RTHC

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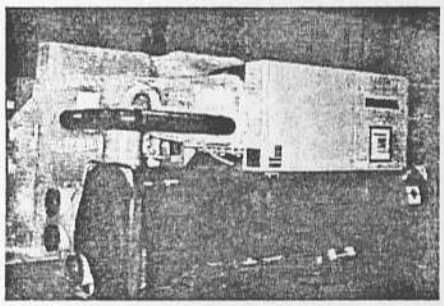
1

RTHC

ROTARY CHILLER



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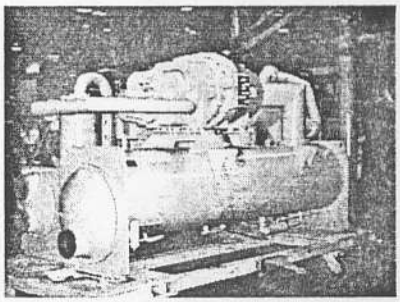
ROTARY CHILLER



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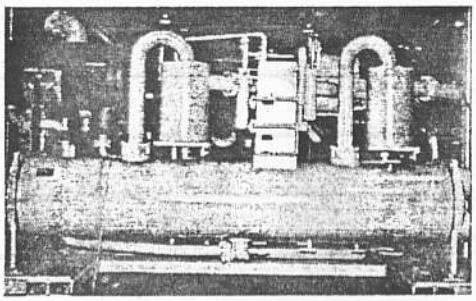
ROTARY CHILLER



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RTHC

PERFORMANCE COMPARISON
General

- RTHB
  - R22 Mineral Oil
- RTHC
  - R134a/Polyol Ester Oil

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RTHC

PERFORMANCE COMPARISON
Compressor

- RTHB
  - TYPE Helirotor
  - Motor
    - Hermetic Liquid Cooled
  - Variations
    - 2 Models, 2 Motor Sizes
  - Oil Separator
    - Horizontal, integral with compressor
  - Oil Cooler
    - Not Available
- RTHC
  - TYPE Helirotor
  - Motor
    - Hermetic, **Suction Gas Cooled**
  - Variations
    - 2 Models, 1 Motor Size
  - Oil Separator
    - 1 or 2 Vertical - Floats on Condenser
  - Oil Cooler
    - Application Based

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RTHC

PERFORMANCE COMPARISON
Evaporator

- RTHB
- TYPE
  - Shell & Tube, Flooded
- Construction
  - ASME Welded - Two Half Shells
- Design Pressure
  - 300 psi
- Waterboxes
  - Flanged Standard

- RTHC
- TYPE
  - Shell & Tube, **Falling Film**
- Construction
  - ASME Welded - **Rolled Pipe**
- Design Pressure
  - 200 psi
- Waterboxes
  - Victaulic Standard
  - Flanged Optional
    - Victaulic # 741

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RTHC

PERFORMANCE COMPARISON
Condenser

- RTHB
- Type - Shell & Tube
- Construction
  - ASME Welded. Two Half Shells
- Design Pressure - 300 psi
- Variations
  - 2 Lengths
  - 2 Tube Counts
- Waterboxes
  - 2 Pass 150 psi flanged standard. 3 pass,300psi or marine optional

- RTHC
- Type - **Shell & TubeWith Integral Subcooler**
- Construction
  - ASME Welded. **Rolled Pipe**
- Design Pressure - **200 psi**
- Variations
  - 2 Diameters, 3 Lengths, 6 different tube counts
- Waterboxes
  - 2 pass 150psi victaulic standard. 300psi victaulic optional

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RTHC

PERFORMANCE COMPARISON
Refrigeration Cycle

- RTHB
- Cycle
  - Vapor Compression with Economizer
- Expansion Device
  - One EXV, One Orifice
- Oil Return System
  - Oil Returned to Compressor via Wet Suction

- RTHC
- Cycle
  - Vapor Compression with **Subcooler**
- Expansion Device
  - One EXV
- Oil Return System
  - Oil Rich Refrigerant Returned to Compressor via **Gas Powered Pump**

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RTHC

PERFORMANCE COMPARISON
Controls

- RTHB
- UCP2
  - Chiller Module
  - Circuit Module
  - Stepper Module
  - Starter Module
  - Options Module
  - Comm Modules
  - Printer Module
  - CLD

- RTHC
- UCP2
  - Chiller Module
  - Stepper Module
  - Starter Module
  - Options Module
  - Comm Modules
  - Printer Module
  - CLD
- No Circuit Module
- No Remote CLD

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RTHC

Components

- Vapor Cooled Motor
- Compressor
- Gas Powered Unloader Piston
- Oil Separators
- Oil Sump
- Condenser with Subcooler
- EXV
- Liquid/Vapor Separator (LVS)
- Falling Film Evaporator
- Gas Pump
- Starter/Control Panel
- Optional Oil Cooler

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Components

- Oil Sump Heaters
- Oil Filter
- Oil Presence Sensor
- Oil D/P Switch
- Master Oil Solenoid Valve
- Refrigerant Filter (In Oil Circuit)
- Unload Solenoid
- Load Solenoid

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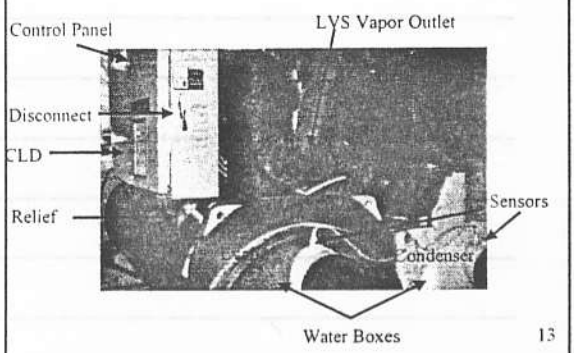
RTHC



