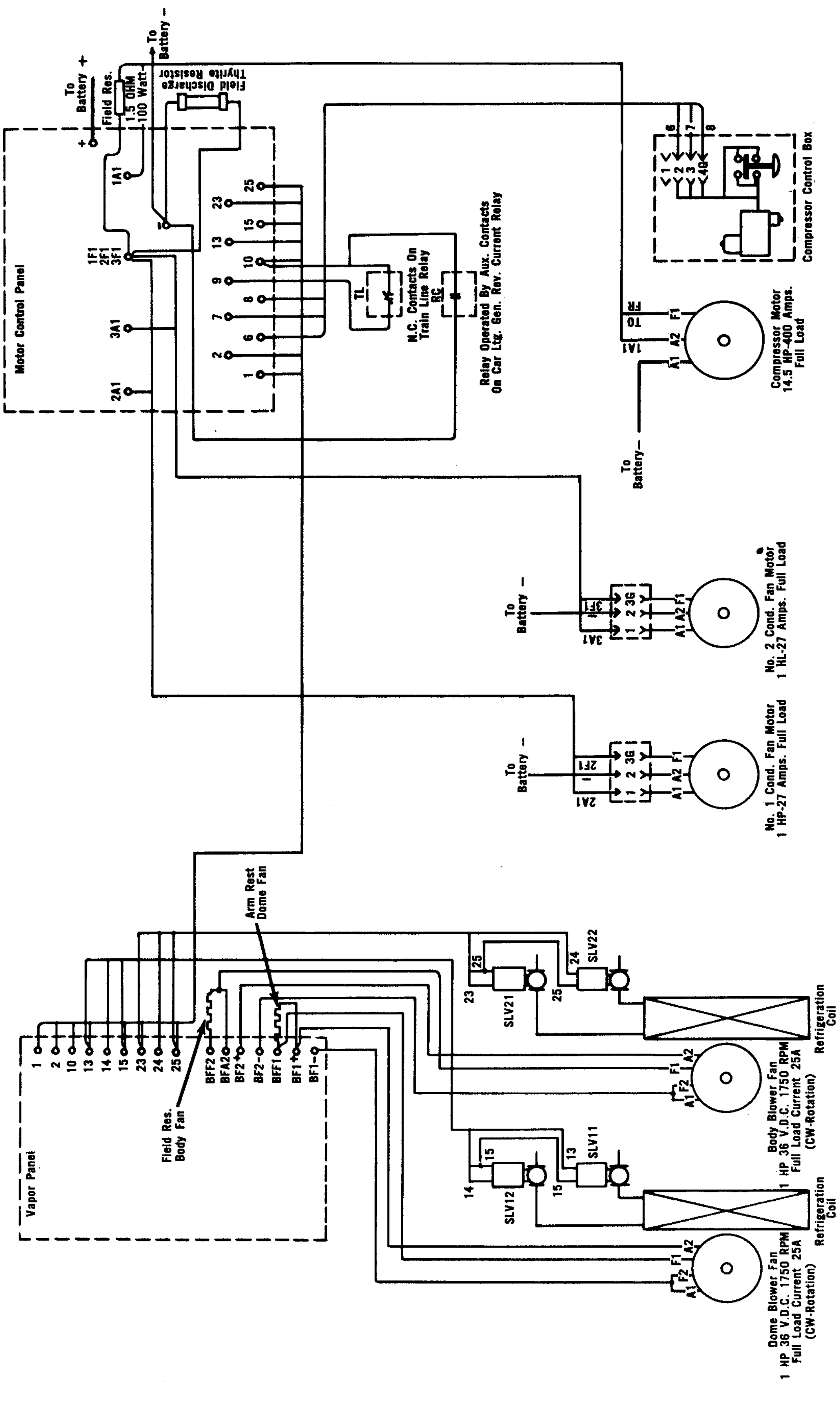


FIGURE 7
Interconnecting Wiring Diagram for Dome Coaches
12 Ton System

FRONT VIEW DIAGRAM

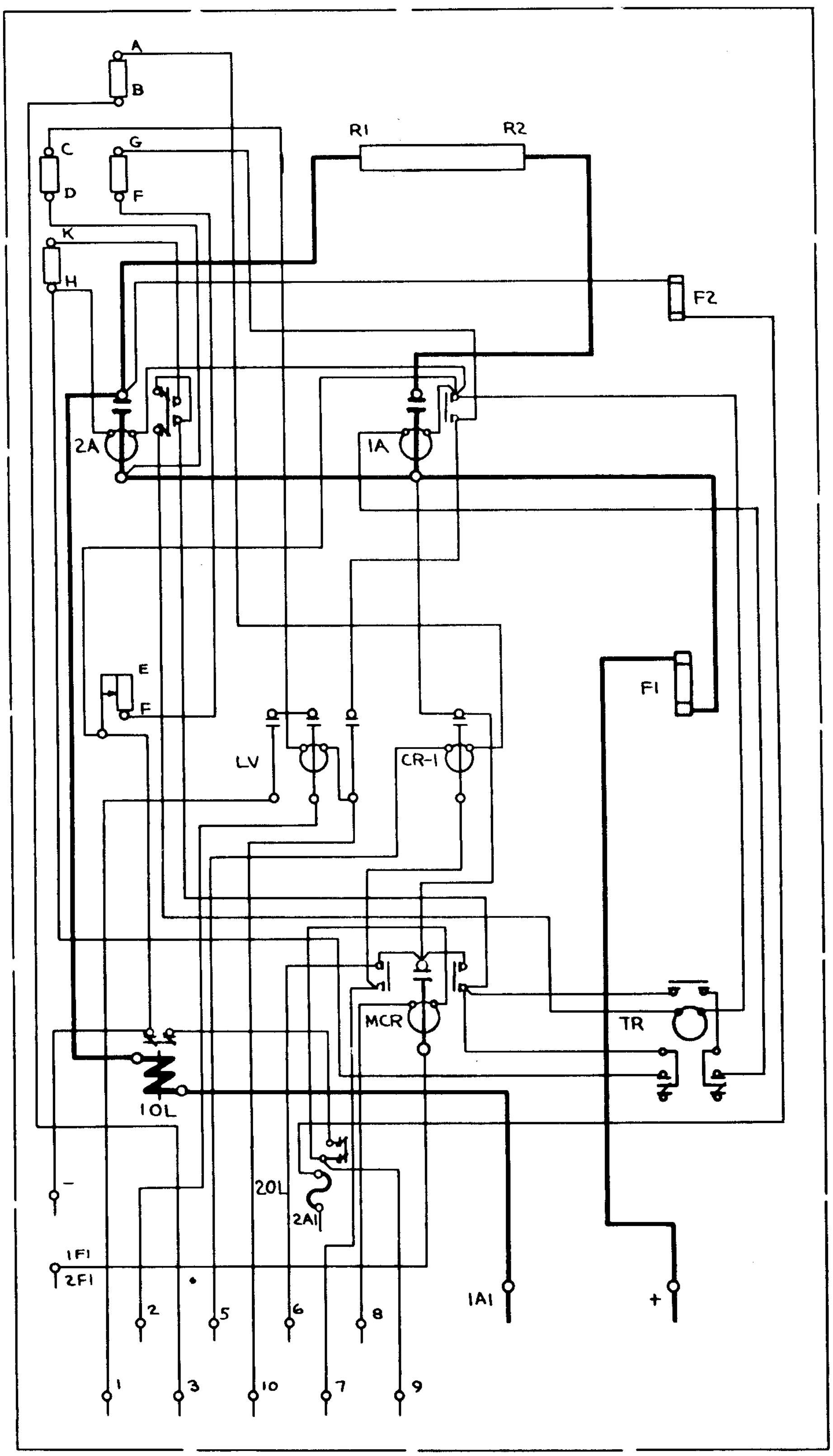
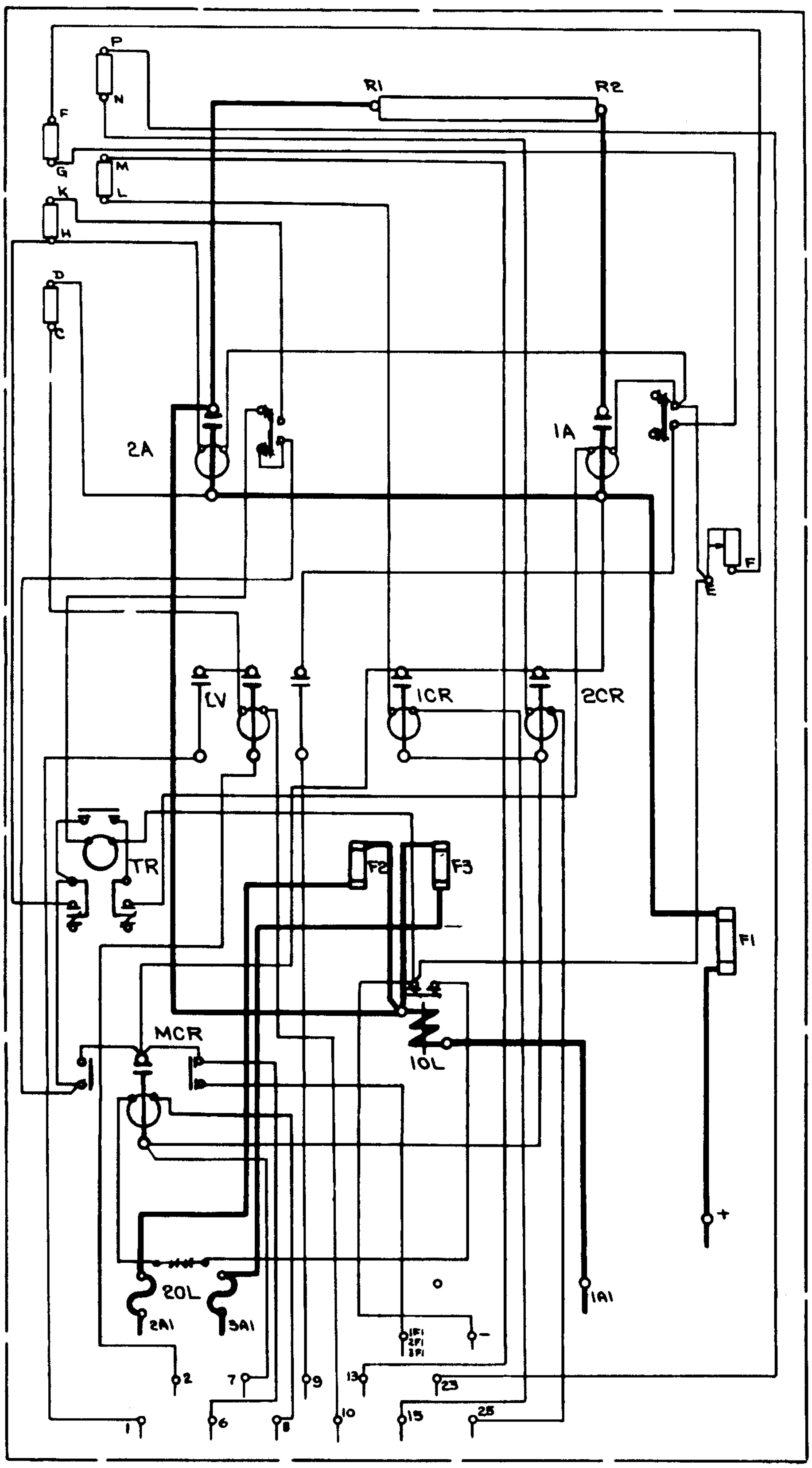


FIGURE 10
Control Panel
Wiring
Coaches, Diners,
Sleepers
8 Ton System

(Cutler-Hammer Co.)

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN
SUPERSEDES

FRONT VIEW DIAGRAM



(Cutler-Hammer Co.)

FIGURE 11
Control Panel Wiring
Domes
12 Ton System

REFRIGERATION PIPING (12 Ton System)

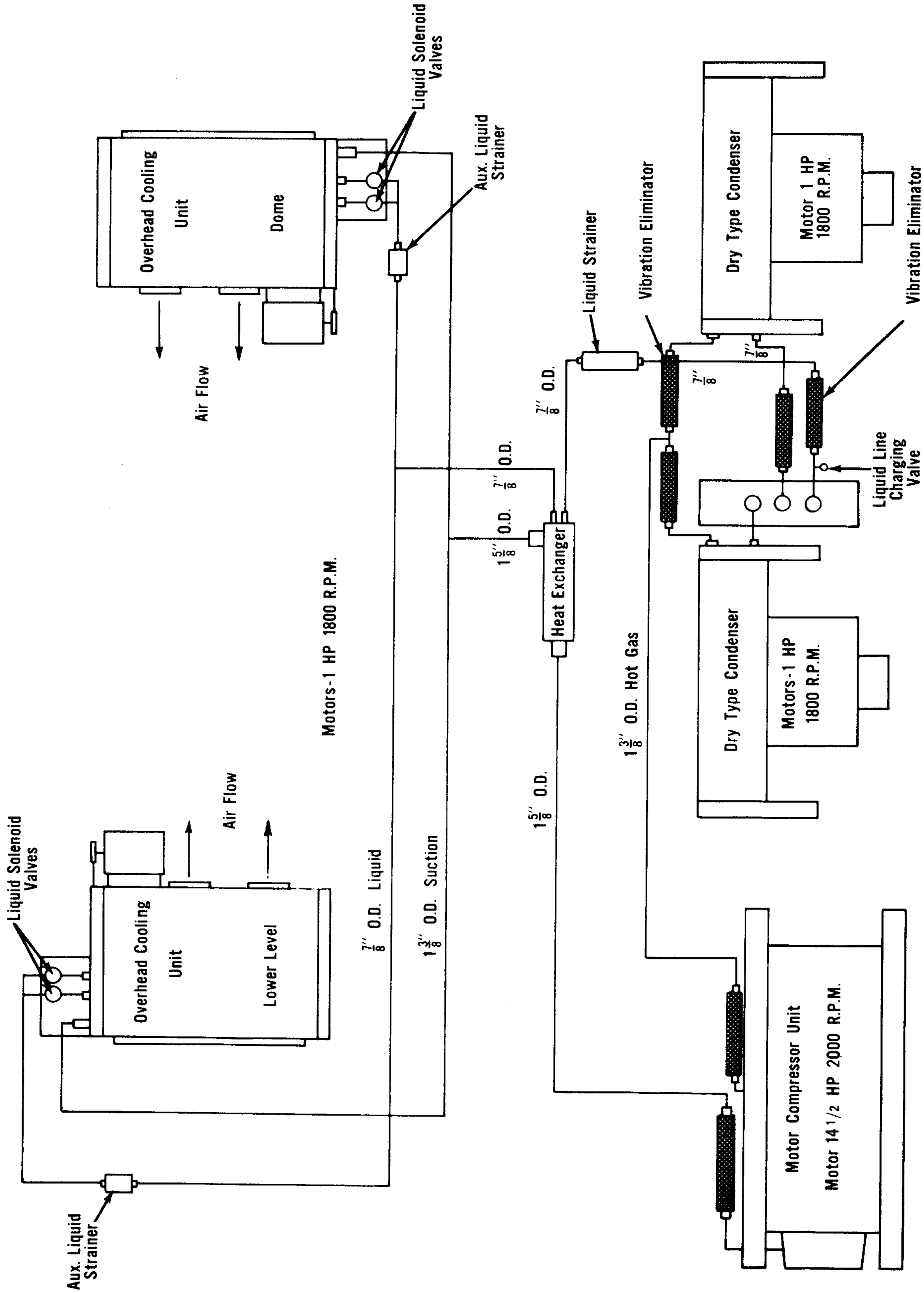


FIGURE 12
(For accessories in above diagram see Page 26, Table 12)

REFRIGERATION SERVICE MANUAL

COMPONENTS

PRINTED IN U.S.A.
SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN

SUPERSEDES

REFRIGERATION PIPING (8 Ton System)

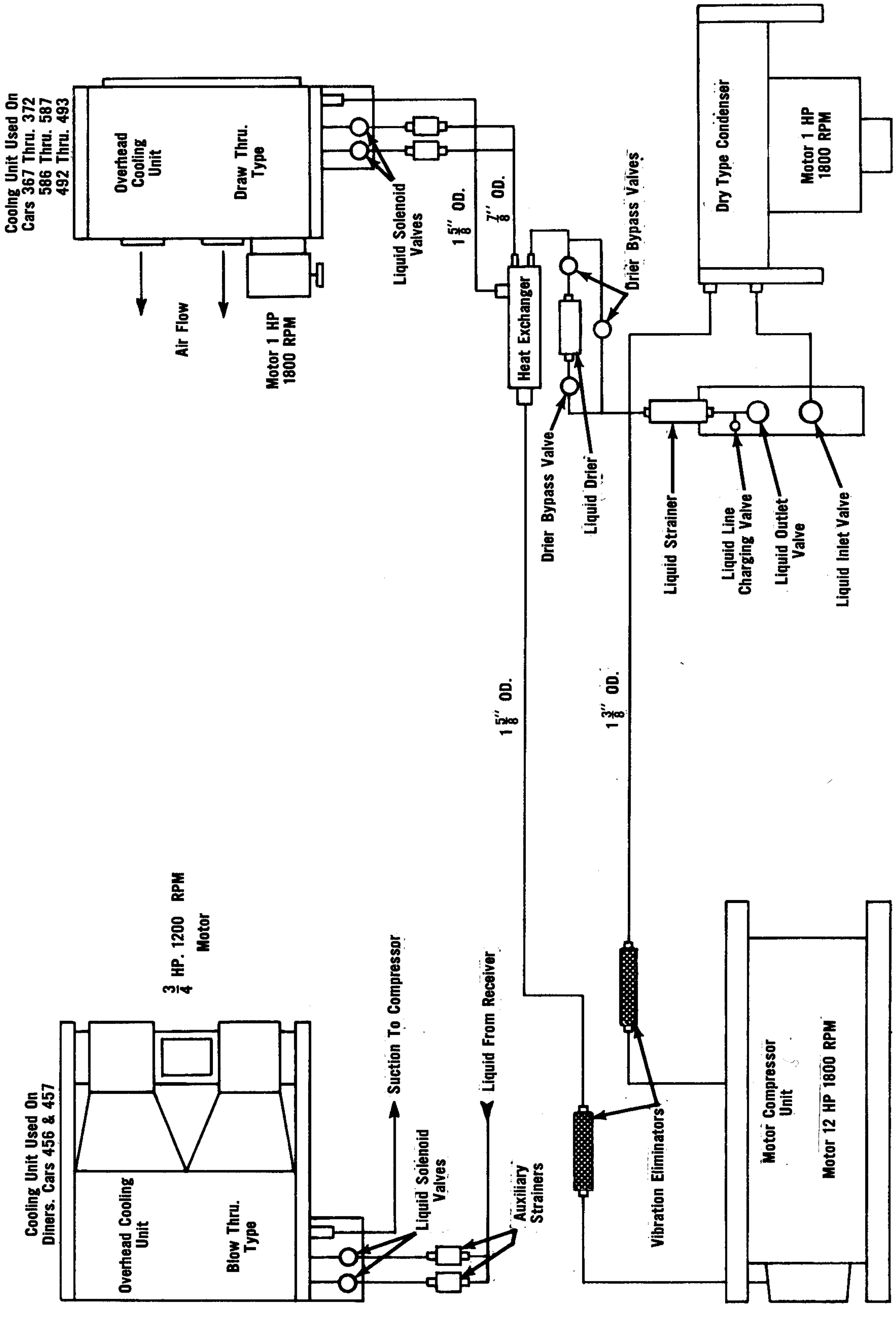


FIGURE 13
(For accessories in above diagram, see Page 26, Table 12)

COMPRESSOR UNIT

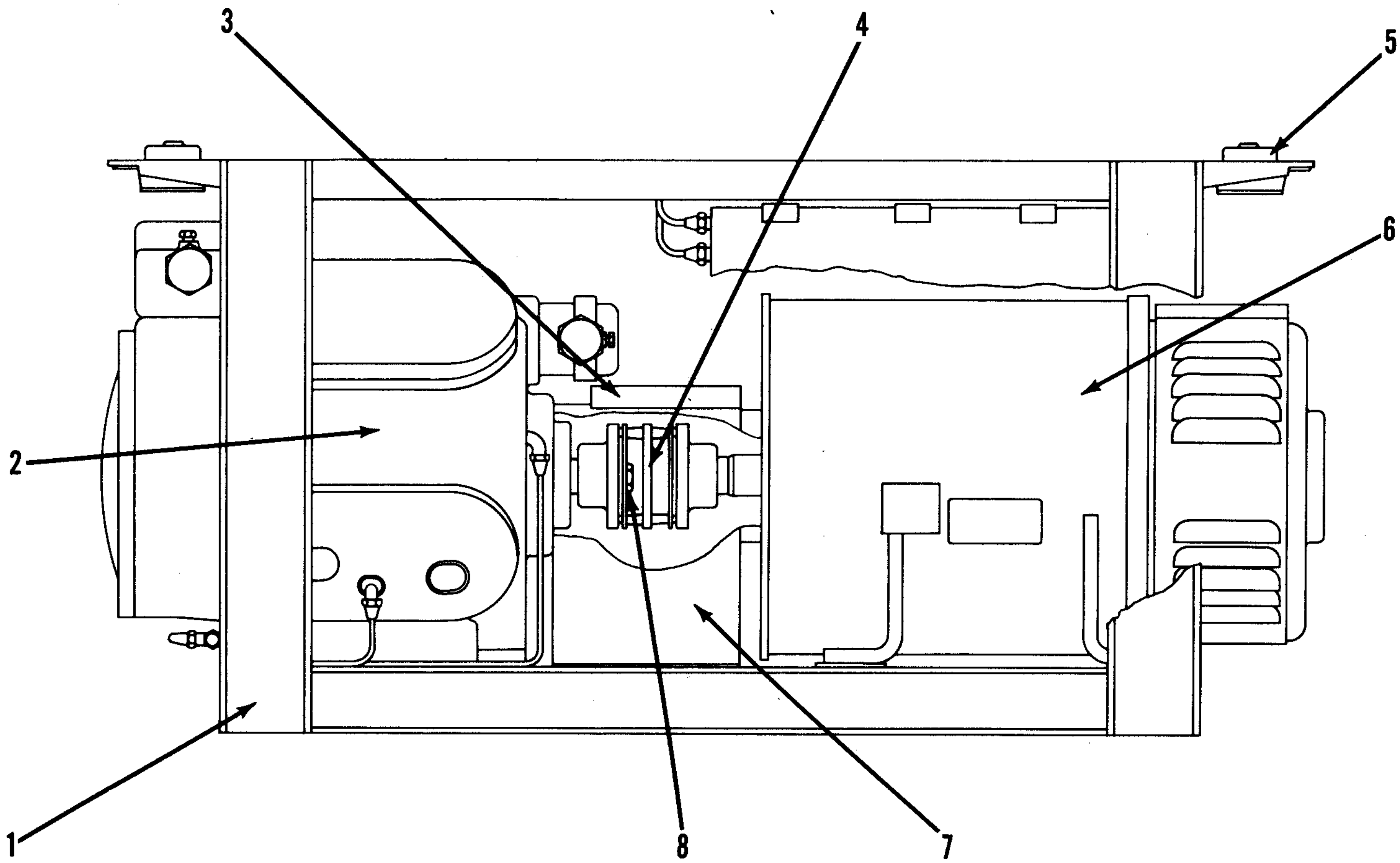


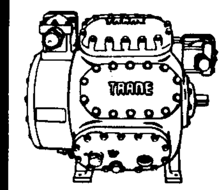
FIGURE 14

TABLE 1

PARTS LIST

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NO. REQ.
1	Frame - Assembly (Compressor Mounting)	FRM-800	1
2.	Compressor - Reciprocating, Model B-514C	COM-800	1
3	Guard - Coupling (Front Section)	GRD-800	1
4	Coupling - Steel, Compressor Drive, Thomas Special 162-MT-B	CPL-1	1
5	Mount - Isolation, M.B. #510-C56	MNT-800	4
6	Motor-Electric, 14.5 HP, 36 VDC, 2,000 RPM, Frame T-326-V12.	MOT-800	1
7	Guard - Coupling (Rear Section)	GRD-801	1
8	Screw - Hex Head Cap, NF2, 5/8" x 1-3/4" (Coupling Mounting)	SCR-7	1
*	Washer - Steel, 1/2" x 1-3/4" O.D. x 41/64" I.D. (Coupling Mounting)	WAS-6	1

* Part not illustrated.



COMPRESSOR LUBRICATION

It may occasionally be necessary to replace compressor oil which has been lost through a leak in the system. Oil capacity of the compressor crankcase is 6 quarts and with the compressor operating, the oil level should be maintained to 7/8 full on the oil sight glass.

USE ONLY THE FOLLOWING APPROVED OILS IN THE COMPRESSOR:
Ansul #300 new non-foaming oil, Texaco Capella "D" new wax-free oil, Caloil 13W.

TABLE 2 CONTROL SETTINGS

CONTROL	CONTROL SETTING		REMARKS
DUAL PRESSURE CONTROL	CUT-OUT	CUT-IN	
LOW PRESSURE	5-7 psig.	25-30 psig.	
HIGH PRESSURE	290 psig.	240 psig.	

TABLE 3 NORMAL GAUGE READINGS

GAUGE	GAUGE READING	REMARKS
CONDENSER PRESSURE GAUGE	100 TO 200 psig.	
EVAPORATOR PRESSURE GAUGE	30 TO 50 psig.	
OIL PRESSURE GAUGE	50 TO 80 psig.	OIL PUMP DISCHARGE PRESSURE. TO COMPUTE ACTUAL OIL PRESSURE, SEE SECTION 7A4A, PAGE 3.

TABLE 4 COMPRESSOR CONTROL BOX COMPONENTS

PART NAME AND DESCRIPTION	PART NUMBER	NO. REQ.
Box - Control (Complete)	BOX-800	1
Box - Control (Less Components)	BOX-801	1
Cover - Box, Control	COV-800	1
Pin - Taper	PIN-800	1
Ring - 1" x 5/32"	RNG-800	1
Plate - Adapter	PLT-800	1
Block - Valve and Gauge Assembly (Complete)	BLK-801	1
Switch - Test, AH&H #PP-16	SWT-800	1
Control - Dual Pressure	CNT-800	1
Receptacle - P-N, #RNLJ 2000, AP-420 Insert	RCT-801	1
Plug - P-N, Shell #PNLD 2005, AR-420 Insert	PLU-801	1
Gauge - Compound, Freon 2-1/2" Dia., 30" 200#	GAG-1	2
Gauge - Pressure, Freon 2-1/2" Dia., 0 - 300#	GAG-2	1
Nameplate - Evaporator Pressure	PLT-4	1
Nameplate - Condenser Pressure	PLT-6	1
Nameplate - Oil Pressure	PLT-5	1

DUAL PRESSURE CONTROL

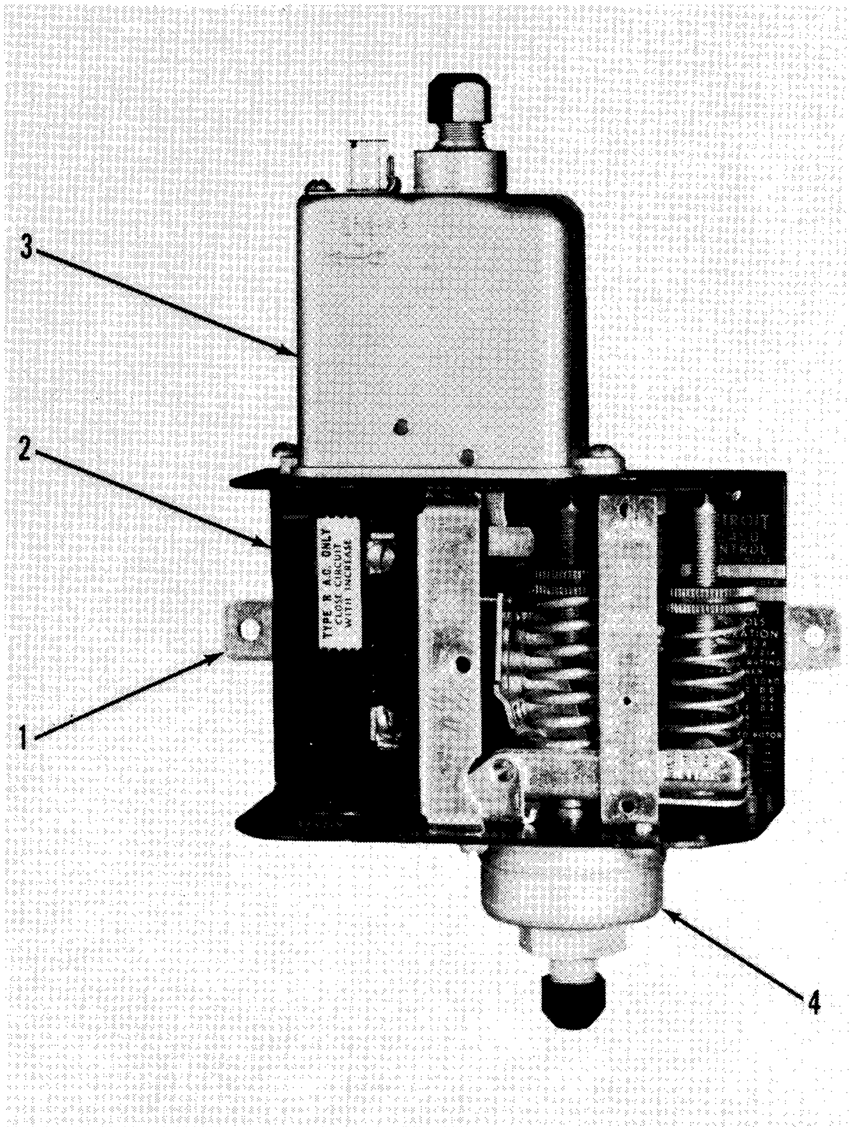


FIGURE 15

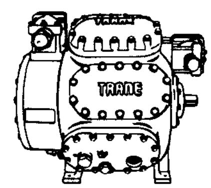
(Detroit Control)

TABLE 5 PARTS LIST (Detroit Lubricator #450949)

REF. NO.	PART NAME AND DESCRIPTION	DETROIT CONTROLS PART NUMBER	NO. REQ.
*	Lockwasher - Snap Switch	S-415	1
1	Bracket - Mounting (Flat Type)	45075	1
2	Switch - Snap Assembly	450481	1
3	Cut-Out Assembly, High Pressure	450950	1
4	Element - Power, Pressure Type	450374	1
*	Screws - Mounting Bracket	450250	4
*	Cover - Assembly	450391	1
*	Screw - Snap Switch	586363	1

* Part not illustrated.

