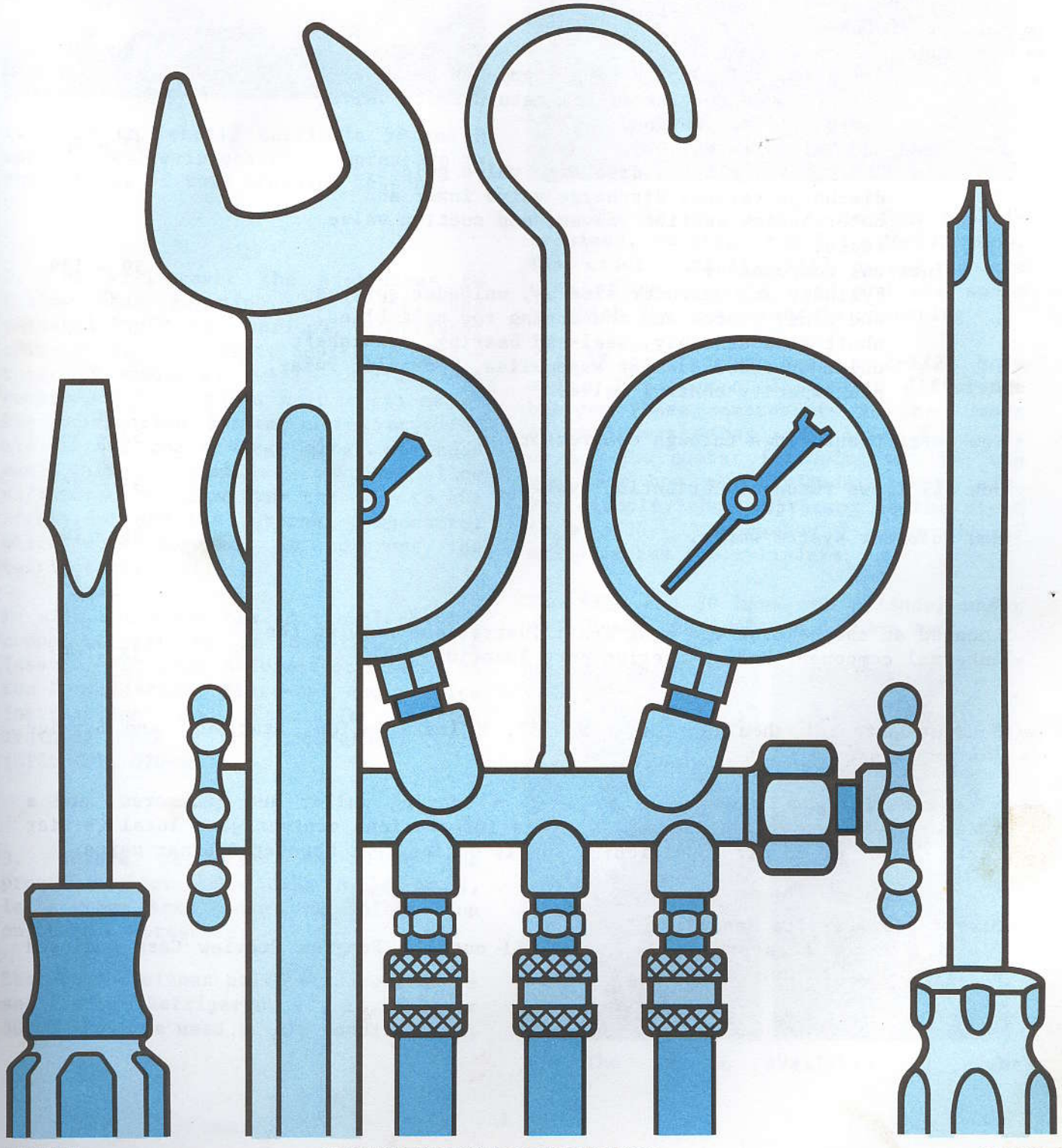
SERVICE TRAINING

Carrier®

REBUILDING 5F & H COMPRESSORS



5F AND H LESSON GUIDE

This training lesson is intended to give the service person the background necessary to identify each compressor component and determine the proper procedure for servicing them.

In this lesson we will cover:

SUBJECT	SLIDES
Background Information (5F and H)	1 - 8
Service Procedures -	
Lubrication System; oil pump, oil pump bushing, pump-end bearing, oil pressure regulator, oil return check valve, and oil filter screen.	9 - 36
Head and Valve Assemblies; heads, valveplates, discharge valve guides, discharge valves, discharge valve inner and outer seats, suction valves, and suction valve seats.	37 - 58
Internal Components; cylinder and unloader sleeves, unloader springs and pins, piston and connecting rod assemblies, shaft seal assembly, seal-end bearing, crankshaft, unloader power element assemblies, hydraulic relay, and capacity control valve.	59 - 139
How refrigerant flows through compressor.	52 - 56
How oil flows through lubrication system.	91 - 96
How unloader system works.	98 - 104
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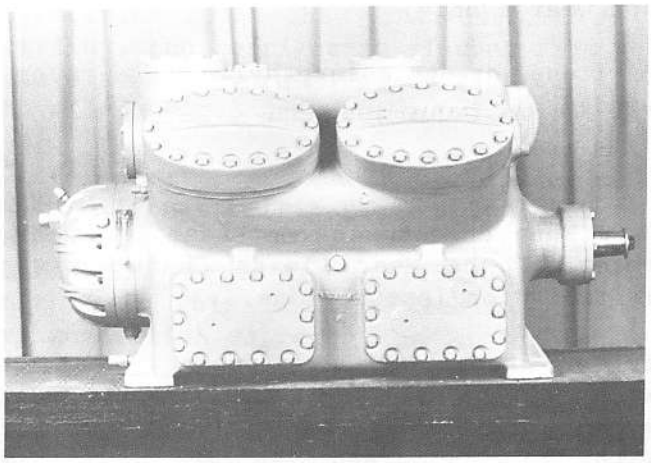
Located at the back of the book are illustrations showing the external component and connection port locations.	38 - 46

Handout material should include the 5F, H Installation, Start-up, and Service Instructions.

When rebuilding a 5F or H compressor, a bearing puller and jackscrew, and a sleeve puller are recommended. For more information, contact your local Carrier Parts Center or an air conditioning supply outlet that handles Robinar parts.

Distributor Service Managers:
Please preview this program. Then, fill out the Program Preview Card enclosed and return it to us.



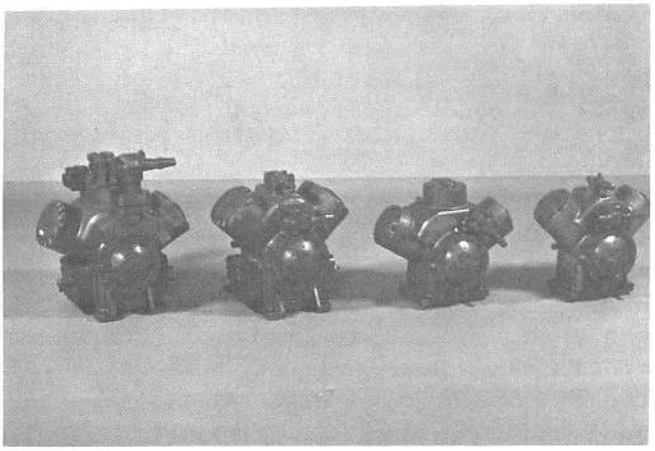
1. How to rebuild Carrier's 5F and H open-drive, reciprocating compressors is the subject of this training lesson.

2. We will cover the procedures to follow when removing, servicing, and reinstalling the various compressor components. To make it easier to follow these procedures, we'll divide the compressor into three main sections -- the lubrication system, which supplies oil to all the moving parts; the head and valve assemblies, which allow refrigerant to flow from the low- to the high-side; and the internal components, which work together to compress the refrigerant.

We will not cover how to troubleshoot a component failure in detail in this lesson. For this information, refer to the Installation, Start-up, and Service Instructions and Carrier's Service Training book - Why Compressors Fail (GTC2-101, 020-342).

3. Before we start to cover the procedures for rebuilding a 5F or H, let's cover some background information on these compressors.

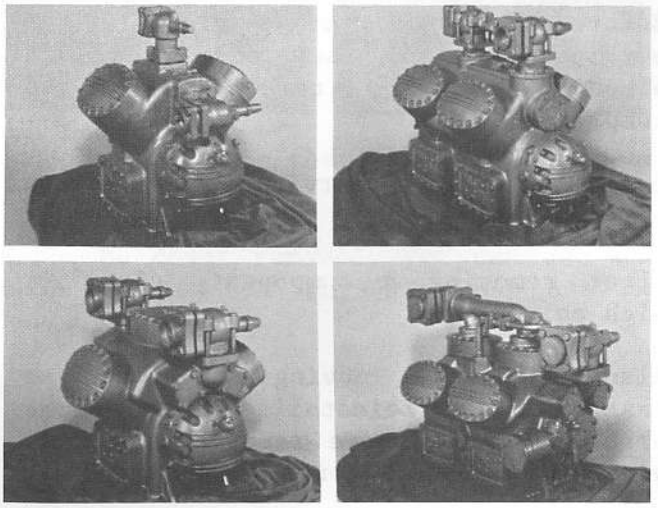
They can be either belt- or direct-drive and can use Refrigerant 12, 22, 500, or 502. They are used in air conditioning, refrigeration, and process cooling applications.



4. The 5F is available in four capacity sizes, ranging from 5 to 26-1/2 tons. The exact capacity will depend on the type of refrigerant used and the speed at which the compressor is operating.

All 5F compressors have a 2-1/2" bore and a 2" stroke. The basic difference between these compressors is the number of cylinders; they will have: 2, 3, 4, or 6. The number following the 5F lets you know how many cylinders there are. For example, the compressor at the right is a 5F20. The number 2 after the 5F means it has two cylinders.

The 5F20 and 30 have one cylinder under each head; the 5F40 and 60 have two.



5. The 5H is available in eight

capacity sizes, ranging from 25 to 150 tons. These compressors will have 4, 6, 8, or 12 cylinders.

All 5H compressors have a 3-1/4" bore, with either a 2-3/4" standard stroke or a 3-7/16" extended stroke. The compressors with the extended stroke have a higher capacity rating than the standard stroke compressor with the same number of cylinders.

Like the 5F, the number after the 5H represents the number of cylinders. All 5H compressors have two cylinders under each head. To determine if the compressor has a standard or an extended stroke, check the last digit of the model number. For example, if it's a 5H40, the zero means it has the standard stroke; if it's a 5H46, the six means it's the extended stroke.

6. Now, let's cover the procedures to follow when checking out and servicing a 5F or H compressor. We'll be using a 5H80 with a standard stroke. The service procedures for the other compressors are basically the same. However, some of the component locations are different; for complete details, refer to the Installation, Start-up, and Service Instructions.

Keep the following points in mind when servicing:

Before opening the compressor for service, close the service valves, and bleed the charge remaining in the compressor.

Drain the oil, if servicing in the area of the crankcase.

After removing a component, clean it with solvent.*

Also, label all moving components so that they are reinstalled in the same place that they were removed from. If you mix the components, they may not have the same wear pattern and they will not wear evenly.