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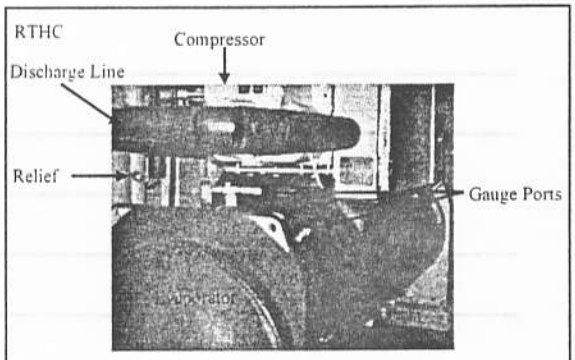
RTHC



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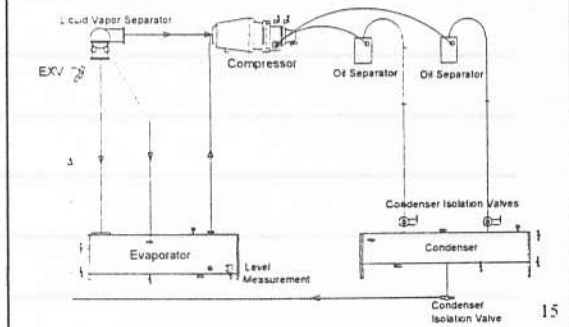
Refrigeration Circuit



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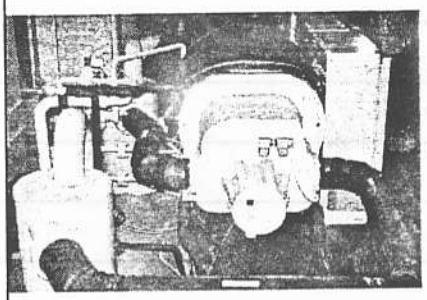
RTHC1- Compressor

RTHC

COMPRESSOR (CHHC)



- Dual Discharge Lines
- R-134a Refrigerant
- Unload to 25%

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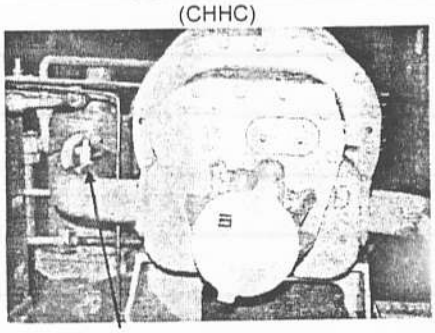
RTHC

COMPRESSOR (CHHC)



- Discharge Temp Sensor

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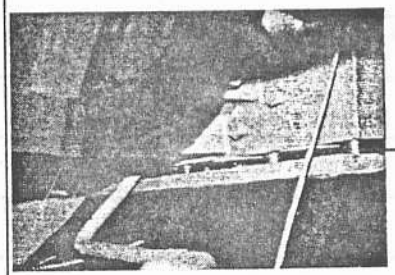
RTHC

Shipping Stops



- Drive Out

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RTHC

COMPRESSOR
Rotors

- Male Rotor
  - 5 Lobes
- Female Rotor
  - 7 Cavities
- 320° Wrap Angle
- Optimized for Refrigerant 134a

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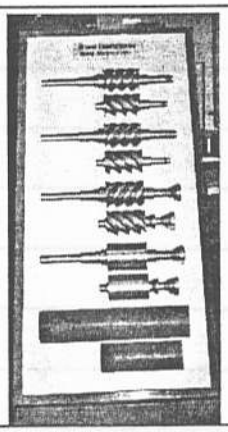
RTHC



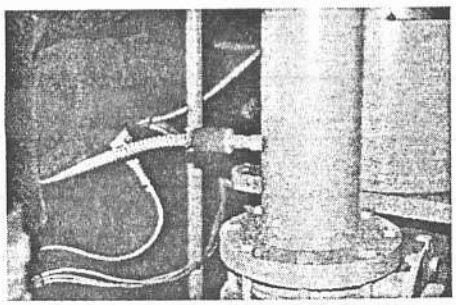
COMPRESSOR
Rotors

- Machining Steps
  - Billet
  - Rough Cut
  - Spline Cut
  - Finish Cut
  - Grind Finish

20

RTHC

High Pressure Cutout



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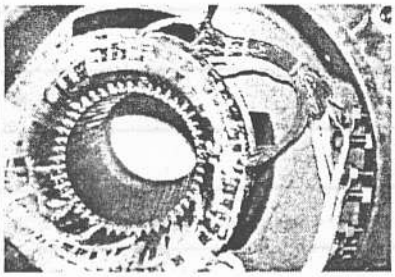
RTHC

COMPRESSOR
Motor



- Vapor Cooled
- No Winding T-Stats
- No Suction Inlet Screen in Vapor Line
- 3600 RPM
- WYE Delta Starter

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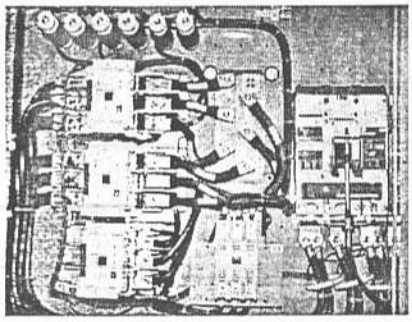
RTHC

WYE DELTA STARTER



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COMPRESSOR
Rotor Bearings

- 7 Total
  - 4 on Male
    - 1 Radial Thrust on Suction End
    - 1 Radial Thrust on Discharge End
    - 2 Axial Thrust on Discharge End
  - 3 on Female
    - 1 Radial Thrust on Suction End
    - 1 Radial Thrust on Discharge End
    - 1 Axial Thrust on Discharge End