COMPONENTS



PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN

DRY CONDENSER

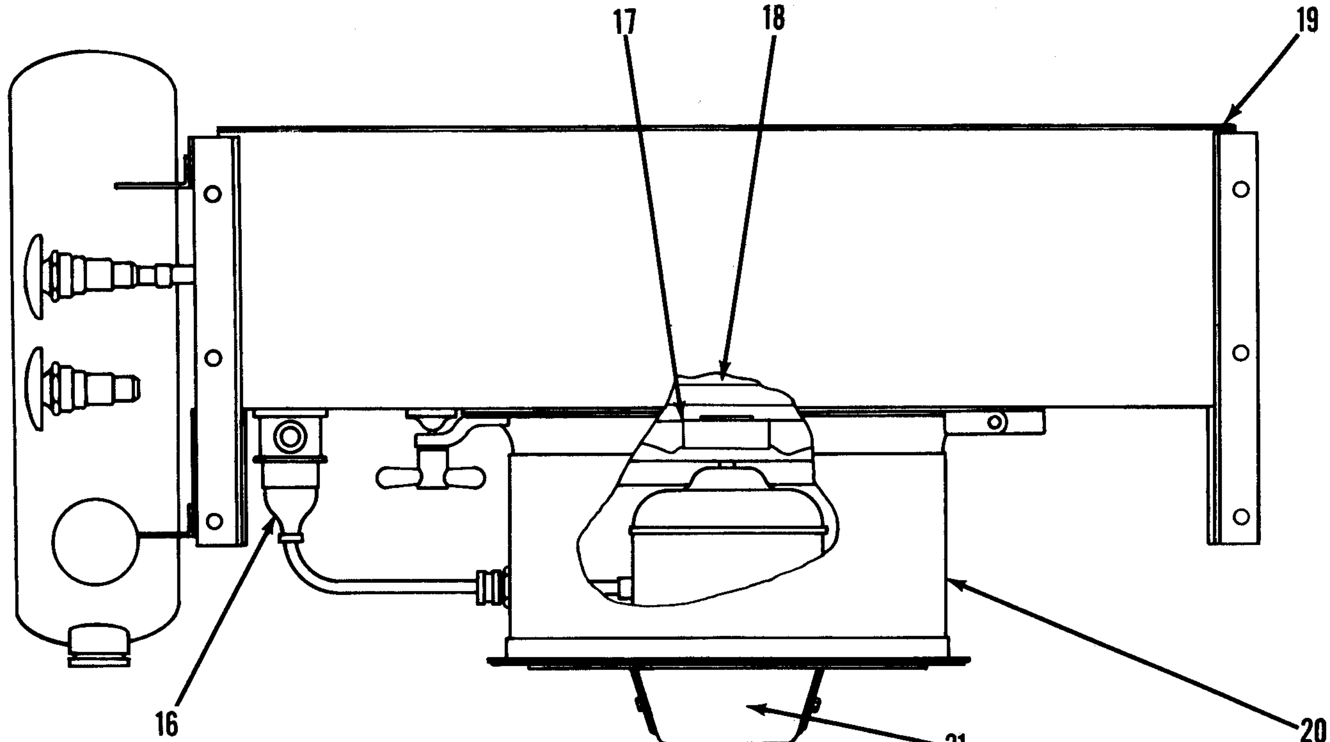


FIGURE 16
Top View

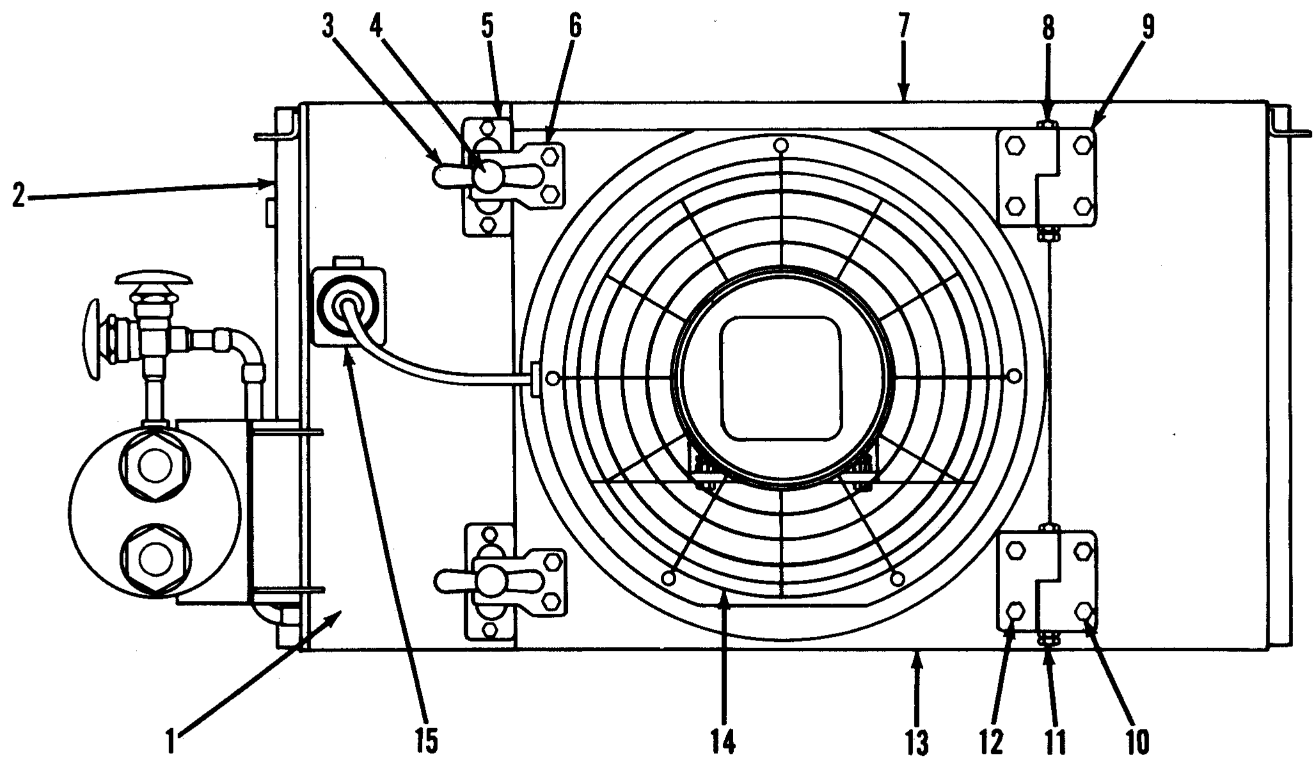


FIGURE 17
End View

(Parts list on following page)

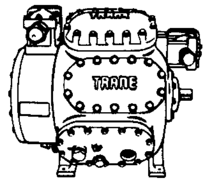
TABLE 6

PARTS LIST

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NO. REQUIRED
*	Condenser - Assembly (Complete With 2 Valve Receiver)	CDS-801	1
*	Condenser - Assembly (Complete Less Receiver)	CDS-800	1
1	Condenser - Assembly (Complete With 3 Valve Receiver)	CDS-803	1
2	Frame - Assembly	FRM-801	1
3	Handle	HDL-800	2
4	Bolt - Tee	BLT-800	2
5	Retainer - Tee Bolt	RTR-800	2
6	Latch	LAT-800	2
7	Panel - Condenser (Top)	PNL-800	1
8	Screw - Hex Head Cap, 1/2"-13 x 6" (Hinge Pin)	SCR-76	2
9	Hinge - Half	HNG-800	4
10	Screw - Hex Head Cap, 1/2"-13 x 2-3/4" (Casing Hinge Mounting)	SCR-12	4
11	Nut - Hex Head, 1/2" - 13	NUT-2	12
12	Screw - Hex Head Cap, 1/2"-13 x 2-1/4" (Door Hinge Mounting)	SCR-75	4
13	Panel - Condenser (Bottom)	PNL-801	1
14	Guard - Wire	GRD-802	1
15	Receptacle - Pyle National KRCA 33036	RCT-800	1
16	Plug - Pyle National KPD 63036	PLU-800	1
17	Fan - 21" Diameter, 7 Blade	FAN-800	1
18	Coil - Assembly	CDS-802	1
19	Coil Protector - Assembly (Front)	SRN-800	1
20	Barrel - Assembly (Less Fan and Motor)	BBL-800	
21	Motor - Electric, Reliance, 1 HP, 36 VDC, 1750 RPM, BB, Totally Enclosed, Frame CT-204	MOT-801	1
*	Mount - Isolation, Firestone, CA-368-7	MNT-801	12

* Part not illustrated.

(Illustration on preceding page)



LIQUID RECEIVER

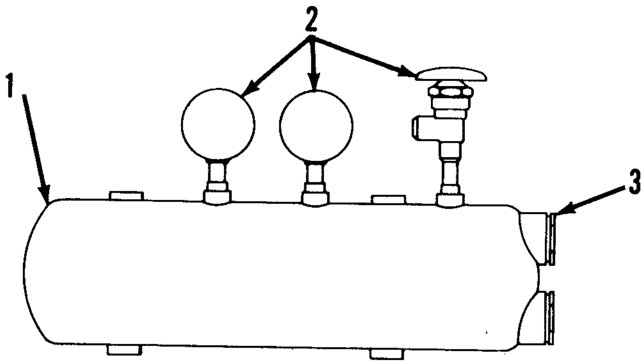


FIGURE 18
30" Length

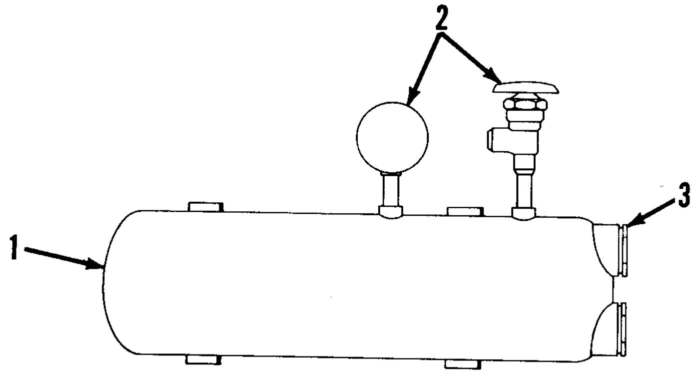


FIGURE 19
24" Length

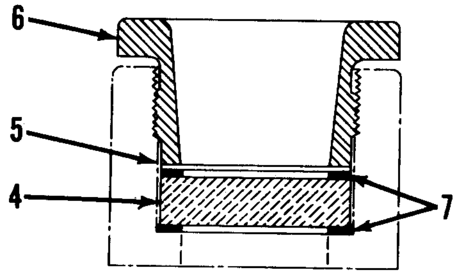


FIGURE 20
Sight Glass Assembly

TABLE 7 PARTS LIST

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NO. REQUIRED
1	Receiver - Liquid, 30" (Complete)	REC-800	1
1	Receiver - Liquid, 24" (Complete)	REC-801	
1	Receiver - Liquid, 30" (Shell Only)	REC-802	1
1	Receiver - Liquid, 24" (Shell Only)	REC-803	1
2	Valve - Shut-off, Angle, Mueller #A-14876	VAL-800	†
3	Glass - Sight Assembly (Complete)	GLS-6	2
4	Glass - Sight, 3/4" Pyrex (Glass Only)	GLS-7	2
5	Washer - Sight Glass	WAS-39	2
6	Nut - Retaining, Sight Glass	NUT-26	2
7	Gasket - Sight Glass	GKT-40	4

† 3 Required on 30" Receivers
† 2 Required on 24" Receivers

COOLING UNIT – DRAW THRU TYPE

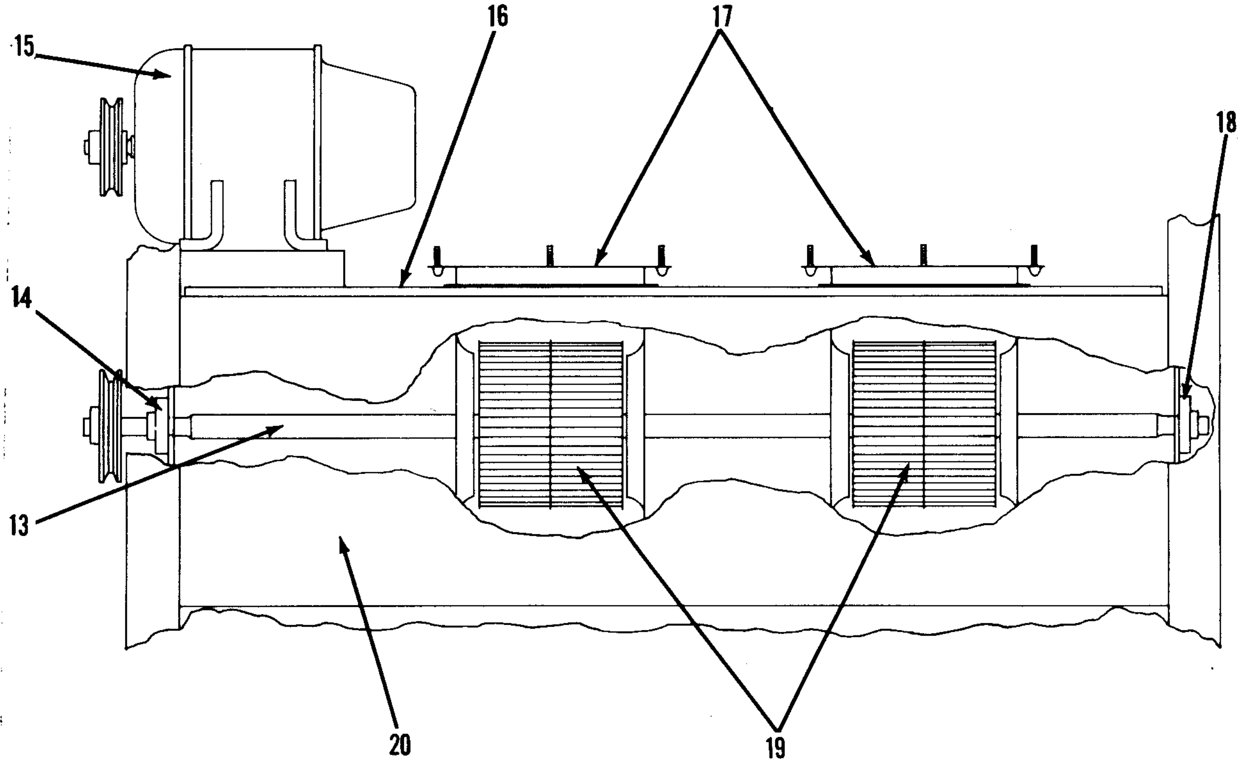


FIGURE 21
Top View

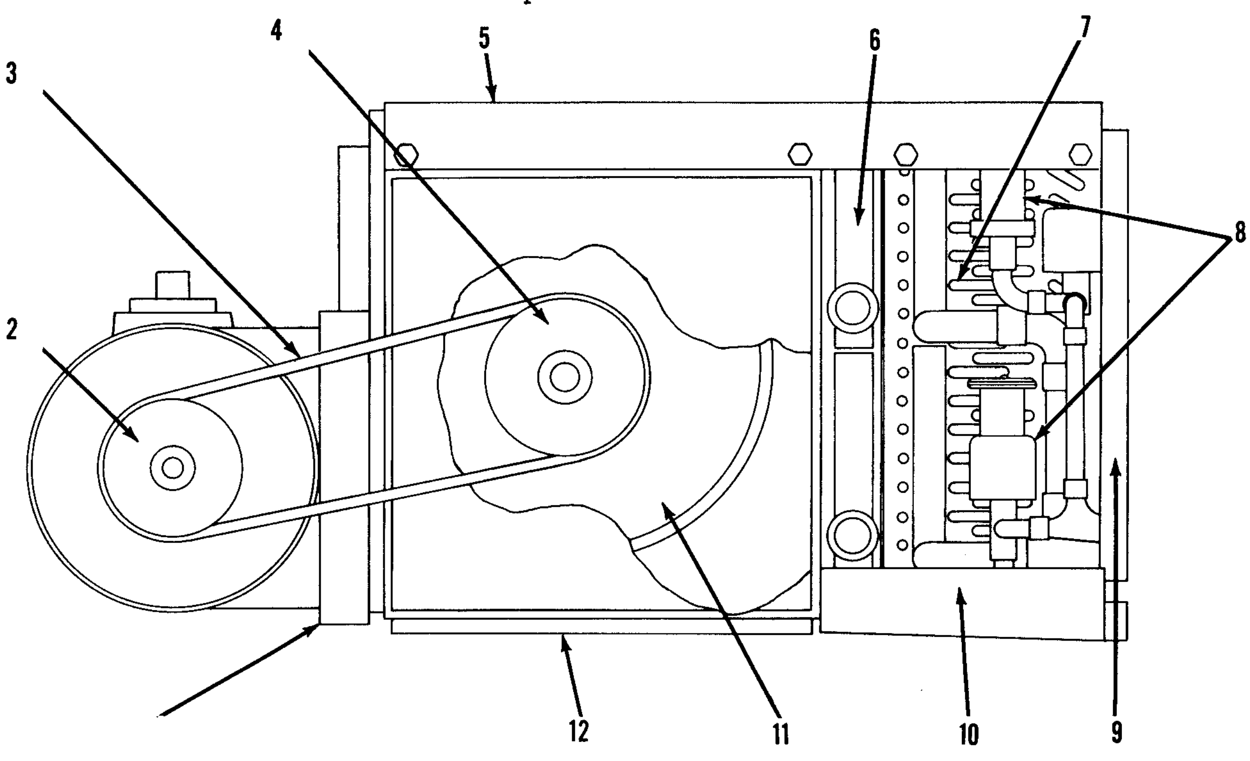


FIGURE 22
Side View

(Parts list on following page)

REFRIGERATION SERVICE MANUAL

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN

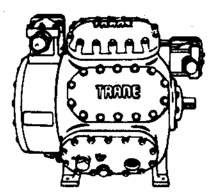


TABLE 8

COOLING UNIT PARTS LIST (DRAW THRU TYPE)

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER		NO. REQUIRED
		DOMES	SLEEPERS	
1	Evaporator Assembly Complete	EVP-800		1
1	Evaporator Assembly Complete		EVP-806	1
2	Sheave - Motor, IVM 50, 3.7 - 4.7, 3/4" Bore	SHE-801	SHE-~~800~~ 801	1
3	Belt - Fan Drive, FPH-242, 14", 1260-1520 RPM	B-800	B-800	1
4	Sheave - Fan, BK 60, 5.4 PD, 15/16" Bore	SHE-800	SHE-800	1
5	Frame - Blower Assembly	FRM-803	FRM-803	1
6	Coil Heating, 1 Row, 15" x 36"	C-800		1
6	Coil Heating, 1 Row, 15" x 41"		C-802	1
7	Coil Cooling, 8 Row, 15" x 36"	EVP-802		1
7	Coil Cooling, 8 Row, 15" x 41"		EVP-808	1
8	Expansion Valve - Top Half	T03007FG		1
8	Expansion Valve - Bottom Half	T03008FG		1
9	Frame - Duct Mounting	FRM-802		1
10	Pan - Condensate Drain	PAN-800		1
10	Pan - Condensate Drain		PAN-802	1
11	Housing - Fan, 8", 3/4 DWDI	HUS-800	HUS-800	2
12	Panel - Bottom	PNL-806	PNL-806	1
13	Shaft - Fan	SHF-800	SHF-800	1
14	Bearing - Ball, S-A SF-15, Rigid, 15/16" Diameter	BRG-801	BRG-801	1
15	Motor - Electric, Reliance, 1 HP, 36 VDC, 1800 RPM, BB, Open, Frame CT-203	MOT-802	MOT-802	1
16	Panel - Discharge	PNL-803		1
17	Frame - Outlet Collar		FRM-807	2
18	Bearing - Ball, S-A SF-15, Floating, 15/16" Diameter	BRG-800	BRG-800	1
19	Wheel - Fan, 8" 3/4 DWDI	WHL-800	WHL-800	2
20	Panel - Top	PNL-802	PNL-802	1
*	Evaporator-Assembly Complete	PLT-28	PLT-28	1
*	Frame - Inlet Collar		FRM-806	1
*	Cut-Off Fan, 8", 3/4 DWDI	CO-800	CO-819	2
*	Panel - End (R.H.)	PNL-804	PNL-804	1
*	Panel - End (L.H.)	PNL-805	PNL-805	1

* Part not illustrated.
(Illustration on preceding page)

BEARING LUBRICATION

The evaporator fan shaft bearings should be greased every 8 to 10 weeks with alemite #33 solid oil, or equal.

COOLING UNIT — BLOW THRU TYPE

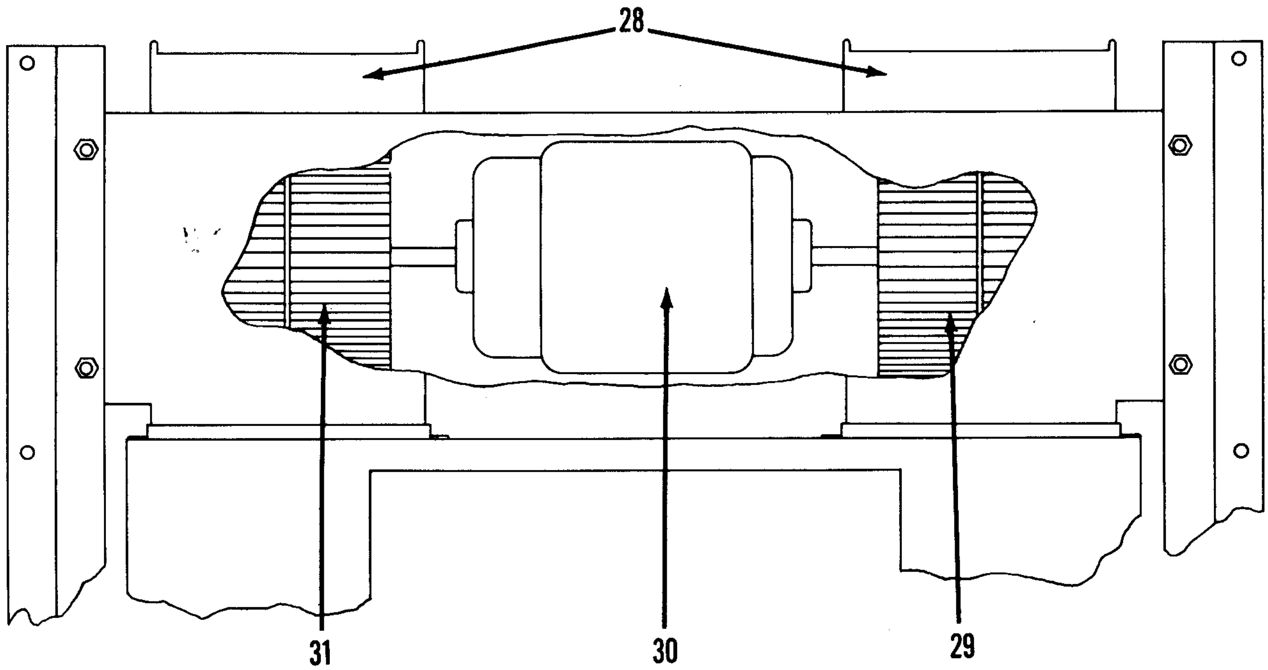


FIGURE 23
Cooling Unit Blower Assembly, Blow Thru

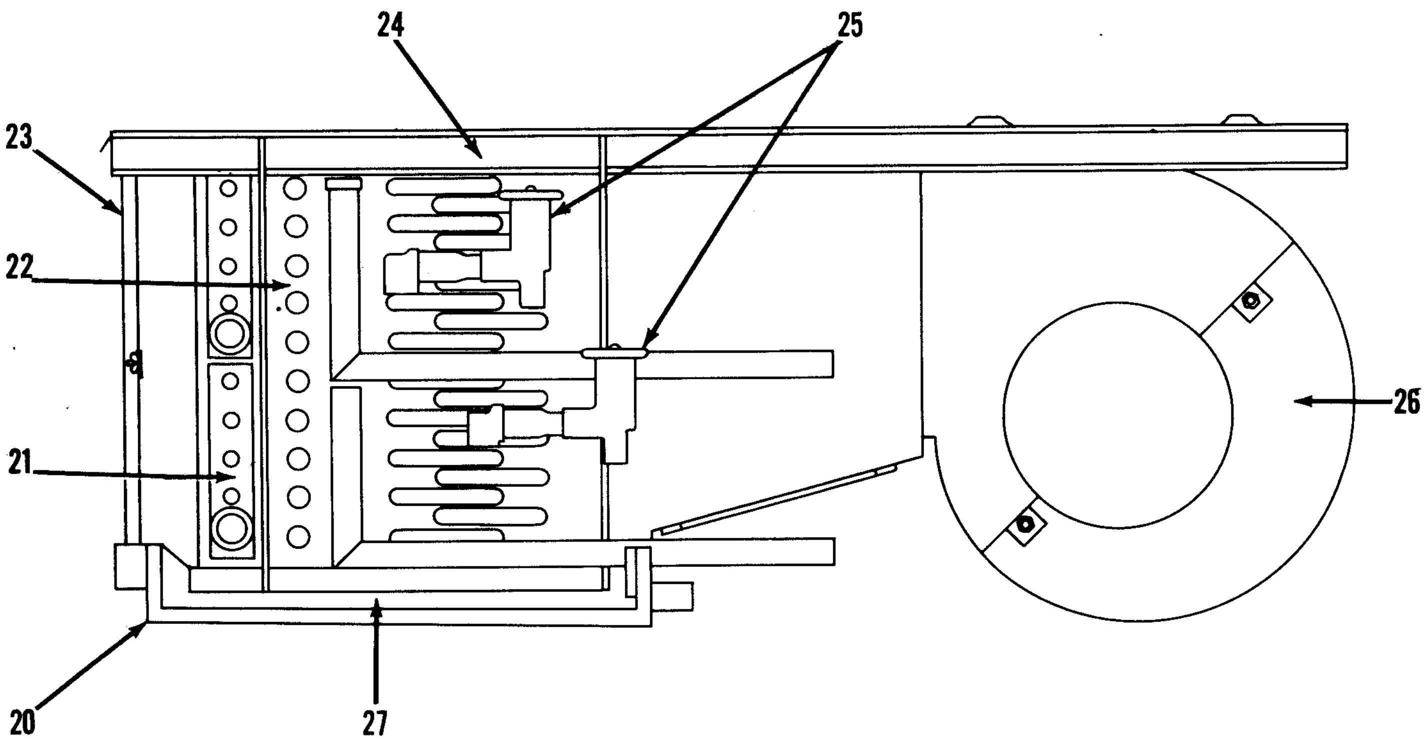
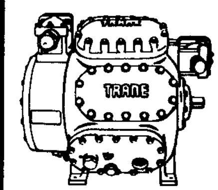


FIGURE 24
End View

(Parts list on following page)



COOLING UNIT PARTS LIST - BLOW THRU TYPE

TABLE 9

REF. NO.	PART NAME AND DESCRIPTION	DINERS	NO. REQUIRED
20	Evaporator Assembly Complete	EVP-803	1
21	Coil Heating, 1 Row, 15" x 41"	C-801	1
22	Coil Cooling, 6 Row, 15" x 41"	EVP-805	1
23	Frame - Clamping	FRM-805	1
24	Support - Motor and Fan	SUP-800	1
25	Expansion Valve	TDL2F	2
26	Housing - Fan, 10", 3/4 DWDI	HSG-801	2
27	Pan - Condensate Drain	PAN-801	1
28	Frame - Discharge Duct	FRM-804	1
29	Wheel - Fan, 10", 3/4" DWDI (L. H.)	WHL-802	1
30	Motor - Electric, Louis Allis, 3/4 HP, 32 VDC, 1140 RPM, BB, Open, Frame 204Y	MOT-803	1
31	Wheel - Fan, 10", 3/4 DWDI (R. H.)	WHL-801	1
*	Nameplate - Serial	PLT-28	1
*	Cut-Off Fan, 10", 3/4 DWDI	CO-801	2
*	Duct - Assembly	DUC-800	1
*	Mounts - Isolation, Motor, 1-3/8" x 1/2" I.D. x 5/8"	MNT-802	4
*	Mounts - Isolation, Motor, 1-1/2" x 1/2" I.D. x 15/16"	MNT-803	4
*	Block - Mounting	BLK-800	4
*	Seal - Suction	SEL-800	2

*Part not illustrated.
(Illustration on preceding page)

BEARING LUBRICATION

The evaporator fan shaft bearings should be greased every 8 to 10 weeks with alemite #33 solid oil, or equal.

THERMOSTATIC EXPANSION VALVE

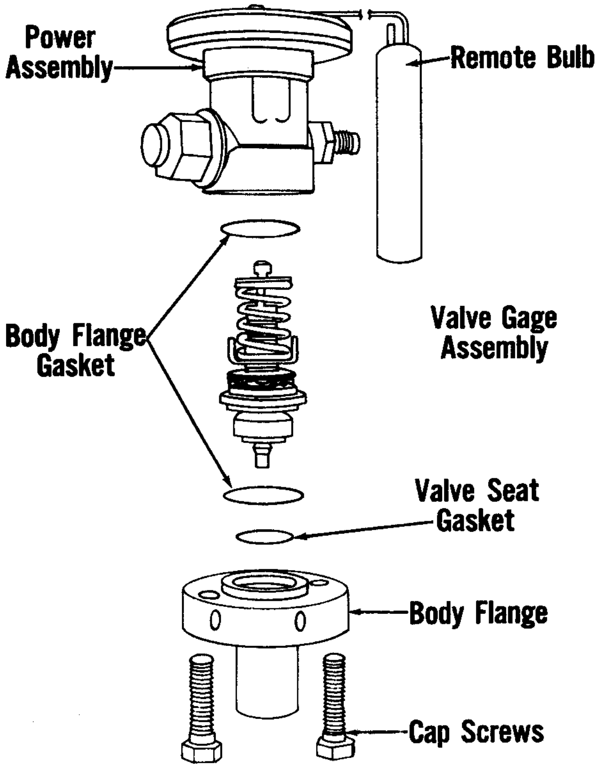


FIGURE 25
Thermostatic Expansion Valve
(Multi-Outlet)

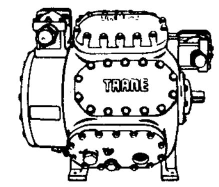
(Alco Valve Co.)

TABLE 10 PARTS LIST

PART NAME AND DESCRIPTION	ALCO PART NUMBER	NO. REQUIRED
Valve Complete (7 Outlet)	T0300-7FG	1
Valve Complete (8 Outlet)	T0300-8FG	1
Power Assembly (External Bulb)	XB1019	1
Cage Assembly (Includes Gaskets) (Specify capacity and number of outlets)	XC713	1
Body Flange Gasket	A625-4	2
Seat Gasket	A625-3	1
Body Flange --		
7 Outlets (Top)	A1011	1
8 Outlets (Bottom)	A1013-4	1
Cap Screw	PS286	2
External Bulb Clamp	XA1728-4	2
Outlet Plug	A1855-1	---
Nameplate (Specify Charge)	A1059	1

NOTE: When ordering parts for Thermostatic Expansion Valves, specify type T0300-7FG Valve for replacement of parts on upper (7 Outlet) valves, and type T0300-8FG for replacement of parts on lower (8 Outlet) valves.

(Parts list, model TDL2F on following page)



THERMOSTATIC EXPANSION VALVE

TABLE 11

PART NAME AND DESCRIPTION	ALCO PART NUMBER	NO. REQUIRED
Valve Complete	TDL2F	1
Power Assembly (External Bulb)	XB1019	1
Cage Assembly (Specify capacity and internal or external equalizer)	XC709	1
Body Flange, 5/8" x 7/8" O.D.S.	A576	1
Body Flange Gasket	A625-4	2
Seat Gasket	A625-2	1
Adjusting Stem and Packing Assembly	XA1360	1
Cap Screw (3/8" - 24 x 1-3/8" SAE)	PS168	2
External Bulb Clamp	XA1728-4	2
Seal Bonnet	5055-1	1
Seal Cap	A716-1	1
1/8" Steel Equalizer Connection Pipe Plug	PS207	1
Nameplate (Specify Charge)	A1059	1

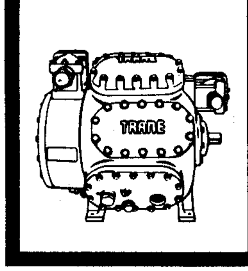
(Illustration on preceding page)

SUPPLEMENTAL EQUIPMENT

TABLE 12

PART NAME AND DESCRIPTION	PART NUMBER	NUMBER REQUIRED		
		DOME	SLEEPER	DINER
Strainer - Liquid, Main Line, Mueller #13497	SRA-800	1	1	1
Strainer - Liquid, Auxiliary, Metrix F-6340	SRA-801	2	2	2
Exchanger - Heat	EXC-800	1	1	1
Eliminator - Vibration, American #5454M Type S-1 (Compressor Discharge, Condenser Line)	ELN-800	3	1	1
Eliminator - Vibration, American #3434M, Type S-1-H (Condenser Line)	ELN-801	2	---	---
Eliminator - Vibration, American #6464M, Type S-1 (Compressor Suction Line)	ELN-802	1	1	1
Resistor - Compressor Motor Field Discharge, Ward-Leonard, 15 Ohm, 160 Watt, Single Step, Fixed, Ribflex, 6-1/2" B Core With Type 802 Mounting Brackets	RES-809	1	1	1
Resistor - Motor Field, 2 Ohm, 100 Watt, Adjustable, Ohmite #09563	RES-801	1	---	---
Valve - Liquid Line Charging	VAL-15	1	1	1
Drier - Liquid Mueller	DHY-1	---	1	1

(See illustrations, pages 13 & 14)



SOLENOID VALVE

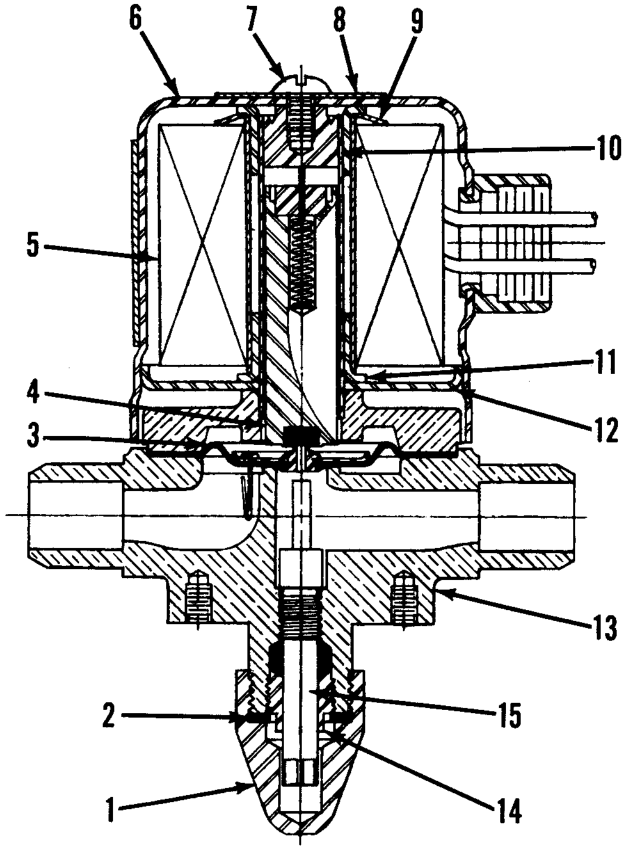


FIGURE 26

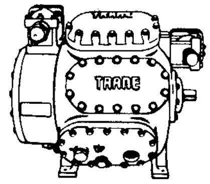
TABLE 13

PARTS LIST (Jackes-Evans Type 70)

REF. NO.	PART NAME AND DESCRIPTION	J-E PART NUMBER	NO. REQD.
1	Cap - Manual Stem Seal	3MP-5	1
2	Gasket - Seal Cap	3MP-6	1
3	Diaphragm - Assembly	3MP-7	1
4	Plunger - Assembly	3MP-17	1
5	Coil	†	1
6	Housing - Coil	3MP-27	1
7	Screw - Coil Housing	3MP-29	1
8	Plate - Coil Data	3MP-30	1
9	Washer - Coil Spring	3MP-26	1
10	Bonnet - Assembly	3MP-15	1
11	Sleeve - Coil	3MP-25	2
12	Plate - Coil	3MP-24	1
13	Body - Valve	70-1	1
14	Nut - Manual Packing Stem	3MP-4	1
15	Stem - Manual	3MP-2	1
*	Screw - Bonnet	3MP-16	1

*Part not illustrated.

