

# **SERVICE TRAINING FILM SUPPLEMENT**

*Volume 1*

*Film 9*



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BY SERVICE PROMOTION DEPARTMENT  
**PACKARD MOTOR CAR COMPANY**  
DETROIT, MICHIGAN



## FOREWORD

By oil balance, the subject of this Service Training Sound Slide-film, is meant the adjustment of the various parts of the engine and its oiling system so that all parts receive ample lubrication without excessive oil consumption.

A new car as delivered by the factory has oil balance. This condition of oil balance, however, cannot be expected to continue indefinitely. Pistons, piston rings and cylinders are moving, wearing parts - like tires, it is to be expected that they will wear out. When a cylinder wears in service it wears tapered. A tapered cylinder presents quite a different problem from straight, round new ones and special piston ring combinations are necessary to control the oil flow and accomplish oil balance. The pistons, also, are affected and require special treatment to offset the effects of wear and possible collapse and to adapt them for service in the tapered cylinder.

The Packard factory engineers have given careful study to the problem of reconditioning worn cylinders and, in conjunction with the Perfect Circle piston ring engineers, have developed cylinder reconditioning equipment with which we can re-establish the oil balance of a worn engine.

This film, "Oil Balance," describes that equipment and shows how to use it.



Pete: "Hiya Al."

Al: "Hello Pete. I see you got old man Peck's car in here again."

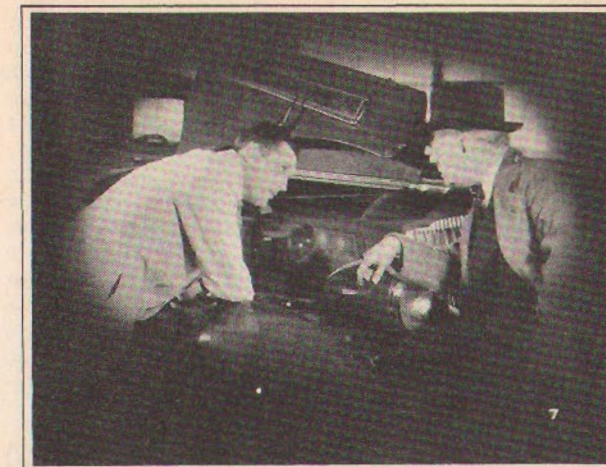
Pete: "Yeah - he burns me up."

Al: "What's the trouble?"



Pete: "Aw, you know how he is, Al - always hanging around and asking dumb questions. We ought to have a sign up to keep those birds out of the shop."

Al: "Well Pete - I know how you feel. But that's not the good old Packard spirit you know -



Al: "Seriously though, Pete, it doesn't do any harm to make customers welcome in the shop. Sure they get on your nerves sometimes. But it gives them confidence if they can see that you know what you're doing. And then, they're right there to authorize additional work if it's necessary. Sometimes you can sell them some accessories, too."

Pete: "Yeah, I suppose so."



Al: "What's the matter with Peck's car this time?"

Pete: "Looks like a ring job."

Al: "Sure about it?"

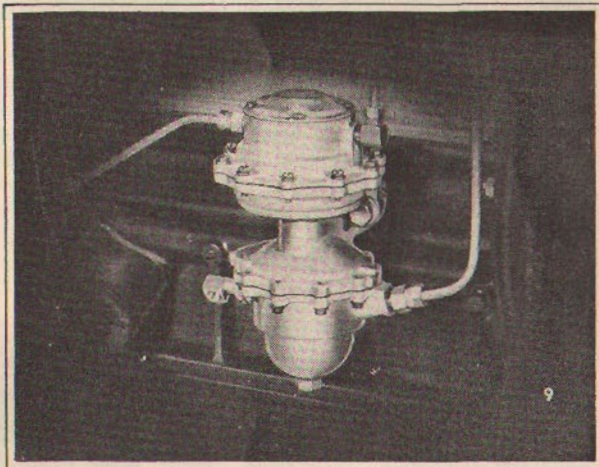
Pete: "Well no - we'll have to find out. He came in the other day squawking about oil consumption. So I gave him an oil change and showed him how to keep an accurate check. This morning he came back and we looked over his record....."