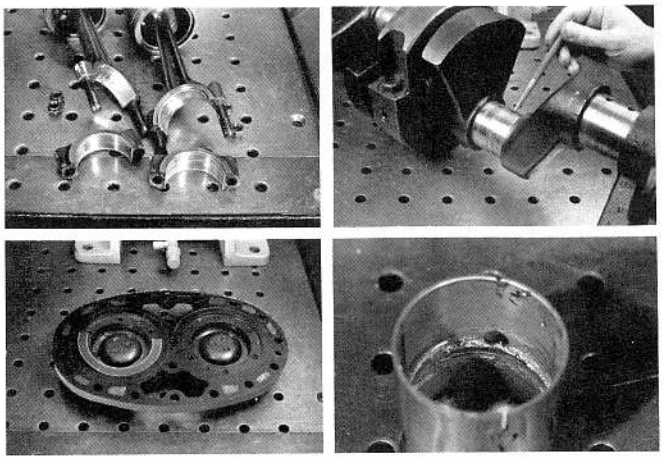
*Agitene or trichlorethylene is recommended.

7. When checking a component for wear, refer to the Wear Limits Chart in the Installation Instructions.

Before installing a component, coat it with compressor oil and inspect all gasket surfaces. Replace all gaskets with new ones, and lightly coat them with oil. Factory-made gaskets are recommended.

Tighten all bolts to the torque values in the Installation Instructions.

And, when you're done servicing, refill the crankcase if the oil was removed.



8. The compressor we'll be using in this lesson isn't new. It was returned as a field failure. As we tear down the compressor, you'll notice some of the parts are worn or damaged.

Here we can see (starting at the top left, going clockwise) wear on the connecting rod bearings and the crankshaft journals, and damage to the seal-end bearing and a suction valve.

Most of the wear or damage was due to flooded starts. This is when the

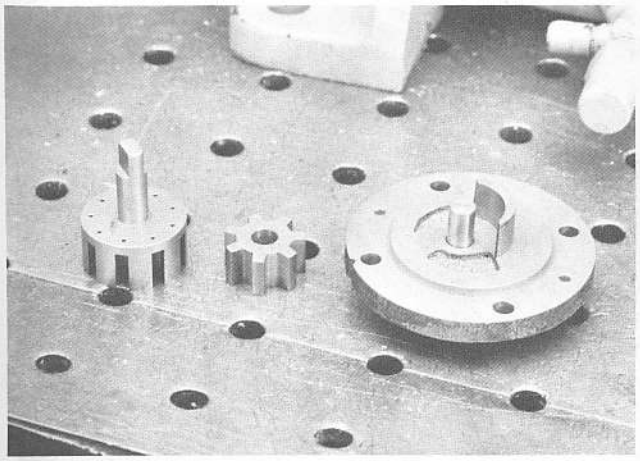
compressor starts with liquid refrigerant in the crankcase. At start-up, the refrigerant flashes from a liquid to a gas, causing restrictions in the oil passages and poor lubrication.

Flooded starts can also cause a slug of oil and liquid refrigerant, which cannot be compressed, to enter a cylinder causing damage to the compressor components. In this case it resulted in a broken suction valve.

So, when you're rebuilding a compressor, find out what caused it to fail and correct the problem. If you don't, you can count on another failure.

Because this compressor is not going back into the field again until it goes to a rebuild station, we'll be reinstalling some of the old components.

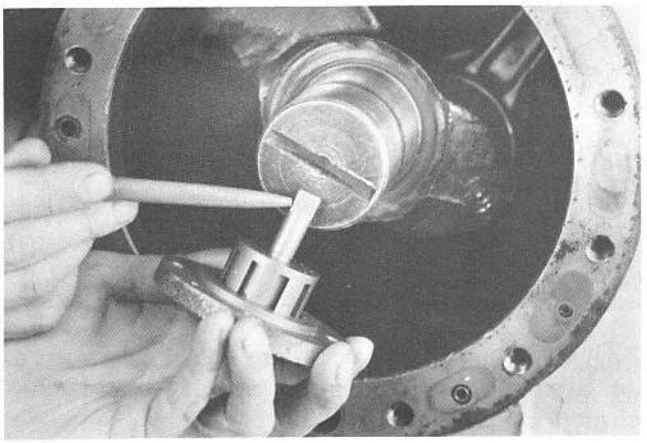
If this was an actual rebuild job, you would not normally reuse these parts. Also, some of the old gaskets will not be removed or be completely scraped off.



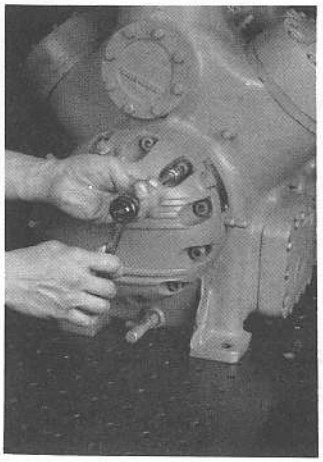
9. Now, before we start with the service procedure for the lubrication system, let's take a look at the oil pump.

It's a rotary type and (starting from the left) it consists of a rotor, an idler, and a cover.

This pump works with an oil pressure regulator, which we'll see later, to provide positive pressure lubrication.

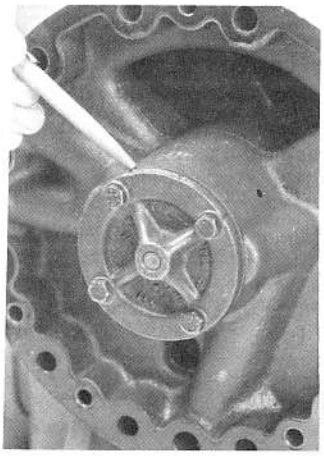


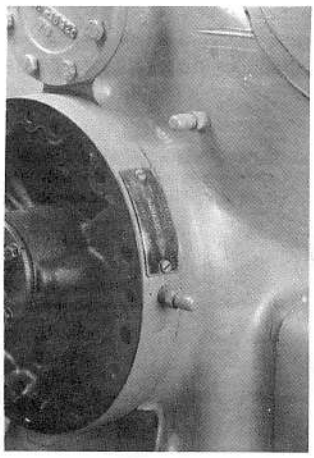
10. Notice the tang on the rotor. It fits into a slot at the end of the crankshaft. This is how the pump is driven. If this tang is broken, the pump will not operate and the complete pump assembly will have to be replaced.



11. To get to the pump, remove the pump-end cover.

With the cover removed, you can see the pump located on the pump-end bearing head.



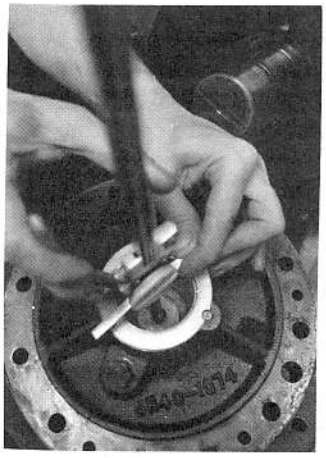


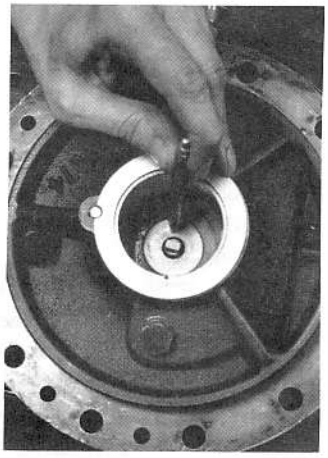
12. On the oil pump cover, there are two arrows -- one is at the top and the other is at the bottom.

The arrow at the top must be pointing in the same direction that the motor rotates. If it isn't, the pump will not work. You'll have to rotate the pump cover 180°; it's a manually-reversible pump.* Depending on how old the pump is, the arrows may not be exactly at the top or bottom.

On some compressors, like the 5H80, there's also a directional tag on the bearing head. It should also be turned to match the direction of rotation of the pump. This way the next mechanic that works on the compressor will know in what direction the pump is set up to rotate, without removing the pump-end cover.

*Beginning in 1986, the 5H120 and 126 will have a pump that will reverse automatically.



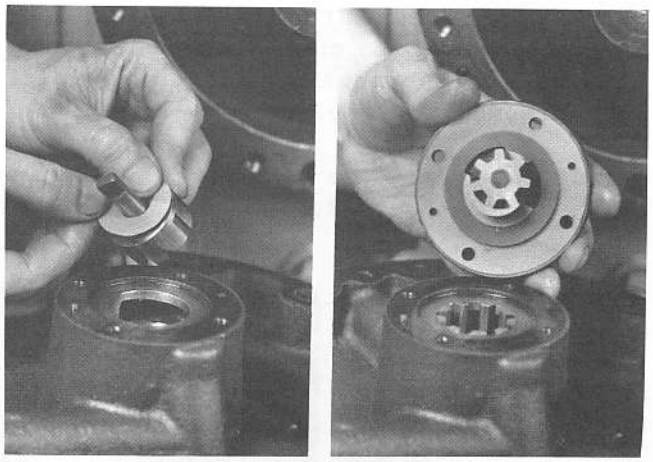


13. Now, let's see how to check out the lubrication system. We'll start by checking the oil pump rotor for excessive end play or binding.

To do this, remove the pump-end bearing head from the compressor.

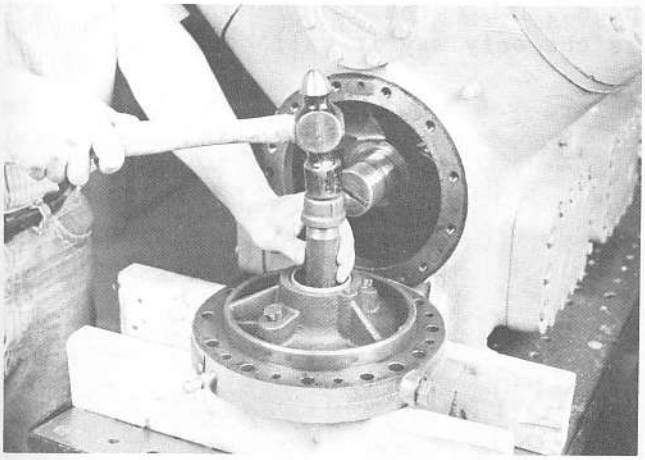
Reach into the bearing head with needle nose pliers and grip the tang on the rotor. Move the rotor up and down and use a depth gauge to check the movement. The maximum allowable is .0025 inches; you'll see why a little later. If there's too much clearance, you'll have to reposition the oil pump bushing.

14. To check for binding, turn the rotor. If there's more than a slight drag, you may have to replace the oil pump assembly or the bearing head. The oil pump assembly includes the bushing.



15. Let's see how to reposition the bushing first.

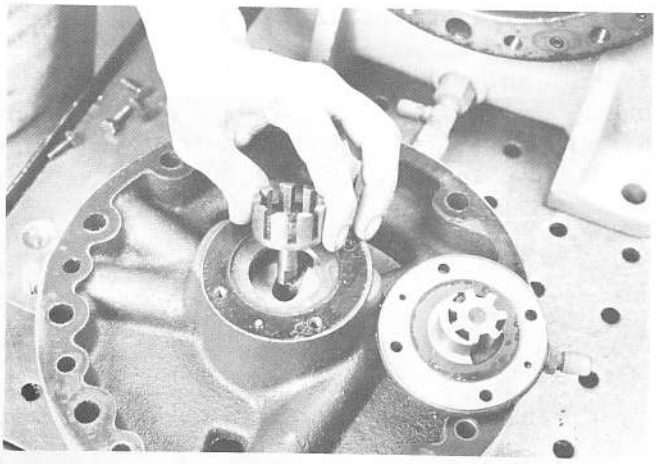
Remove the oil pump and place a .001" circular shim on the rotor. Reinstall the rotor first; then the idler and oil pump cover together. Don't forget to install the oil pump cover gasket. If you don't, you won't get the correct clearance.