†Specify Valve type and voltage.



OPERATION AND MAINTENANCE OF RELIANCE TYPE "T" STANDARD D-C. MOTORS

1. UNPACKING - If facilities for shelter of equipment are not available, do not unpack until ready for use. After unpacking, check to see that all parts have been received in good condition. Turn motor shaft by hand to be sure that there are no obstructions to free rotation.

2. POWER SUPPLY - Check nameplate data to be sure that voltage is same as that at power source.

3. WIRING - Refer to diagram for proper connections to power supply.

4. NO PRE-LUBRICATION REQUIRED - Lubrication of anti-friction bearings at installation is not required, inasmuch as motor has been properly lubricated before shipment.

5. STARTING - Before starting the motor check the following items:

   1. The armature should rotate freely and be clear of any obstructions.

   2. The brushes should move easily in their holders and should make proper contact on the commutator.

   3. The driven machinery should be unloaded, if possible.

   4. There should be no obstruction of ventilation to the motor.

When starting, small sparks may appear on the commutator due to particles of dirt. Other than this, there should be little, if any, sparking at the brushes. The motor should run smoothly with little noise. The bearings should not over-heat. While operating the motor, notice the performance. Any noise, overheating or erratic performance should be investigated and repaired immediately in order to prevent further damage.

6. INSPECTION AND MAINTENANCE - The motor should be inspected weekly in order to keep it in good operating condition. Remove the drip and protective covers and check the following:

   1. Windings should be dry and free of dust, grease and dirt.

   2. Commutator should be clean, smooth, polished and have a very light chocolate color.

3. Brushes should move freely in their holders and have correct, equal pressure on the commutator.

4. Armature and field leads should be undamaged. Terminal connections should be tight.

In maintaining motors, cleanliness is of prime importance. Dirty windings may overheat and cause failure of the insulation. Windings may be cleaned by suction cleaners, compressed air or by wiping. The compressed air must be free of moisture and the pressure must not be excessive. Nozzles on suction type cleaners should be non-metallic. Gummy deposits of dirt and grease may be removed by using carbon tetrachloride. Be sure that adequate ventilation is provided as the fumes have a toxic effect. Do not use gasoline or other inflammable solvents.

More detailed instructions as to maintenance and repair are given on following pages.

THE COMMUTATOR

APPEARANCE - A commutator in good operating condition should be clean, smooth, and have a medium polish. The surface should have a stable, copper oxide-carbon film (not a bright copper surface). The color of the film may vary from copper to chocolate. The mica should be undercut.

CARE - The commutator should be kept clean and well polished. Clean it occasionally with a pad of canvas or other similar hard-woven, non-linting material. Use no grease or lubricant on the commutator.

UNDERCUTTING - Keep the mica between the commutator segments undercut between 1/64 and 1/32 inch, and keep the undercut slots clean. When the motor is shipped, the slots are undercut 1/32 inch and should not be allowed to be less than 1/64 inch.

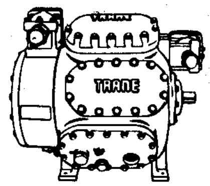
If an undercutting tool is not available, a piece of hacksaw blade mounted in a suitable holder may be used. Use no lubricant while undercutting.

Thin edges of uncut mica should be removed from the sides of the slots. These mica fins may prove a source of trouble and should be removed with a knife blade or other suitable tool such as a hacksaw blade ground in the form of a hook-shaped cutter.

Rough edges that are raised on the edge of the commutator bars by the undercutting tool should be removed by a triangular file or suitable shaped scraper.

After undercutting, the commutator should be polished as outlined below.

POLISHING - A roughened commutator may be polished by grinding with a commutator dressing stone fitted to the curvature of the commutator. If this is not available, sandpaper can be used by pressing it against the commutator with a block of wood having the same curvature. The armature should be removed and the commutator



turned at least as fast as its normal speed while polishing. Move the dressing stone or sandpaper slowly back and forth parallel to the shaft. Finish with a fine grade of sandpaper to give a smooth surface. Wipe off all grit and copper particles before reassembling. Never use emery, carborundum cloth or paper on a commutator.

An extremely rough commutator, or one that is out of round should be turned in a lathe. Light cuts should be taken.

OVERHEATING - Overheating of the commutator may be caused by overloads, shorted or open armature winding, or excessive brush pressure.

BRUSHES

MOUNTING ARRANGEMENT - The brushes fit in brushholders provided with spring operated fingers to maintain pressure on the brushes. The brushholders are clamped to a stud. The stud is bolted to a rocker which holds the studs equally spaced around the commutator. The rocker is clamped around the bearing housing inside the front bracket. Correct position is indicated by a white stripe painted on bracket and yoke. On small motors the rocker is made of micarta while on the larger machines it is made of cast steel with fibre sleeves and washers to insulate the stud.

ALIGNMENT - The spacing and setting of the brushes is correct when the motor leaves the factory and should require no adjustment. However, if for some reason, the brush rigging is disassembled for replacement or repair, the following suggestions should be followed when re-assembling:

The correct position of the rocker (or yoke) is indicated by a white mark. If this mark has been obliterated then the correct position must be determined. There are several methods of checking the setting of the rocker. The most simple is checking to see that the speed in both directions of rotation under full load is the same. Another method is to use a voltmeter of about 5 volts range. Hold the leads about as far apart as the width of one commutator bar and touch them to the surface near the brush while the motor is running under full load. Move the leads until the voltmeter reads zero and adjust the brushes so that they are over this spot. The brushes then are on the electrical neutral, which is their correct position.

The brushholders should have 1/8 inch clearance from the surface of the commutator. A piece of fiberboard or micarta of the correct thickness may be used as a gauge.

All the brushes on each stud should be in line. This may be checked by noting if they toe the same slot in the commutator.

The brushes must be equally spaced around the commutator. As mentioned before the rocker serves to hold them in this position and therefore, they are not apt to become mis-aligned except through rough handling when disassembling. The spacing may be checked easily by wrapping a piece of paper around the commutator underneath the brushes and marking it with a sharp pencil at the toe of each brush, identifying the marks in some manner with the several brush studs. If measurement in these marks indicates uneven spacing, the studs must be adjusted to give even spacing.

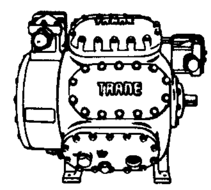
SPARKING - Under normal conditions of operation there should be no sparking at the brushes. Sparking is injurious to both the commutator and the brushes and should never be permitted to continue. Some of the causes of sparking are:

1. Brushes not set at the proper place.
2. Brushes not properly fitted to the commutator.
3. Brushes do not have proper pressure.
4. Brush pressure not equal on all brushes, this causing a heavier current to flow through some brushes.
5. Brushes not fitted to the surface of the commutator due to burned or chipped contact surfaces.
6. A rough commutator.
7. A loose, high, or low commutator bar.
8. High mica or projecting mica fins.
9. Dirty or oily commutator.
10. A loose connection between the armature conductors and the armature bars, or an open circuit in the armature winding.
11. Brushes wedged in the holders.

Make sure that brush leads (pigtails) are secure. A loose connection may cause the current to flow from the brush through the sides of the holder or tension spring, causing burning of the holder and possible sticking of the brush or overheating of the tension spring.

CHATTERING - Chattering of the brushes may be due to:

1. Rough commutator
2. Dirty commutator
3. High mica
4. High or low bars
5. Incorrect brush pressure
6. Incorrect brushholder position and thus giving the wrong angle to the brush.



Chattering, if allowed to continue will chip and shatter the brush and will burn the commutator bars. Incorrect spring tension is perhaps the most common cause of chattering. Too much tension increases the friction while insufficient tension allows the brush to bounce on small irregularities of a commutator surface.

PRESSURE - The correct brush pressure is approximately 1-1/2 pounds per square inch and should be the same for all brushes. The pressure may be checked by means of a small spring scale. The scale should be connected directly to the brush or brushholder finger (not the pigtail) and held in line with the brush. Read the scale just as the brush leaves the commutator surface. A good method is to slip a strip of paper beneath the brush face and pull on it gently while lifting the spring scale. Read the scale when the tension is such that the paper may just be pulled from beneath the brush.

The tension may be adjusted by means of the notches and spring lever that are provided on the brushholder.

REPLACEMENT - Brushes should be replaced before they wear down so far that the spring can no longer exert the correct pressure.

To remove the brushes, disconnect the pigtail from the holder, loosen the tension, lift the brushholder finger and remove the old brush.

Check the inside of the brushholders for burned spots. If any burned spots are found, smooth them with sandpaper.

Insert the new brush making sure it slides easily in the holder, connect the pigtail and adjust the tension on the spring.

After placing the new brushes in the holders, carefully fit the face (contact or rubbing surface) of the brush to the curvature of the commutator. This is called seating the brush and may be done by strips of flintpaper or sandpaper, first using No. 1 grit and then a finer grade such as No. 00. <u>Never use emery carborundum cloth or paper</u> as they are conductors and the particles of their grit will cause serious trouble if imbedded in brush or commutator. Cut the sandpaper into strips slightly wider than one brush. Insert a strip under a brush with the smooth side of the sandpaper next to the commutator and draw the sandpaper in the direction of rotation of the commutator while pressing down on the brush. Lift the brush and repeat until the brush is a good fit. Make sure the sandpaper is held to the curvature of the commutator.

Blow out all carbon dust, wipe off the commutator, the connections and the carbon brushes. Adjust the brushholder springs so that all brushes have the same pressure.

Examine the contact that the brushes make after a period of operation and continue inspection and fitting until the brush face shows a good contact over the full surface of the brush face.

WINDINGS

MAINTENANCE - Keep windings clean and dry. Even though protected by enclosures, the armature and field coils will become dirty and must be cleaned to prevent overheating and breaking down of insulation. Dry dirt and dust may be removed by wiping with a clean dry cloth, blowing it out with compressed air, or using a suction cleaner. If the accumulation contains oil or grease, a solvent such as carbon tetrachloride may be used.

DO NOT USE GASOLINE for cleaning due to the fire hazard. When using compressed air be sure the air stream is free from water.

REPLACEMENT - If it becomes necessary to replace a field coil or interpole coil, study the connections and installation in order that the new coil can be installed in the same manner as the old. Refer also to the cross section drawing. The faulty coils may be replaced by following instructions given in Disassembly. When the pole is removed from the frame, the coil may be slipped off and a new one installed.

The shunt field coil is mounted on a metal bobbin and held in place by clips welded to this bobbin. The series field coil is slipped over the shunt field coil and held in place by metal bands.

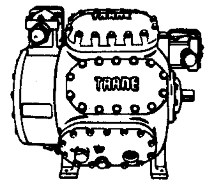
Interpole coils are held in position by means of clips welded to the core. To remove the coil from the core, carefully straighten these clips and slide the coil off. Some spare interpole coils are wound directly on the interpole core. When installing a new pole of this type, the air gap should be checked carefully to make sure the gap under the newly installed interpole is the same as that under the others.

Connections should be made just as they were on the coil that was removed. Leads should be lashed with cord, if necessary, to keep them from interfering with the armature or brush rigging. The main field poles should be of alternate North and South polarity. This may be tested by placing two ordinary nails, or an iron bar between adjacent field poles. The point of one nail should touch one pole tip, the point of the other nail should touch the other pole tip, and the heads should touch each other. If an iron rod is used it should be long enough to reach from one pole to another. When current is sent through the field coils the nails should stick together or the iron bar should be held strongly between the poles. If the nails do not stick together or there is little attraction for the bar, the new field coil is reversed. Either the coil itself or the connections of the coil should be reversed.

The interpoles should have the same polarity as the main field pole just back of the interpole. Thus, in a motor having clockwise rotation, the interpole should have the same polarity as the adjacent main pole in the counter clockwise direction. (Directions of rotation given are as seen when facing commutator end).

DISASSEMBLY

GENERAL - The motor should not be disassembled unless it is necessary to replace a field pole or bearings or make repairs on the armature. When dismantling the motor, care must be taken not to damage the field coils or armature windings as the insulation



may be injured by improper or rough handling. The bearings should not be allowed to become dirty through handling.

PRELIMINARY - Before removing either end shield:

1. Make certain the motor is disconnected from the line.

2. Disconnect leads in the terminal box. Tag incoming leads to insure correct reconnection.

3. Remove the motor from its base.

4. Mark the brackets and frame so they can be replaced easily.

5. Remove drip covers and protective covers.

6. Remove brushes, disconnect leads to brushholder studs.

REMOVING END SHIELDS AND ARMATURE

7. Remove two grease cups and pipe nipples.

8. Remove four cap screws and washers holding inner bearing cap.

9. Remove four cap screws and washers from front end only. Some force may be required to remove the front end bracket due to the machined fit on the frame and the snug fit on the frame and the snug fit on the bearing. Force should be evenly applied around the edge using either a wood block or a lead mallet to transmit the blows. Use care to avoid injury to the commutator when removing the bracket.

10. Remove four bolts and washers attaching the rear end bracket; remove armature and end bracket together. Do not injure the armature coils or commutator. Rest the armature on wood supports.

11. Remove four cap screws and washers.

12. Remove rear end bracket from armature shaft.

REMOVING FIELD POLES

13. Field poles (either main or interpole) may be removed by removing the bolts which attach them to the frame.

The leads must be disconnected before removal. The shims must be kept and replaced with the pole to which they belong.

REMOVING BALL BEARING - Bearings should not be removed unless they are to be replaced. To remove bearings:

14. Bend up the ear of the lock washer and unscrew lock nut using spanner wrench.

15. Pull off bearing. Apply pressure to the inner race only, using a steady pressure rather than hammer blows. If a hammer must be used, the blows should be transmitted through a hard wood or fibre block.

A bearing puller may be rigged by using a metal plate, with holes drilled to match the tapped holes in the inner cap. Use care to keep the pressure equal to prevent breaking the cap.

RE-ASSEMBLY - (Refers also to sections on Winding, Brushes and Bearings).

1. Install the rear bearing by placing on the inner cap and the retaining ring. Press on the bearing. Use a steady pressure on the inner race. One method is to use a piece of pipe of the correct size to slip over the shaft. Then use pressure to bear against the inner race, using a hammer to transmit the blows if it is the only tool available. A block of wood or fibre should be used to transmit the blows. Put on lock washer and lock nut. Bend down the ears in the slots of the lock nut.

2. Put on the inner cap, retainer ring and front bearing.

3. Slip on the rear end bracket.

4. Install field poles and connect correctly. Make sure the original shims are replaced and that the field pole attaching bolts are tight.

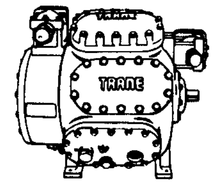
5. Place the armature in the frame and bolt the rear bracket to the frame. Make sure the end bracket is on the correct end and in the same position as before removal.

6. Bolt the front end Bracket to the frame. Make sure the end shield is in the correct position.

7. Reconnect the leads to the brushholder studs and replace brushes. Make sure the rocker is in the correct position as indicated by the white marks.

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN



LUBRICATION OF BEARINGS - Ball and roller bearing motors are properly lubricated when shipped from the factory. Therefore, it is unnecessary to grease the motor when installing.

MOTOR LUBRICATION (RELIANCE) - Grease motors at least once a year. Use a neutral, non-fibrous grease with a high melting point (350° F.) and with a minimum tendency to separate into oil and soap. The grease should have a very slow oxidizing rate.

Several greases having desirable motor bearing lubricating properties are listed below:

MANUFACTURER	GREASE
Standard Oil Co. of N. J.	Andok C and B
Master Lubricants Co.	Lubriko M-6, M-21 and M-32
New York and New Jersey Lubricant Co.	F-925, S-58 and S-58-M
The Texas Company	Starfak H and M
Gulf Refining Company	Precision No. 2 and No. 3
Keystone Lubricating Co.	No. 44H and 84H Light
Sinclair Refining Co.	AF No. 2
Socony Vacuum Oil Co.	Gargoyle BRB No. 1
Tide Water Assoc. Oil Co.	Tycol Armitage 0
Union Oil Co. of California	Strona HT-1
Shell Oil Co.	Alvania No. 2

RENEWAL PARTS - When ordering spare or replacement parts, give data from the motor nameplate. Be sure to include the motor serial number. Refer to spare parts list included with spares for applicable spare parts numbers.

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN

COMPRESSOR MOTOR

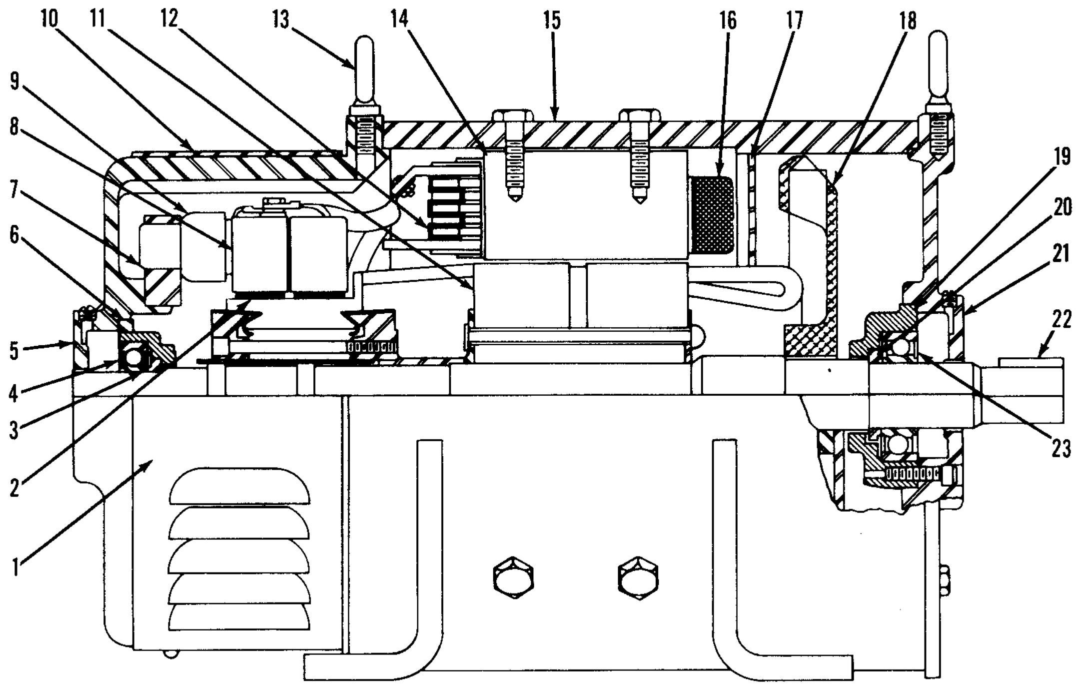


FIGURE 27

PARTS LIST (Frame T-326-Y12, 12 HP, Compressor Motor Components, Voltage 36, DC, Shunt Windings, Speed 1750/2000, Duty Cont. 50° C., Trane Specification 5232-5230).

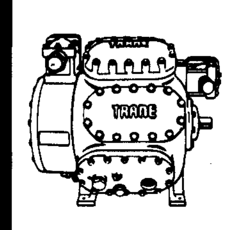
TABLE 14

REF. NO.	PART NAME AND DESCRIPTION	RELIANCE PART NUMBER	NO. REQUIRED
1	Cover	75410-R	1
2	Brushes	3306-DS	8
3	Bearing Spacer F. E.	48501-A	1
4	Bearing F. E.	307	1
5	Bracket	80122-9-A	1
6	Inner Cap	49408-A	1
7	Rocker	75576-R	1
8	Brushholder	63961-2-R	8
9	Brush Studs	63962-9-R	4
10	Cover		
11	Armature	E/S E19A	1
12	Inter. Coils	E/S 0-0-F2B	2
13	Eyebolt		
14	Field Pole	49851-1-R	4
15	Frame	73735-10-R	1
16	Field Coils	E/S 0-F16S	4
17	Baffle		
18	Fan	73678-2-R	1
19	Inner Cap B. E.	49410-A	1
20	Bearing Spacer B. E.	48501-G	1
21	Bracket B. E.	80036-43-R	1
22	Key	4600-DK	1
23	Bearing B. E.	309	1

REFRIGERATION SERVICE MANUAL

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY - LA CROSSE, WISCONSIN
SUPERSEDES



CONDENSER AND EVAPORATOR FAN MOTOR

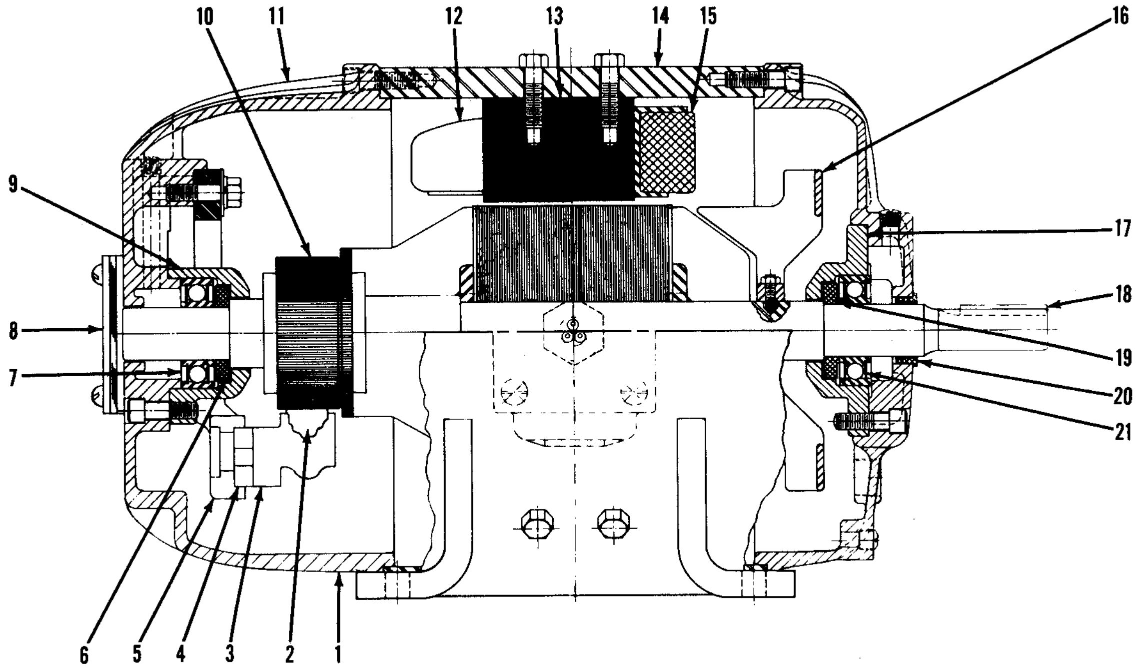


FIGURE 28

PARTS LIST (Condenser Motor) (Frame CT-204, HP 1, Voltage 36, DC, Shunt Windings, Speed 1750, Duty Cont. 55° C., Trane Specification 5234).

TABLE 15.

REF. NO.	PART NAME AND DESCRIPTION	RELIANCE PART NUMBER	NO. REQUIRED
1	Cover	63079-2-A	2
2	Brushes	3306-DG	4
3	Brush Stud		
4	Brushholder	63080-RA	2
5	Rocker	63072-B	1
6	Bearing Spacer F. E.	47579-U	1
7	Bracket F. E.	205	1
8	Bracket F. E.	80100-14C	1
9	Inner Cap F. E.	48891-B	1
10	Armature	E/S A55A	1
11	Cover		
12	Field Coil	E/S 0-A87S	2
13	Field Pole	48882-1-R	2
14	Frame	71841-R	1
15	Inter. Coil	E/S 0-0-0	
16	Fan	62676-RA	1
17	Inner Cap B.E.	48886-A	1
18	Key	4600-AE	1
19	Bearing Spacer B. E.	47579-U	1
20	Bracket B. E.	8907-R	1
21	Bearing B. E.	205	1

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN

PARTS LIST (Evaporator Motor)

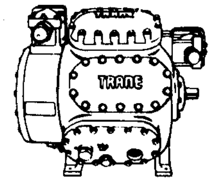
(Frame CT-203, HP 1, Voltage 36, DC, Shunt Windings, Speed 1750, Duty Cont. 40° C., Trane Specification 5236)

TABLE 16

REF. NO.	PART NAME AND DESCRIPTION	RELIANCE PART NUMBER	NO. REQUIRED
1	Cover		
2	Brushes	3306-EA	4
3	Brush Studs		
4	Brushholder	63080-U	2
5	Rocker	63072-B	1
6	Bearing Spacer F. E.	47579-U	1
7	Bearing	205	1
8	Bracket	80100-15-A	1
9	Inner Cap	48959-RA	1
10	Armature	E/S A46A	1
11	Cover		
12	Field Coil	E/S 0-A38S	2
13	Field Pole	48882-RA	2
14	Frame	71842-R	1
15	Inter. Coil	E/S 0-0-0	1
16	Fan	62676-RA	1
17	Inner Cap B. E.	48886-A	1
18	Key	4600-AE	1
19	Bearing Spacer B. E.	47579-U	1
20	Bracket B. E.	8906-A	1
21	Bearing B. E.	205	1

(See illustration on preceding page)

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY · LA CROSSE, WISCONSIN



EXHAUST FAN (Lounge)

TABLE 17 PARTS LIST (Fan)

PART NAME AND DESCRIPTION	PART NUMBER	NO. REQ.
Support - Motor and Fan Support	SUP-801	1
Housing - Fan, 4-1/2" FC DWDI	HUS-802	2
Wheel - Fan, 4-1/2" FC DWDI, 5/8" Bore (R. H.)	WHL-803	1
Wheel - Fan, 4-1/2" FC DWDI, 5/8" Bore (L. H.	WHL-804	1
Mount - Unit	MNT-804	4
Mount - Motor	MNT-805	4
Connector - Cord, ASE-1413V	CON-800	1
Motor - Electric, Wagner, 1/8 HP, 32 VDC, Regulated, Double Extended Shaft, 1725 RPM, BB, #56 JZ1487, Frame V56 RD	MOT-804	1

PARTS LIST (Motor)
(Frame V56RD, HP 1/8, Voltage 32 DC Regulated, Speed 1725 RPM, Wagner #56 JZ1487)

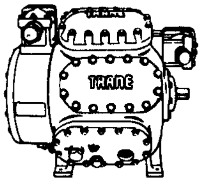
TABLE 18

PART NAME AND DESCRIPTION	WAGNER PART NUMBER
Bearing - Ball, Front	SKF-FLB-16
Bearing - Ball, Rear	SKF-FLB-16
Cap - Ball Bearing, Front	1HC7433
Locknut - Ball Bearing, Front	HC6056
Lockwasher - Ball Bearing, Front	2MC16333
Shim - Ball Bearing	HC5368
Blower - Assembly	HC9476-2
Brush - Carbon	HC2660
Spring - Brush	HC2127
Commutator	HC5088-1
Plate - End, Front (Bare)	6HD9028
Plate - End, Rear (Bare)	1HE4995
Clamp - Index	HC5558
Key - Pulley	272MC5550
Shaft - Motor	HD9569
Bolt - Thru	4HC7137

EXHAUST FAN (Electric Locker)

TABLE 19 PARTS LIST

PART NAME AND DESCRIPTION	PART NUMBER	NO. REQ.
Fan - Assembly, Exhaust (complete)	FAN-801	1
Ring - Orifice	RNG-801	1
Fan - 6", 5/16" Bore, Torrington	FAN-802	1
Bracket - Motor, Support	BRK-800	2
Motor - Electric, Universal, 32 VDC, 2400 RPM, 1/8 HP, Model 4-039	MOT-805	1



COMPONENTS

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY · LA CROSSE, WISCONSIN

PARTS LIST (Motor)
(Universal Model 4-039, HP 1/2, Voltage 32 DC Regulated, Speed 2400 RPM)

TABLE 20

PART NAME AND DESCRIPTION	PART NUMBER
Stator - Assembly	29B66A-1-4-039
Armature - Assembly (With Bearings)	15C13A-10-4-039
Cap - Brush	14123
Assembly - Brush and Spring	25A18A-3
Head - Assembly, Rear	39A30A-4-039
Head - Assembly, Brush	39B81A-10-4-039
Bearing - Ball	12A12-1

UTILITY FAN

TABLE 21

PARTS LIST (Fan)

PART NAME AND DESCRIPTION	PART NUMBER	NO. REQ.
Fan - Utility Blower, 6" S.W.	FAN-803	1
Housing - Fan	HUS-803	1
Wheel - Fan	WHL-805	1
Support - Assembly	SUP-802	1
Mount - Isolation	MNT-806	4
Motor - Electric, Wagner, 32 VDC, 1360 RPM, 1/8 HP BB, Frame V56RD	MOT-806	1

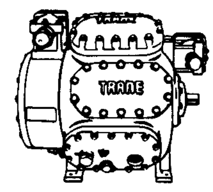
PARTS LIST (Motor)
(Wagner Motor Type RD, Frame V-56, Model O, 1/8 HP, 32 Volts, D.C., 1360 RPM)

TABLE 22

PART NAME AND DESCRIPTION	WAGNER PART NUMBER
Bearing - Ball	SKF FLB16
Cap - Ball Bearing, Front	1HC7433
Locknut - Ball Bearing, Front	HC6056
Lockwasher - Ball Bearing, Front	2MC16333
Shim - Ball Bearing	HC5368
Blower - Assembly	HC9476-2
Commutator	HC5088-1
Conduit Box Assembly	HD1224-2
Plate - End, Front (Bare)	2HE5049
Plate - End, Back (Bare)	4HE4995
Plate - End, Cover	HC8410
Clamp - Index	HC5558
Bushing - Lead	HC5152
Key - Pulley	272MC5550
Shaft	HD9558
Bolt - Thru	4HC7137

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY · LA CROSSE, WISCONSIN



CONTROL PANEL

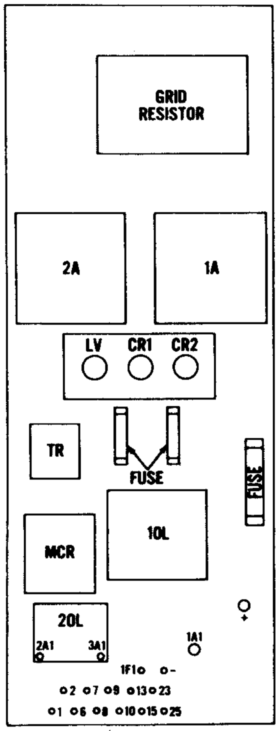


FIGURE 29
12 Ton System

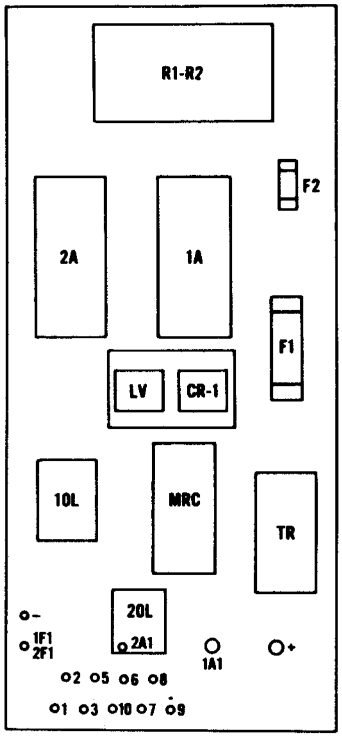


FIGURE 30
8 Ton System

(See following page for parts list)

TABLE 23 PARTS LIST (12 Ton System)

DESCRIPTION	DIAGRAM DESIGNATION	COMPONENT DESIGNATION	COIL	RENEWAL PART SHEET
Final Accelerator	2A	545	95-15	8684
Starting Contractor	1A	542	92-24	8683
Main Control Relay	MCR	369	483-13	9154
Timing Relay	TR	693	1332-24	8460
Low Voltage Relay	LV	735	561-18	A70-615
Control Relay	1CR	739	561-18	A70-759
Control Relay	2CR	739	561-18	A70-759
Compressor Overload	1OL	609	179-2	7235
Condenser Fan Overload	2OL	306	9586H228	1759
		SIZE OR VALUE		PART NUMBER
Main Fusetron	F1	600A	----	BUSS FRN 600
Condenser Fan Fuse	F2	45A	----	PT. 611-802
Condenser Fan Fuse	F3	45A	----	PT. 611-802
Starting Resistor (Grids in Series)	R1-R2	.042 ohms	----	G-7C7
Control Resistor	C-D	125 ohms	----	11003H29A57
Control Resistor	E-F	320 ohms	----	11003H32A61
Control Resistor	F-G	360 ohms	----	11003H29A66
Control Resistor	H-K	25 ohms	----	11003H29A43
Control Resistor	L-M	125 ohms	----	11003H29A57
Control Resistor	N-P	125 ohms	----	11003H29A57

COMPONENTS

PRINTED IN U.S.A. SM-400-1-154

THE TRANE COMPANY - LA CROSSE, WISCONSIN

TABLE 24 PARTS LIST (8 Ton System)