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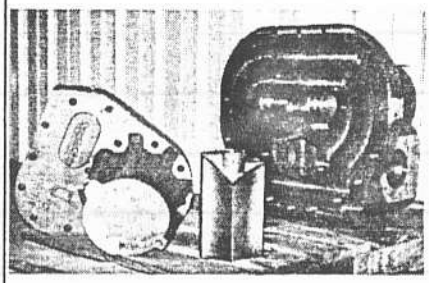
RTHC

COMPRESSOR
Slide Valve



- Gas Operated Unloader Piston
- Slide Valve Located on Bottom of Compressor
- Unloader Springs
- No Major or Minor Stops

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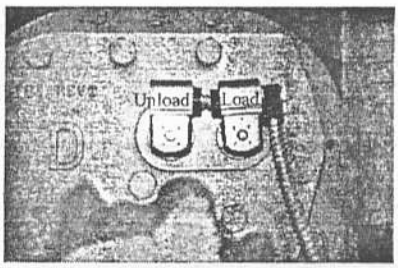
Load/Unload Solenoids



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RTHC

Load Solenoid

- Internal Supply Pressure to Load Solenoid
  - From Discharge Chamber
- Ensures High Loading Pressure at Startup and For Inverted Starts
- Discharge Chamber Tap Allows Loading At Higher Head Pressures
- Passage is Filtered And Uses a Snubber

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RTHC

Unload Solenoid

- Piston Pressure Routed To Compressor Suction
- Solenoid Remains Energized After Unit Shutdown
  - 60 Minutes
  - Power Up - Also 60 Minutes
- Unloading Is Spring Assisted
  - Unfriendly Shutdown
    - 2 to 10 Minutes to Unload

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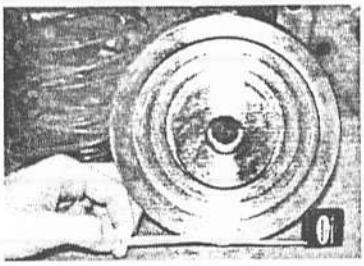
RTHC

Unloader Piston



- Spring Lands
- Inner O Ring
- 33.3% Larger Than RTHB

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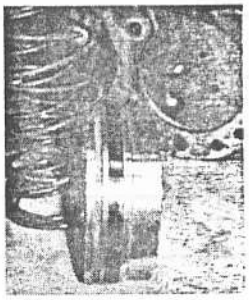
RTHC

Unloader Piston

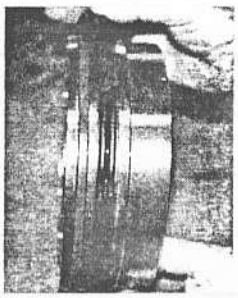


- Wear Ring
- Compression Ring

30

RTHC

Piston O Rings



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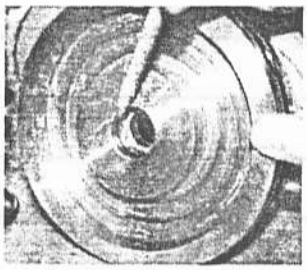
RTHC

Piston Inner O Ring



- Spring Lands
- If Leaking, Compressor Will Never Unload

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RTHC

Unloader Springs

- 3 Springs
- Forces Compressor to Unload When Off
- Unload Solenoid Energized For 60 Minutes

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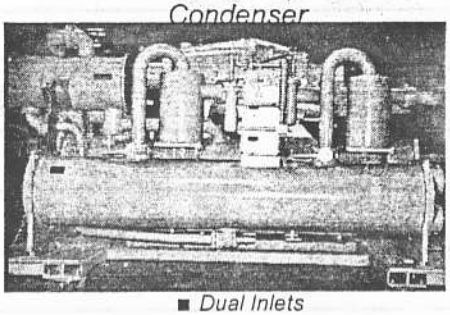
RTHC

REFRIGERATION CYCLE

Condenser



- Dual Inlets
- Shell & Tube
- Separate Subcooler

1

RTHC

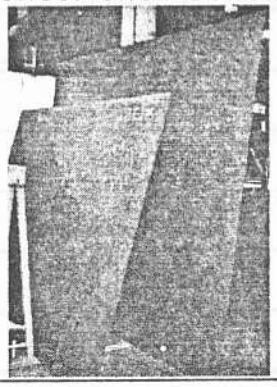
Condenser Shell Construction

- RTHB Shells
  - 2 Halves

2

RTHC

Condenser Shell Construction



- RTHC

3

RTHC

Condenser Shell Construction

- Flat Stock is Rolled

4

RTHC

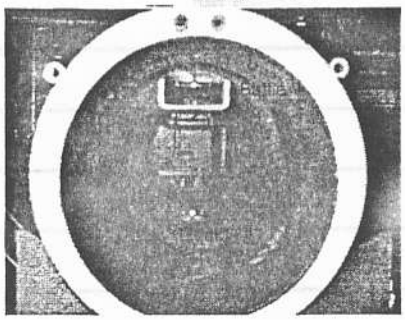
Condenser Shell Construction

- Ready To Weld!