16. Drive the bushing toward the oil pump rotor, using a 1-1/4" pipe capped at one end and a 20 ounce or heavier ball peen hammer.*

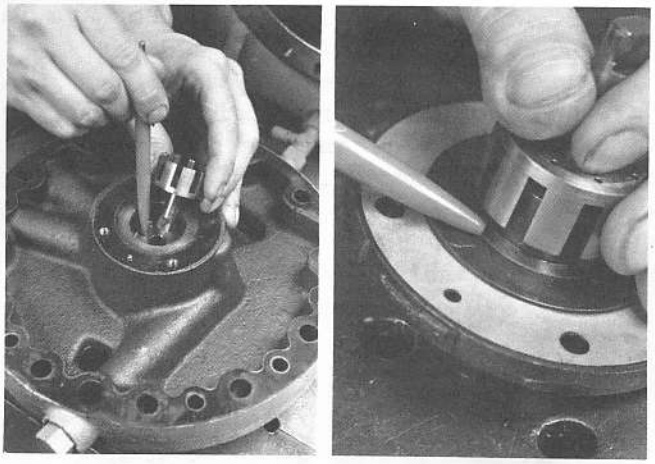
Although you can't see it here, a washer was brazed on the end of the pipe opposite the cap. This is to prevent the bushing from being damaged.

*A bearing press can also be used.



17. After repositioning the bushing, remove the pump and take out the shim that you placed on the rotor. Reinstall the pump and recheck the rotor end play.*

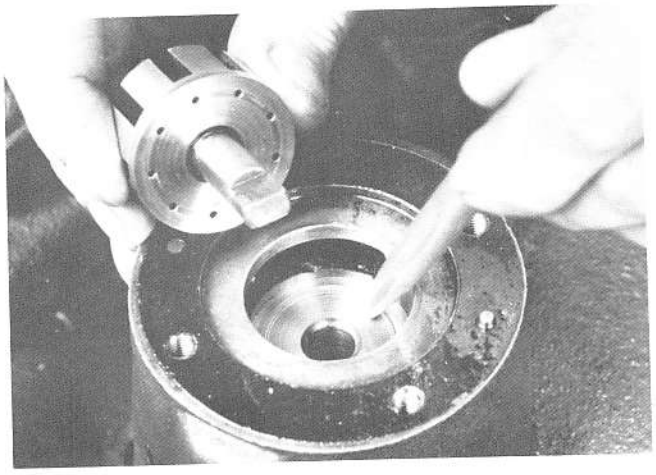
*Refer to the Wear Limits Chart in the Installation Instructions to determine the minimum and maximum tolerances for all compressor parts.



18. Although we placed the shim between the rotor and the bushing to set the clearance, the actual operating clearance will be between the rotor and oil pump cover.

Too much clearance here will cause some of the oil to slip around the rotor instead of being compressed and forced out the discharge side of the pump. This will reduce the oil pressure and

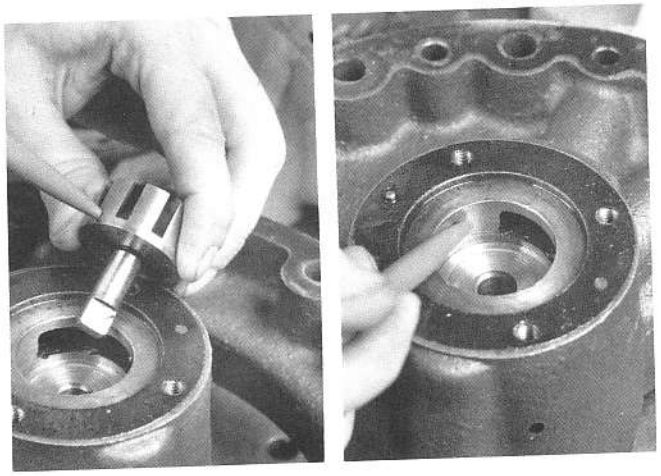
the amount of oil going to the parts that should be lubricated.



19. Now, here's how to determine if the oil pump and bushing, or the bearing head, should be replaced.

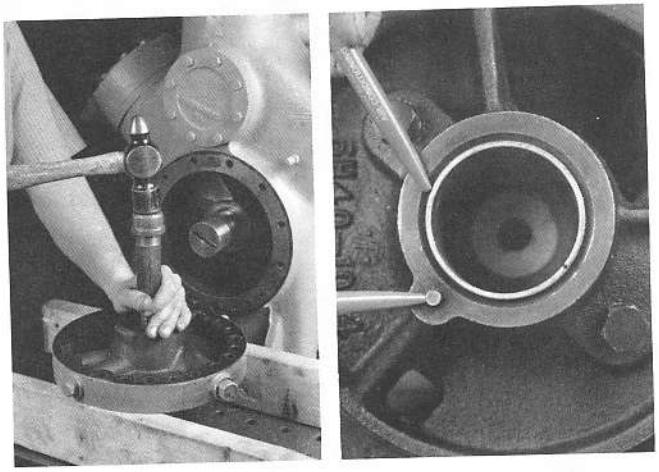
After removing the oil pump, check the bushing and oil pump rotor for scoring. This can include cuts, gouges, or burrs. Look at the surfaces shown here. These are the ones that are next to each other, when the bushing and rotor are in the pump head.

If the bushing or rotor is scored, you must replace the complete pump assembly, so that all the parts will wear evenly. In a minute, we'll see how to replace the bushing.



20. Another surface on the rotor that you should check for scoring is the one that rotates next to the bearing head. If the rotor is scored in this area, this will also require that the complete pump assembly be replaced.

You'll also have to replace the bearing head, if it's scored.

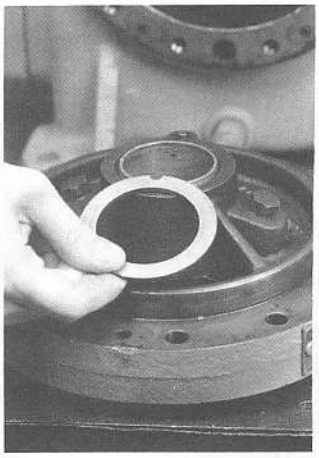


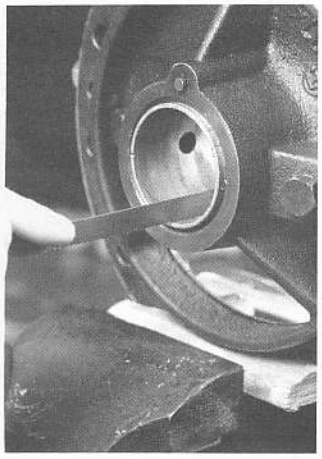
21. Now, here's how to replace the bushing. To remove it, you must drive it out toward the inside of the bearing head, using the pipe and hammer. This is the only way it will come out.

Before you start, place the head on two pieces of wood so that it's completely off the surface that you're working on. This is necessary so that you don't damage the end of the pump-end main bearing or the locating dowel.

22. Before installing the new bushing,

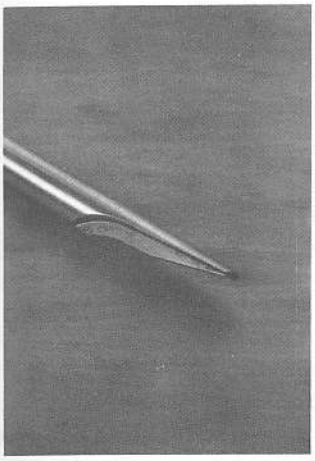
check the pump-end main bearing for wear or damage. Make sure it's within the tolerance specified in the Installation Instructions.

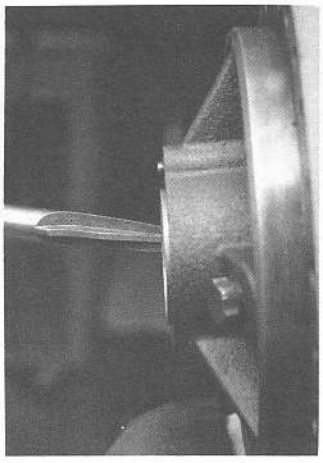




23. If the bearing is worn, remove the bronze bearing washer from the bearing head, if it's not already off.

Then, use a hacksaw blade and make at least three cuts in the bearing about an inch apart. To prevent damage to the bearing housing, DO NOT cut all the way through the bearing.



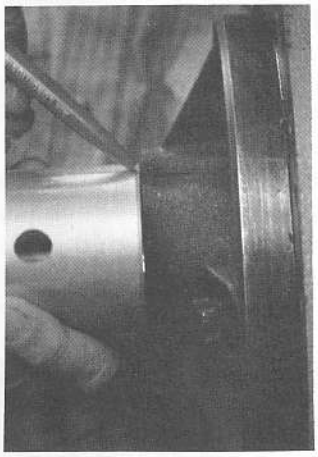


24. Next, use a tube collapsing tool* like the one shown here.

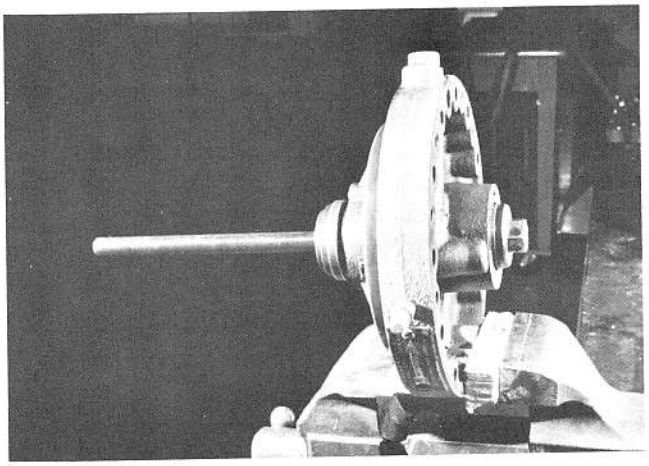
Hit it with a hammer to pry up the bearing between the cuts. Because the collapsing tool has a round surface, it's less likely to dig into the housing. Once the bearing is pried up, you can pull it out with vice grips.

After you've removed the bearing, check the housing for burrs. If there are any, use a 120 grade sanding cloth to remove the high spots, so that you'll be able to install the new bearing.

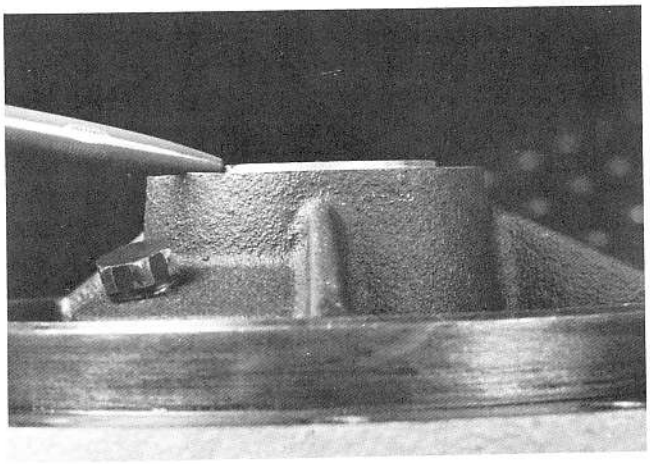
*Collapsing tools are available from Elliott through your Carrier Distributor.