DESCRIPTION	DIAGRAM DESIGNATION	COMPONENT DESIGNATION	COIL	RENEWAL PART SHEET
Starting Contactor	1A	541	91-48	8682
Final Accelerator	2A	542	92-24	8683
Main Control Relay	MCR	369	483-13	9154
Timing Relay	TR	693	1332-24	8460
Low Voltage Relay	LV	735	561-18	A70-615
Control Relay	CR-1	739	561-18	A70-759
Compressor Overload	1OL	609	179-2	7235
Condenser Fan Overload	2OL	307	9104H50B	4527
		SIZE OR VALUE		PART NUMBER
Main Fusetron	F1	600A	---	BUSS FRN600
Condenser Fan Fuse	F2	50A	---	PT. 611-844
Starting Resistor (2 in parallel)	R1-R2	.042 ohms	---	6TC28
Control Resistor	A-B	125 ohms	---	11003H29A57
Control Resistor	C-D	125 ohms	---	11003H29A57
Control Resistor	F-G	360 ohms	---	11003H29A66
Control Resistor	E-F	320 ohms	---	11003H32A61
Control Resistor	H-K	64 ohms	---	11003H29A51

LOW VOLTAGE RELAY #735 (Cutler Hammer)

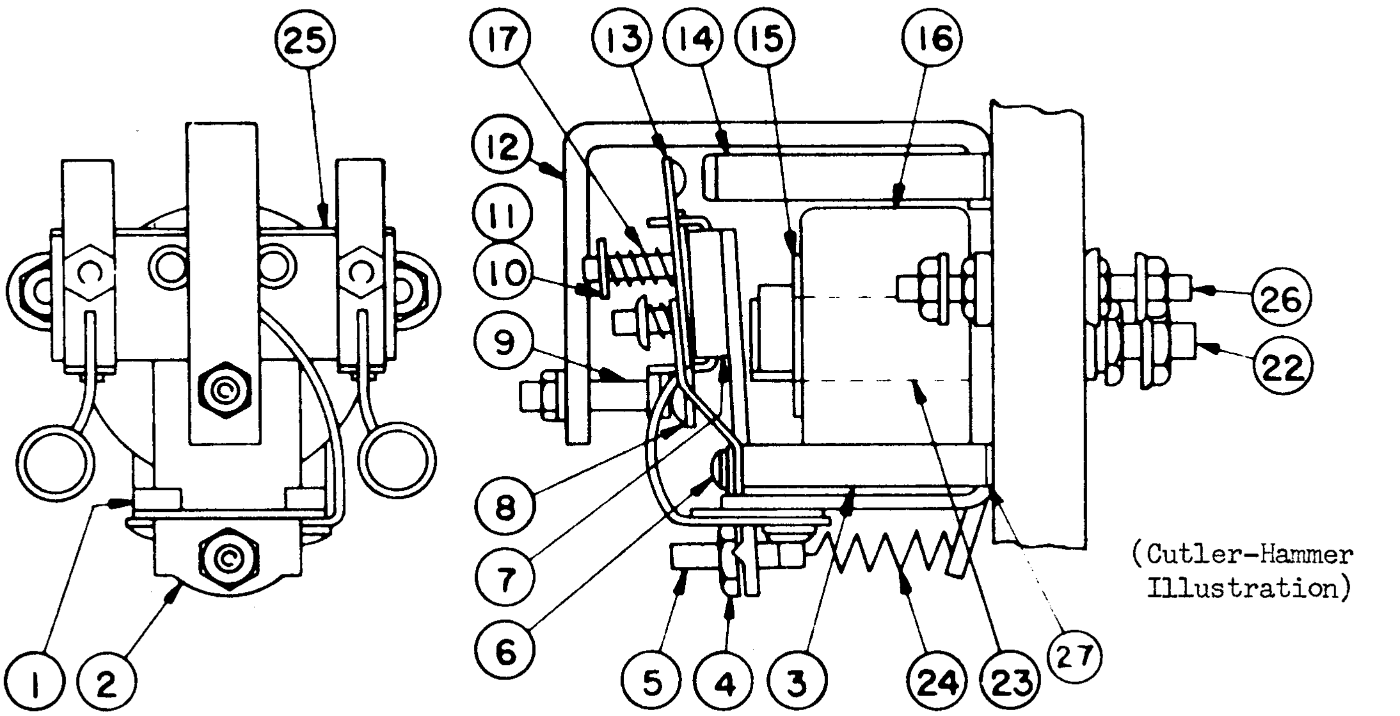
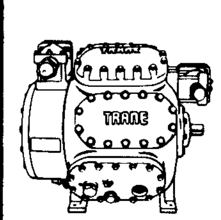


FIGURE 31

(Parts list on following page)

PRINTED IN U.S.A. SM-400-1-154
THE TRANE COMPANY · LA CROSSE, WISCONSIN



PARTS LIST
LOW VOLTAGE RELAY #735
(Cutler-Hammer)

TABLE 25

ITEM NO.	PART NAME AND DESCRIPTION	C-H PART NUMBER	NO. REQ.
1	Frame	17-366	1
2	Armature Lever	24-1905	1
3	Post	18-882	2
4	Nut	815-247	1
5	Stud	914-105Z	1
6	Binding Head Screw	811-7248F1	2
7	Finger Board	81-3985	1
8	Contact Finger	40-337	1
9	Contact Stud	14-206	1
10	Cupwasher	16-543	1
11	Spring	969-579	1
12	Contact Post	23-2057-2	1
13	Contact Finger	40-317	2
14	Contact Post	18-883	2
15	Washer	16-658	*
16	Coil (Give Number on Coil)	---	1
17	Spring	969-494	2
22	Stud	---	1
23	Core	11-1265	1
24	Spring	69-84	1
25	Armature Lever (Includes Items 2, 7, 8, 10, 11, 13 and 17)	24-2474-2	1
26	Stud	814-277	*
	Nut	815-150	*
	Cupwasher	816-69	*
	Lockwasher	916-402Z	*
	Washer	816-102	*
	Shakeproof Washer	16-639	*
	Insulating Cupwasher	16-772	*
27	#6 Shakeproof Washer	916-114	4

* Quantity as required.

When ordering renewal parts, specify Cutler-Hammer Drawing Number A70-615, item number, part name, part number, and complete nameplate data.

(Illustration on preceding page)

These voltage relays are factory adjusted to pick up from reset button at 25 volts or less - resistors EF and FG are by-passed at pickup.

During operation resistors EF - FG and CD are in series with the low voltage relay coil, and drop out may be set from 26 to 30 volts. Factory setting is about 28 volts.

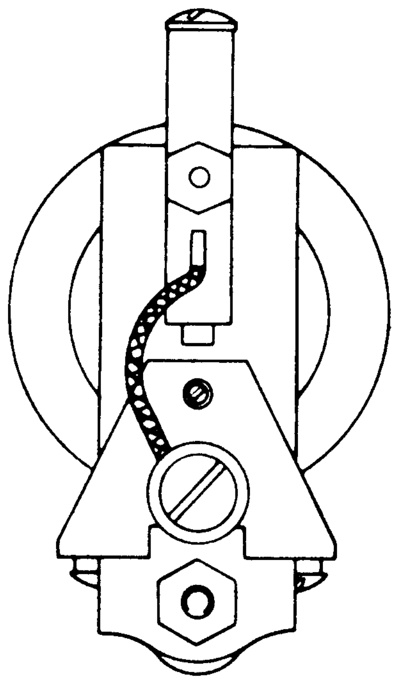
The drop out voltage must be measured from positive (+) line to negative (-) line.

To change setting from 28 volt drop out to 26 volt drop out, slider resistor EF should be changed to a lower value (less ohms). With slider EF adjusted for nearly all resistance out the relay should drop at approximately 26 volts.

Nut 4 in Figure 31, Page 43 has been factory adjusted to obtain the above setting. If the drop out at 26 volts does not occur with nearly all EF resistor shorted out, it may be necessary to move adjusting nut 4 one notch at a time (one sixth revolution). Turn nut clockwise to lower drop out. This nut should never be loosened enough to allow spring 24 to be loose when relay is in "Off" position.

Once the nut 4 is adjusted - then only the slider resistor EF should be used to obtain a drop out setting between 26 and 30 volts.

CONTROL RELAY #739



(Cutler-Hammer Illustration)

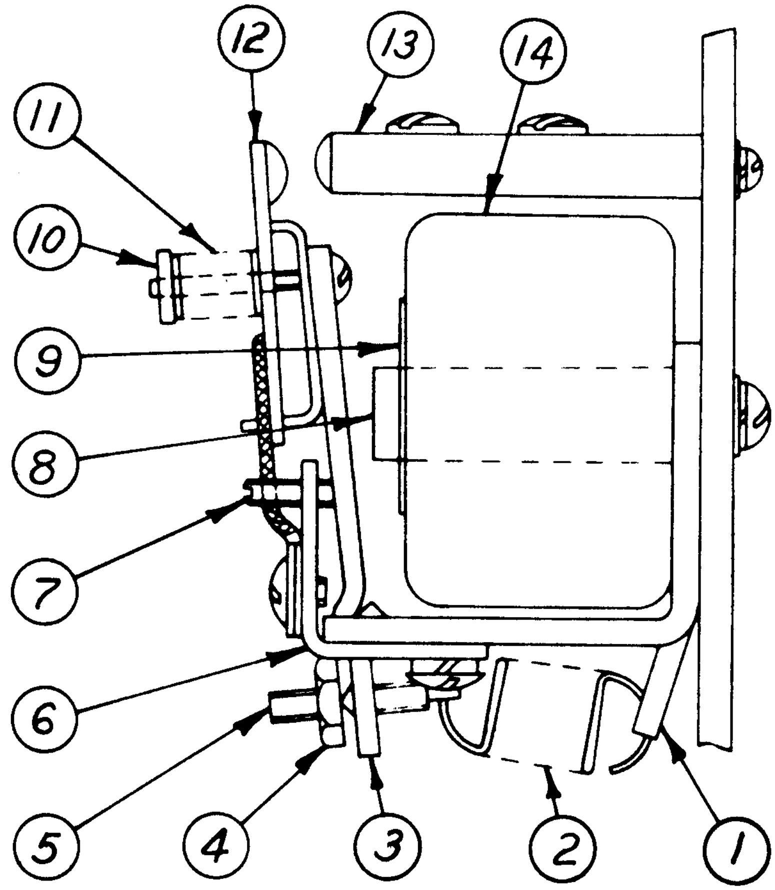


FIGURE 32

TABLE 26 PARTS LIST

ITEM NO.	PART NAME AND DESCRIPTION	C-H PART NUMBER	NO. REQ.
1	Frame	17-366	1
22	Spring	69-84	1
3	Armature Lever	24-1906-3	1
4	Adjusting Nut	815-247	1
5	Adjusting Stud	914-105Z	1
6	Stop Bracket	79-1366	1
7	Adjusting Screw	911-379	1
8	Core	51-306-2	1
9	Insulating Washer	16-657	1
10	Adjusting Nut	15-267	1
11	Spring	969-494	1
12	Movable Contact	40-317	1
13	Stationary Contact	18-597	1
14	Coil (Give number on coil)	---	1

When Ordering Renewal Parts, Specify Cutler-Hammer Drawing Number A70-759, Item Number, Part Name, Part Number And Complete Nameplate Data.

The following pages are from a Trane manual covering the following Northern Pacific cars:

- Diner 458-463
- Dome Coach 314
- Dome Sleeper 549

SYSTEM COMPONENT DESCRIPTION

COMPRESSOR UNITS -- Compressor, Trane 2B-514, 2-1/2" Bore x 2" Stroke, 4 Cylinder With Cylinder Unloaders For 4-Step Capacity. Motor, Reliance, Electric, 12-1/2 - 14-1/2 HP, 1800-2000 RPM, 28-46 V DC, Ball Bearing, Trane Specification D4520/6806. Control Box, Contains Evaporator, Condenser And Oil Pressure Gages, Mueller Diaphragm Valves, Test Switch And Detroit Controls Dual Pressure Control.

DRY-TYPE CONDENSER UNITS -- Coil, 24" x 42", 8-Row With Copper Tubes, Headers And Fins. Fan, 21" Aerovent, 7-Blade Axial Flow Type. Motor, Reliance, Electric, 1 HP, 1750 RPM, 28-42 V DC, Directly Connected To Motor, Trane Specification D4520/5234. Liquid Receiver, Drawn Steel, Complete With Two Sight Glasses And Three Liquid Shut-Off Valves.

DOME CAR COOLING UNITS -- Cooling Coil, 15" x 36", 8-Row Type DE With Copper Tubes And Fins, Silicon Bronze Tube Sheets, Furnished With Thermostatic Expansion Valves For Each Section And Solenoid Valves For Remote Installation. Heating Coil, 15" x 36", 1-Row With Copper Tubes And Fins And Steel Casing, Arranged For Two-Pass Steam Distribution. Fans, Two, 8"-3/4 DWDI, Belt Driven. Motor, Reliance, Electric, 1 HP, 1800 RPM, 36 V DC, Trane Specification D4520/5236.

DINER CAR KITCHEN-PANTRY UNITS -- Cooling Coil, 15" x 24", 6-Row Type DE With Copper Tubes And Fins And Silicon Bronze Tube Sheets, Furnished With Thermostatic Expansion And Solenoid Valve. Heating Coil, 15" x 24", 1-Row With Red Brass Tubes, Copper Fins And Silicon Bronze Tube Sheets, Arranged For Two-Pass Steam Distribution. Fan, One, 8"-3/4 DWDI, Belt Driven. Motor, Reliance, 1/2 HP, 1800 RPM, 32 V DC, Trane Specification D4520/6746.

DINER CAR DINING SECTION UNITS -- Cooling Coil, 15" x 36", 8-Row Type DE With Copper Tubes And Fins And Silicon Bronze Tube Sheets, Furnished With Thermostatic Expansion And Solenoid Valve For Each Section. Heating Coil, 15" x 36", 1-Row With Red Brass Tubes, Copper Fins And Silicon Bronze Tube Sheets, Arranged For Two-Pass Steam Distribution. Fans, Two, 8"-3/4 DWDI, Belt Driven. Motor, Reliance, Electric, 1 HP, 32 V DC, 1800 RPM, Trane Specification D4520/5236.

ELECTRICAL CONTROL INFORMATION

DOME COACH AND DOME SLEEPER CARS

On dome coach and dome sleeper cars, the air conditioning system consists of two overhead cooling units with each coil split into two equal sections, two dry-type condensers, and a single motor-compressor unit. The condensers and compressor unit are installed under the car and the cooling units are mounted overhead.

TEMPERATURE CONTROL

All overhead cooling coils are split into two equal sections for capacity control. Each section has an expansion valve and solenoid valve. When the car thermostat calls for cooling, the solenoid valve under the control of that thermostat opens, admitting refrigerant to the coil section. When the car thermostat is satisfied, the solenoid valve closes.

Two thermostats on the Vapor Control System control the two coil sections of each cooling unit. The low-temperature (first-stage) thermostat controls the lower section of the cooling coil. The high-temperature (second-stage) thermostat controls the upper section of the cooling coil. On these cars, two cooling coils are used -- one for the body of the car, the other for the dome. Each coil is split into two equal sections and is under the control of individual thermostats.

When car temperature rises to a point requiring cooling, the first-stage thermostat (low-temperature) opens the solenoid valve of the lower half of the cooling coil and starts the compressor. Further rise in car temperature will cause the second-stage thermostat to open the solenoid valve on the remaining top half of the coil. This provides full cooling capacity.

As car temperature falls, the thermostat will close the solenoid valve on the top half of the cooling coil first, and the solenoid valve on the bottom half of the cooling coil last. The compressor will pump-down the system until it shuts down on low suction pressure through the action of the dual pressure controller.

CAPACITY CONTROL

The capacity of the compressor automatically adjusts to changes in load through the action of cylinder unloaders. These compressor cylinder unloaders are actuated by compressor oil pump pressure and respond automatically to changes in suction pressure. The compressor will unload on decreasing suction pressure and will load on increasing suction pressure. Three of the four cylinders of each compressor has cylinder unloaders.

When all the cooling coil sections are in operation, suction pressure is normal and all cylinders of the compressor are loaded. As one coil section is shut off, leaving three in operation, one of the four cylinders unloads. When two sections are shut off, two cylinders will unload, and when three sections are shut off, three cylinders will be unloaded. As the last section of the cooling coil is shut off, the compressor will continue to operate on the remaining cylinder (does not have an unloader) until the system is pumped down. The compressor will then shut off on low suction pressure.

CONTROL CIRCUIT

The motor starting control panel (located in the electrical locker), in conjunction with the Vapor Control Panel and other components, operates the compressor motor and the condenser fan motors. In the following discussion refer to Figures 1, 3 and 4 on Pages 7, 9 and 10

In automatic operation, the Vapor Control Panel, through the action of either first stage cooling thermostat (Body or Dome), energizes its own control relay (1CR and 2CR) on the motor control panel which closes and energizes the main control relay (MCR). MCR closes and maintains itself, energizing a timing relay (TR), and energizes the compressor and condenser fan motor field. After a time delay, the first accelerating contactor (1A) closes and connects the compressor and condenser fan motors to the power source through the starting resistor. After an additional time delay, the second accelerating contactor (2A) closes and short circuits this resistor, connecting the motors directly across the line. As 2A closes, it drops out TR and 1A.

The condenser fan motors and compressor motors are stopped by dropping out the main control relay (MCR) which opens the second accelerating contactor (2A). The main control relay (MCR) drops out when the dual pressure control (RPC) opens, when an overload contact opens, or when the system test switch (TS) is in the "off" position. The system test switch (TS) is located on the compressor unit. When this system test switch is in the "automatic" position, the compressor is under the control of the temperature control panel. When it is in the "Manual" position, it bypasses the temperature controls and will close the main control relay (MCR), and the motor starting sequence proceeds as described above. Since the test switch is a spring return to the "off" position when it is released from the "manual" position, it will shut off all of the equipment. This switch should always be kept in the "automatic" position.

A low-voltage relay (LV) is provided on the motor starting control panel for protection of the battery. The low-voltage relay (LV) is closed by pressing the low-voltage reset button on the Vapor Panel. This relay (LV) is then maintained through a resistor as long as the voltage does not fall below the specified minimum. A contact on the first accelerating contactor (1A) shorts out this resistor to prevent the low-voltage relay (LV) from dropping out when all of the motors are started, even if the voltage falls below the minimum setting. A contact on the reverse current relay prevents the low-voltage relay (LV) from dropping out as long as power is being drawn from the car generator, and resets the low-voltage relay (LV) automatically when the generator operates. A contact on the low-voltage relay (LV) is connected in the thermostat circuits to prevent operation of the solenoid liquid valves or automatic starting of the refrigeration equipment if the low-voltage relay is not closed.

The condenser fan motors are protected by thermal overload devices, and the compressor motor is protected by an overload relay. A main fuse (F1) and the condenser fan motor fuses (F2 and F3) are for short circuit protection only.

SAFETY DEVICES

The dual pressure control (RPC) is primarily a protective device for the compressor. Its main function is to stop compressor operation whenever operating pressures are abnormal (high or low). A secondary function is to stop the compressor at the end of each cooling cycle.

If system operating pressures reach 290 psi, the high pressure side of this switch will cut-out and stop the refrigeration system. It will automatically cut-in and start operation whenever the pressure falls 50 psi below the cut-out point.

The low pressure side of this switch has an adjustable cut-in point and an adjustable differential (cut-out point). At 25 psi (rise in suction pressure), it will start compressor operation, and at 7½ psi (fall in suction pressure) it will stop compressor operation.

DINER CARS

Each diner car air conditioning system consists of two overhead cooling units, two dry-type condensers and a single motor compressor unit. The condensers and compressor units are installed under the car. One cooling unit is used for the dining section and one unit is used in the kitchen.

TEMPERATURE CONTROL

All Trane overhead cooling coils used in the dining section are split into two equal sections for greater capacity control. The coils used in the kitchen cooling units are not split. Each coil section is furnished with an expansion and solenoid valve. When the car thermostat calls for cooling, the solenoid valve under the control of that thermostat opens, admitting refrigerant to the coil section. When the thermostat is satisfied, the solenoid valve closes.

Two thermostats on the Vapor Control System control the two coil sections of the dining room units and the single coil section of the kitchen unit. The low-temperature thermostat (first-stage cooling) controls the lower section of the cooling coil and the complete kitchen unit. The high-temperature thermostat (second-stage cooling) controls the upper section of the dining room cooling coil.

When cooling is required, the low-temperature (first-stage cooling) thermostat opens the solenoid valve of the lower half of the dining room cooling coil and single coil kitchen unit, and also starts the compressor. Further rise in car temperature will cause the high-temperature thermostat (second-stage cooling) to open a solenoid valve on the remaining top half of the dining room cooling coil, providing full cooling capacity.

As the car temperature falls, the thermostat will close the solenoid valve on the top half of the dining room cooling coil first, and the solenoid valve on the bottom half next. The kitchen unit will close down after the dining room. The compressor will continue to operate until it shuts down on low suction pressure through the action of the dual pressure controller. This is called a pump-down cycle.

CAPACITY CONTROL

The capacity of the compressor automatically adjusts to changes in load through the action of the cylinder unloaders. These compressor cylinder unloaders are actuated by the compressor oil pump pressure and respond automatically to changes in suction pressure. The compressor will unload on decreasing suction pressure and will load on increasing suction pressure. Three of the four cylinders of the compressors are provided with these cylinder unloaders.

When all the cooling coil sections are in operation at peak load, suction pressure is normal and all cylinders of the compressor are loaded. When one section of the cooling coil is shut off, suction pressure will drop and the compressor will unload. Conversely, with one cooling coil section operating, the suction pressure will rise when the other section is energized, loading the compressor.

CONTROL CIRCUIT

The motor starting control panel operates the compressor motor and the condenser fan motors. This panel is, in turn, controlled by the Vapor panel, temperature controllers and protective devices. In the following discussion refer to Schematic and Interconnecting Diagrams (Figures 2 and 5, Pages 8 and 11).

Through the first-stage cooling thermostat, the Vapor panel energizes the first control relay (CR11) on the motor control panel. This closes and energizes the main control relay (MCR). MCR closes and maintains itself, energizing a timing relay (TR), and energizes the compressor and condenser fan motor field. After a time delay, the first accelerating contactor (1A) closes and connects the compressor and condenser fan motors to the power source through the starting resistor (SR). After an additional time delay, the second accelerating contactor (2A) closes and short circuits the starting resistor (SR), connecting the motors directly across the line. As 2A closes, it drops out TR and 1A.

The condenser fan motor and compressor motor are stopped by dropping out the main control relay (MCR) which opens the second accelerating contactor (2A). This relay (MCR) drops out when the dual pressure control switch (RPC) opens, when an overload contact opens, or when the system test switch is in the "off" position. The system test switch (S1) is located on the compressor unit. When this switch is in the "automatic" position, the compressor is under the control of the temperature control panel. When it is in the "manual" position, it bypasses the temperature controls and will close the main control relay (MCR) and the motor starting sequence proceeds as described above. Since the test switch is a spring return to the "off" position, it will shut off all of the equipment when released from the "manual" position.

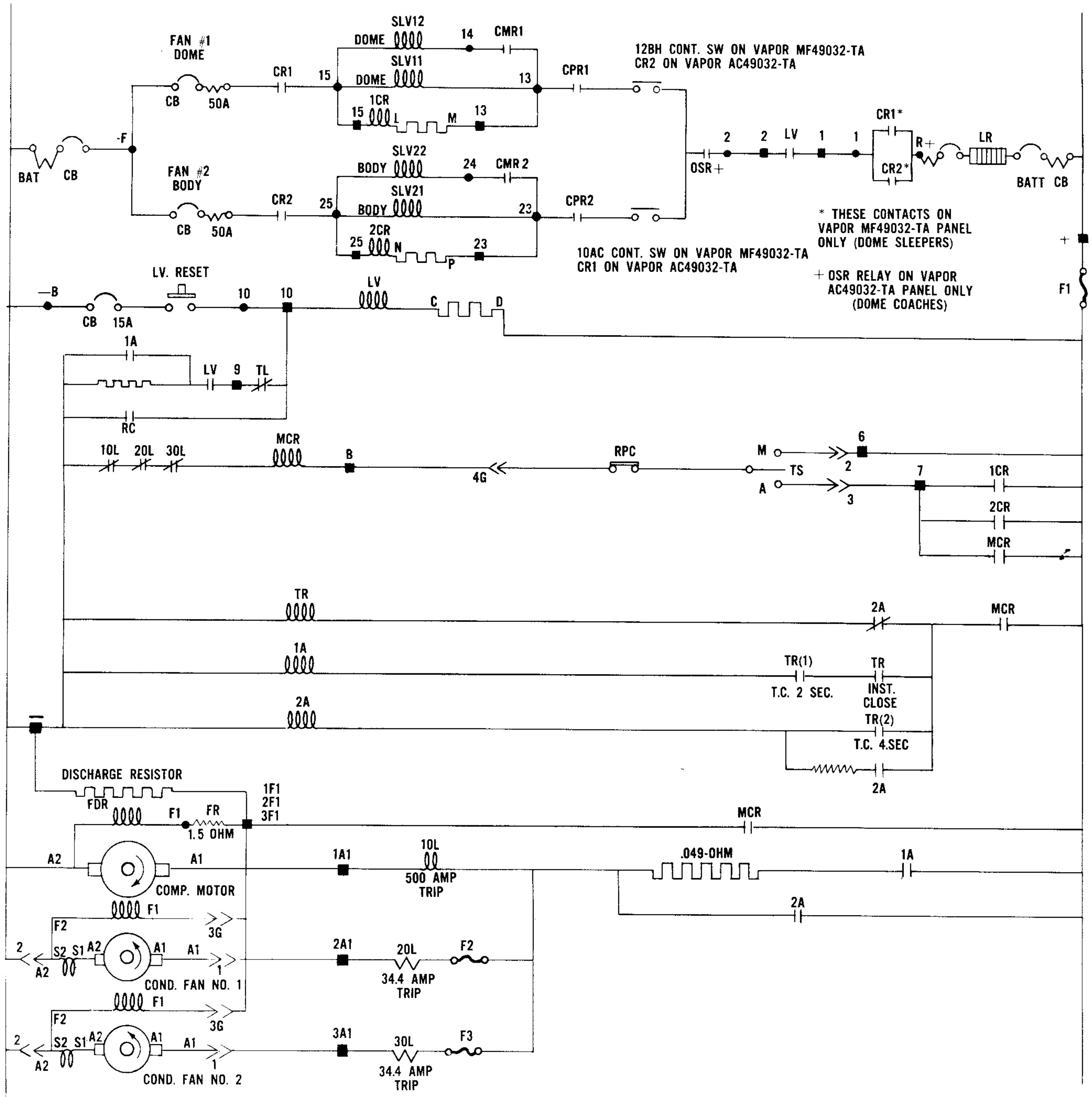
A low-voltage relay (LV) is provided on the motor starting control panel to protect the battery. The low-voltage relay (LV) is closed by pressing the low-voltage reset button on the Vapor panel. Relay LV is then maintained through a resistor as long as the voltage does not fall below the specified minimum. A contact on the first accelerating contactor (1A) shorts out this resistor to prevent the low-voltage relay (LV) from dropping out when all of the motors are started -- even if the voltage falls below the minimum setting. A contact on the reverse current relay prevents the low-voltage relay (LV) from dropping out as long as power is being drawn from the car generator. It also resets the LV relay automatically when the generator operates. A contact on the low voltage relay (LV) is connected to the thermostat circuits to prevent operation of the solenoid liquid valves or automatic starting of the refrigeration equipment if the low-voltage relay (LV) is not closed.

SAFETY DEVICES

The dual pressure control (RPC) used on all cars is primarily a protective device. Its main function is to stop the operation of the compressor unit whenever operating pressures are abnormal (high or low). The secondary function of the device is to stop the operation of the compressor unit at the end of each cooling cycle. The high pressure side of the switch is factory-set to stop operation of the system at 290 psi. It will automatically cut in and start operation whenever the pressure falls to a point of 50 psi below the cut-out setting.

The low pressure side of the switch has an adjustable cut-in setting and an adjustable differential (cut-out point). The switch is factory-set to start operation of the compressor unit at 25 psi (rise in suction pressure) and stop operation at 7½ psi (fall in suction pressure).

DOME COACH AND DOME SLEEPER CARS



VAPOR PANEL	CR1	CONTROL RELAY
	CR2	CONTROL RELAY
	CPR1	COOLING PILOT RELAY
	CPR2	COOLING PILOT RELAY
	CMR1	COOLING MODULATING RELAY
	CMR2	COOLING MODULATING RELAY
	OSR	OUTSIDE THERMOSTAT RELAY
MOTOR CONTROL PANEL	LV	LOW VOLTAGE RELAY
	1CR	CONTROL RELAY
	2CR	CONTROL RELAY
	MCR	MAIN CONTROL RELAY
	TR	TIME RELAY
	1A	FIRST ACCELERATING CONTACTOR
	2A	SECOND ACCELERATING CONTACTOR
	10L	COMPRESSOR MOTOR O. L. RELAY
	20L	CONDENSER MOTOR O. L. RELAY
	30L	CONDENSER MOTOR O. L. RELAY
	F1	MAIN FUSE
	F2	CONDENSER FAN MOTOR FUSE
	F3	CONDENSER FAN MOTOR FUSE
	FDR	FIELD DISCHARGE RESISTOR
COMPRESSOR UNIT	RPC	DUAL REFRIGERATION PRESSURE CONTROL
	TS	COMPRESSOR TEST SWITCH
EVAPORATOR UNIT	SLV11	FIRST STAGE SOLENOID LIQUID VALVE
	SLV12	SECOND STAGE SOLENOID LIQUID VALVE
	SLV21	FIRST STAGE SOLENOID LIQUID VALVE
	SLV22	SECOND STAGE SOLENOID LIQUID VALVE
SEPARATELY MOUNTED	FR	COMPRESSOR FIELD RESISTOR
BY OTHERS	RC	RELAY OPERATED BY AUXILIARY CONTACTS ON CAR LIGHTING SYSTEM
	TL	TRAIN LINE RELAY

■ INDICATES TERM ON MOTOR CONTROL PANEL
● INDICATES TERM ON VAPOR PANEL

FIGURE 1

Schematic Wiring Diagram.

DINER CARS

VAPOR PANEL	CB	CIRCUIT BREAKER
	CPR	COOLING PILOT RELAY NO. 1 STAGE
	CMR	COOLING MOD. RELAY NO. 2 STAGE
	OSR	OUTSIDE TEMPERATURE RELAY
	ICR	CONTROL RELAY
MOTOR CONTROL PANEL	CR11	CONTROL RELAY
	LV	LOW VOLTAGE RELAY
	TR	TIMING RELAY
	1A	NO. 1 ACCELERATING CONTACTOR
	2A	NO. 2 ACCELERATING CONTACTOR
	F1	MAIN FUSE
	F2	CONDENSER FAN MOTOR FUSE
	F3	CONDENSER FAN MOTOR FUSE
	MCR	MAIN CONTROL RELAY
	FR	FIELD WEAKENING RESISTOR
	FD	FIELD WEAKENING RESISTOR
COMPRESSOR UNIT	RPC	DUAL REFRIGERATION PRESSURE CONTROL
	SI	COMPRESSOR TEST SWITCH
EVAPORATOR UNIT	SLV11	NO. 1 STAGE SOLENOID LIQUID VALVE
	SLV12	NO. 2 STAGE SOLENOID LIQUID VALVE
	SLV21	SOLENOID VALVE
SEP MOUNTED	RC	AUXILIARY CONTACT ON CAR LIGHTING SYSTEM
	TL	TRAIN LINE SWITCH
	SR	STARTING RESISTOR
	2CR	CONTROL RELAY

● TERMINAL ON VAPOR PANEL
■ TERMINAL ON MOTOR CONTROL PANEL
◆ TERMINAL ON RESISTOR PANEL

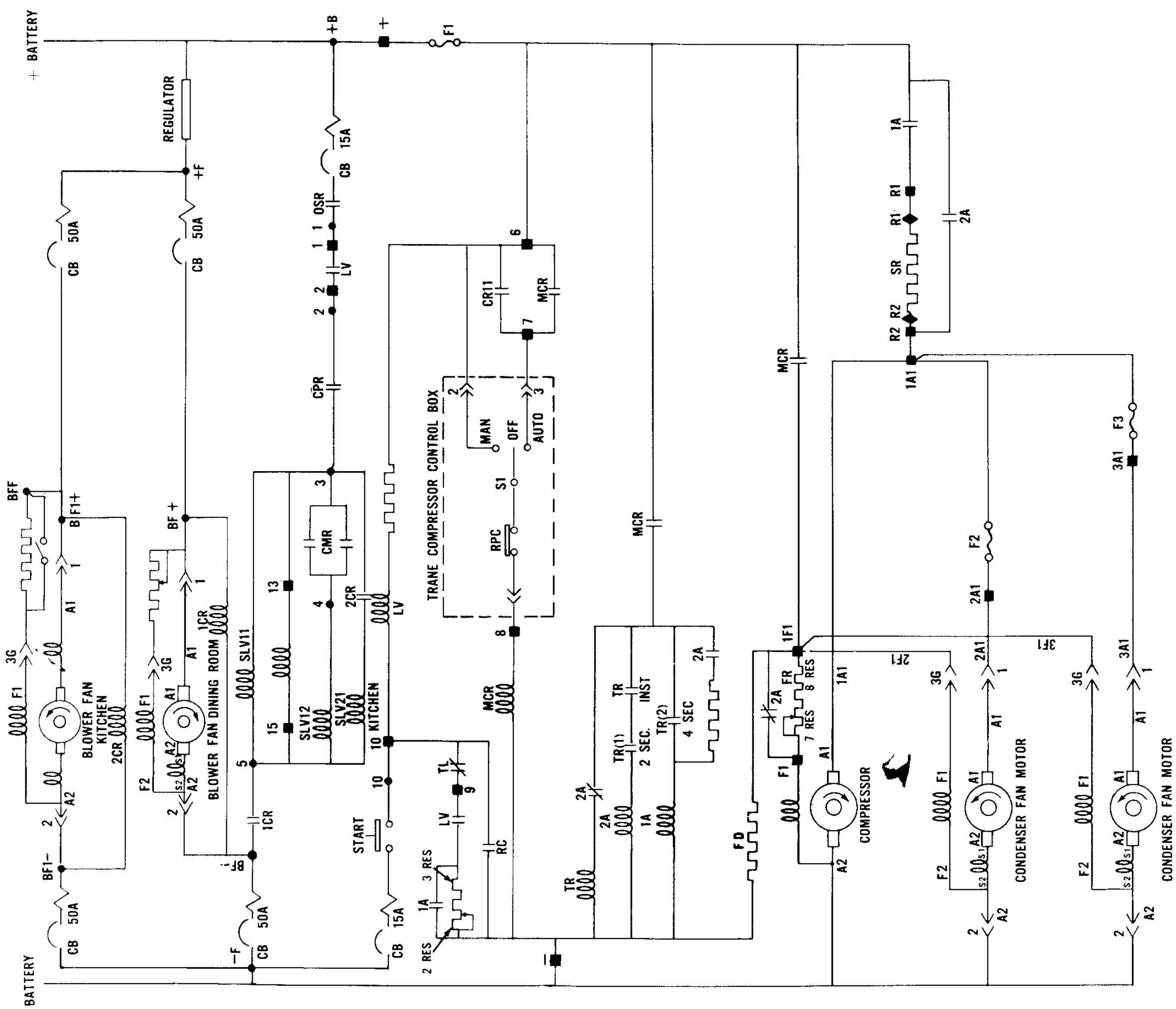


FIGURE 2

Schematic Wiring Diagram.