5

RTHC

Condenser Shell Construction



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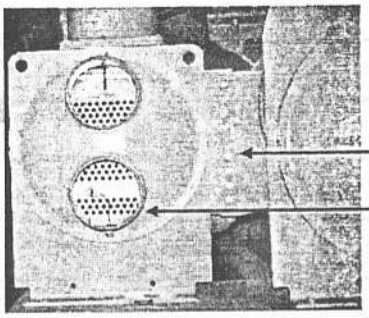
RTHC

Condenser Water Box



- Reversible
- Water Sensors
- Separable Shells
- Subcooler

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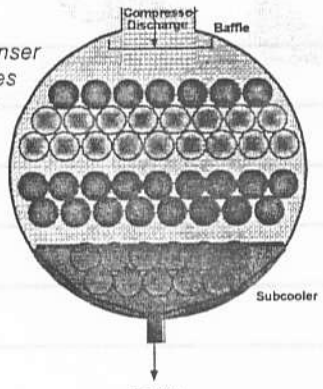
Condenser Tubes

- Tubes Held In Place With Clips



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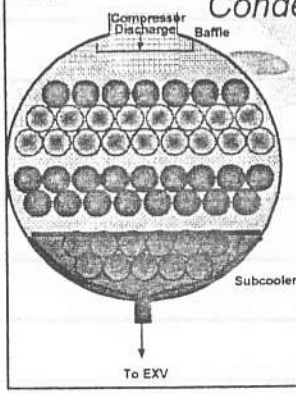
RTHC

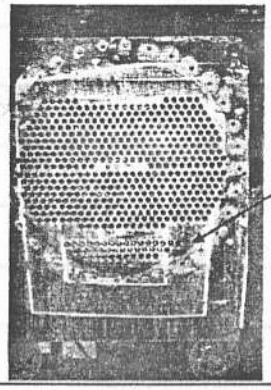
Condenser Subcooler



- Separate Circuit
- # Tubes Based On Tonnage
- Water Passes Through Subcooler Circuit First
- 8° @ Full Load
- 2-3° F @ Min. Load

9

RTHC



Condenser Subcooler

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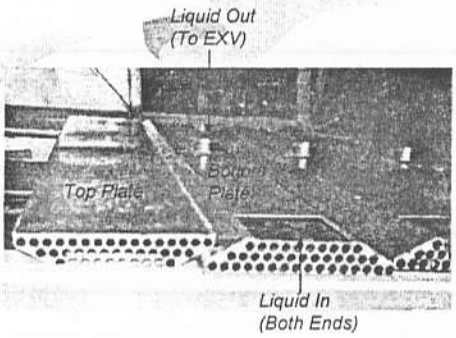
RTHC

Condenser Subcooler



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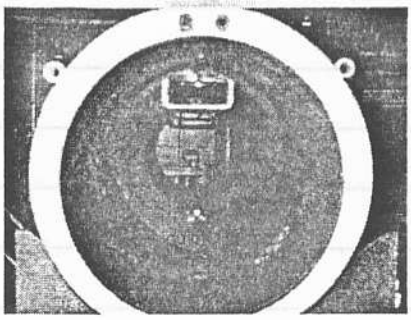
Condenser Subcooler



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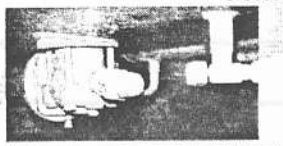
REFRIGERATION CYCLE
Condenser



- Liquid Out
- Flanged Standard
- Optional Isolation Valve Kit
  - 2 Butterfly Valves
  - 1 Angle Valve
  - 1 Liquid Line
  - 2 Discharge Lines
  - 2 Relief Valves

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RTHC

ARI Full Load Conditions

- Entering Condenser Water 85°F
- 3 GPM/Actual Ton
- Evaporator Delta T 44-54°F

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RTHC

Operating Conditions At Full Load

- Evaporator Pressure 40 - 55 psig
- Condensing Pressure 85 - 120 psig
- Discharge Superheat 17°F
- Subcooling 6 - 8°F
- Condenser Approach 0°F
- Evaporator Approach ~2°F
- EXV Percent Open 40 - 50% Open
- Slide Valve Fully Extended

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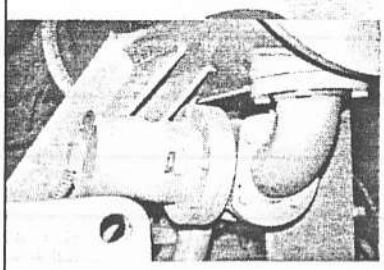
EXV



- Feeds LVS
- Positioned by D.C. Voltage from Evaporator Float Valve
- Alco Valve with Superior Actuator
- Max Drive Frequency is 200/steps/second
- 24VDC

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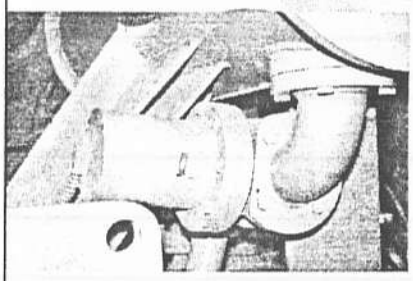
RTHC

REFRIGERATION CYCLE

TWO SIZES OF EXV



- LARGE EXV = 2760 Steps to Full Stroke
- SMALL EXV = 2040 Steps to Full Stroke

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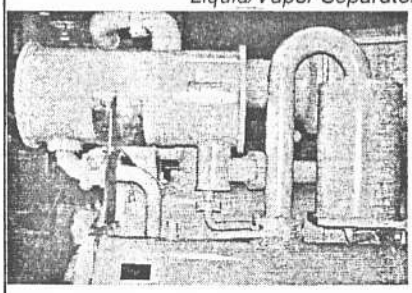
REFRIGERATION CYCLE

Liquid/Vapor Separator



- Liquid/Vapor mix enters Separator from EXV
- Vapor Vented back to Suction Line
- Liquid Temperature is Approximately Suction Temp
- Similar to RTHB Economizer