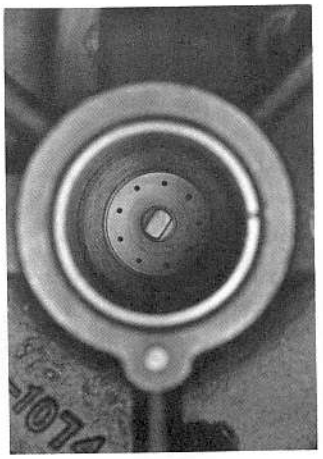
25. The bearing should be lubricated and then installed so that the end with the larger chamfer enters the housing first. Make sure the hole in the bearing lines up with the oil port in the housing. To do this, the oil groove in the bearing must be at the top. This groove helps to distribute the oil evenly around the journal.



26. Press the new bearing into place using a bearing puller shoulder and jackscrew. Keep in mind that if the oil pump bushing is in place, you won't be able to do it this way. You'll probably have to have a machine shop do it. They'll use a bearing press.



27. The bearing should be positioned so that it's 3/32 of an inch above the bearing head.



28. Now, install the oil pump assembly and then the new bushing.

The oil pump idler and rotor should be installed through the inside of the bearing head. Make sure they are seated on the pump cover. If you install them with the oil pump cover from the outside, they will probably fall through because the bushing isn't in place to stop them.

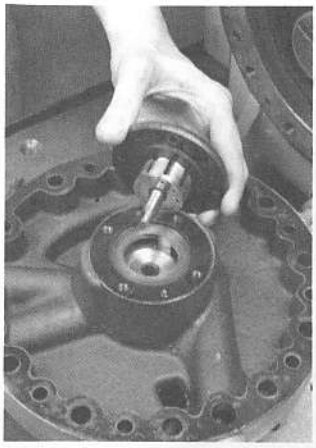
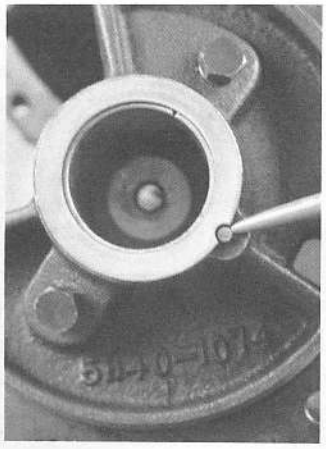
To install the new bushing, we'll need a shim like we used to reposition it. After placing the .001" shim on the rotor, install the bushing so the lead end is toward the pump.

The lead end can be identified by the machined lines.

When you're driving in the bushing, place the bearing head on two pieces of wood so that the oil pump cover isn't damaged.

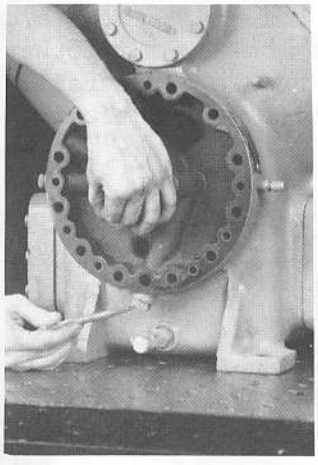
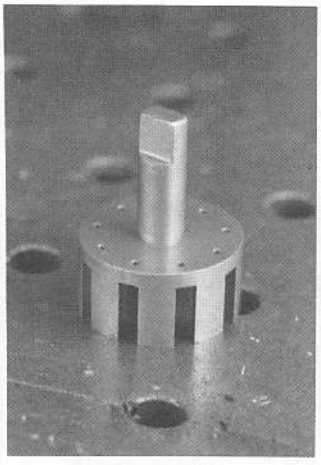
Once the bushing is in place, remove the shim.

After installing a new bushing or repositioning an old one, the next step is to install the bearing head.

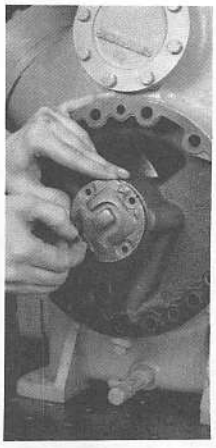
29. The easiest way to do this is to leave the oil pump assembly off; then do the following:

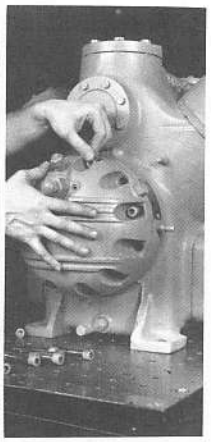
Put a coat of oil on the bronze washer and place it in position in the bearing head. The coat of oil will hold it in place. Make sure the notch in the washer is around the dowel key.

30. Install the bearing head so the magnetic oil plug is at the bottom. Then, insert the rotor so the tang fits into the slot at the end of the crankshaft.

If you try to install the bearing head with the oil pump assembly in place, it will take you more time to line up the tang; that's why we recommend installing the rotor separately.

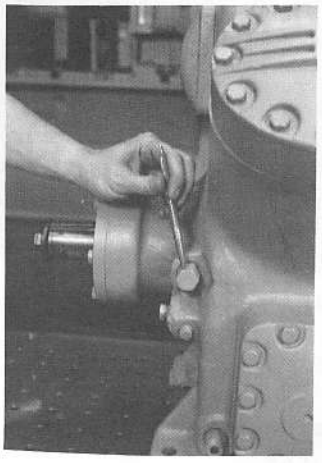
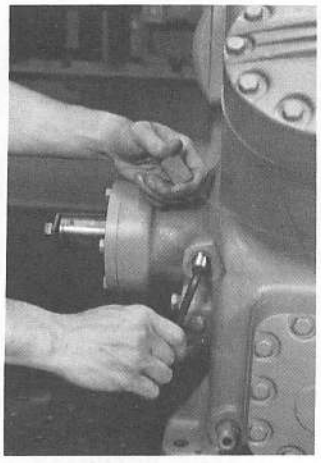




31. Install the idler and oil pump cover together.

Remember, there are two arrows on the pump cover. Make sure the correct arrow is near the top. It must be the one that matches the rotation of the motor, when looking at the motor from the shaft end.

After installing the oil pump cover, install the pump-end cover.

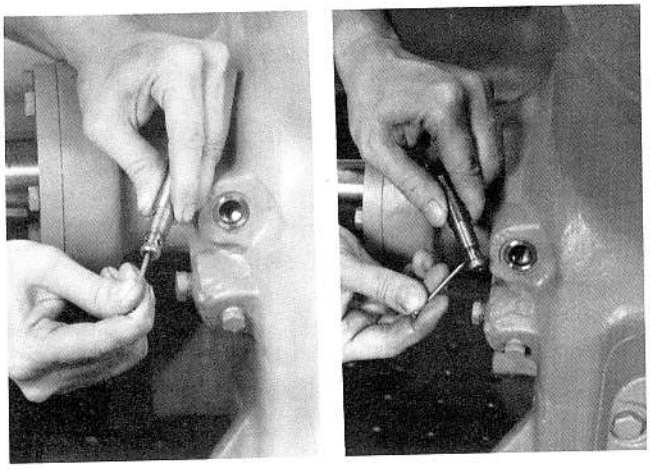
32. Now, let's check out the oil regulator.

It's located near the drive end (or seal end) of the compressor. On the 5H80, it's on the right-hand side when facing the drive end.

The regulator, which is not adjustable, maintains the oil pressure necessary to

lubricate the compressor and operate the unloader system.

To remove the regulator, first take off the cap. Then, use an allen wrench to unscrew it.



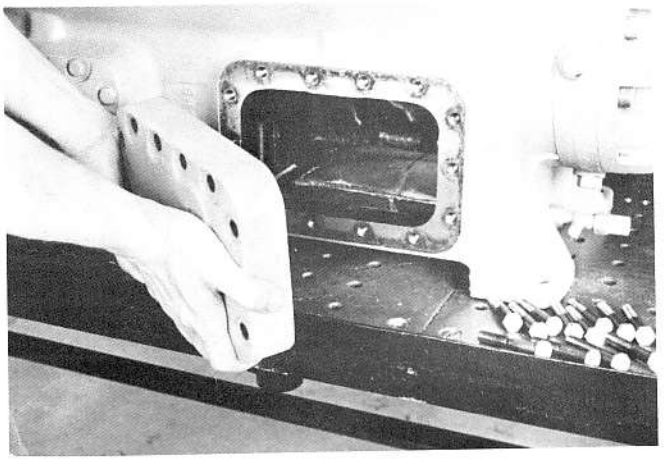
33. To make sure the regulator is working properly, there are two checks you should make:

One, check the plunger. To do this, push it with a nail; it should move freely. If it doesn't, replace the regulator.

Early 5F and H compressors were equipped with adjustable regulators. If you have to replace one of these, use the non-adjustable type shown here.

The second check is to make sure the ports in the regulator are clean.

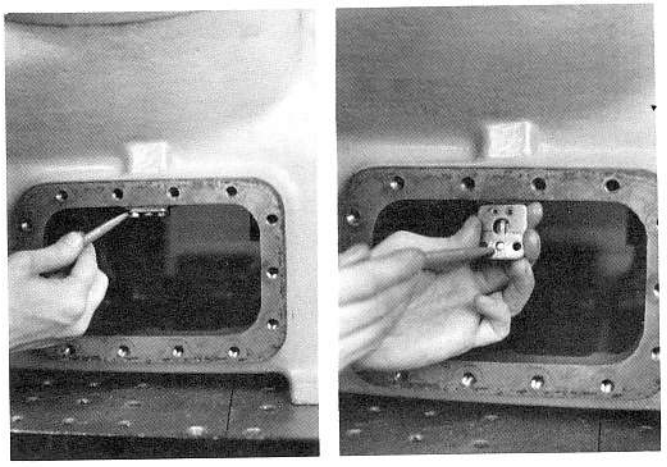
Later in this lesson, when we have the compressor apart, we'll see how the oil flows through the compressor and how the regulator actually works.



34. There are two more components in the lubrication system -- the oil return check valves and the oil filter screen.

To get to these components, remove the hand hole covers on both sides of the compressor.

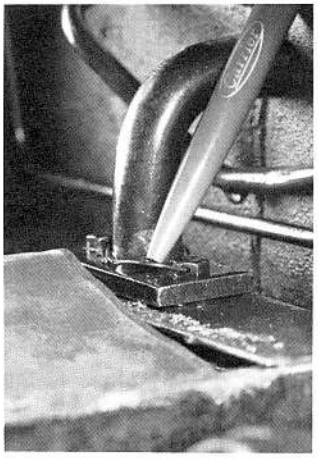
Remember, in this training lesson we are working on a 5H80. The components and the procedures for removing them are slightly different on some of the other compressors. For complete details, refer to the Installation Instructions.

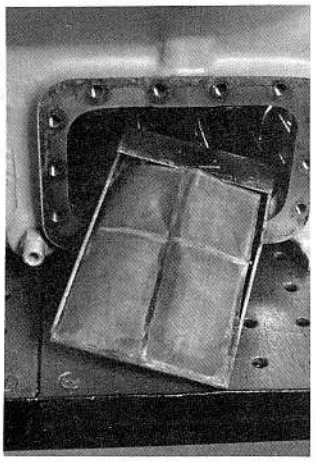


35. The 5H80 uses leaf-type check valves. They are located at the top center of the two hand hold cover openings, near the drive end of the compressor. These valves allow oil to return from the suction manifold to the crankcase. They are normally open. But

they will close if the crankcase pressure goes above the suction pressure, as is the case in a flooded start. The valves close to prevent oil from "blowing" out of the compressor sump.