DOME COACH CAR

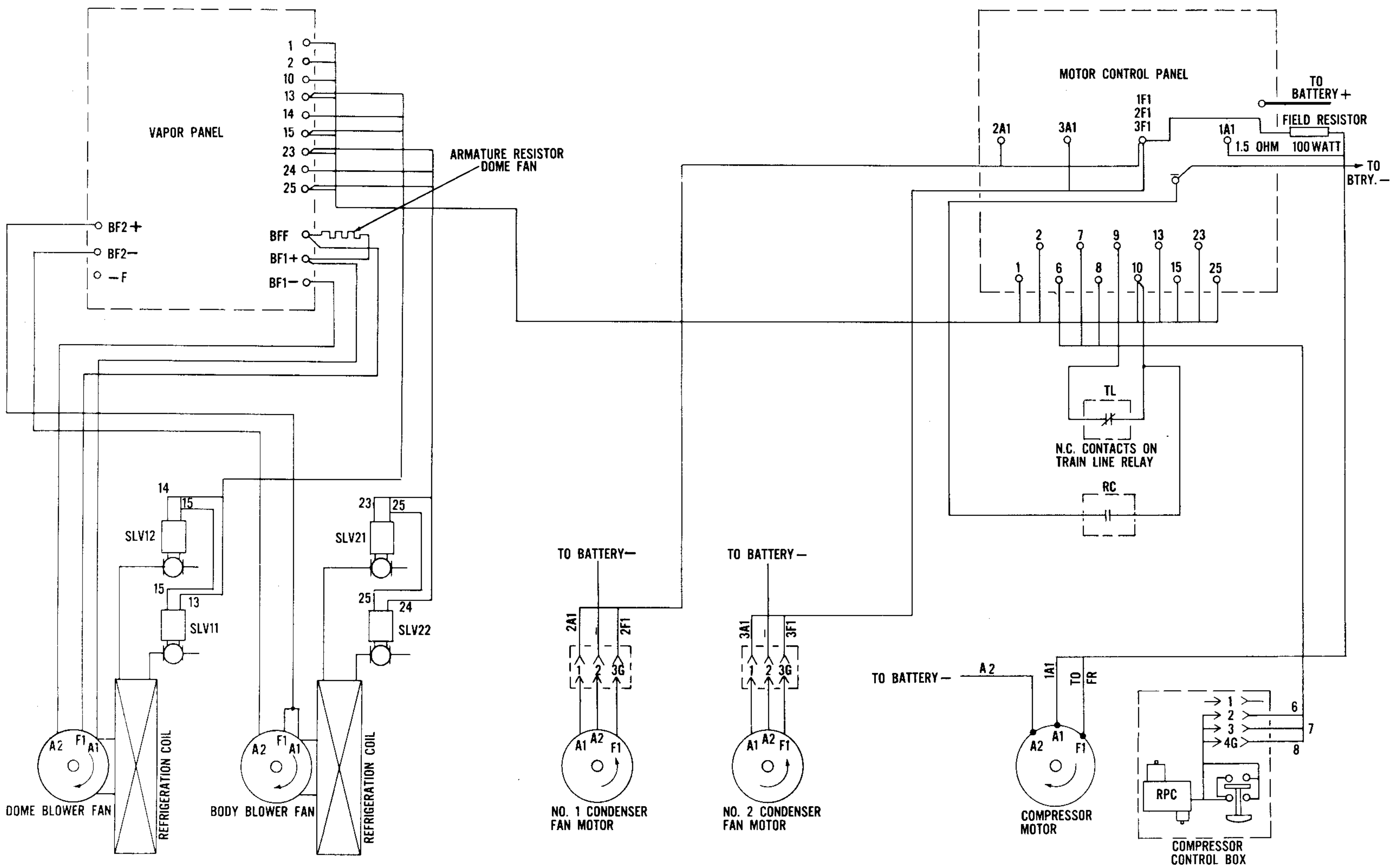


FIGURE 3

Interconnecting Wiring Diagram.

DOME SLEEPER CAR

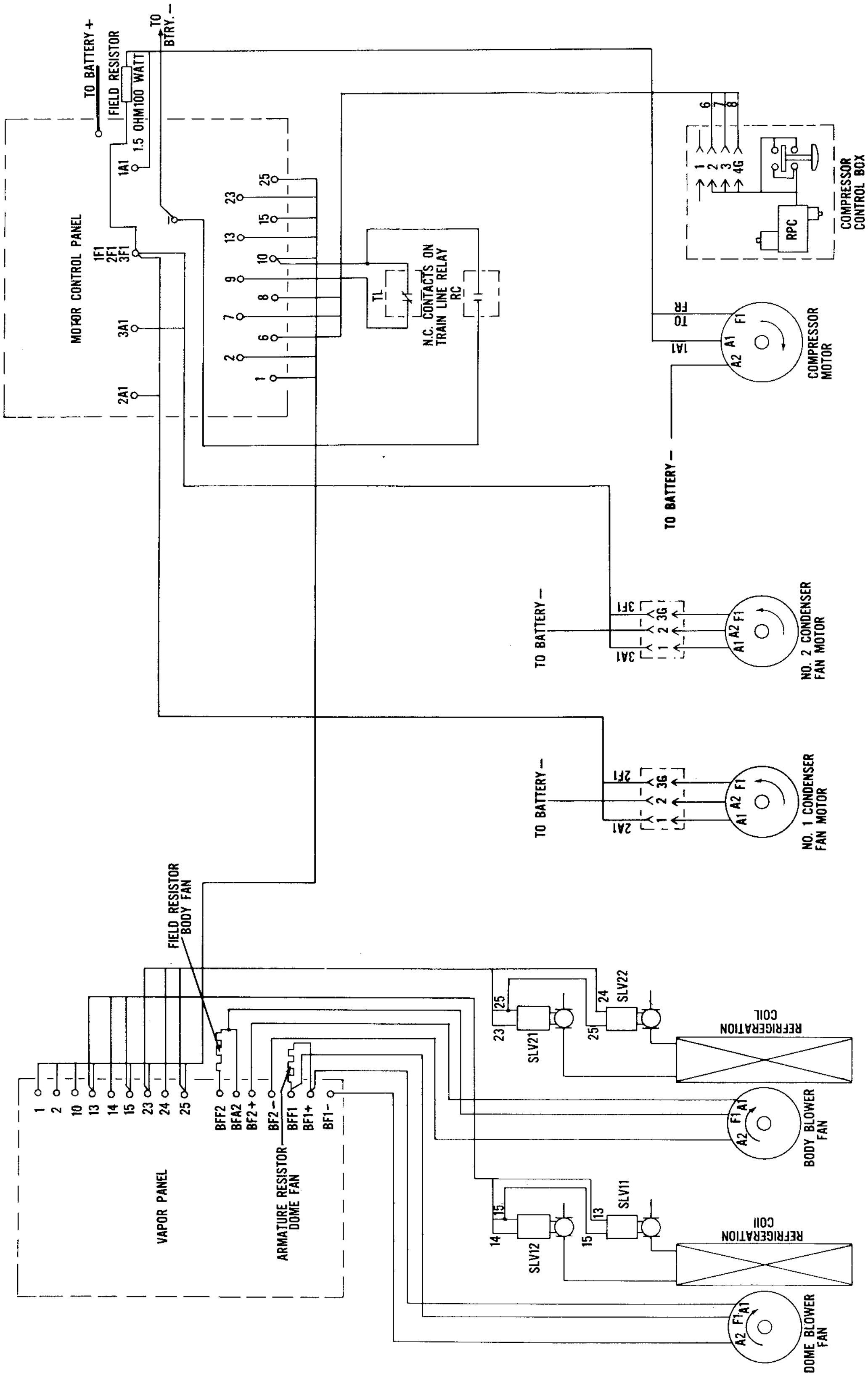


FIGURE 4

Interconnecting Wiring Diagram.

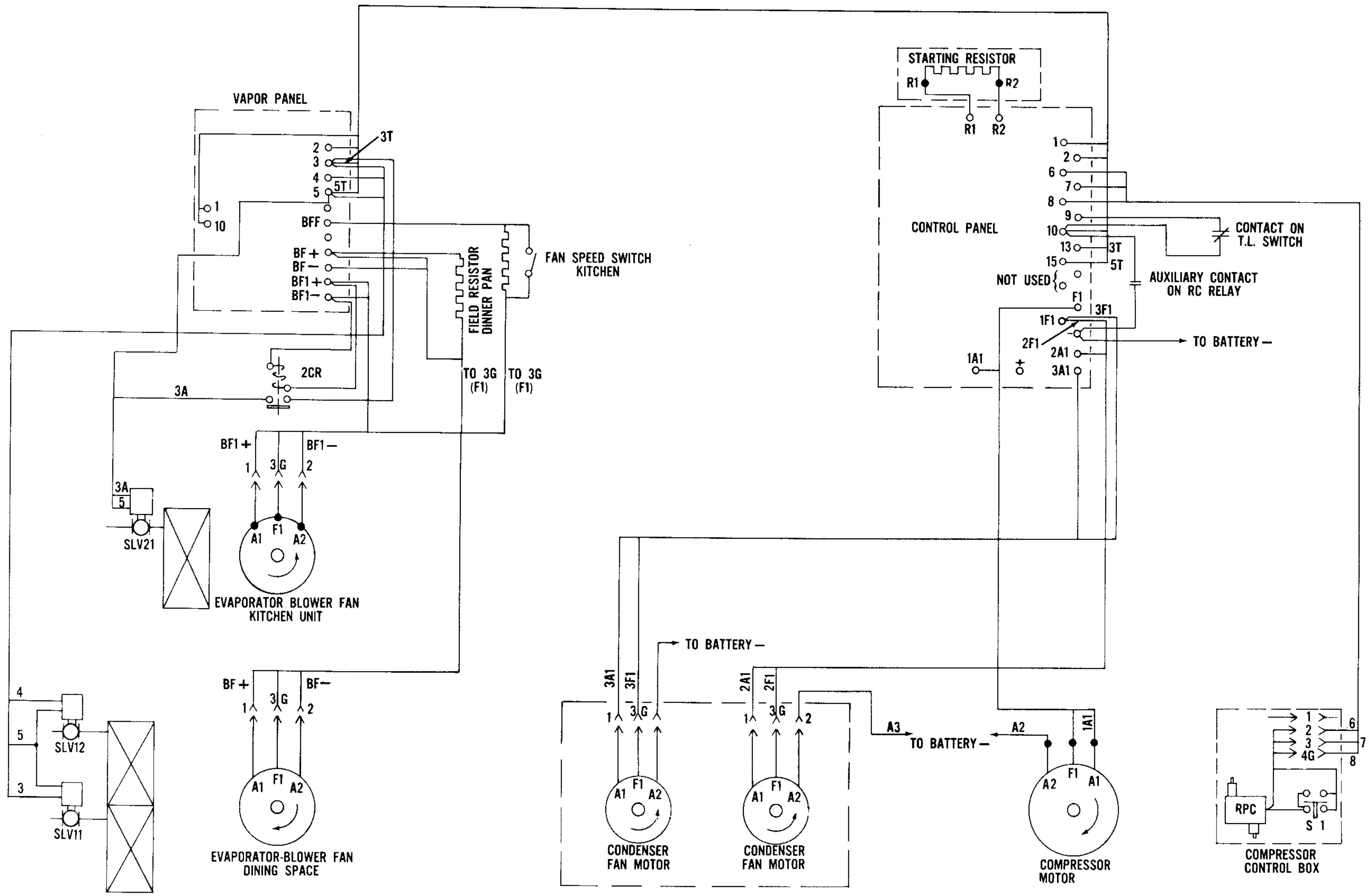


FIGURE 5

Interconnecting Wiring Diagram.

DOME COACH AND DOME SLEEPER CARS

FRONT VIEW DIAGRAM

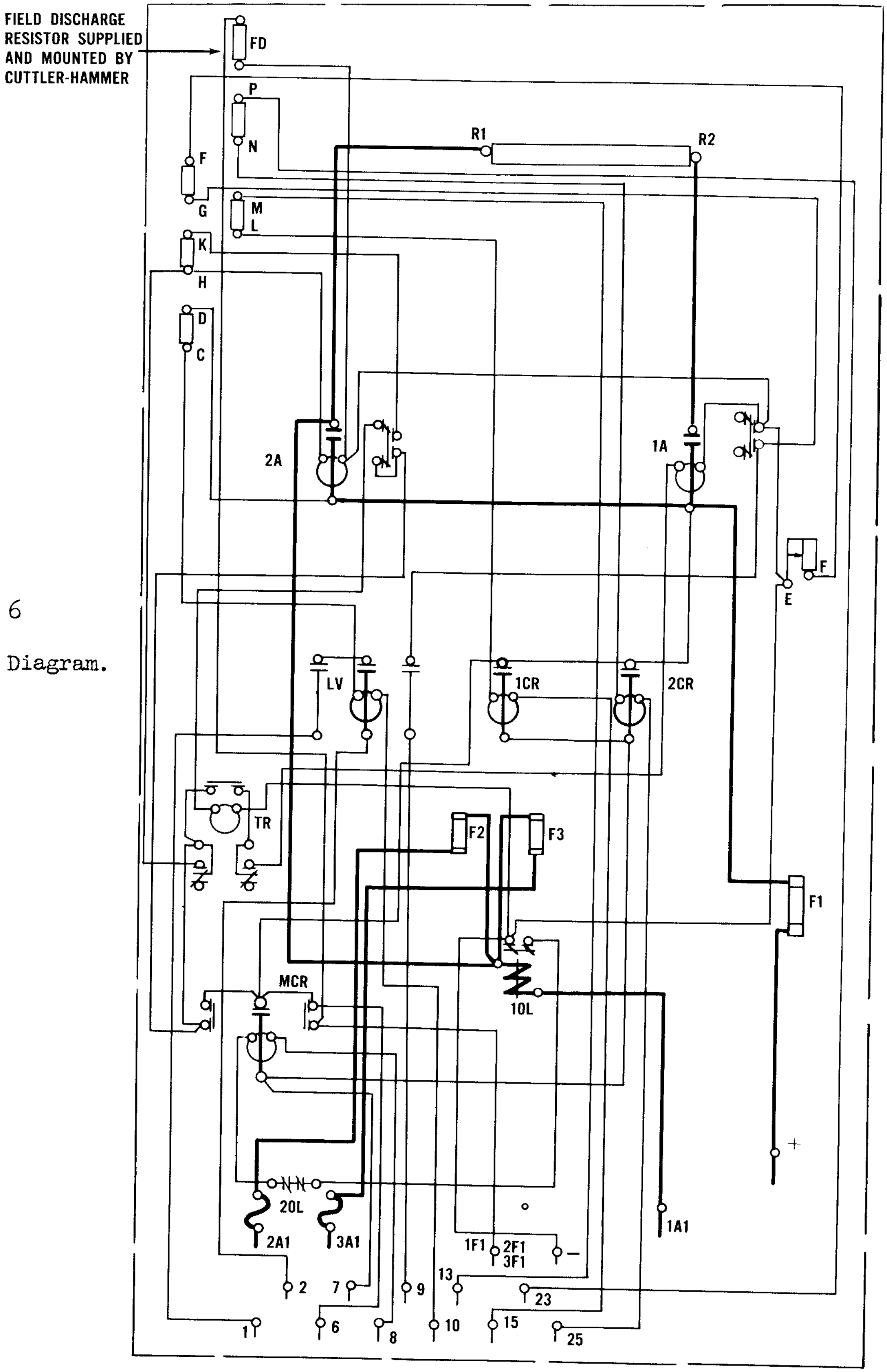


FIGURE 6

Panel Wiring Diagram.

ELECTRICAL CONTROL PANEL PARTS LIST
DOME COACH AND DOME SLEEPER CAR

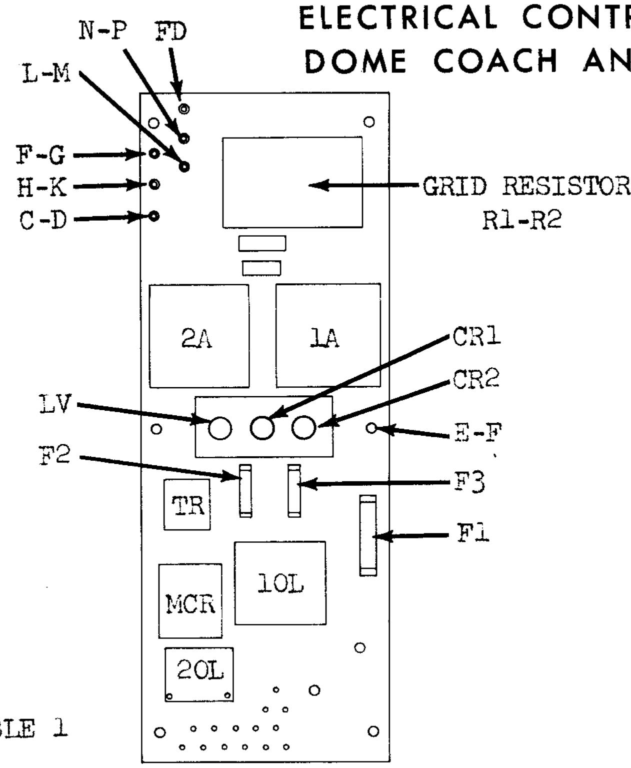


FIGURE 7

Illustration Of
Electrical Control Panel.

TABLE 1

REF. NO.	PART NAME AND DESCRIPTION	C-H DEVICE NO.	OPERATING COIL NO.	C-H PARTS LIST
1A	Contactor	542	92-24	*
2A	Contactor	545	95-15	B70-2292
MCR	Contactor	369	483-13	B70-2299
TR	Timer Relay - Set For 3 Sec. And 5 Sec.	693	1332-24	B70-2295
LV	Low Voltage Relay	---	561-18	A70-2297
1CR-2CR	Control Relays - 1 Pole	---	561-18	A70-2296
10L	Overload Relay	909	179-2	*
20L	Overload Relay	306	9586H228B	*
F1	Fusetron - 600 Amp, 250 V, Type FRN600	---	---	---
F2-F3	Fusetron - 45 Amp, 250 V, No. 611-802	---	---	---
	RESISTOR UNITS			
C-D	Resistor Unit - 1-D Unit	11003H29A57	---	---
E-F	Resistor Unit - 1-SE Unit	11003H32A61	---	---
F-G	Resistor Unit - 1-D Unit	11003H29A66	---	---
H-K	Resistor Unit - 1-D Unit	11003H29A43	---	---
L-M	Resistor Unit - 1-D Unit	11003H29A57	---	---
N-P	Resistor Unit - 1-D Unit	11003H29A57	---	---
R1-R2	Resistor Unit - 6-TC Grids	---	---	---
FD	Field Discharge Resistor - 1-R Unit	11003H44B12	---	---

* Parts List Not Available. Order By Complete Serial Number And Nameplate Data.

DINER CARS

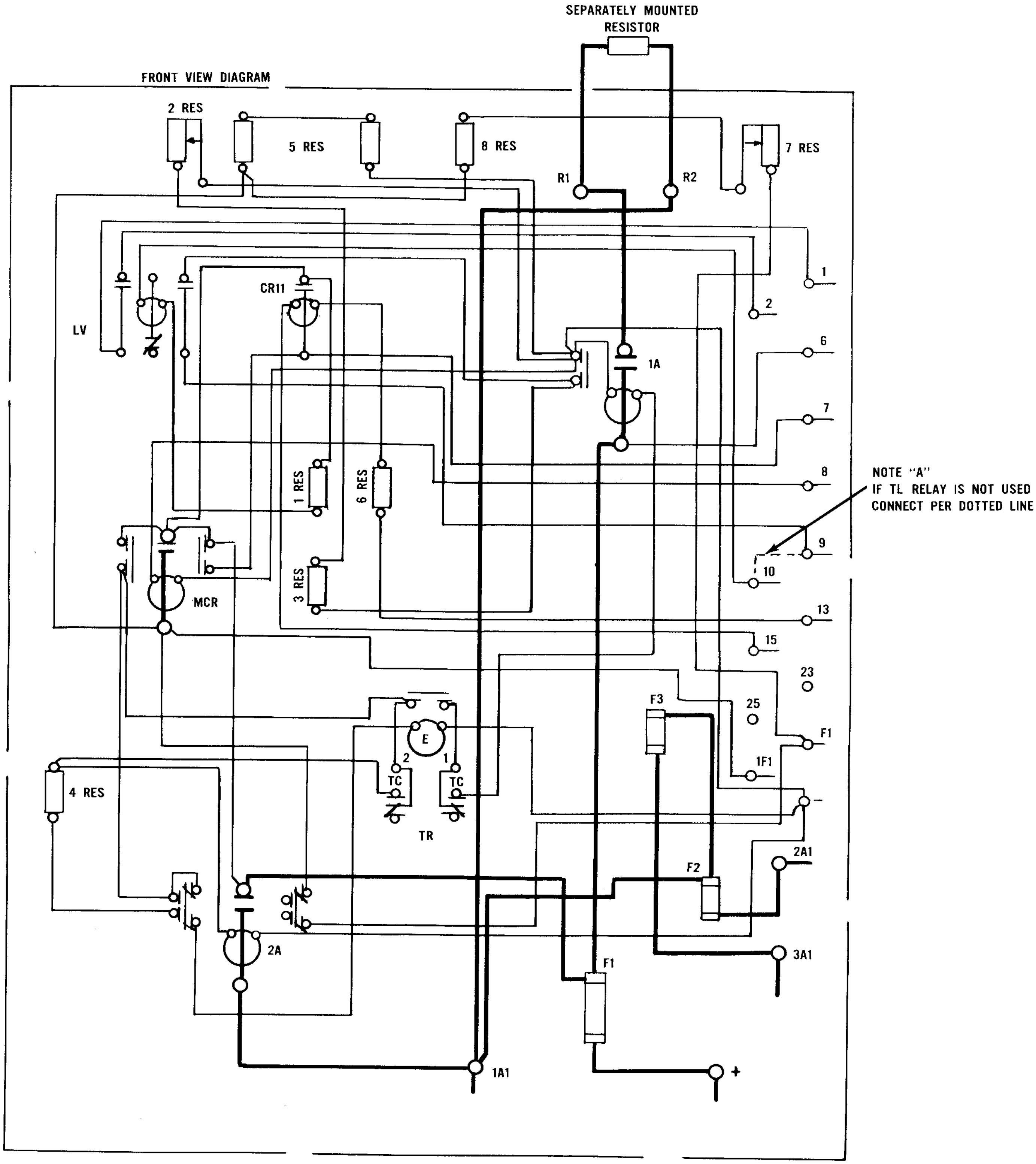


FIGURE 8

Panel Wiring Diagram.

ELECTRICAL CONTROL PANEL PARTS LIST

DINER CARS

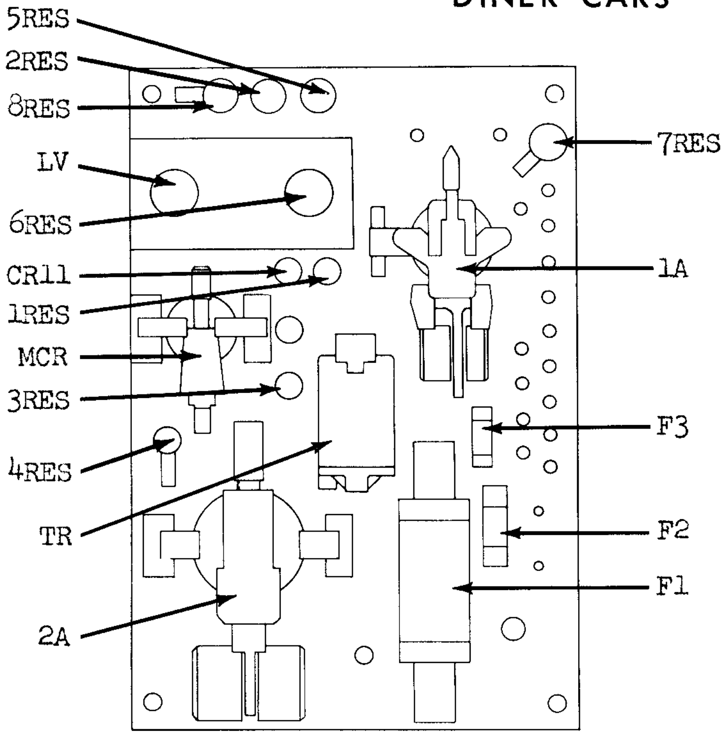


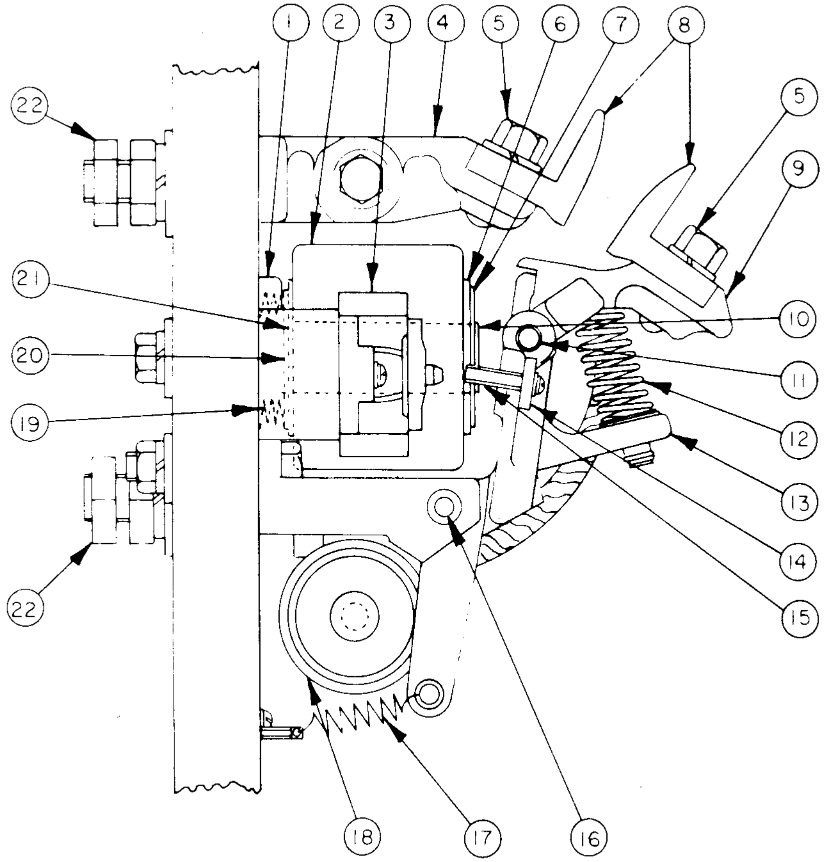
FIGURE 9

Illustration Of Electrical Control Panel.

TABLE 2

REF. NO.	PART NAME AND DESCRIPTION	C-H DEVICE NO.	OPERATING COIL NO.	C-H PARTS LIST
1A	Contactor	541	91-84	B70-2294
2A	Contactor	545	95-15	B70-2292
MCR	Contactor	369	483-13	B70-2299
TR	Timer Relay	693	1332-24	B70-2295
LV	Low Voltage Relay	---	561-18	A70-2297
CR11	Control Relay - 1 Pole	---	561-18	A70-2296
F1	Fusetron - 600 Amp, 250 V, Type FRN600	---	---	---
F2-F3	Fusetron - 45 Amp, Part No. 44-866	---	---	---
	RESISTOR UNITS			
1RES	Resistor Unit - 1-D Unit	11003H29A57	---	---
2RES	Resistor Unit - 1-SE Unit	11003H32A61	---	---
3RES	Resistor Unit - 1-D Unit	11003H29A66	---	---
4RES	Resistor Unit - 1-D Unit	11003H29A43	---	---
5RES	Resistor Unit - 2-E Units	11003H31A26	---	---
6RES	Resistor Unit - 1-D Unit	11003H29A57	---	---
7RES	Resistor Unit - 1-SE Unit	11003H32A11	---	---
8RES	Resistor Unit - 1-E Unit	11003H31A9	---	---

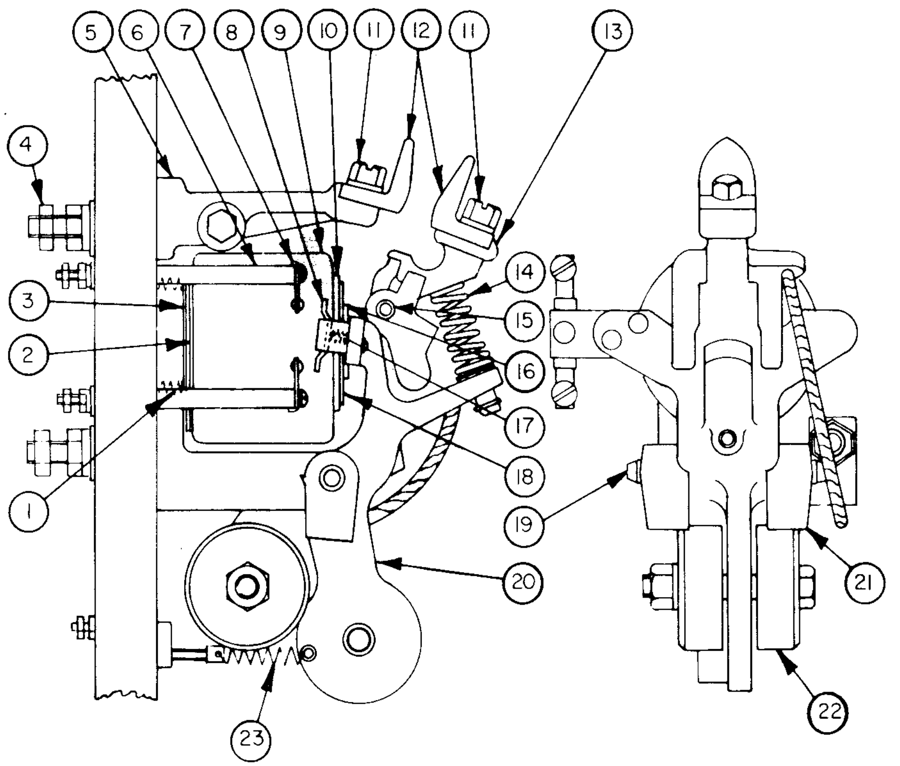
CUTLER HAMMER DRAWING B—M—70—2292



ITEM NO.	DESCRIPTION OF PART	NO. REQ.	PART NO.
1	MAGNET FRAME	1	17-207-16
2	COIL (GIVE NO. ON COIL)	1	———
3	NORMALLY OPEN AND NORMALLY CLOSED ELECTRICAL INTERLOCK	2	10-1569
4	CONTACT POST (INCLUDES 2 OF ITEM 22. DOES NOT INCLUDE ITEMS 5 & 8)	1	79-3837
5	CONTACT SCREW 1/2-13 X 1 1/4 LONG	2	911-5890Z
	1/2 LOCKWASHER	2	916-1161Z
6	WASHER	1	16-253
7	WASHER	1	16-426
8	CONTACT	2	23-1288
9	CONTACT LEVER.(INCLUDES ITEM 5 DOES NOT INCLUDE ITEM 8	1	24-1330
10	COIL CORE	1	685-119
11	SHAFT	1	956-1870
12	SPRING	1	969-583
13	ARMATURE LEVER	1	58189Y2 FIG.4
14	OPERATING ARM FOR ELECTRICAL INTERLOCK	2	81-5682
15	OPERATING POST FOR ELECTRICAL INTERLOCK	2	18-793-2
16	SHAFT	1	13-164
17	SPRING	1	969-268
18	COUNTERWEIGHT		
	LEFT HAND SIDE	1	58189Y2 FIG.2
	RIGHT HAND SIDE	1	58189Y2 FIG.1
19	SPRING	2	969-1162
20	WASHER	1	916-2921Z
21	WASHER	1	16-1551-2
22	TERMINAL NUT	6	815-1408

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO.(B70-2292), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA

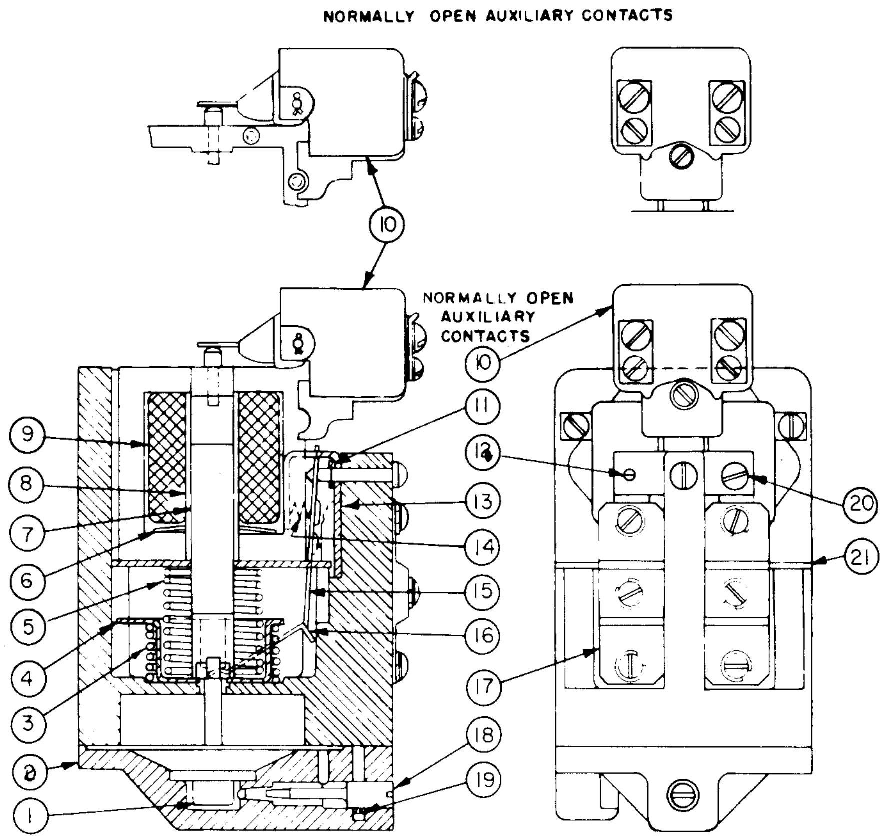
CUTLER HAMMER DRAWING B—M—70—2294



ITEM NO.	DESCRIPTION OF PART	NO. REQ.	PART NO.
1	SPRING	2	969-1001J
2	WASHER	1	4416-1321
3	WASHER	1	916-2881Z
4	TERMINAL NUT	1	15-399
5	CONTACT POST (INCLUDES ITEMS 11 & 12)	1	18-240-3
6	CONTACT POST	2	6004 2Y3 FIG.3
7	STATIONARY CONTACT	2	21-174-2
8	MOVABLE CONTACT	1	4221-4
9	COIL (GIVE NO. OF COIL)	1	-------
10	WASHER	1	16-399
11	CONTACT SCREW	2	911-5606FZ
	LOCKWASHER	2	916-196
12	CONTACT (COPPER)	2	23-717
13	CONTACT LEVER (INCLUDES ITEMS 11 & 12)	1	24-825-5
14	SPRING	1	69-432
15	SHAFT	1	956-1838
16	CORE	1	51-195-2
17	SPRING	1	969-633
18	WASHER	1	16-398
19	SHAFT	1	13-716
20	ARMATURE LEVER	1	6004 2Z1 FIG.7
21	MAGNET FRAME	1	17-207-7
22	WEIGHT	2	54-469
23	SPRING	1	969-686J

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO.(B70-2294), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA.