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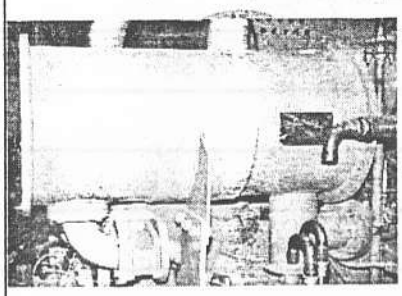
Liquid/Vapor Separator



- *Entering Refrigerant is ~17% vapor and 83% Liquid*
- *Overflow pipe extends 3 1/2" above bottom of tank*

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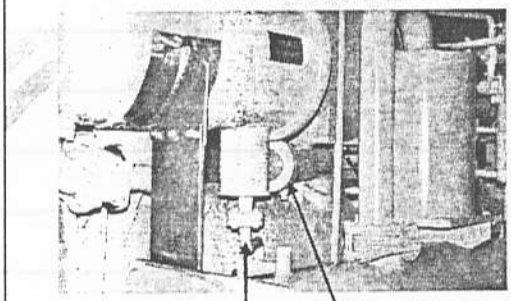
Refrigeration Cycle

LVS Liquid Outlets



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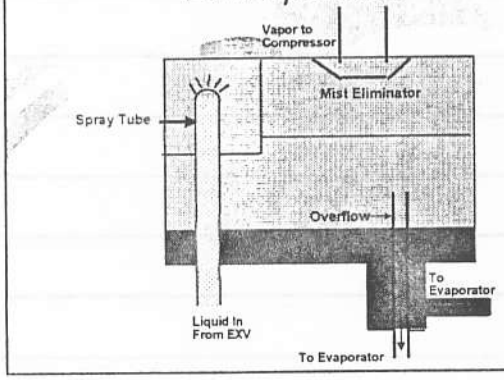
LVS Operation



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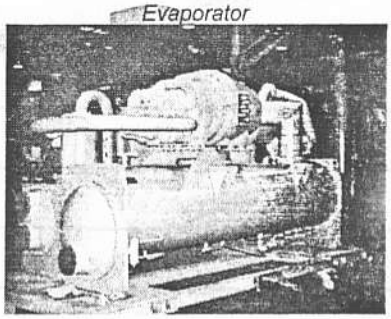
REFRIGERATION CYCLE

Evaporator



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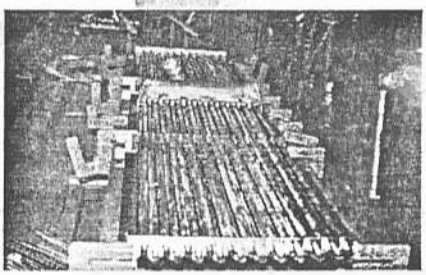
RTHC

Liquid Distributor



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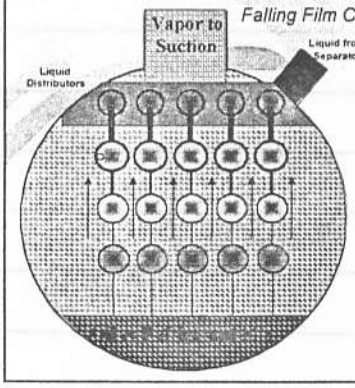
RTHC

Falling Film Concept



- Liquid Refrigerant Flows Around Outer Perimeter of Tube
- Vapor Returns Through the Area Between the Rows
- Excess Liquid Pools @ Bottom of Evaporator
- Advantages:
  - Requires Less Refrigerant
  - Better Heat Transfer w/ 134a
  - Trane owns the Patent

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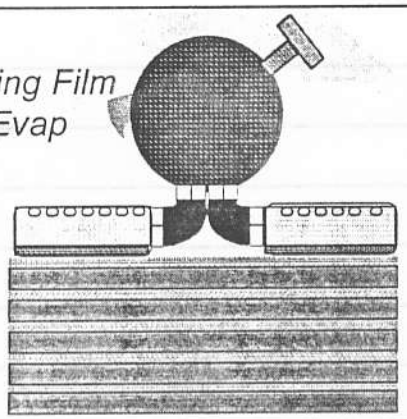
RTHC

Falling Film Evap



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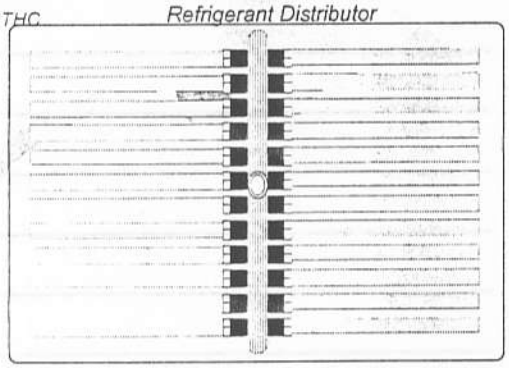
RTHC

Refrigerant Distributor



- Crosses the Upper Diameter of Evap.
- Distributes Liquid to Distributor

Connects to each Spray Tube
Spray Tubes Installed Longitudinally

26

RTHC

Liquid Distributor

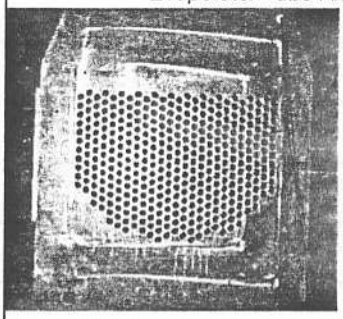
- Tube In a Tube
- Distributor Tube is Dimpled to Hold Spray Tube
- Numerous Small Diameter Holes

27

RTHC

REFRIGERATION CYCLE

Evaporator Tube Arrangement



- Vertical Columns
- Shorter Columns Will be Overfed to Ensure Proper Flow Over Higher Columns
- Nominal 1" Tube
- Externally Enhanced
- Held in Tube Supports with Clips