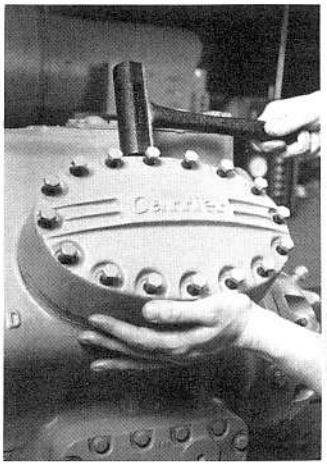
When checking these valves, remove them and make sure the leaf is moving freely and isn't damaged.





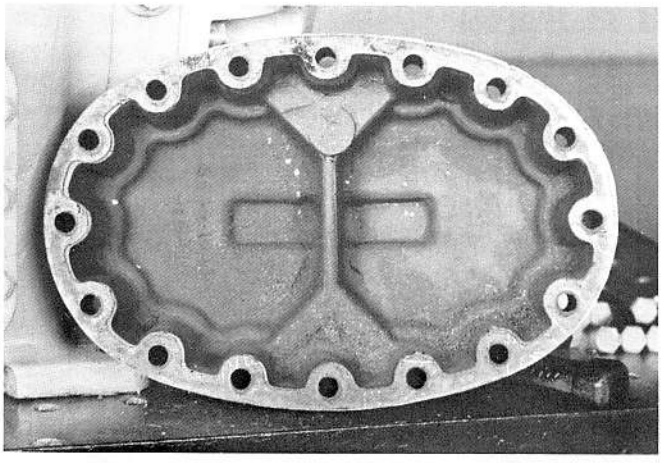
36. The oil filter screen is at the bottom of the crankcase. Notice the wire that runs between the two bolts that attach the screen to the oil pump pick-up tube. This wire prevents the bolts from loosening up.

To check the screen, you'll have to cut the wire before unbolting it. Inspect the screen for holes; if there are any, replace it. If the screen is dirty, clean it with solvent. After reinstalling the screen, insert a new piece of wire through the bolts.

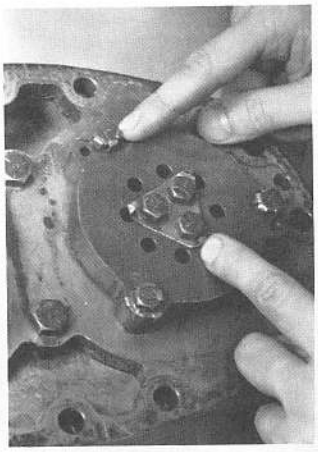


37. Next, let's check out a cylinder head and valve assembly.

After loosening the head bolts, tap the head with a dead blow or other soft-faced hammer to free it.



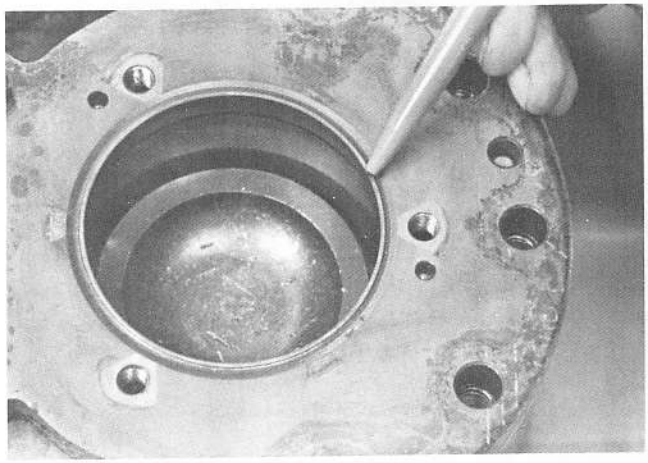
38. Check the head for warping, cracks, and damage to the gasket surfaces. If there is any, replace the head.



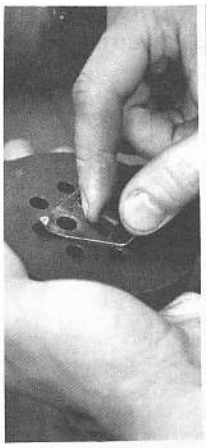
39. Now, loosen but don't remove the three capscrews in the center of the valve guide on the valveplate. These screws hold the discharge valve inner seat in place, which you can't see here.

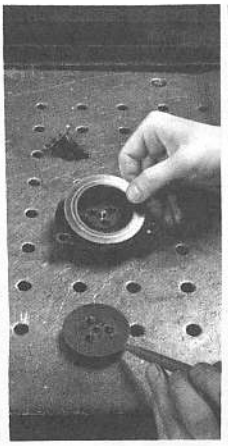
Remove the three screws from around the edge of the valve guide, which attaches it to the valveplate.

Notice the lockplate and lockwashers on the valve guide; they prevent the screws from vibrating loose.



40. After removing the valve guide, check the discharge valve outer seat (on the valveplate) for cracks or wear. If the seat is worn or cracked, replace the valveplate.



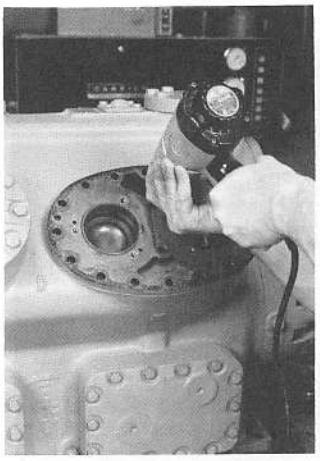


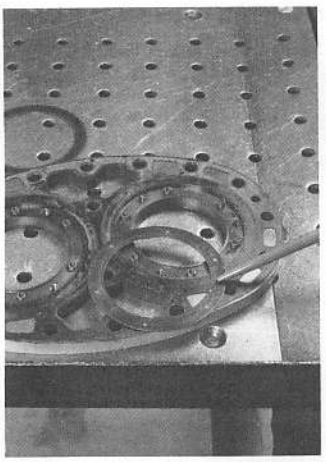
41. Next, remove the capscrews holding the discharge valve inner seat to the valve guide.

Check the inner seat and discharge valve for wear or damage and, if necessary, replace them.

Also, check the six discharge valve springs and spring holes in the guide. If the springs are damaged, replace them. If the holes are worn, replace the guide.

If the springs are the old style, replace them with new springs. The old style did not have the last coil larger than the rest of the spring. Under certain conditions, the springs could spin and cut a hole in the valve guide.





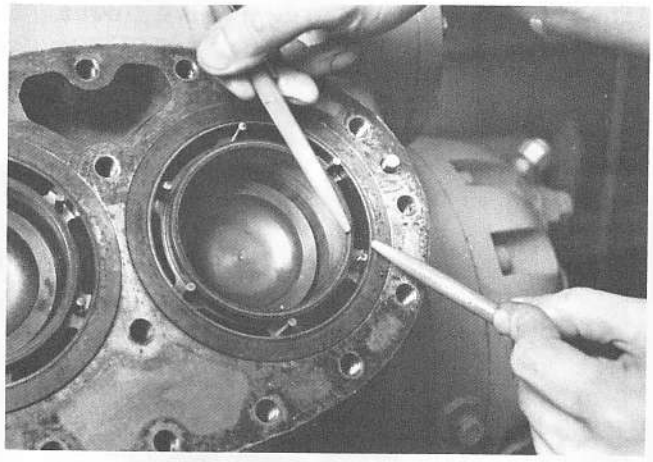
42. After checking the discharge valve

assemblies, remove the capscrews which hold the valveplate to the cylinder deck.

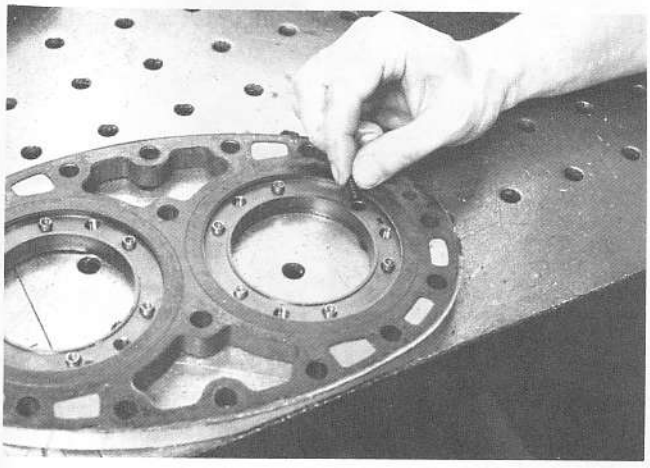
Check the valveplate and suction valves for cracking or excessive wear and, if necessary, replace them.

Notice there are six springs below each suction valve. Check these springs and holes also. If the holes are worn, replace the valveplate.

Like the discharge valve springs, if these springs are the old style, replace them.

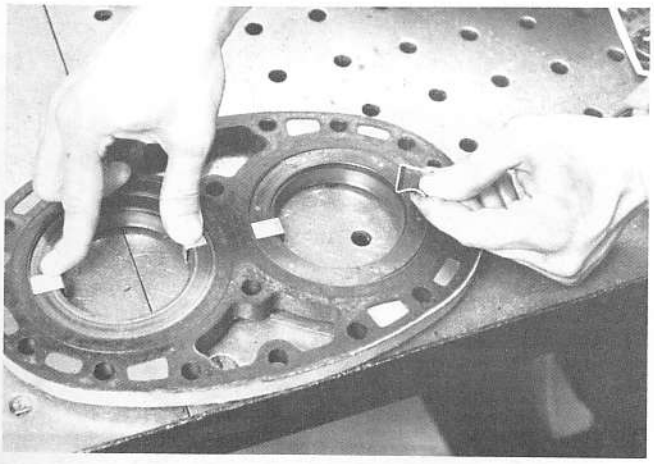


43. Also, look at the suction valve seats on the cylinder sleeves. If they are worn, replace the sleeve. We'll see how to do this later.



44. Now, let's reassemble the valveplate assembly.

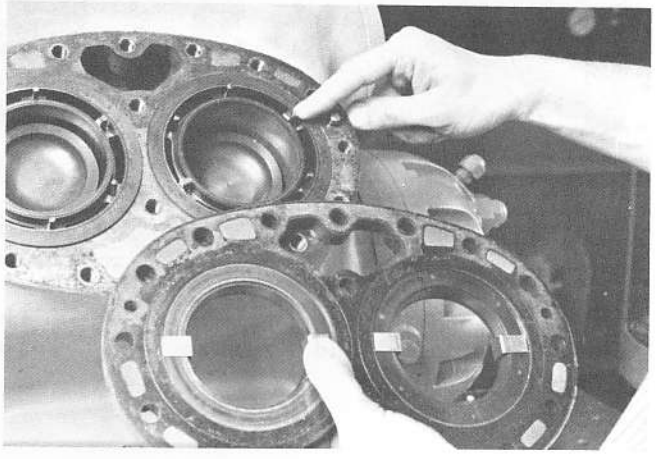
First, place the large end of the suction valve springs in full contact with the bottom of the holes in the valveplate recesses.



45. Then, place the suction valve on the valve springs and press it into the valveplate recess. You'll have to use two retainer clips for each suction valve to hold it in place. These clips are available from Carrier.*

To make it easier to remove the clips when you're done assembling the valveplate, install them so that the flat side is on the valve.