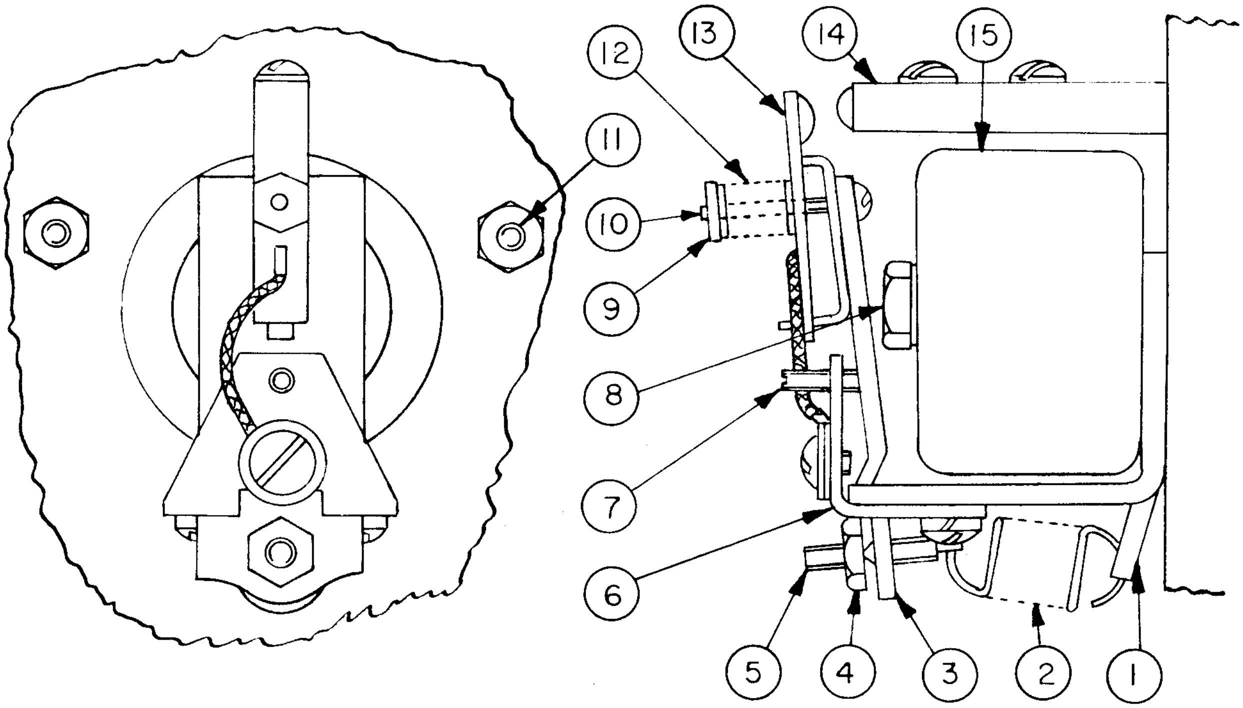
CUTLER HAMMER DRAWING B—70—2295



ITEM NO.	DESCRIPTION OF PART	NO. REQ.	PART NO.
1	VALVE AND DIAPHRAGM ASSEMBLY	1	27-464-2
2	COVER	1	49-1711
3	SPRING	1	69-1312
4	CUP	1	29-1946
5	SPRING	1	69-1314
6	SPRING	1	69-766
7	PLUNGER	1	51-659
8	PLUNGER GUIDE	2	54-297-3
9	COIL (GIVE NO. ON COIL)	1	-----
10	AUXILIARY CONTACT COMPLETE (NORMALLY OPEN)	1	10-1274
11	LOCK PLATE	1	52-557
12	HEADLESS ADJUSTING SCREW	AS REQ	11-1236
13	BRACKET	1	79-2986
14	SPRING	2	69-1313
15	LEVER	2	24-2391
16	LEVER	1	24-2390
17	NORMALLY OPEN AND NORMALLY CLOSED SWITCH	2	10-1342
18	TIMING ADJUSTING SCREW	1	11-1235
19	FRICTION SPRING	1	69-1563
20	ROUND HEAD ADJUSTING SCREW	AS REQ	11-1234
21	INSULATOR	1	56-1677

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO.(B70-2295), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA.

CUTLER HAMMER DRAWING A—M—2296



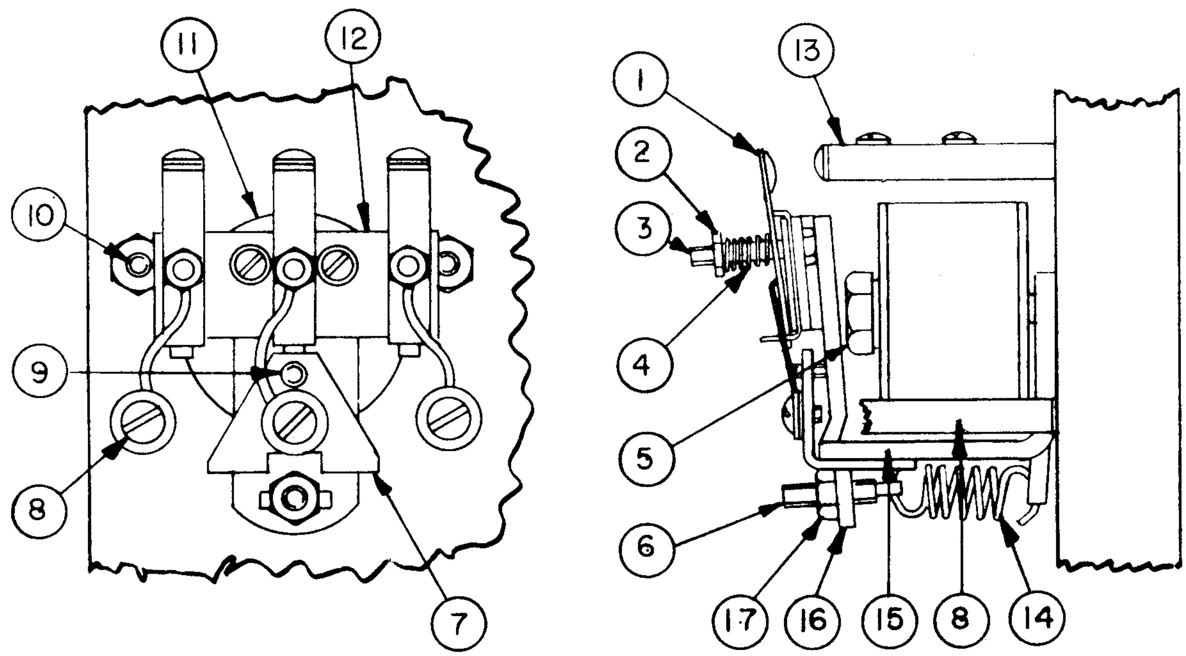
ORDER NO. DV.72-3200-10A4

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO. (A70-2296), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA.

ITEM NO.	DESCRIPTION OF PART	NO. REQ.	PART NO.
1	MAGNET FRAME	1	17-366
2	SPRING	1	69-84
3	ARMATURE LEVER	1	24-1906-3
4	NUT	1	815-247
5	ADJUSTING SCREW	1	914-105Z
6	STOP BRACKET	1	79-1366
7	GAP ADJUSTING SCREW	1	911-379
8	CORE	1	11-1265
9	NUT	1	15-267
10	ADJUSTING SCREW	1	11-277-2
11	STUD (6-32 X 1 1/2 LONG)	2	911-368
	#6 SHAKEPROOF WASHER	2	916-114
	#6 PLAIN WASHER	4	916-401Z
	#6 LOCKWASHER	4	916-402Z
	#6-32 HEX. NUT	6	15-438
	CUPWASHER	2	816-361
	#6 BRASSWASHER	2	816-102
12	SPRING	1	969-494
13	MOVABLE CONTACT	1	40-317
14	CONTACT POST	1	18-597
15	COIL (GIVE NO. ON COIL)	1	-------

TITLE RENEWAL PART DRAWING FOR ONE POLE NORMALLY OPEN D.C. RELAY

CUTLER HAMMER DRAWING A-M-70-2297



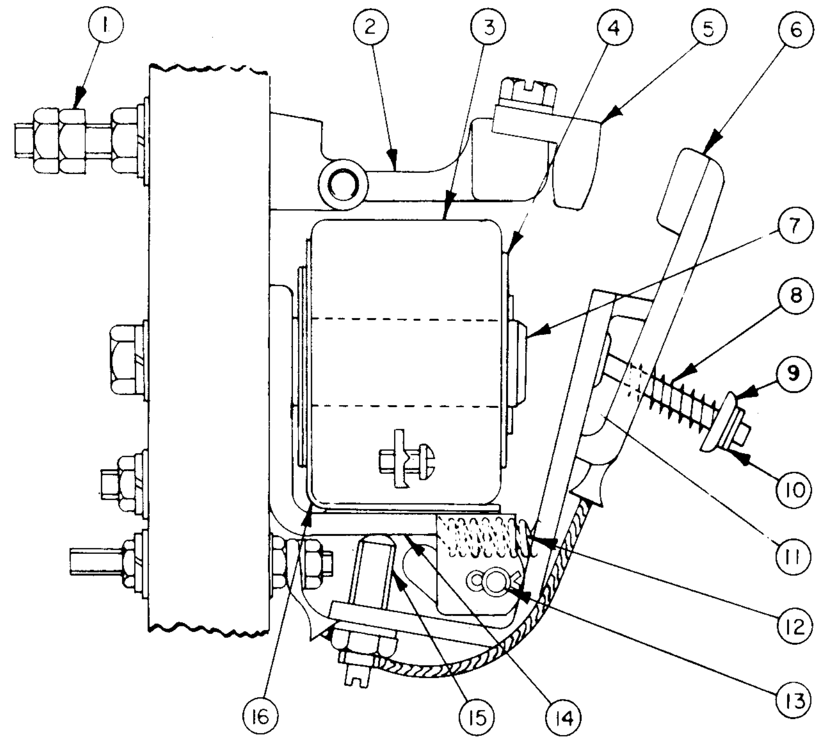
ORDER NO.DV. 72-3200-10A4

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO. (A70-2297), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA.

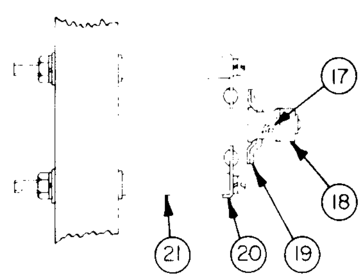
ITEM NO.	DESCRIPTION OF PART	NO. REQ.	PART NO.
1	MOVABLE CONTACT	3	40-317
2	NUT	3	15-267
3	ADJUSTING SCREW	3	11-272-5
4	SPRING	3	969-494
5	CORE	1	11-1265
6	ADJUSTING STUD	1	914-105Z
7	STOP BRACKET	1	79-1366
8	POST	2	18-882
9	GAP ADJUSTING SCREW	1	911-379
10	STUD (6-32 X 1 1/2 LONG)	2	911-368Z
	#6 SHAKEPROOF WASHER	2	916-114
	#6 PLAIN WASHER	4	916-401Z
	#6 LOCKWASHER	4	916-402Z
	#6-32 HEX. NUT	6	15-438
	CUPWASHER	2	816-361
	BRASSWASHER	2	816-102
11	COIL (GIVE NO. ON COIL)	1	-------
12	ARMATURE LEVER COMPLETE (INCLUDES ITEMS 1,2,3,4, AND 16)	1	10-2191-2 IT.5
13	CONTACT POST	3	18-883
14	SPRING	1	69-84
15	FRAME	1	17-366
16	ARMATURE LEVER	1	24-1905
17	NUT	1	815-247

TITLE RENEWAL PART DRAWING FOR 3 POLE NORMALLY OPEN D.C. RELAY

CUTLER HAMMER DRAWING B—70—2299



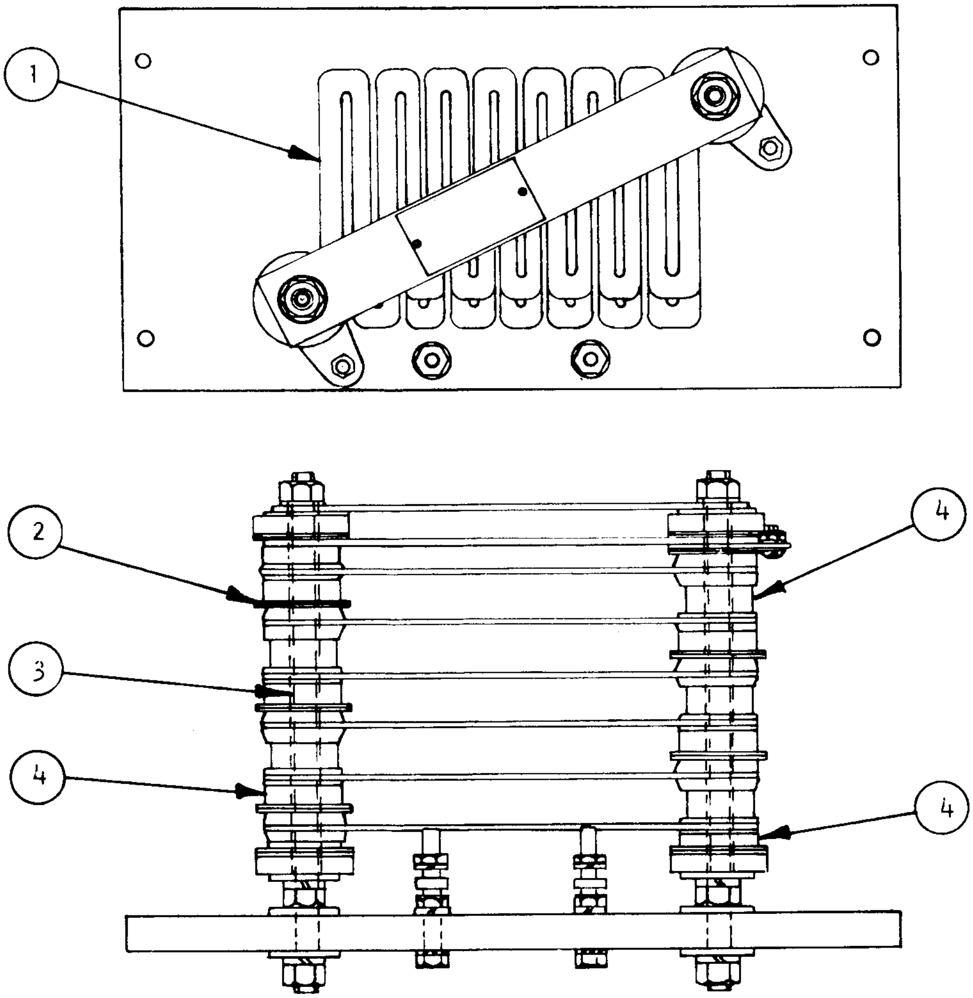
ITEM NO.	DESCRIPTION OF PART	NO. REQ.	PART NO.
1	NUT (5/16-18)	3	815-721
2	CONTACT POST COMPLETE (INCLUDES ITEMS 1 & 5)	1	18-528-12
3	COIL (GIVE NO. ON COIL)	1	---------
4	COIL WASHER	AS REQ	4416-134
5	STATIONARY CONTACT	1	1321-61
	CONTACT MOUNTING SCREW (1/4-20 X 3/4 LONG)	1	911-5446FZ
	1/4 LOCKWASHER	1	916-682Z
6	MOVABLE CONTACT COMPLETE WITH CONTACT FINGER	1	640-246
7	CORE	1	51-64
8	SPRING	1	69-95
9	CUPWASHER	1	916-26412
10	SHIM WASHER	3	16-139
11	ARMATURE LEVER	1	24-315-2
12	SPRING	1	69-179
13	SHAFT	1	956-343
14	MAGNET FRAME	1	649-375
15	ADJUSTING SCREW	1	711-6
	NUT	1	915-113
	LOCKWASHER	1	916-125
16	INSULATOR	1	56-1228
17	SPRING	2	969-633
18	INTERLOCK BAR	2	10-87
19	MOVABLE CONTACT	2	23-887
20	STATIONARY CONTACT	4	21-144
21	CONTACT POST	4	18-527-14



NORMALLY OPEN INTERLOCK

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO.(B70-2299), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA.

CUTLER HAMMER DRAWING A—M—70—2293



ORDER NO. DV. 72-3200-10A4

ITEM	DESCRIPTION OF PART	NO. REQD.	PART NO.
1	TC7 GRIDS	6	3257-7FC
2	MICA WASHERS	AS REQ	1116-1081
3	INSULATOR TUBE	2	57-1005-2 IT.12
4	SPACER		
	5/16" THICK	AS REQ	73-31Z
	7/16" THICK	AS REQ	73-32Z
	9/16" THICK	AS REQ	3229-88FZ

WHEN ORDERING RENEWAL PARTS GIVE THIS DRAWING NO. (A70-2293), ITEM NO., PART NO., DESCRIPTION AND COMPLETE NAMEPLATE DATA.

TITLE RENEWAL PART DRAWING FOR RESISTOR ASSEMBLY.

COMPRESSOR-MOTOR UNIT PARTS LIST
DOME COACH, DOME SLEEPER AND DINER CARS

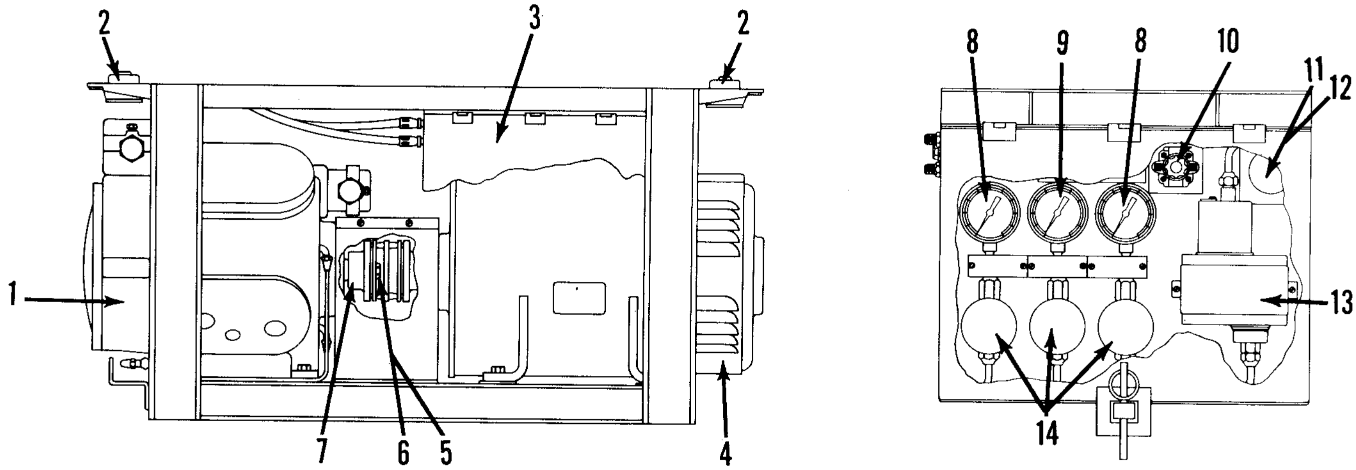


FIGURE 10

Illustration Of Compressor-Motor
Unit And Control Box.

TABLE 3

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
1	Compressor - Trane, Model 2B-514 (See Pages 24 Through 31 For Parts Lists)	COM-805	1
2	Mount - Isolation, M.B. No. 510KKB56	MNT-800	4
3	Box - Control, Complete	BOX-825	1
4*	Motor - Electric, Reliance, 12½ - 14½ HP, 28-46 VDC, 1800/2000 RPM, Ball Bearing	MOT-854	1
5	Washer - Coupling Mounting	WAS-6	1
6	Screw - Hex Head, 5/8 - 18 x 1-3/4" (Coupling Mounting)	SCR-7	1
7	Coupling - Compressor Drive, Thomas Special 162MT-B	CPL-808	1
8	Gage - Compound, 30" - 200 PSI	GAG-1	2
9	Gage - Pressure, 0 PSI - 300 PSI	GAG-2	1
10	Switch - Test	SWT-800	1
11	Plug - P-N PNLD-2005	PLU-801	1
12	Receptacle - P-N RNLJ-2000	RCT-801	1
13	Control - Dual Pressure (See Page 32 For Component Parts)	CNT-811	1
14	Valve - Diaphragm Type, Mueller A15201	VAL-813	3
**	Gasket - Discharge Line Connection	GKT-13	1
**	Gasket - Suction Line Connection	GKT-830	1

* Trane Specification D4520/6806.
** Not Illustrated.

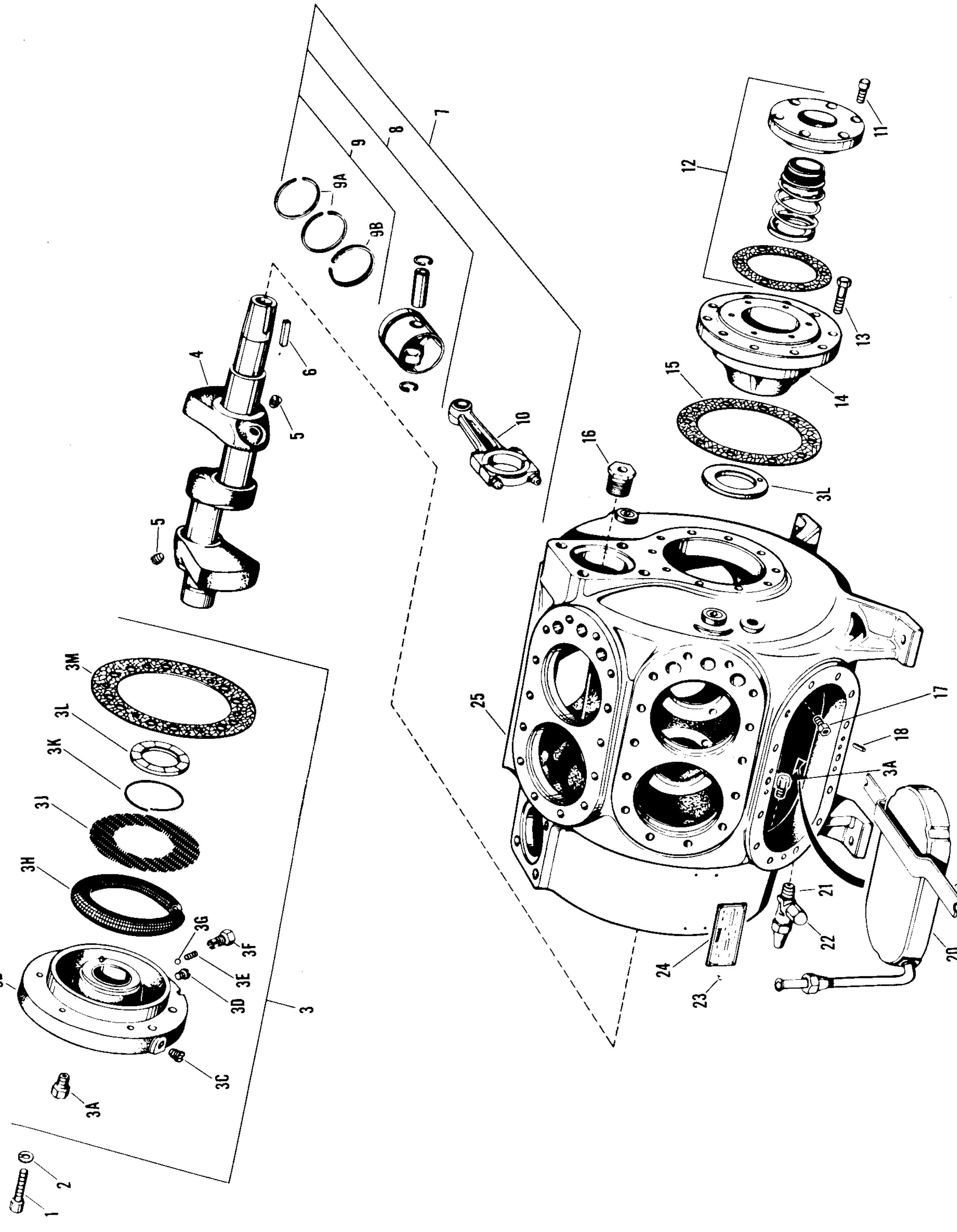

1
2
3
3A
3B
3C
3D
3E
3F
3G
3H
3J
3K
3L
3M
4
5
6
7
8
9
9A
9B
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

FIGURE 11

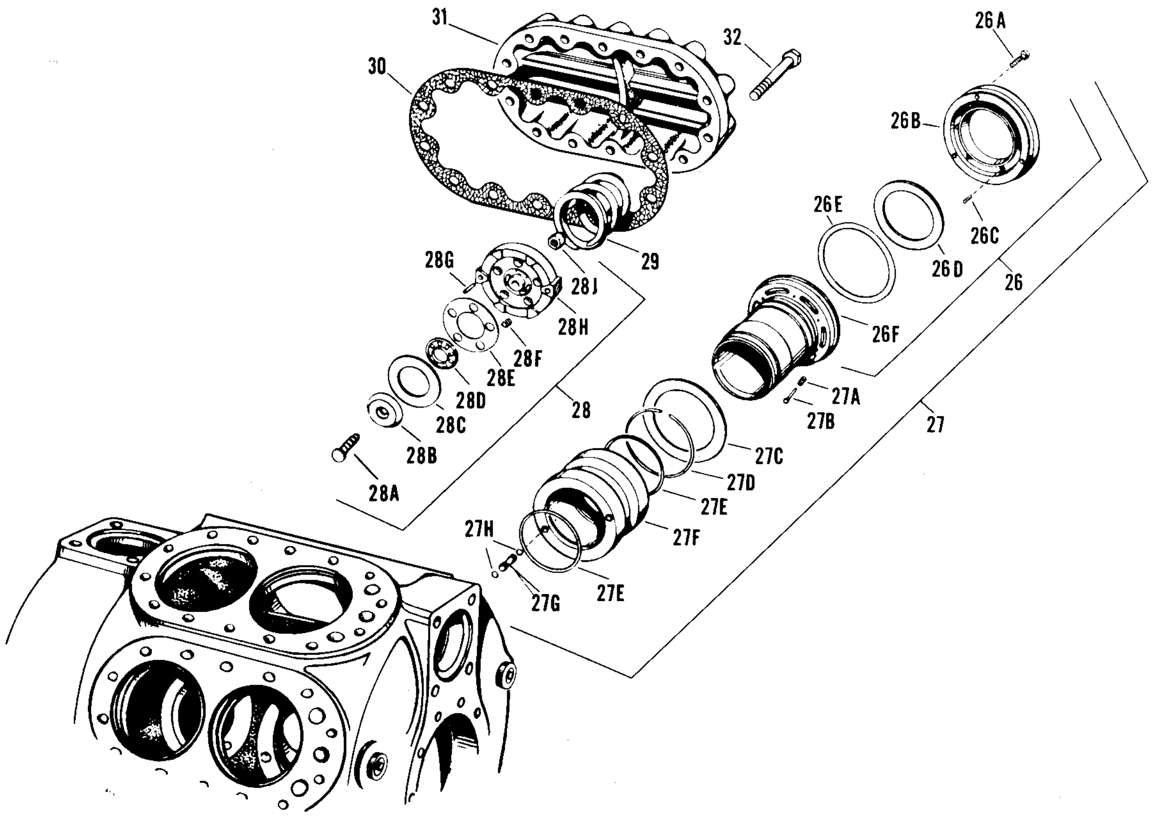
COMPRESSOR PARTS LIST

TABLE 4

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
1	Screw - Socket Head Cap, 3/8" - 24 x 1-1/2" -	SCR-40	6
2	Lockwasher - 3/8" x .156" x .094" -----------	WAS-13	6
3	Bearing Head and Main Bearing Assembly (Pump End), Consisting of: 3A(3), 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3J, 3K, 3L, 3M ----------------	BRG-1	1
3A	Valve - Assembly, Check --------------------	VAL-30	4
3B	Bearing Head With Bearing ------------------	BRG-2	1
3C	Plug - Magnetic Pipe, 1/4" I.P.S. -----------	PLU-10	1
3D	Plug - Square Head Pipe, 1/4" I.P.S. --------	PLU-1	1
3E	Spring - Relief Valve ----------------------	SPG-1	1
3F	Cap - Relief Valve -------------------------	CAP-2	1
3G	Ball - Relief Valve ------------------------	BAL-1	1
3H	Breaker - Foam ----------------------------	BKR-1	1
3J	Ring - End --------------------------------	RNG-1	1
3K	Ring - Retaining --------------------------	RNG-2	1
3L	Bearing - Thrust --------------------------	BRG-3	2
3M	Shim - Bearing Head, Pump End (.010) --------	SHM-5	*
3M	Shim - Bearing Head, Pump End (.015) --------	SHM-6	*
4	Crankshaft - 4 Cylinder, Including Magnetic Plugs ------------------------------------	CSF-1	1
5	Plug - Magnetic Pipe, 1/4" I.P.S. -----------	PLU-10	2
6	Key ---------------------------------------	KEY-2	1
7	Piston and Connecting Rod Assembly, Consisting of: 8 and 10 --------------------------	PST-2	4
8	Piston Assembly With Pin and Piston Rings ---	PST-1	4
9	Piston Ring Kit, Consisting of: 9A(2), 9B(1)	RNG-3	4
9A	Ring - Compression ------------------------	RNG-4	8
9B	Ring - Oil --------------------------------	RNG-5	4
10	Connecting Rod Assembly --------------------	ROD-1	4
11	Screw - Socket Head Cap, 3/8" - 24 x 3/4" ---	SCR-41	6
12	Seal Assembly -----------------------------	SEL-1	1
13	Screw - Hex Head Cap, 7/16" - 14 x 1-1/4" ---	SCR-42	10
14	Bearing Head and Main Bearing Assembly (Seal End) ------------------------------	BRG-4	1
14	Bearing Head and Main Bearing Assembly (Seal End) (Use With Low Lift Valves) -----------	BRG-29	1
15	Gasket - Bearing Head, Seal End ------------	GKT-21	1
16	Valve - Pressure Relief, 300# ---------------	VAL-53	1
17	Valve Assembly - Oil Check -----------------	VAL-55	2
18	Pin - Roll, 5/16" x 1-1/4" -----------------	PIN-1	2
19	Hold Down Strip - Screen Assembly -----------	STR-1	1
20	Screen Assembly - Oil Strainer -------------	SRN-1	1
21	Valve - Angle, 3/8" ------------------------	VAL-31	1
22	Cap - Angle Valve, Brass, 3/8" Flare --------	CAP-26	1
23	Screw - Nameplate --------------------------	SCR-1	4
24	Nameplate ---------------------------------	PLT-9	1
25	Housing - Compressor, Model 2B-514 ----------	HUS-1	1

* As Required.