28

RTHC

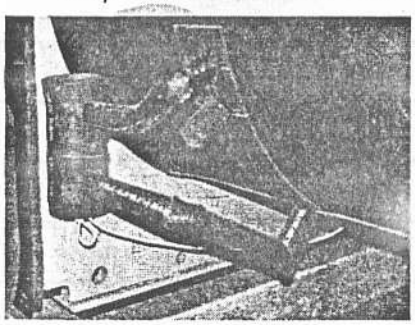
REFRIGERATION CYCLE
Evap Liquid Level Control

- Float Ball
- Reed Switches
- 3 Magnets 120° Apart
  - Makes/Breaks Switches as Level Varies
- Purpose: Control Liquid Level in Shell to 3 1/2" (Optimal) +/- 1.0"
- Outputs VDC to Control EXV Position
  - At 2 1/2" - EXV Driving Open (.6VDC)
  - At 3 1/2" - EXV is Controlling (2.5VDC)
  - At 4 1/2" - EXV Driving Closed (4.4VDC)
  - Read in Menus via CLD - (Setpoint = 0)
- Liquid Pool Will be Comprised of Approx 10% Oil and 90% Refngerant

29

RTHC

Evaporator
Liquid Level Float

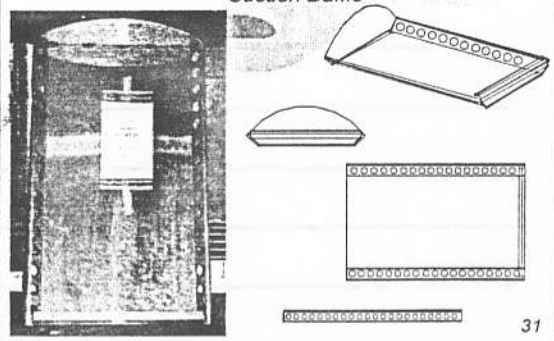


30

RTHC

REFRIGERATION CYCLE

Suction Baffle



31

RTHC

REFRIGERATION CYCLE

Logging

- Discharge Superheat
  - 17-22°F
- Subcooling

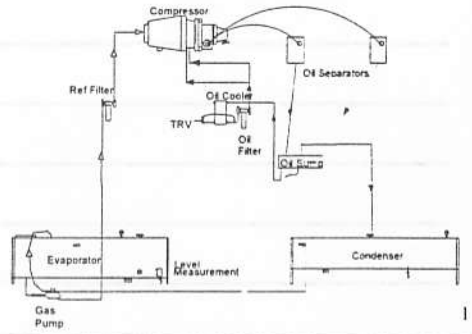
	Full Load	Part Load
– Efficient	9-10°F	2 - 3°F
– High Efficient	8 - 9°F	2 - 3°F
– Premium Eff.	7 - 8°F	2 - 3°F

- Condenser Approach = < 2°F
- Evaporator Delta T =Varies But Typically ~10°F
- Water Flow Rates
- Evaporator Approach = ~2°F
- Evaporator Superheat = None

32

RTHC

Compressor Oil Circuit



1

RTHC

OIL SYSTEM
Polyolester Oil Characteristics

- Trane Oil# 48
- Very Hygroscopic
- Acceptable Moisture Content
  - Less Than 300 PPM
- Acceptable Acid Level
  - Less Than .5 TAN
- Reacts With Water To Produce Weak Acids
- Thermally More Stable Than Mineral Oil
- Refrigerant & Moisture Difficult To Remove Via Vacuum
- Relieve Pressure Twice

2

RTHC

OIL SYSTEM
Polyolester Oil Handling

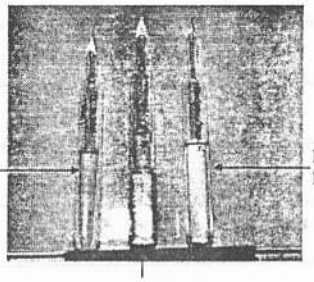
- Store In Tightly Closed **METAL** Containers
- Compressor Open to Atmosphere < 1 Hour
- **Do Not Use Filter/Driers**
- Obtaining Oil Samples
  - Run Unit Fully Loaded
    - Hot Oil - Less Refrigerant
  - Use Glass Bottle
    - Fill to 80%
    - Relieve Pressure Twice

3

RTHC

OIL SYSTEM

Polyolester Oil Characteristics

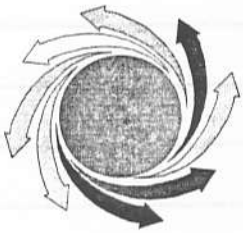


4

RTHC

OIL SYSTEM

Oil Separator



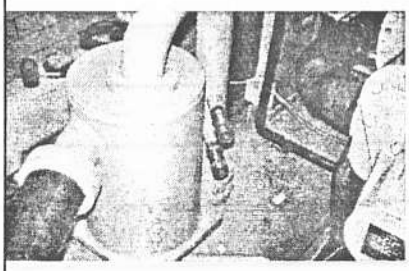
- Gas Must Make a 180* Turn to Exit
- Oil Liberated from Vapor in Turn
- 3 PSID in Separator
- 1 3/8" Oil Outlet @ bottom

5

RTHC

OIL SYSTEM

Oil Separator

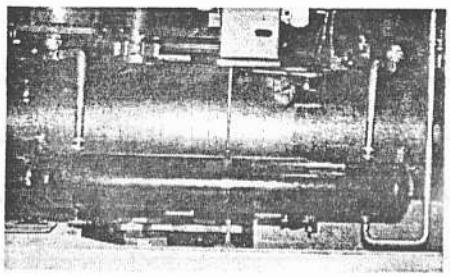


- Dual Separators
  - Large Tonnages
- Single Separator
  - Small Tonnages
- 99.9% Efficient
- Inlet Offset from Centerline
- Gas Outlet at top of Cylinder
- Oil Outlet at Bottom