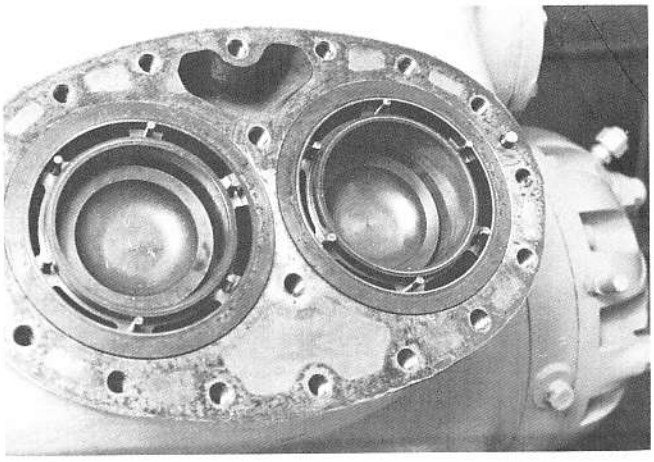
*These clips are part of most service replacement valveplate kits.



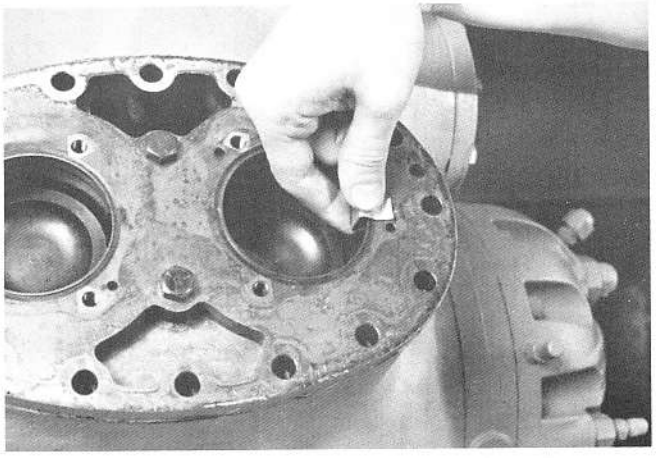
46. Locate the clips so they don't

cover the valve lifter pins when you install the valveplate. This will prevent the clips from getting caught between the suction valve and lifter pins.

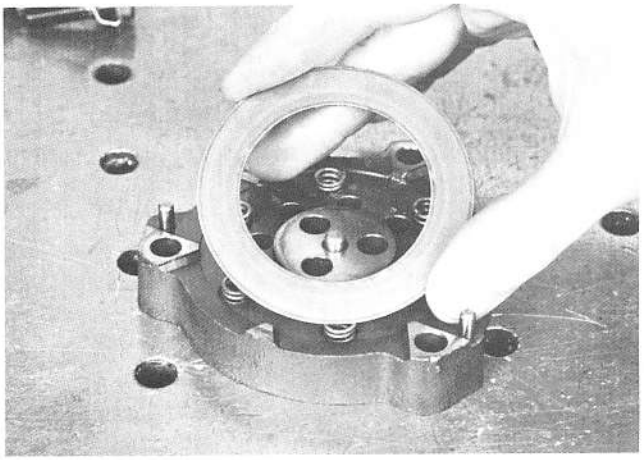
The valve lifter pins are part of the unloader, which we'll cover later.



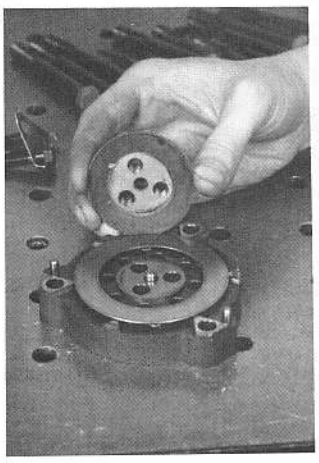
47. Also, make sure the pistons are below the cylinder sleeves before installing the valveplate. If they aren't, the valve clips will be caught between the valveplate and pistons and it may damage them.

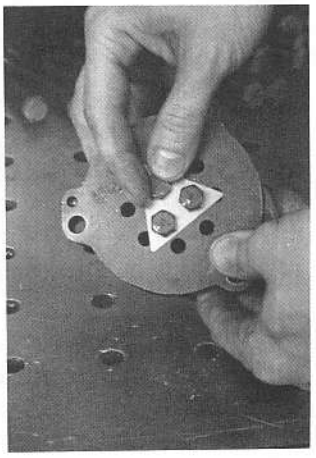


48. Now, bolt the valveplate to the cylinder deck and remove the valve clips.

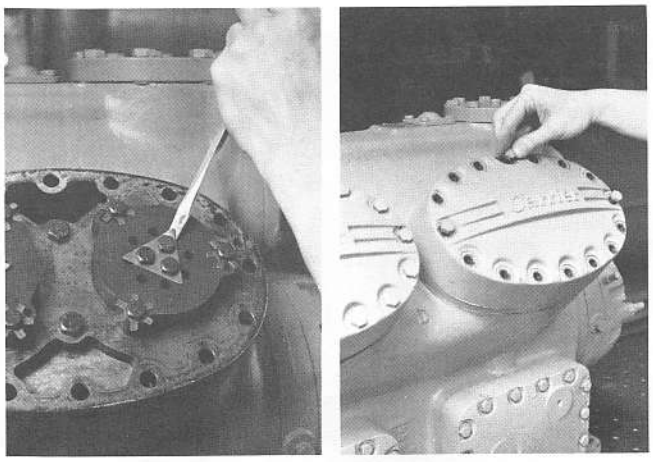


49. Next, place the discharge valve springs into the valve guide recess and install the discharge valve over the springs. Just like the suction valve springs, the large ends go in first.





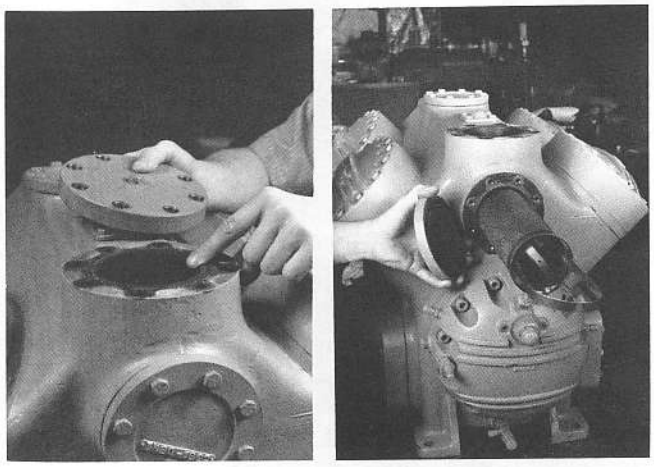
50. Place the inner seat over the discharge valve and hand tighten the capscrews holding the seat to the valve guide.



51. Place the valve guide assembly on the valveplate and tighten all bolts. Also, don't forget to bend the tabs on the lockplates and washers so the screws don't vibrate loose. Although the old lockplates and washers can be reused if the tabs don't break, new ones are recommended.

After installing the valve guides, replace the cylinder head.

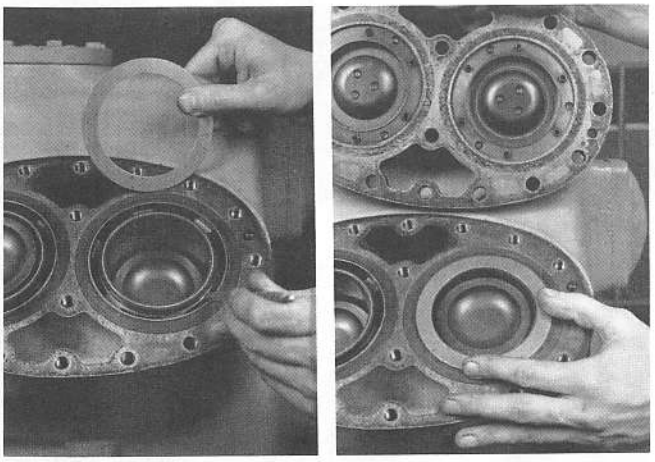
Now that we know the procedure for checking out and servicing the suction and discharge valve assemblies, let's see how the refrigerant flows through the compressor.



52. After the refrigerant enters the suction manifold, it flows through a suction strainer.

This strainer is located behind the suction manifold cover. If the strainer is dirty, clean it with solvent or replace it if it's broken or corroded.

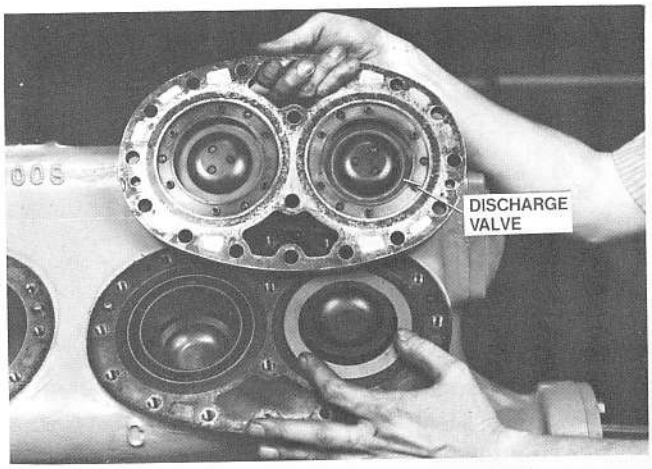
The strainer protects the compressor from metal chips, copper oxide scale, and other contaminants that may have entered the refrigerant piping when it was installed in the field.



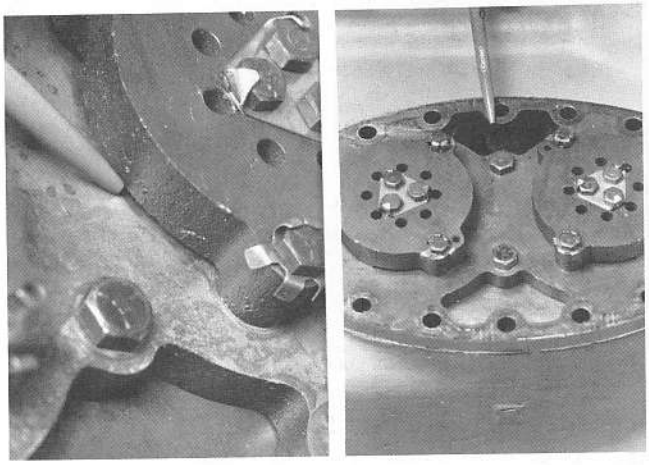
53. The refrigerant then flows through the suction passages in the compressor to the ports around the outer edge of the cylinder sleeves.

On the intake stroke, when the pressure in the cylinder drops below the suction pressure, the suction valve is pushed off its seat and refrigerant flows into the cylinder.

During the compression stroke, the combination of discharge pressure and the suction valve springs will seat the suction valve.