Illustration Precedes This List.


31
32
26A
30
26B
26E
26C
26D
26
28G
29
28J
28H
26F
28F
28E
27A
28D
27B
27
28C
28
28B
27C
27D
28A
27E
27H
27F
27G
27E

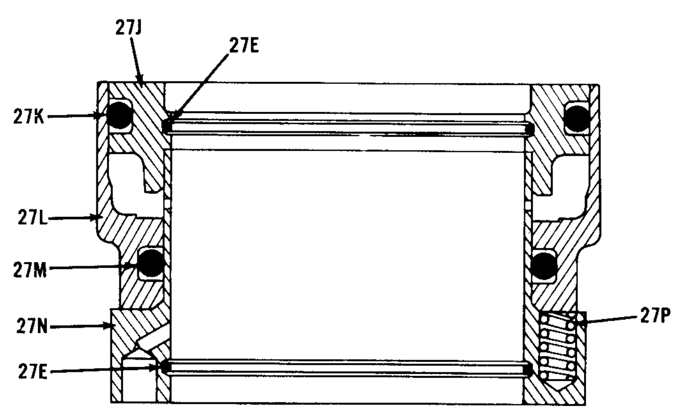

27J
27E
27K
27L
27M
27N
27E
27P

FIGURE 12

COMPRESSOR PARTS LIST

TABLE 5

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
26	Liner Assembly - Without Unloader, Consisting of: 26A, 26B, 26C, 26D, 26E, 26F ---------	LNR-1	1
26A	Screw - Socket Head Cap, 1/4" - 28 x 5/8" ---	SCR-43	12
26B	Valve Plate --------------------------------	PLT-10	4
26C	Spring - Suction Valve ---------------------	SPG-2	24
26D	Valve - Suction ----------------------------	VAL-32	4
26E	"O" Ring -----------------------------------	RNG-6	4
26F	Liner - Cylinder ---------------------------	LNR-2	4
27	Liner - Assembly, With Unloader, Consisting of: 26, 27A, 27B, 27C, 27D, 27E, 27F, 27G, 27H ----------------------------------	LNR-3	3
27A	Spring - Lift Pin --------------------------	SPG-3	24
27B	Pin - Lift ---------------------------------	PIN-2	24
27C	Ring - Takeup ------------------------------	RNG-7	4
27D	Ring - Retaining ---------------------------	RNG-8	4
27E	"O" Ring -----------------------------------	RNG-9	8
27F	Unloader Assembly - Consisting of: 27J, 27K, 27L, 27M, 27N, 27P (See Illustration) -----	UNL-1	3
27G	Connector - Oil ----------------------------	CON-1	3
27H	"O" Ring -----------------------------------	RNG-10	6
27J	Ring - Seal, Unloader Assembly -------------	**	3
27K	"O" Ring - Unloader Seal Ring --------------	RNG-53	3
27L	Piston - Unloader Assembly -----------------	**	3
27M	"O" Ring - Unloader Piston -----------------	RNG-54	3
27N	Cylinder - Unloader Assembly ---------------	**	3
27P	Spring - Unloader Piston Lift --------------	SPG-23	36
28	Valve Assembly - Discharge, Consisting of: 28A, 28B, 28C, 28D, 28E, 28F, 28G, 28H, 28J	VAL-54	4
28A	Bolt - Discharge Valve Cage ----------------	BLT-1	4
28B	Seat - Discharge Valve ---------------------	SET-1	4
28C	Valve - Discharge --------------------------	VAL-34	4
28D	Retainer - Valve Cushion -------------------	RTR-1	4
28E	Cushion - Valve, Teflon --------------------	CUS-5	4
28F	Spring - Discharge Valve -------------------	SPG-4	20
28G	Pin - Dowel, 1/4" x 3/4" Long --------------	PIN-3	8
28H	Cage - Discharge Valve ---------------------	CAG-1	4
28J	Locknut - Discharge Valve Bolt -------------	NUT-17	4
29	Spring - Cylinder --------------------------	SPG-5	4
30	Gasket - Cylinder Head ---------------------	GKT-23	2
31	Head - Cylinder ----------------------------	HD-1	2
32	Screw - Hex Head, 7/16" - 14 x 2-1/2" -------	SCR-44	28
*	Kit - "O" Ring, Consisting of: 26E, 27E, 27H, 27K, 27M --------------------------	KIT-7	4

* Not Illustrated.
** Not Available Separately, Order UNL-1.

Illustration Precedes This List.

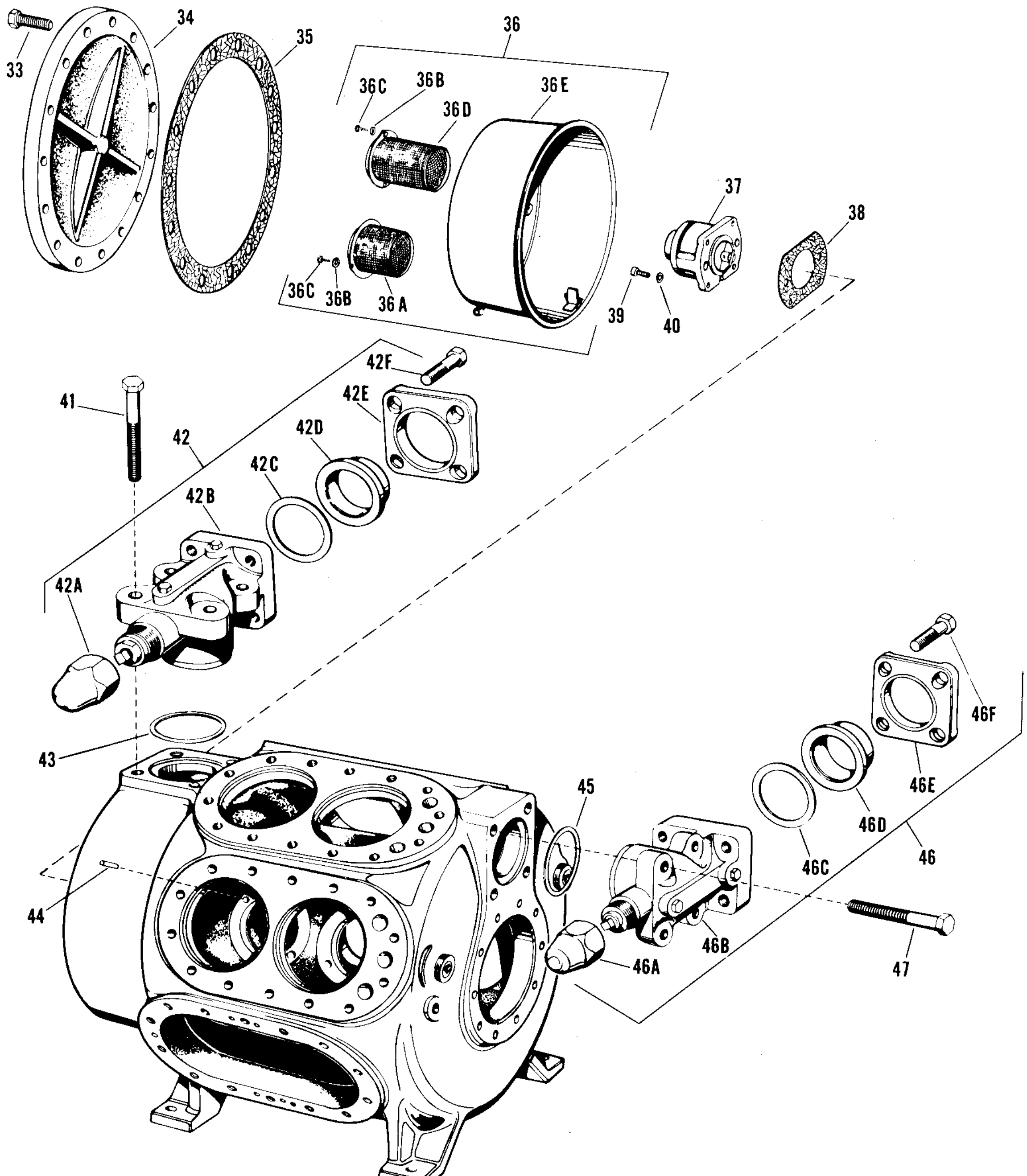

33
34
35
36
36C
36B
36D
36E
36C
36B
36A
37
38
39
40
41
42
42A
42B
42C
42D
42E
42F
43
44
45
46
46A
46B
46C
46D
46E
46F
47

FIGURE 13

COMPRESSOR PARTS LIST

TABLE 6

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
33	Screw - Hex Head, 1/2" - 13 x 1-1/2"	SCR-51	15
34	Cover - Suction	COV-6	1
35	Gasket - Suction Cover	GKT-30	1
36	Suction Strainer Assembly, 4 Cylinder, Consisting of: 36A, 36B, 36C, 36D, 36E	SRA-6	1
36A	Filter - Oil	FLR-6	1
36B	Lockwasher - No. 10	WAS-18	10
36C	Screw - Round Head, No. 10 - 32 x 3/8"	SCR-9	10
36D	Screen - Suction Strainer	SRN-3	2
36E	Pan - Suction Strainer	PAN-3	1
37	Pump - Oil, Including Gasket	PMP-1	1
38	Gasket - Oil Pump	GKT-34	1
39	Screw - Hex Head, 5/16" - 24 x 3/4"	SCR-50	4
40	Lockwasher - 5/16" x .130" x .097"	WAS-14	4
41	Screw - Hex Head Cap, 5/8" - 11 x 4"	SCR-14	4
42	Valve - Suction Stop, 2-1/8", Consisting of: 42A, 42B, 42C, 42D, 42E, 42F	VAL-36	1
42A	Cap	CAP-4	1
42B	Body	BOD-2	1
42C	Gasket	GKT-32	1
42D	Adapter	ADP-8	1
42E	Flange	FLG-3	1
42F	Screw	SCR-49	4
43	Gasket - Suction Stop Valve	GKT-15	1
44	Pin - Roll, 3/16" x 1"	PIN-4	3
45	Gasket - Discharge Stop Valve	GKT-14	1
46	Valve - Discharge Stop, 1-5/8", Consisting of: 46A, 46B, 46C, 46D, 46E, 46F	VAL-37	1
46A	Cap	CAP-5	1
46B	Body	BOD-3	1
46C	Gasket	GKT-33	1
46D	Adapter	ADP-9	1
46E	Flange	FLG-4	1
46F	Screw	SCR-52	4
47	Screw - Hex Head Cap, 1/2" - 13 x 3-1/4"	SCR-13	4
*	Kit - Gasket, B Compressor	KIT-2	1

* Not Illustrated.
Specify Valve Manufacturer - M.B. (Mueller Brass Co.), H.V. (Henry Valve Co.), Metrix.

Illustration Precedes This List.

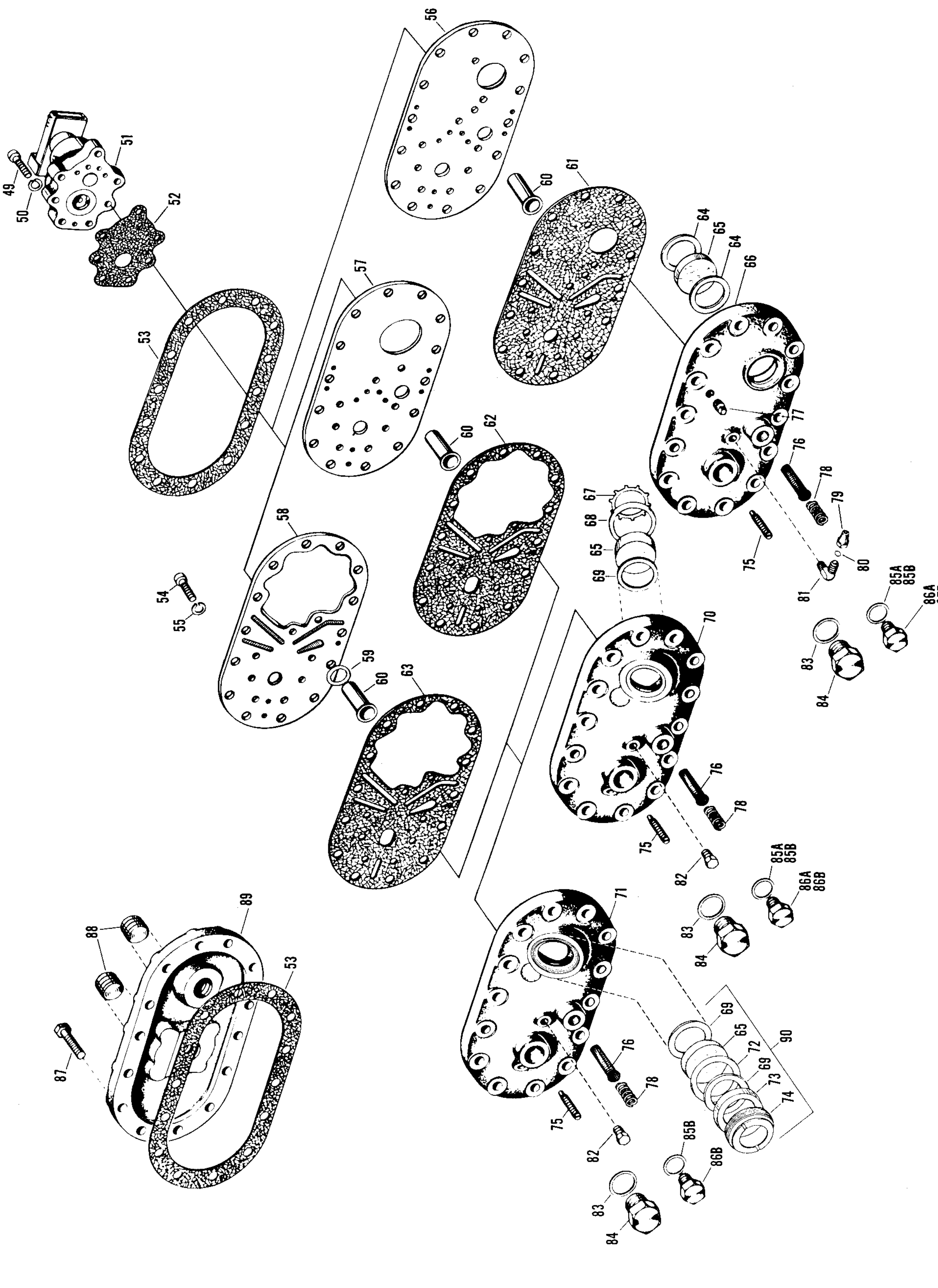

49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85A
85B
86A
86B
87B
87
88
89
90

FIGURE 14

COMPRESSOR PARTS LIST

TABLE 7

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
49	Screw - Socket Head Cap, 3/8" - 24 x 1-3/4" -	SCR-46	7
50	Lockwasher - 3/8" x .078" x .125" -----------	WAS-17	7
51	Capacity Control Assembly -------------------	CNT-4	1
52	Gasket - Capacity Control Assembly ----------	GKT-24	1
53	Gasket - Handhole Cover ---------------------	GKT-25	2
54	Screw - Socket Head Cap, 3/8" - 24 x 1" -----	SCR-45	1
55	Lockwasher - 3/8" x .078" x .125" -----------	WAS-17	1
56	Plate - Steel Back, Obsolete, See Note (1) --	PLT-11(1)	--
57	Plate - Steel Back, Obsolete, See Note (2) --	PLT-66(2)	--
58	Plate - Steel Back --------------------------	PLT-79	1
59	"O" Ring - Strainer Screen Cover ------------	RNG-52	1
60	Cover - Strainer Screen ---------------------	COV-4	1
61	Gasket - Distributor (Used With PLT-11) -----	GKT-26	1
62	Gasket - Distributor, 1/16" Thick (Used With PLT-66) ----------------------------------	GKT-85	1
63	Gasket - Distributor, 1/32" Thick (Used With PLT-79) ----------------------------------	GKT-154	1
64	Gasket - Sight Glass ------------------------	GKT-27	2
65	Glass - Sight -------------------------------	GLS-4	1
66	Cover - Control Handhole (With Oil Pressure Switch Tappings) Obsolete, See Note (3) ---	COV-5(3)	--
67	Ring - Retaining ----------------------------	RNG-20	1
68	"O" Ring - Sight Glass ----------------------	RNG-21	1
69	Gasket - Sight Glass ------------------------	GKT-51	1
70	Cover - Control Handhole (With Oil Pressure Switch Tappings) Obsolete, See Note (4) ---	COV-38(4)	--
71	Cover - Control Handhole (With Oil Pressure Switch Tappings) ------------------------	COV-123	1
72	"O" Ring - Sight Glass ----------------------	RNG-58	1
73	Bushing - Sight Glass -----------------------	BUS-28	1
74	Nut - Sight Glass ---------------------------	NUT-62	1
75	Screw - Bellows Adjusting -------------------	SCR-47	1
76	Screen - Strainer ---------------------------	SRN-2	1
77	Plug - Hex Head Pipe, Steel, 1/8" I.P.S. ----	PLU-20	1
78	Spring - Strainer Screen --------------------	SPG-6	1
79	Nut - Flare, 1/4" S.A.E. --------------------	NUT-1	1
80	Bonnet - Flare, 1/4" S.A.E. -----------------	BON-1	1
81	Elbow - 90°, 1/4" S.A.E. x 1/8" M.P.S. ------	ELL-2	1
82	Plug - Hex Head Pipe, 1/8" MPT --------------	PLU-29	1
83	Gasket - Bellows Adjusting Screw Cover Plug -	GKT-29	1
84	Plug - Bellows Adjusting Screw Cover --------	PLU-13	1
85A	Gasket - Strainer Screen Plug, Asbestos, Copper Sheathed, Obsolete, See Note (5) ---	GKT-28(5)	--
85B	"O" Ring - Strainer Screen Plug -------------	RNG-34	1
86A	Plug - Strainer Screen, Obsolete, See Note (6)	PLU-12(6)	--
86B	Plug - Strainer Screen ----------------------	PLU-22	1
87	Screw - Hex Head Cap, 7/16" - 14 x 1-3/4" ---	SCR-67	28
88	Plug - Pipe, Socket Head Square, 3/4" I.P.S. -	PLU-28	2
89	Cover - Handhole, Including Plugs -----------	COV-2	1
90	Kit - Sight Glass Assembly ------------------	KIT-12	1

(1) Obsolete. For Replacement Order Items 58, 59, 63, 71 and 90.
(2) Obsolete. For Replacement Order Items 58, 59 and 63.
(3) Obsolete. For Replacement Order Items 58, 59, 63, 71 and 90.
(4) Obsolete. For Replacement Order Items 71 and 90.
(5) Obsolete. For Replacement Order Items 85B and 86B.
(6) Obsolete. For Replacement Order Items 85B and 86B.

Illustration Precedes This List.

DUAL PRESSURE CONTROL
DOME COACH, DOME SLEEPER AND DINER CARS

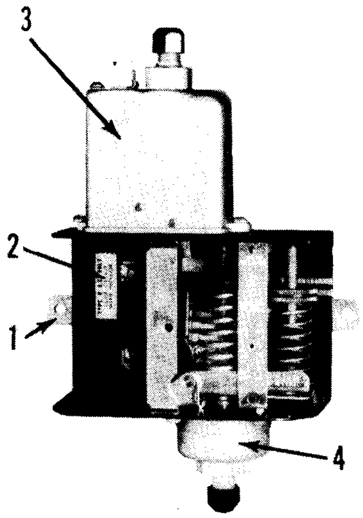


FIGURE 15

Illustration Of Detroit Controls No. 450949 Dual Pressure Control (Trane Part No. CNT-811).

TABLE 8

REF. NO.	PART NAME AND DESCRIPTION	DETROIT CONTROLS PART NUMBER**	NO. REQ.
1	Bracket - Mounting (Flat Type)	45075	1
2	Switch - Snap Assembly	450481	1
3	Cut-Out Assembly, High Pressure	450950	1
4	Element - Power, Pressure Type	450374	1
*	Lockwasher - Snap Switch	S-415	1
*	Screws - Mounting Bracket	450250	4
*	Cover - Assembly	450391	1
*	Screw - Snap Switch	586363	1

* Part Not Illustrated.

** Order Parts From Detroit Controls, 5900 Trimbull Avenue, Detroit, Michigan. Only Complete Control Stocked By The Trane Company.

LIQUID RECEIVER SIGHT GLASS
DOME COACH, DOME SLEEPER AND DINER CARS

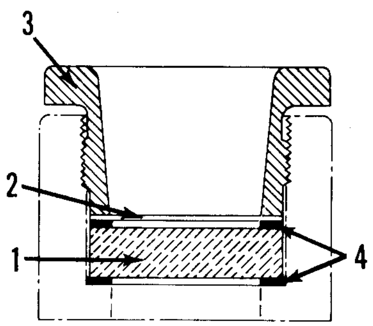


FIGURE 16

Illustration Of Sight Glass Assembly.

TABLE 9

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER	NO. REQ.
1	Glass - Sight, 3/4" Pyrex (Glass Only)	GLS-7	1
2	Washer - Sight Glass	WAS-39	1
3	Nut - Retaining, Sight Glass	NUT-26	1
4	Gasket - Sight Glass	GKT-40	2

DRY-TYPE CONDENSER PARTS LIST
DOME COACH, DOME SLEEPER AND DINER CARS

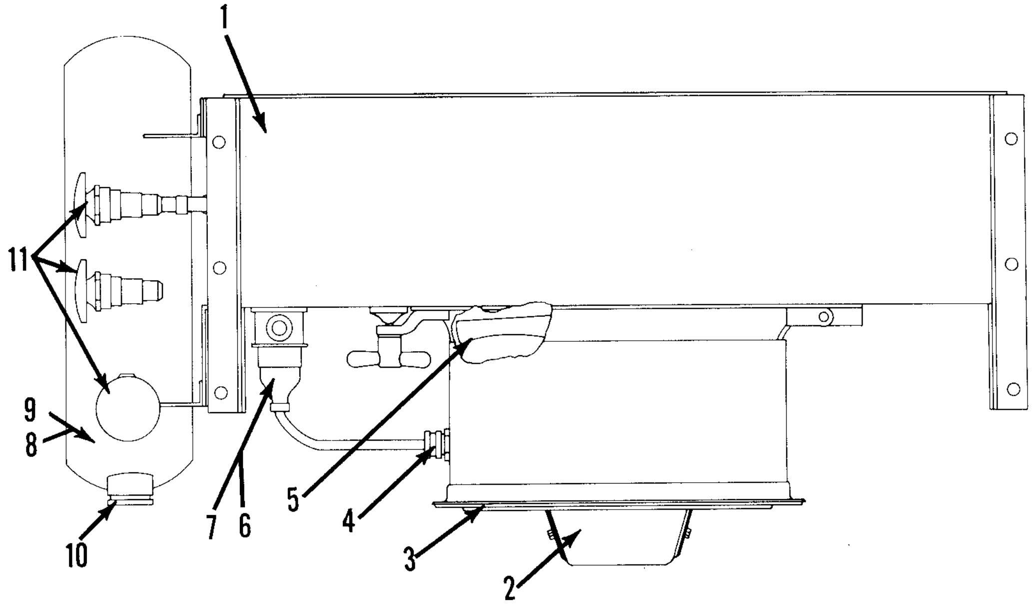


FIGURE 17

Top View Of Dry-Type Condenser With Liquid Receiver.
One Unit On Each Car Does Not Have A Liquid Receiver.
(See Parts List, Table 10.)

TABLE 10

REF. NO.	PART NAME AND DESCRIPTION	WITH LIQUID RECEIVER	WITHOUT LIQUID RECEIVER	NO. REQ.
1	Coil - Assembly, 24" x 42", 3/8" Tubes	C-865	C-866	1
2*	Motor - Electric, Reliance, 1 HP, 1750 RPM, 28-42 V	MOT-801	MOT-801	1
3	Guard - Wire	GRD-802	GRD-802	1
4	Grip - Cable, P-N DB-111316	GRP-800	GRP-800	1
5	Fan - 7 Blade, 21" Aerovent	FAN-800	FAN-800	1
6	Receptacle - P-N KRCA-33036	RCT-800	RCT-800	1
7	Plug - P-N KPD-83036	PLU-803	PLU-803	1
8	Receiver - Liquid, Complete, Consisting of: 9, 10, 11	REC-800	---	1
9	Receiver - Liquid, Shell Only	REC-802	---	1
10	Sight Glass Assembly - Liquid (See Page 32, Figure 16, For Component Parts)	GLS-6	---	2
11	Valve - Angle, Mueller A-14876	VAL-800	---	3
**	Mount - Isolator, Firestone CA-368-7	MNT-801	MNT-801	12

* Trane Specification D4520/5234.
** Not Illustrated.

COOLING UNIT PARTS LIST
DOME COACH AND DOME SLEEPER CARS

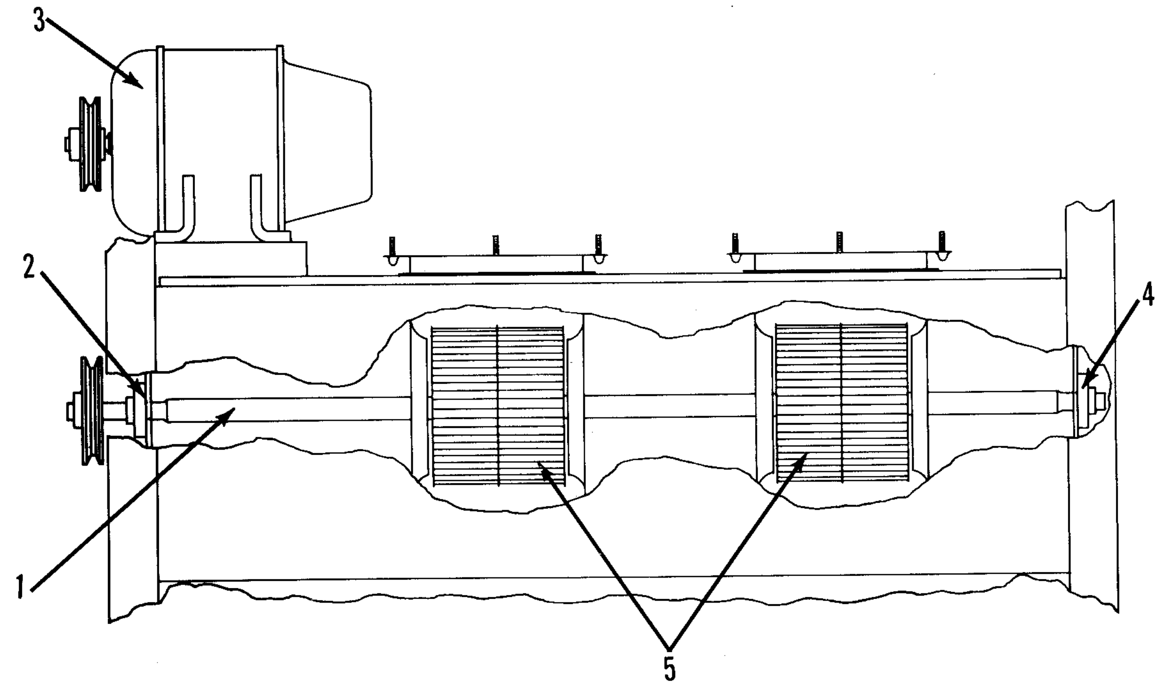


FIGURE 18

Top View.

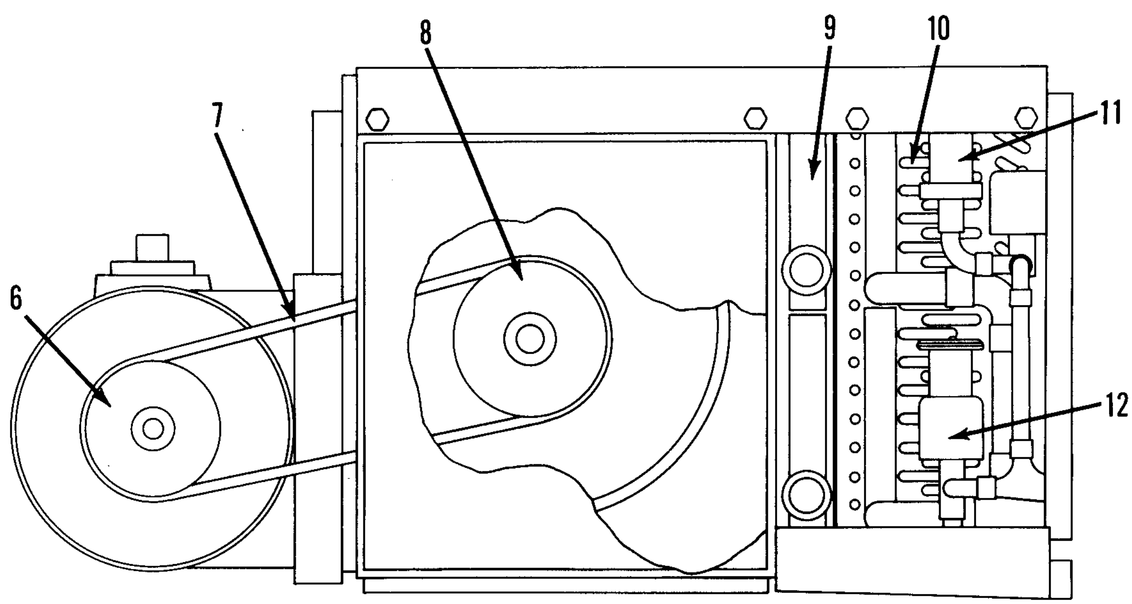


FIGURE 19

Side View.

COOLING UNIT PARTS LIST
DOME COACH AND DOME SLEEPER CARS

TABLE 11

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER DOME CAR BODY UNIT	PART NUMBER DOME CAR DOME UNIT	NO. REQ.
1	Shaft - Fan	SHF-800	SHF-800	1
2	Bearing - Ball, S-A SFT-15, Rigid, 15/16" Diameter	BRG-810	BRG-810	1
3*	Motor - Electric, Reliance, 1 HP, 36 VDC, 1800 RPM	MOT-802	MOT-802	1
4	Bearing - Ball, S-A SFT-15, Floating, 15/16" Diameter	BRG-810	BRG-810	1
5	Fan - Wheel, 8" 3/4 DWDI	FAN-848	FAN-848	2
6	Sheave - Motor, IVM-50, 3.7 - 4.7, 3/4" Bore	SHE-801		1
6	Sheave - Motor, IVL-44, 3.1 - 4.1 PD, 3/4" Bore		SHE-4	1
7	Belt - Fan Drive, 5L450, 14.1 C. to C.	B-800	B-800	1
8	Sheave - Fan, BK-60, 5.4 PD, 15/16" Bore	SHE-800	SHE-800	1
9	Coil - Heating, 1-Row, 15" x 36"	C-829	C-829	1
10	Coil - Cooling, 8-Row, 15" x 36"	C-867	C-867	1
11	Valve - Expansion, TO3007FG (See Page 39 For Parts List)	VAL-807	VAL-807	1
12	Valve - Expansion, TO3008FG (See Page 39 For Parts List)	VAL-805	VAL-805	1

* Trane Specification D4520/5236.

SOLENOID LIQUID VALVE PARTS LIST *
DOME COACH, DOME SLEEPER AND DINER CARS

TABLE 12

TRANE PART NUMBER ... VAL-858

PART NAME AND DESCRIPTION	ALCO PART NUMBER**	NO. REQ.
Body, Tube and Plunger Assembly. Includes Body, Piston, Enclosing Tube Assembly, Plungers and Stern Assembly, Union Nut and Gasket	XA1864-2	1
Enclosing Tube Assembly	X5179	1
Body, 5/8" OD	6796-2	1
Union Nut	A1391	1
Enclosing Tube-To-Body Gasket	A650-24	1
Coil Housing Assembly	XA1654	1
Coil Housing Nut	PS334	1
Coil Plate	A3558	1
Nameplate S804-6 Solenoid Valve	A1133	1
Coil Sleeves, Upper and Lower (DC)	A1128-2	2
Coil Assembly, 32 VDC	XA1550	1

* Not Illustrated.