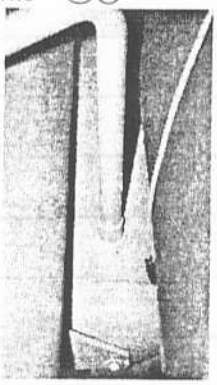
6

RTHC

OIL SYSTEM
Oil Sump



RTHC

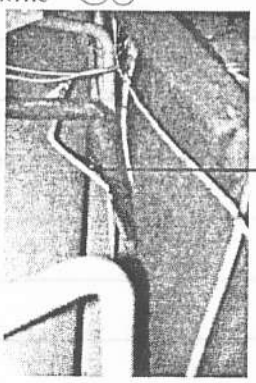


OIL SYSTEM
Oil Sump

- Located Below & Between Shells
- Receives Oil from Separators
- Has Heater(s)
- Oil Drain Valve
- 2 Different Size Tanks
  - PE - 11 gal
  - HE - 10.6 gal
  - EFF - 6 gal
- Vented to Condenser to Prevent Vapor Lock

8

RTHC



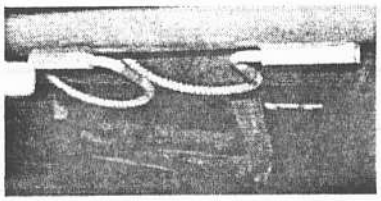
OIL SYSTEM
Oil Sump

- Sump Vent

9

RTHC

OIL SYSTEM
Oil Sump

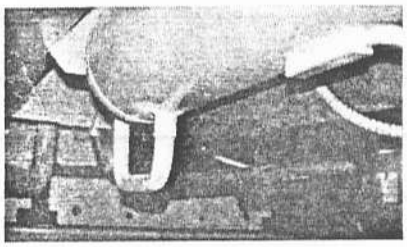


- Oil Sump Heaters
- Energized Continuously in Off Cycle

10

RTHC

OIL SYSTEM
Oil Sump

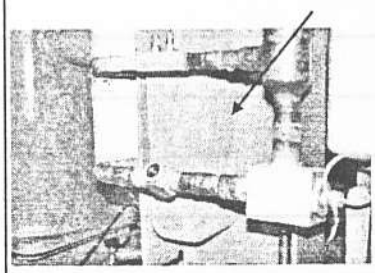


- Oil Outlet to Filter

11

RTHC

OIL SYSTEM
Oil Cooler

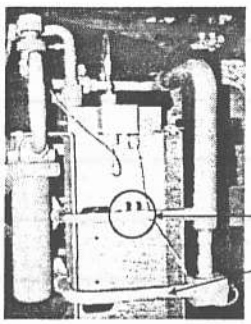


- 1 Size Fits All
- Used if Evap LWT < 40°F and/or if Condenser LWT > 100°F
  - Unless Ice Making with SP >20°F
- Brazed Plate Heat Exchanger

12

RTHC

OIL SYSTEM

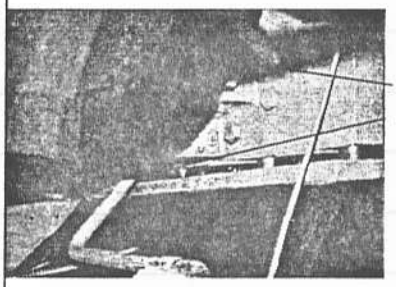


- To Bearings
  - Orifice
- To Rotors

16

RTHC

Oil System

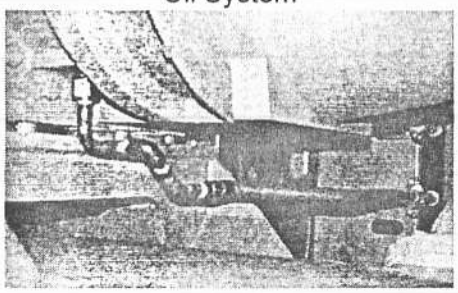


- Bearing Injection
- Rotor Injection

17

RTHC

Oil System



- Rotor Lube Feed

18

RTHC

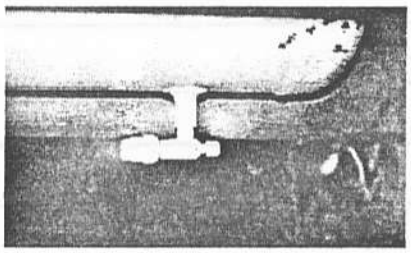
OIL SYSTEM
Level Check

- Run Fully Loaded for 20 Mins.
- Shut Down Machine for 10 Mins.
- Attach Hoses & Sight Glass
  - Sump Drain & Condenser
- 2"- 5" From Bottom of Oil Sump
- If > 8" - Excess Oil
- If < 2"
  - Not Enough Oil
  - Oil Logged in Evaporator
    - Check Gas Pump Operation