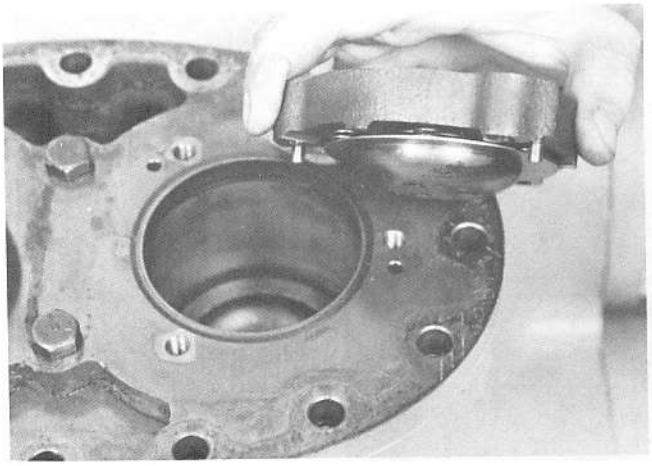


54. The pressure will continue to rise and when it is above the discharge pressure, the discharge valve will be pushed off its inner and outer seat.



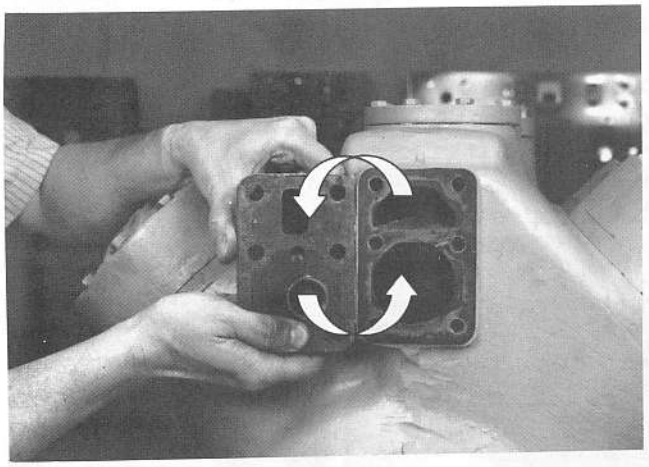
55. This allows the refrigerant to flow past the discharge valve and through the slots around the bottom of the valve guide, shown on the left.

From here it flows through the discharge passage, shown on the right, and out the discharge manifold into the system.



56. As the cylinder goes through another intake stroke, the cylinder pressure drops below the discharge pressure and the valve guide springs will seat the discharge valve.

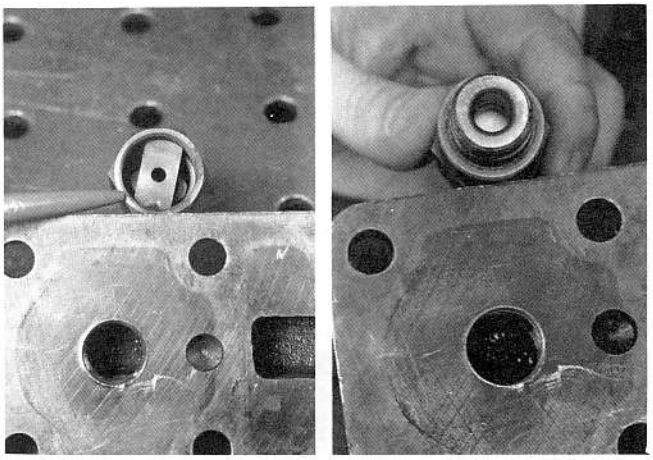
The process of opening and closing the valves will now repeat itself.



57. To prevent the possibility of an excessive pressure build-up in the system, the compressor has an internal pressure relief valve. It's located on the combination suction and discharge manifold cover.*

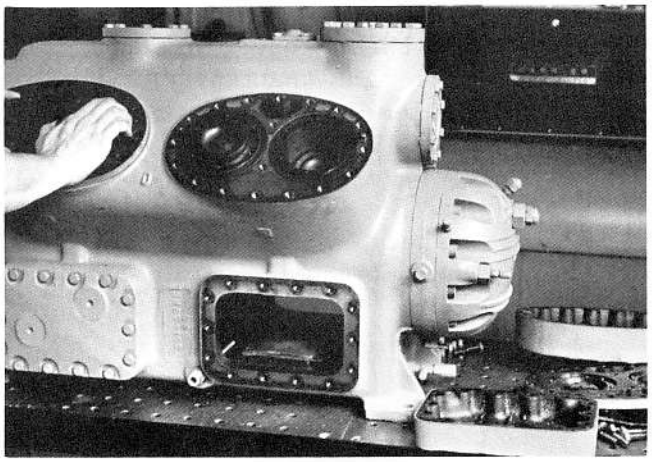
The relief valve allows the refrigerant in the compressor to vent from the high side back to the low side. It does that at a pressure differential of 350 ± 35 psi.

*The 5F60 and all 5H compressors have a pressure relief valve. 5F60 relief valve has a pressure differential of 400 ± 40 psi.



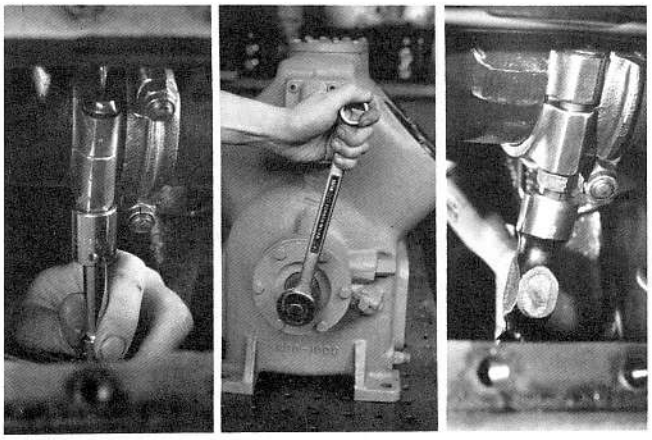
58. To check the relief valve, remove it from the cover and look for signs of overheating, which will be indicated by discoloration. If it has overheated, this means the valve has opened and should be replaced.

Also, if the seat is chipped or cracked, replace the valve. The seat is shown on the right; it's down inside the valve.



59. Next, we'll check out the compressor's internal components, starting with the cylinder sleeves, and the piston and connecting rod assemblies.

To do this, the cylinder heads, the valveplate assemblies, and the hand hole covers must be removed.

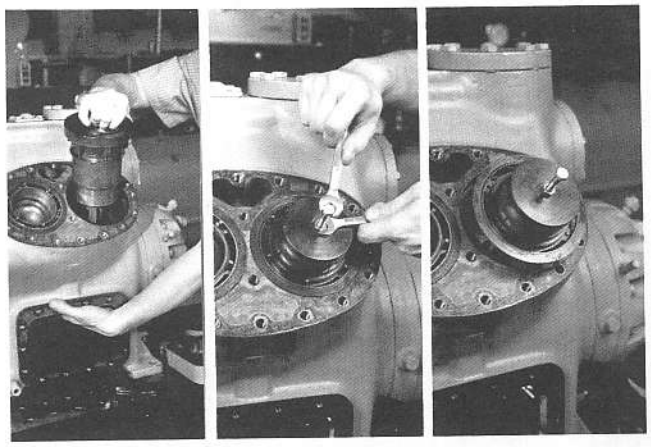


60. Then, reach in through the hand holes and loosen, but don't remove, the connecting rod lock nuts. They should be loosened enough so that they cover the threads at the end of the rod bolt.

You'll have to turn the crankshaft to position the lock nuts so that you can use a socket and ratchet. Use the bolt at the end of the crankshaft to do this.

Tap the lock nuts until the rod cap is loose. Then, remove the lock nuts and pull off the rod cap. You may have to use a screwdriver to pry the rod cap off the connecting rod. Be careful not to damage the mating surfaces.

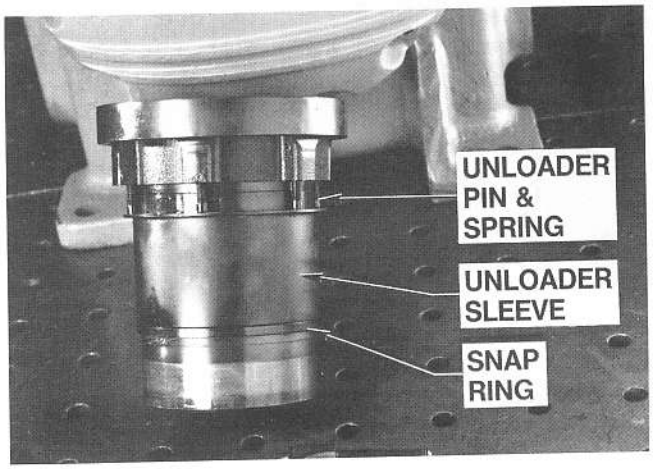
When loosening and tapping the lock nuts on the connecting rods near the pump-end of the compressor, it's a good idea to remove the oil screen so you don't hit and damage it.



61. After removing the rod cap, push the connecting rod and piston assembly, and cylinder sleeve up through the cylinder deck.

You may have to use a sleeve puller to "break" the cylinder sleeve free. Before inserting the puller into the sleeve, turn the crankshaft until the piston is in mid-position. With the puller in the sleeve, tighten the nut on the top of the puller while holding the bolt. This will expand the puller. Then, turn the crankshaft again. This will cause the piston to push against the puller, forcing the sleeve out.

If you do it this way, you can remove the sleeve, and the piston and connecting rod assembly separately.

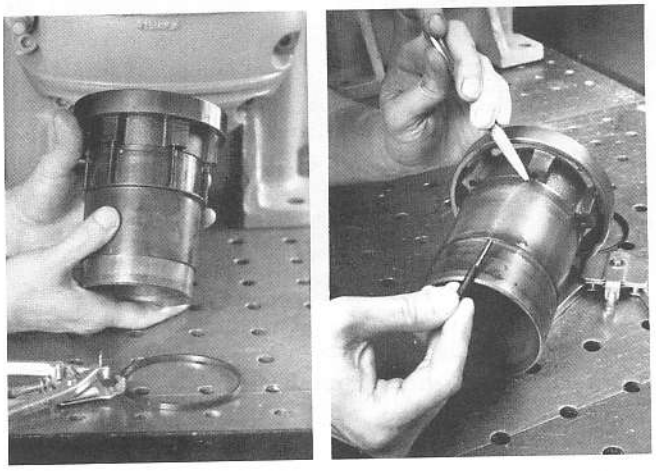


62. Let's check out the sleeve first.

If you pulled it out with the piston and connecting rod assembly, pull the piston out through the bottom of the sleeve.

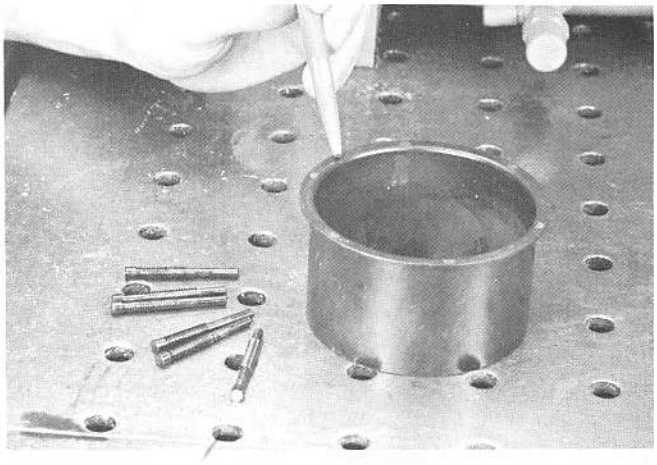
Notice on this sleeve there's an unloader sleeve, and unloader pins and springs. These components, which are part of the unloader system, control the compressor's capacity. We'll see how this is done later.

Also, on the cylinder sleeve there is a snap ring which holds the unloader sleeve in place.