** Order Parts From Alco Valve Co., 865 Kingsland Ave., St. Louis, Mo. Only Complete Valve Stocked By The Trane Company.

COOLING UNIT PARTS LIST

DINER CARS - DINING UNIT

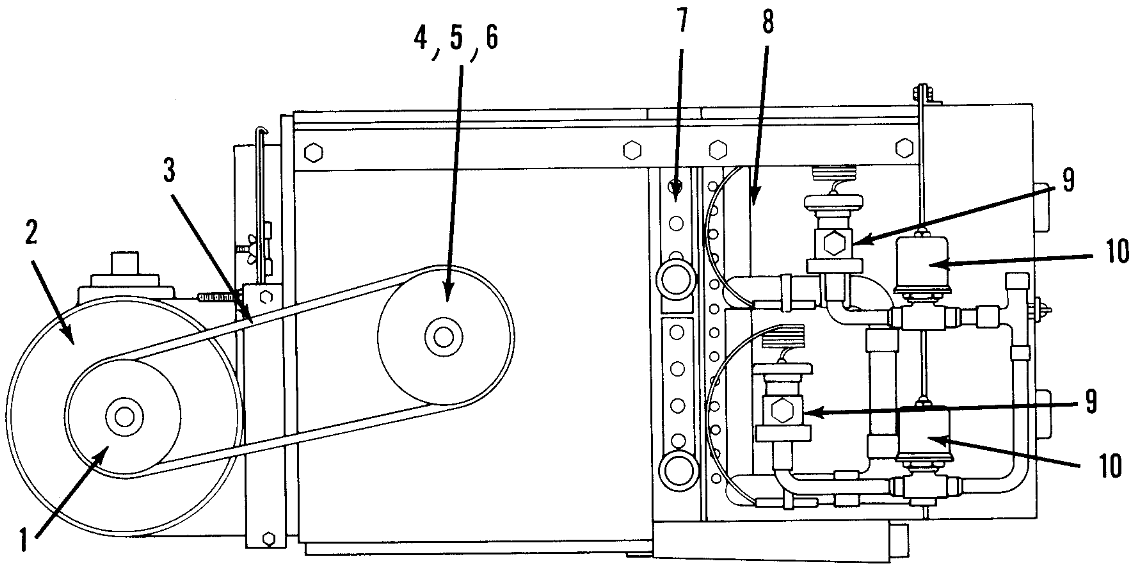


FIGURE 20

Side View.

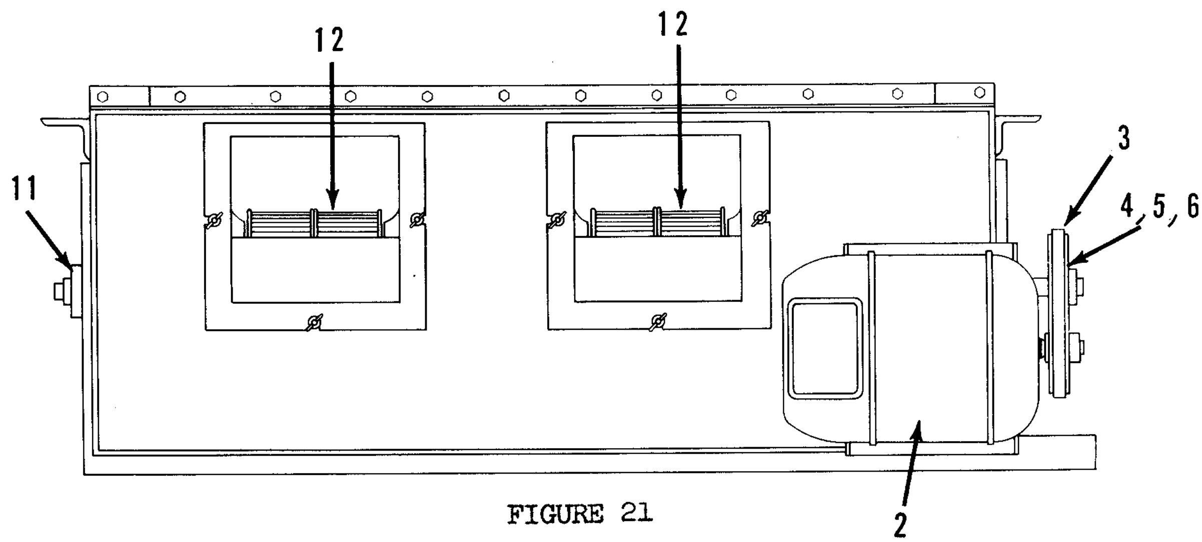


FIGURE 21

Front View.

COOLING UNIT PARTS LIST
DINER CARS - DINING UNIT

TABLE 13

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ. DINER CAR DINING UNIT
1	Sheave - Motor, IVM-50, 3.7 - 4.7 PD, 3/4" Bore	SHE-801	1
2*	Motor - Fan, Reliance, 1 HP, 32 VDC, Open, Ball Bearing, 1800 RPM	MOT-802	1
3	Belt - Fan Drive, 5L450, 14.2 C. to C.	B-800	1
4	Sheave - Fan, BK-60, 5.4 PD, 15/16" Bore	SHE-800	1
5	Bearing - Floating, S-A SFT-15, 15/16" Bore	BRG-810	1
6	Shaft - Fan	SHF-800	1
7	Coil - Heating, 1-Row, 15" x 36"	C-829	1
8	Coil - Cooling, 8-Row, 15" x 36"	C-841	1
9	Valve - Thermostatic Expansion, Alco T0300-8FG (See Page 39 For Parts List)	VAL-805	2
10	Valve - Solenoid, Alco S-804-6 (See Page 35 For Parts List)	VAL-858	2
11	Bearing - Rigid, S-A SFT-15, 15/16" Bore	BRG-810	1
12	Fan - Wheel, 8" 3/4 DWDI, 1-7/16" Bore	FAN-848	2
**	Plug - P-N KPLD 83036	PLU-808	1
**	Receptacle - Including Housing, P-N KRLA 33036, 1"	RCT-811	1

* Trane Specification D4520/5236.
** Part Not Illustrated.

SUPPLEMENTAL EQUIPMENT

TABLE 14

PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
Exchanger - Heat	EXC-800	1 Per Car
Duct Frame - Flexible	DUC-811	3 Per Car (Diner)
Duct Frame - Inlet	DUC-812	2 Per Car (Dome)
Valve - Charging, Packed Angle, Mueller A-11031	VAL-853	1 Per Car

COOLING UNIT PARTS LIST
DINER CARS - KITCHEN, PANTRY UNITS

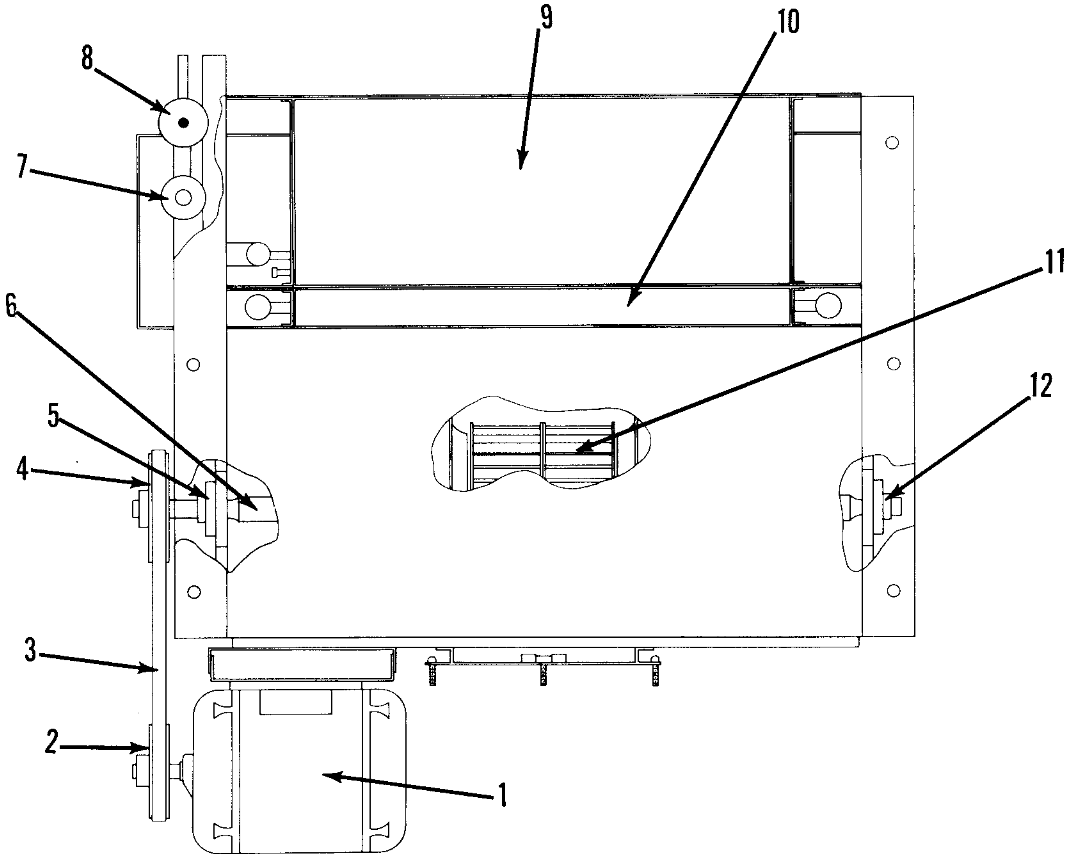


FIGURE 22

Top View.

TABLE 15

REF. NO.	PART NAME AND DESCRIPTION	PART NUMBER DINER CAR KITCHEN-PANTRY UNIT	NO. REQ.
1*	Motor - Electric, Reliance, 1/2 HP, 1800 RPM, 32 V DC	MOT-858	1
2	Sheave - Motor, IVM-50, 3.7 - 4.7 PD, 3/4" Bore	SHE-801	1
3	Belt - Fan Drive, 5L480, 13.8 C. to C.	B-821	1
4	Sheave - Fan, BK-55, 4.9 PD, 15/16" Bore	SHE-807	1
5	Bearing - Ball, S-A SFT-15, Rigid, 15/16" Diameter	BRG-810	1
6	Shaft - Fan	SHF-820	1
7	Valve - Thermostatic Expansion, Alco TO600-9FG (See Page 39 For Parts List)	VAL-842	1
8	Valve - Solenoid, Alco S-804-6 (See Page 35 For Parts List)	VAL-858	1
9	Coil - Cooling, 8-Row, 15" x 36"	C-841	1
10	Coil - Heating, 1-Row, 15" x 24"	C-839	1
11	Fan - Wheel, 8", 3/4 DWDI	FAN-848	1
12	Bearing - Ball, S-A SFT-15, Floating, 15/16" Diameter	BRG-810	1

* Trane Specification D4520/6746.

THERMOSTATIC EXPANSION VALVE PARTS LIST
DOME COACH, DOME SLEEPER AND DINER CARS

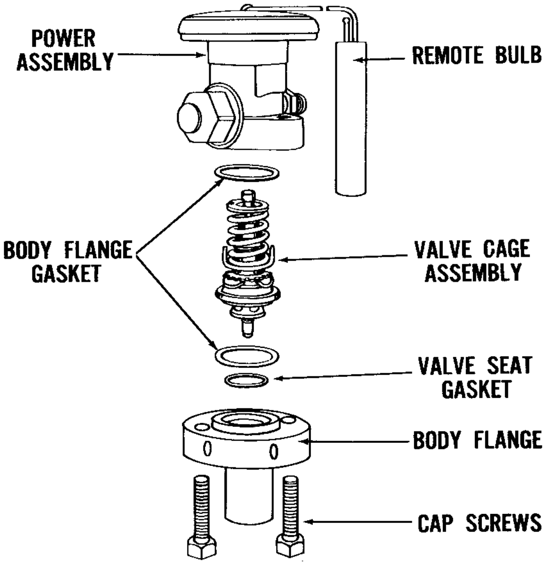


FIGURE 23

TRANE PART NUMBERS

T0300-7FG ... VAL-807
T0300-8FG ... VAL-805
T0600-9FG ... VAL-842

PART NAME AND DESCRIPTION	ALCO PART NO.*	NO. REQ.
Valve, Complete (7 Outlet)	T0300-7FG	1
Valve, Complete (8 Outlet)	T0300-8FG	1
Valve Assembly (9 Outlet)	T0600-9FG	1
Power Assembly (External Bulb)	XB1019	1
Cage Assembly (Includes Gaskets) (Specify Capacity and Number of Outlets)	XC713	1
Body Flange Gasket	A625-4	2
Seat Gasket	A625-3	1
Body Flange --		
7 Outlet	A1011	1
8 Outlet	A1013-4	1
9 Outlet	A2277	1
Cap Screw	PS286	2
External Bulb Clamp	XA1728-4	2
Outlet Plug	A1855-1	---
Nameplate (Specify Charge)	A1059	1

NOTE: When Ordering Parts For Thermostatic Expansion Valves, Specify Type T0300-7FG Valve For Replacement Of Parts On Upper (7 Outlet) Valves, And Type T0300-8FG For Replacement Of Parts On Lower (8 Outlet) Valves.

* Order Parts From Alco Valve Co., 865 Kingsland Ave., St. Louis, Mo. Only Complete Valve Stocked By The Trane Company.

EXHAUST FAN PARTS LIST
DOME COACH AND SLEEPER CARS

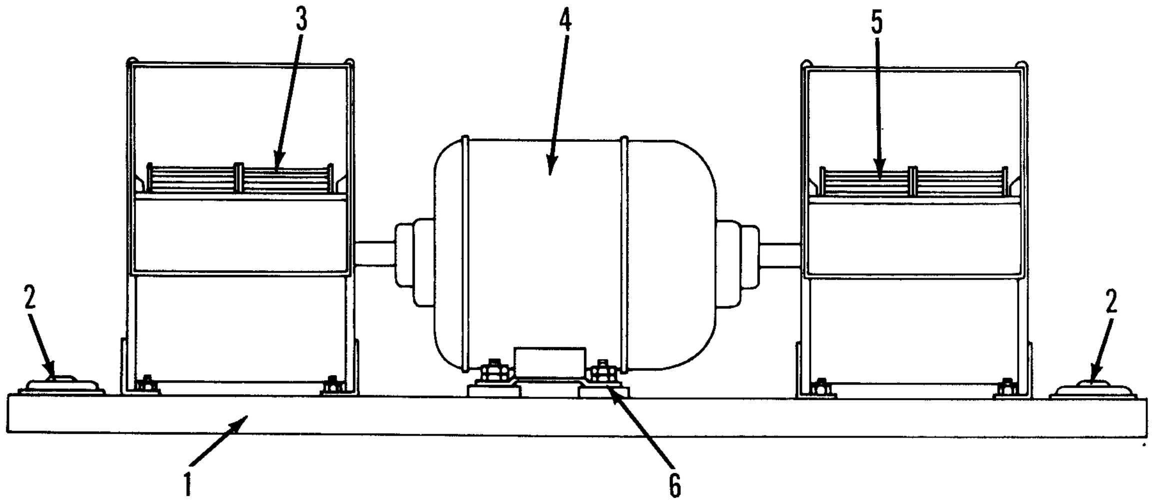


FIGURE 24

Illustration Of Exhaust Fan.

TABLE 17

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
1	Fan - Exhaust, Complete Assembly Consisting of The Following Items:	FAN-849	1
2	Mount - Rubber, Lord No. 200P-15	MNT-823	4
3	Fan - Wheel, DW1, 4-1/2", 5/8" Bore	FAN-850	1
4	Motor - Electric, Century, Frame 63 LDM, 1/8 HP, 1725 RPM	MOT-860	1
5	Fan - Wheel, DW2, 4-1/2", 5/8" Bore	FAN-851	1
6	Mount - Isolator, Motor	MNT-803	4

EXHAUST FAN PARTS LIST
DOME COACH AND SLEEPER CAR LOCKER ROOM

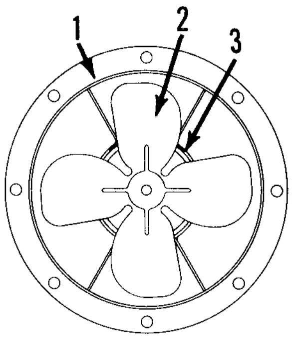


FIGURE 25

Illustration Of
Propeller-Type Exhaust Fan.

TABLE 18

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
1	Fan - Exhaust, Complete Assembly, Consisting of The Following Items:	FAN-801	1
2	Fan - Propeller, 6", Torrington 0-621-4, 5/16" Bore	FAN-802	1
3	Motor - Universal, Electric, .006 BHP, 2400 RPM, 32 V DC, Model 4-039	MOT-805	1

EXHAUST FAN PARTS LIST
DOME SLEEPER CAR TOILET AND BEDROOM

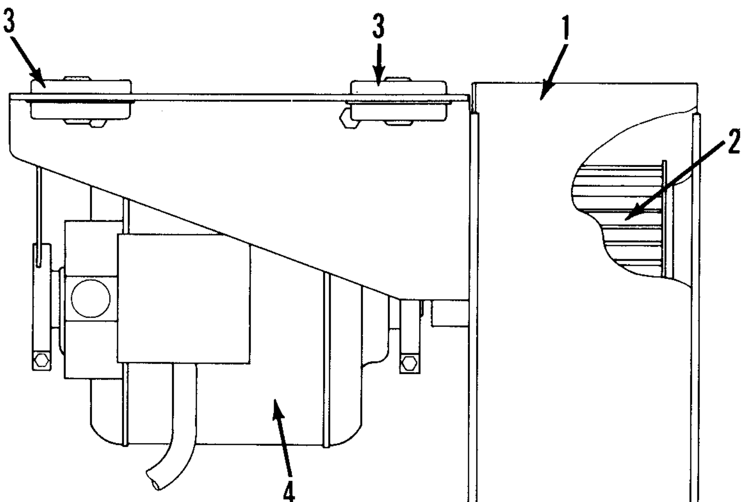


FIGURE 26

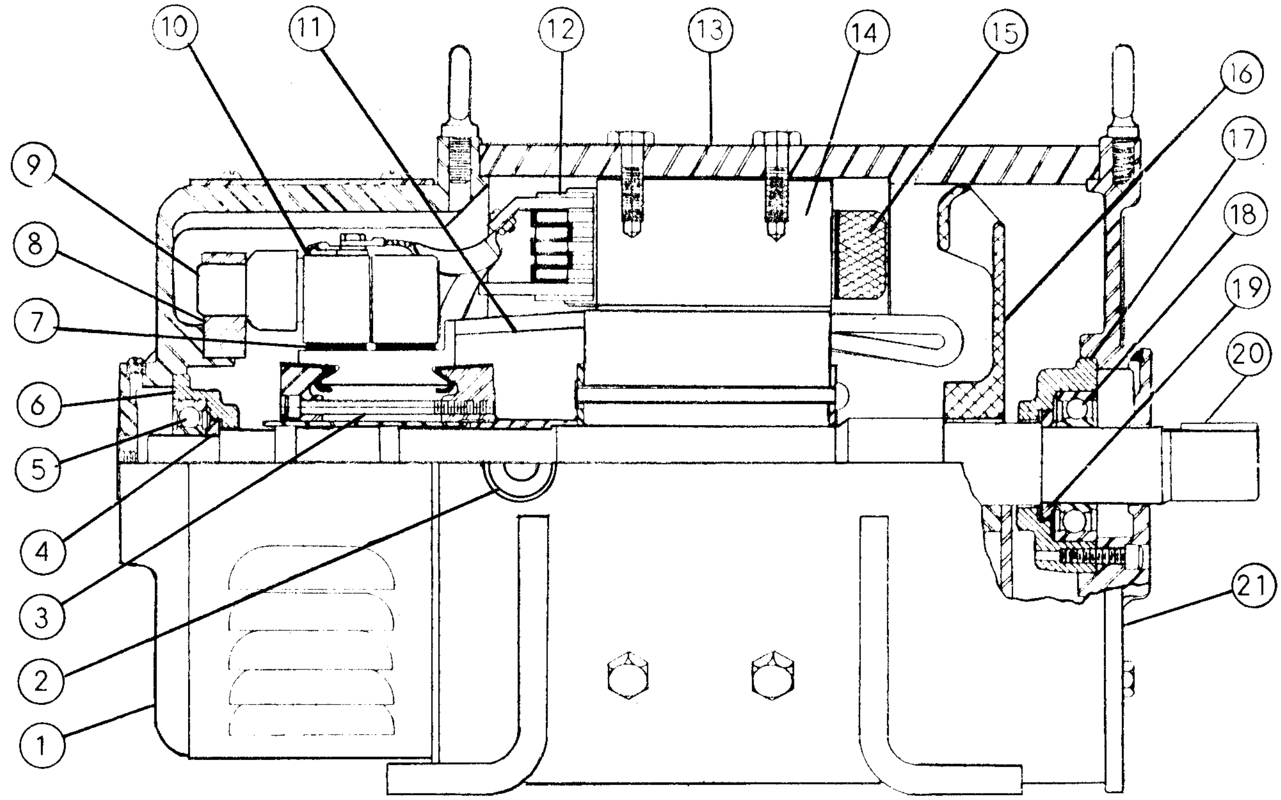
Utility Exhaust Fan.

TABLE 19

REF. NO.	PART NAME AND DESCRIPTION	PART NO.	NO. REQ.
1	Fan - Exhaust, Complete Assembly, Consisting of The Following Items:	FAN-852	1
2	Fan - Wheel	FAN-853	1
3	Mount - Isolator, Lord 200P-45	MNT-806	4
4	Motor - Electric, Century, 1/8 HP, 1360 RPM, 32 V DC	MOT-883	1

COMPRESSOR MOTOR

Trane Spec. 5230 - 5232 - 6806



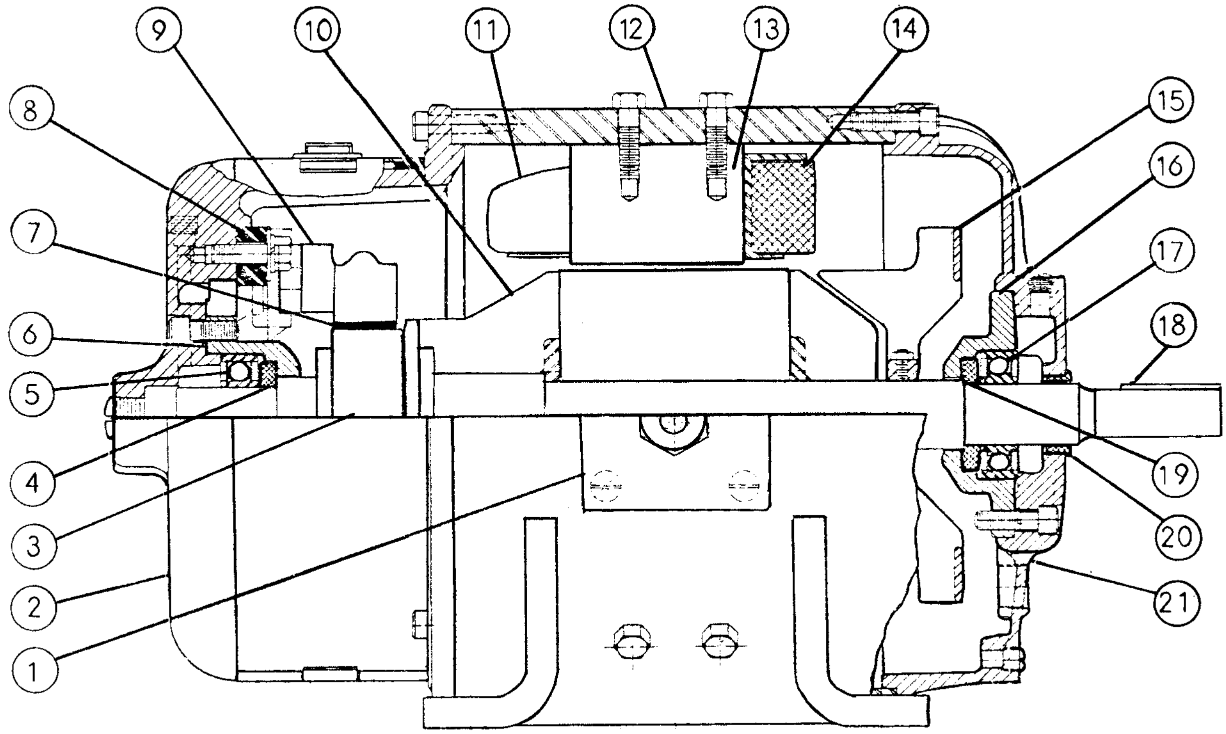
T-326 12.5/14.5 HP 1800/2000 RPM 28/46 Volt Shunt Windings

Ref.	Parts Description	Part No.
1	F.E. Bracket & Cover	80122-9-R/ 75410-6-R
2	Cable & Lead Connectors	#10 & #00 401377-B&C
3	Commutator	402121-8-R
4	F.E. Grease Retainer	48501-A
5	F.E. Bearing	307
6	F.E. Inner Cap	49408-A
7	Brushes	3306-DS
8	Rocker	75476-R
9	Brush Stud	63962-9-R
10	Brushholder	63961-2-R
	Finger	63959-A&B
	Spring	62523-2R&S
11	Armature, Complete	E/S T326-E19A
12	Inter Coil	E/S T326-0-0-F2B
13	Frame	72735-10-AA
14	Field Pole	49851-1-R
15	Field Coil	E/S T326-0-F16S
16	Inner Fan	73678-2-AA
17	B.E. Inner Cap	49410-A
18	B.E. Bearing	309
19	B.E. Grease Retainer	48501-G
20	Shaft	63126-12-RA
21	B.E. Bracket	80036-43-RA

When ordering specify frame size, part number and motor application.

CONDENSER MOTOR

Trane Spec. 5234



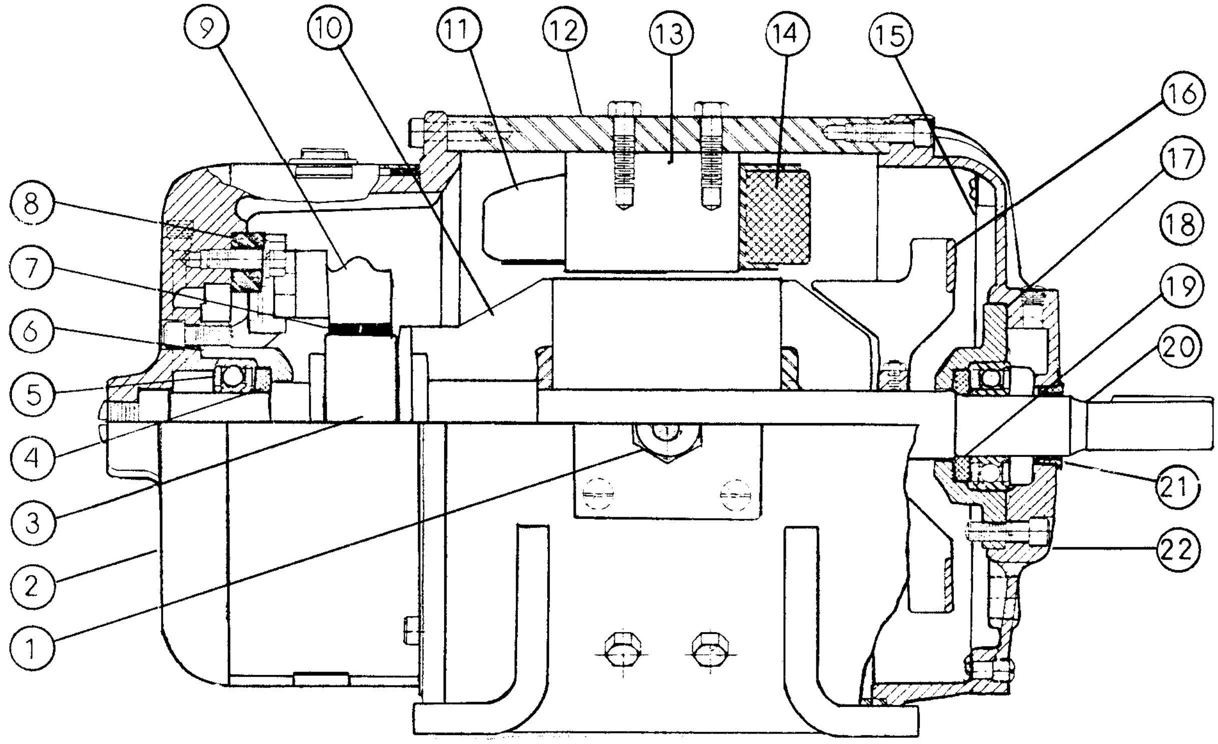
CT-204 1 HP 1750 RPM 28/42 Volts Compound Windings

Ref.	Parts Description	Part No.	Ref.	Parts Description	Part No.
1	Cable &	60955-1-AD/	10	Armature, Complete	E/S CT204-A55A
	Lead Connector	49843-7-T	11	Inter Coil	none required
2	F.E. Bracket &	80100-15-B/	12	Frame	71841-R
	Cover	75410-4-S	13	Field Pole	48882-1-R
3	Commutator	48982-T	14	Field Coil	E/S CT204/
4	F.E. Grease Retainer	47579-U			0-A97S-0-C61S
5	F.E. Bearing	205	15	Inner Fan	62676-RA
6	F.E. Inner Cap	48891-B	16	B.E. Inner Cap	48886-A
7	Brushes	3306-EA	17	B.E. Bearing	205
8	Rocker	63072-B	18	Shaft	62628-A
9	Brushholder	63080-U	19	B.E. Grease Retainer	47579-U
	Finger	49861-A	20	B.E. Brkt. Bushing	48897-A
	Spring	62523-1-B	21	B.E. Bracket	8907-R

When ordering specify frame size, part number and motor application.

EVAPORATOR MOTOR

Trane Spec. 5236 - 7857



CT-203 1 HP 1750 RPM 28/46 Volt Compound Windings

Ref.	Parts Description	Part No.	Ref.	Parts Description	Part No.
1	Cable &	60955-1-AD/	11	Inter Coil	none required
	Lead Connector	49843-7-U	12	Frame	71842-R
2	F. E. Bracket (dbl. ext.)	80100-10-F	13	Field Pole	48882-RA
	" " " (single ext.)	80100-15-A	14	Field Coil	E/S CT203/
3	Commutator	48982-T			0-A48S-0-C37S
4	F. E. Grease Retainer	47579-U	15	Baffle	63381-A
5	F. E. Bearing	205	16	B. E. Inner Fan	62676-RA
6	F. E. Inner Cap	48891-B	17	B. E. Inner Cap	48886-A
7	Brushes	3306-EA	18	B. E. Bearing	205
8	Rocker	63072-B	19	B. E. Grease Retainer	47579-U
9	Brushholder	63080-U	20	Shaft (dbl. ext.)	62629-29-A
	Finger	49861-A		" (single ext.)	62629-AA
	Spring	62523-1-B	21	B. E. Brkt. Bushing	48897-A
10	Armature, Complete	E/S CT203-A46A	22	B. E. Bracket	8906-A

When ordering specify frame size, part number and motor application.

DELCO PRODUCTS DIVISION

SERVICEABLE PARTS LIST

August 14, 1957

CUSTOMER: Trane
MOTOR MODEL: A-9386, 1/2 H. P., 32 Volts, D. C., 1800 RPM

Part No.	Description	No. Req.
5305966	Armature and Fan Assembly	1
38973	Commutator	1
43635	Fan	1
5319079	Balance Disc	1
38194	Balance Weight	2
38195	Balance Weight	1
38078	Key - Shaft Extention	1
5543479	Base, Frame and Coil Assembly	1
1060419	Base	1
5378762	Screw and L. W. - Base Retaining	4
5353739	Frame	1
41809	Pole Piece	2
36776	Screw-Pole Piece Retaining	4
5320617	Field Coil Assembly	1
1880376	Capacitor - Suppressor	2
120216	Screw - Capacitor Retaining	2
106497	L. W. - Capacitor Retaining	2
41808	Grommet Lead	2
38182	Pin - Alignment	2
5320536	End Frame and Brush Bracket Assembly	1
5398108	End Frame	1
42655	Brush Bracket	1
37972	Screw - Brush Bracket Retaining	2
106497	L. W. - Brush Bracket Retaining	2
49681	Nut - Brush Bracket Retaining	2
1057257	Brush and Hook Assembly	2
38575	Spring - Brush Tension	2
38581	Screw - Brush Terminal	2
5387289	L. W. - Brush Terminal	2
1064217	Ball Bearing - Both Ends	2
5300356	Spring - Bearing Thrust	1
131954	Screw - Lead Terminal	2
106496	L. W. - Lead Terminal	2
1055445	Cover Plate	2
436746	Screw - Cover Plate Retaining	4
1078061	Conduit Box	1
142424	Screw - Conduit Box Retaining	2
1078060	Cover - Conduit Box	1
436746	Screw - Conduit Box Cover Retaining	2

Part No.	Description	No. Req.
5398109	End Frame - Drive End	1
1069250	Thru Bolt	2
42455	Nut - Thru Bolt	2
38078	Key - Shaft Extention	1
1062157	Pipe Plug	4
5372048	Connector - Conduit	1
1062869	Cable Assembly	1
5397033	Connector - Lead	3
1056802	Name Plate	1
5327153	Drive Screw - Name Plate	2