19

RTHC

OIL SYSTEM
Level Check

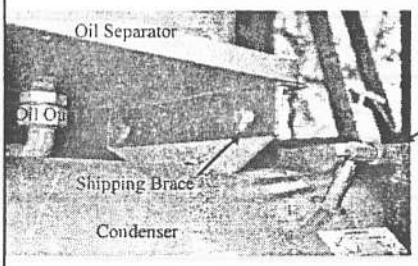


- Oil Hose Connection

20

RTHC

OIL SYSTEM
Level Check

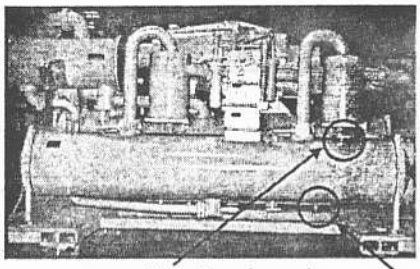


- Vapor Hose Connection

21

RTHC

OIL SYSTEM
Level Check

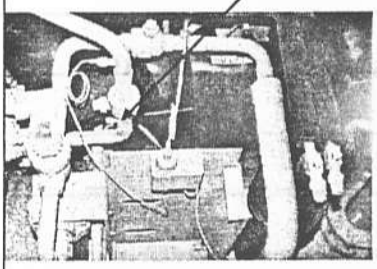


- Vapor Hose Connection
- Oil Hose Connection

22

RTHC

OIL SYSTEM
Oil Charging

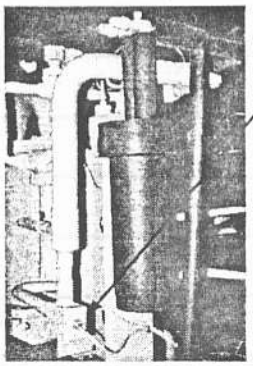


- Oil Charging Port
  - Between Service Valve & Filter (Or Oil Cooler)
- Fill Compressor Feed Lines First
  - Energize Oil Solenoid
  - Takes 2 Gallons
  - Monitor Oil Sensor Status via CLD until "Wet"
- Deenergize Oil Solenoid
  - Open Service Valve
  - Charge Oil Sump

23

RTHC

OIL SYSTEM
Flow Protection

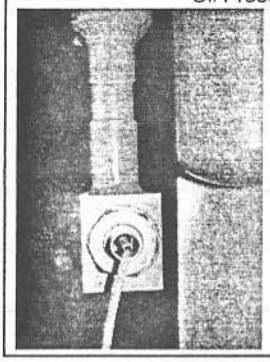


- Oil Presence Sensor
  - 24VDC
  - Rotor Injection
  - Proves Oil Before Startup
    - If Dry, Pump Oil From Sump to Line
  - Trip Time While Running = ~ 9 to 60 Seconds
  - Checkout Procedure????
  - 100% Oil= <1VDC
  - 100% Dry= 24VDC
  - 11.5VDC=Integrates to 23 VoltSeconds

24

RTHC

OIL SYSTEM
Oil Presence Sensor

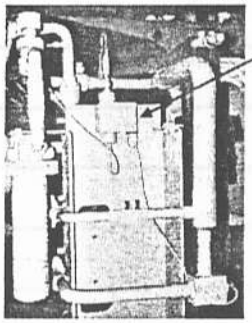


- Remove Snap Ring
- Remove Light
- Check Oil Presence Visually

25

RTHC

OIL SYSTEM
Flow Protection

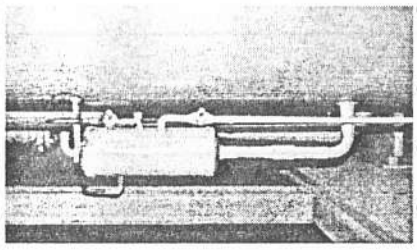


- Differential Pressure Switch
  - Monitors Filter, Check Valve, Master Oil Solenoid, Service Valves, Oil Cooler
  - 180 Seconds to Prove After Startup
  - Opens at 20 psid; 35 w/oil cooler

26

RTHC

OIL SYSTEM
Gas Pump

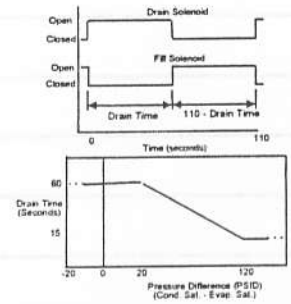


- Returns Oil From Evaporator To Compressor Suction
- Powered by Discharge Pressure
- Controlled by the Cycling of 2 Solenoids
- Discharges to Refrigerant Filter

27

RTHC

OIL SYSTEM
Gas Pump



- Cycles Every 1 Minute 50 Seconds
- Fill Time Varies Between 50-95 Seconds Depending on Condenser/Evaporator PSID

28

RTHC

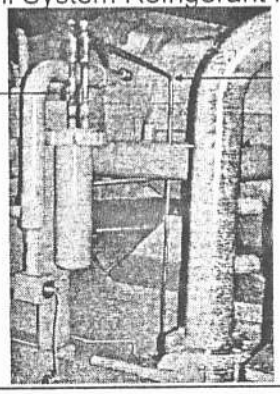
OIL SYSTEM
Gas Pump

- Fill Vent To Evaporator
  - From Gas Pump
- Drain Pressure From Condenser
  - To Gas Pump

29

RTHC

Oil System Refrigerant Filter



To Compressor

From Pump

30

RTHC

OIL SYSTEM
Gas Pump Troubleshooting

- Monitor Pressure With Machine Running
  - Use Gauge on Angle Valve on Refrigerant Filter
- Monitor Cycling Time of Solenoids
- With Machine Off
  - Cycle Solenoids Using Service Test Mode

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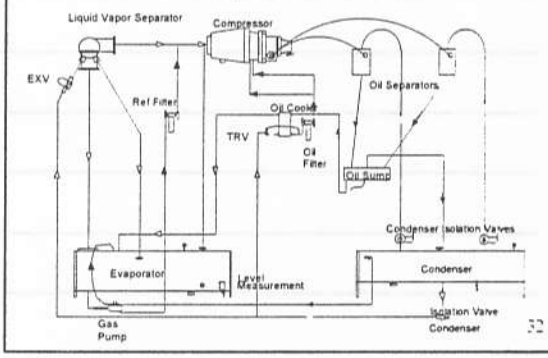
RTHC

Refrigerant/Oil Circuits



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