63. To remove the snap ring, use a ring expander. With the ring removed, you can slide off the unloader sleeve. This will allow the pins and springs to drop out of the holes around the edge of the cylinder sleeve.

Check and replace any pins and springs that are damaged. Also, check the holes that they were in; make sure the holes are clean.



64. With the unloader sleeve removed, take a look at the lip on it. If it's worn or damaged, replace the sleeve.

Keep in mind, if the lip, or the pins and springs are worn, the cylinder may not unload.*

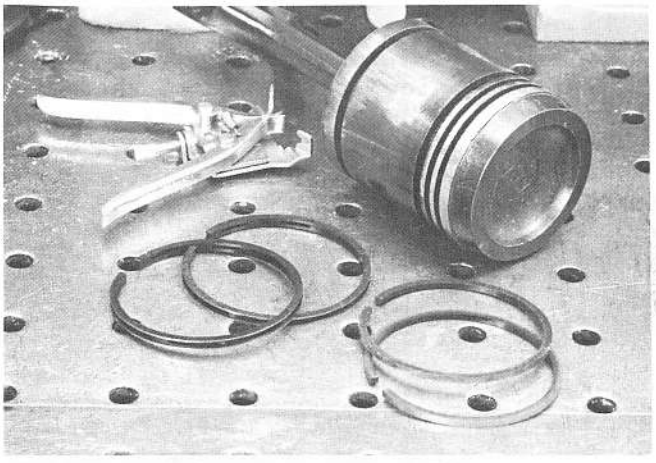
On this compressor only six of the eight cylinders have an unloader sleeve, and unloader pins and springs. The other two cylinders will not unload.

Later in this lesson, we'll cover the other components in the unloader system.

*Refer to the Carrier Service Training book on Capacity Control (GTC1A-101, 020-300) for complete details on how the unloader system works.

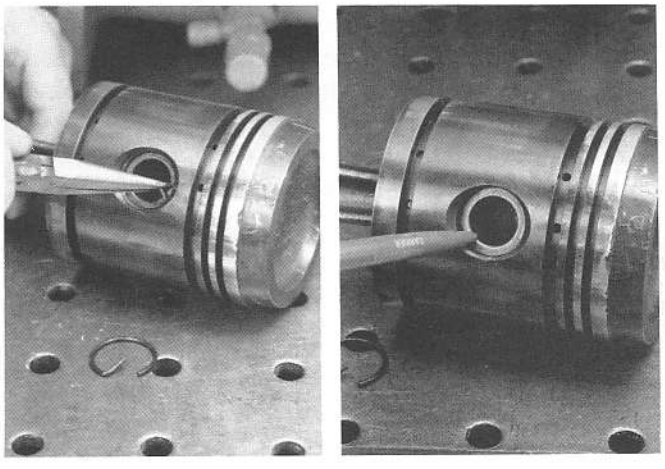
65. When checking the cylinder sleeve, look at the inside surface. If it's worn or damaged, you'll need a new sleeve.

Now, reinstall the pins and springs, and the unloader sleeve on the cylinder sleeve.



66. Next, we'll check out the piston and connecting rod assembly. Remove the rings from the piston, using a ring expander.

After removing the rings, throw them away. Don't try to reuse them. If you do, they may not seat properly; this will cause oil to blow by the piston and a loss of compression.

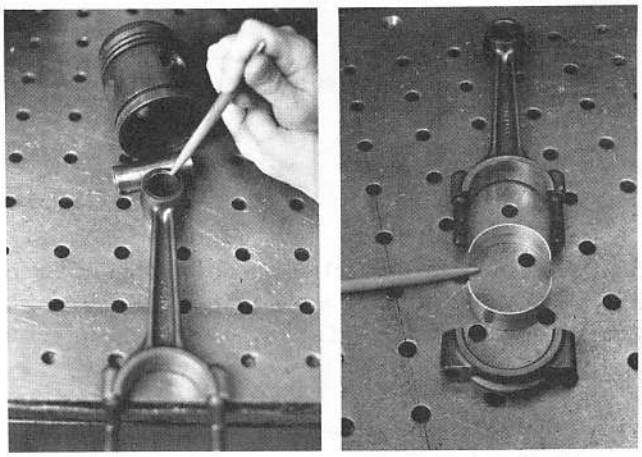


67. Remove the piston from the connecting rod. To do this, pull out the lock rings on each side of the piston pin.

Knock out the pin using a hammer and a brass rod or a socket and extension. If you're using a socket and extension, use a dead blow or other soft-faced hammer to prevent the extension from being damaged. If the pin is frozen, it will have to be pressed out.

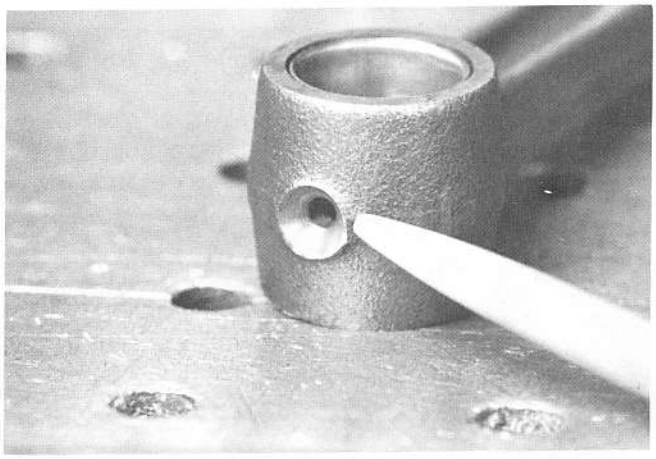
Label the piston pin so that you put it back into the same piston when you're done.

Check the pin, the piston, and the connecting rod for wear and replace them, if necessary.

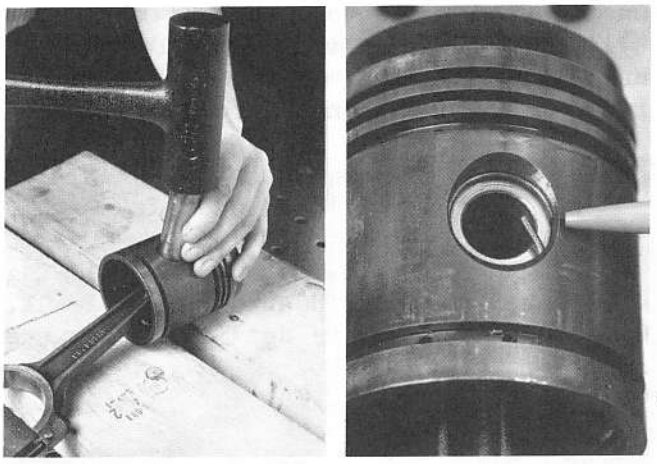


68. Don't forget to check the piston pin bushing in the connecting rod, shown on the left, and the connecting rod bearing inserts.

If the bushing is worn, don't try to remove it. Use a new connecting rod; it will already have the bushing installed.



69. Also, clean the oil hole at the top of the connecting rod. If it's dirty, there may not be enough oil getting between the piston pin and bushing. This can result in excessive wear and eventually the piston may slap against and damage the valveplate.



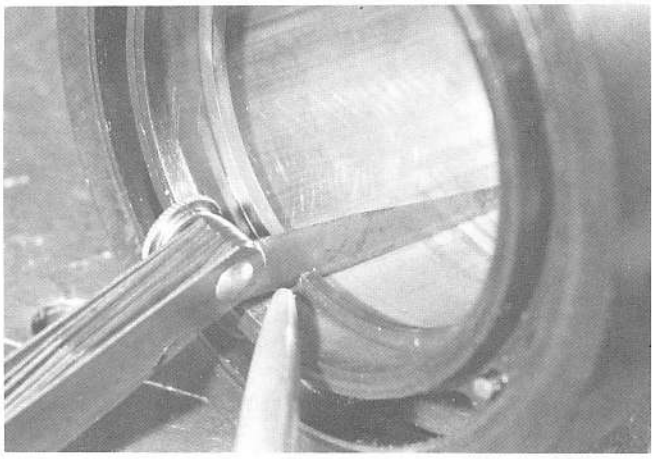
70. Now, reassemble the connecting rod and piston in the reverse order that they were disassembled.

When reinstalling the piston pin, it should be a tight fit through the piston. If it's not, recheck the pin and piston.

Also, install the lock rings so that their gap is at the 3 or 9 o'clock position.

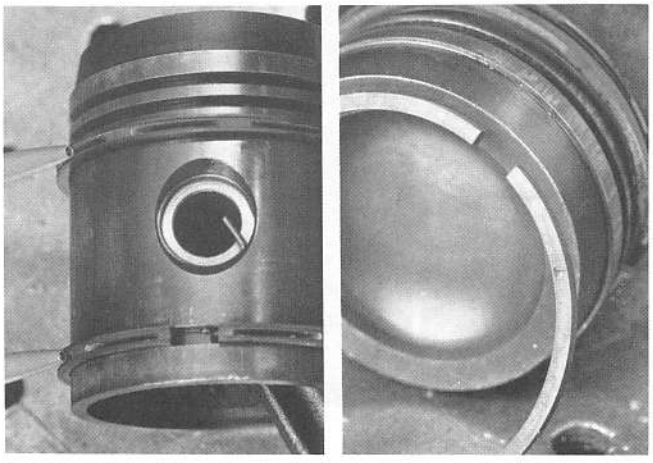
Once the lock rings are in place, check each one to make sure it can't be moved

by finger pressure; if it can, it will have to be replaced.



71. Before installing the new rings, check them first; don't assume they're OK.

Insert each ring separately in the cylinder sleeve approximately 3/8 of an inch from the top. Then, check the ring gap. If it's not within the tolerances shown in the Wear Limits Chart and the sleeve is OK, don't use that ring; get another new one.

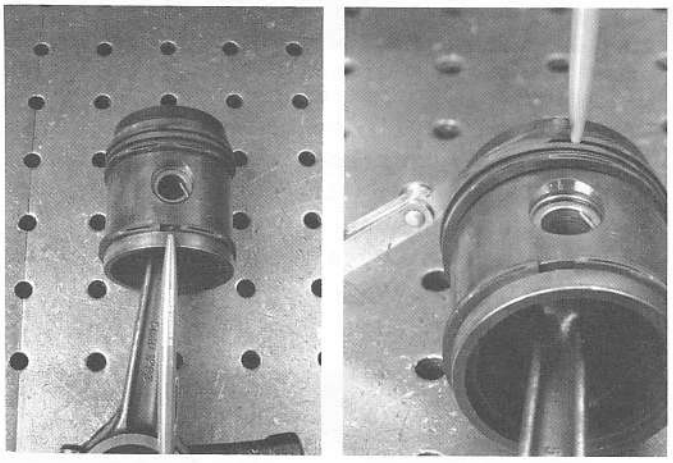


72. There are four rings per piston; two compression and two oil.* Use a ring expander when installing them. Install the rings starting at the bottom and work up.

The oil rings go into the third and fourth grooves from the top, with either side up.

However, when installing the compression rings, which go into the top two grooves, the marked side goes toward the top of the piston.

*The 5H extended stroke compressors have aluminum pistons and use only three rings -- two compression and one oil.



73. Make sure that you stagger the ring gaps around the piston so that you don't have oil blow-by and a loss of compression.

Measure the side clearance between the ring and piston; refer to the Wear Limits Chart for the clearance. If the clearance isn't within the limits and the piston checked out OK, replace the ring.

Also, check to make sure the rings move freely. If they don't, clean the piston grooves.