Al: "What'd it show?"

Pete: "He's using about a quart every hundred miles."



In considering what is proper oil consumption for an individual owner's car, consideration must be given to the type of driving to which the car is subjected. About 2,000 miles per gallon can be considered a fair average oil consumption. All cars, under all conditions, cannot be expected to perform up to this standard. The mileage on the car, the type of driving, the average speed, the number of stops, the number of accelerations per mile, etc., all affect oil consumption. The slidefilm "Talking To Customers About Service Costs They Can Control" will be of considerable assistance to you in showing the owner what is reasonable for him to expect in regards to oil consumption.



Al: "Hmm, that's too much all right. Did you check the vacuum booster pump?"

Pete: "I'll catch that when I give her a regular checkup this afternoon."



Pete: "Peck's coming back after lunch. I suppose he'll be hanging around all afternoon, as usual."

Al: "Well, let's not worry about it. I'll stick around and help you out."



Al: "Mr. Peck, before we do any work on the car, we make a thorough external inspection to discover if there is an oil leak anywhere."

Peck: "I don't think there is - there isn't any oil dropping on the garage floor."

Al: "Well - you'd be surprised, Mr. Peck, at the amount of oil lost through leakage. Sometimes it shows up only when the car is being driven."

Peck: "Then, how can you tell if it's leaking?"

All engines leak some oil, and most engines leak too much. The black streaks down the center of our highways are visible evidence of the amount of oil lost through engine leakage. It is good practice to check for engine oil leaks before disassembling, and in many cases after stopping the leaks disassembling will not be necessary.

**Inspect —**  
**Oil Pan**  
**Front End Plate**  
**Valve Cover Plate**  
**Oil Pump**  
**Fuel Pump**  
**Fly Wheel Housing Cover**  
**— for Oil Leaks**

Al: "We make a close inspection for gasket leaks at the oil pan, front end plate, valve cover plate, oil pump and fuel pump - and for oil drip from the fly wheel housing cover. This tells us whether the oil is leaking out or is getting up into the combustion chamber and being burned."

It is not good practice to check for oil leaks by idling the engine on the service floor because the most troublesome leaks will not show up except on the road. Oil leaks can best be detected by, first, washing and thoroughly cleaning the engine, oil pan, valve cover plates, etc., and then driving the car under varying conditions for some distance on the road. With the engine clean, oil leaks will be apparent upon examination.



"Has the cylinder head been off recently?"

Peck: "No - why?"

Al: "Because, if the cylinder head nuts hadn't been tightened down evenly, it would cause cylinder block distortion. That would throw the cylinder bores out of round so the rings could not seat on the cylinder walls and they would let oil leak past to the combustion chamber."

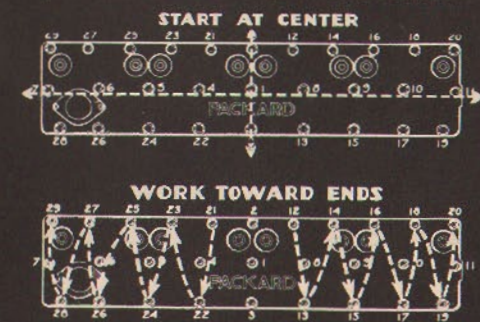
Over-oiling due to uneven cylinder head nut tension, if detected at once, may be corrected by loosening all cylinder head nuts, and retightening to the specified uniform tension. Over-oiling causes oil rings to gum up, which in turn causes a greater degree of over-oiling. This is the reason that if an over-oiling condition due to uneven cylinder head nut tension is not corrected at once before the rings start gumming, it can be corrected later only by installing new rings. (See "Tightening Cylinder Head Nuts", page 4, February 15, 1937 Packard Service Letter.)



"We use this special tension indicating wrench whenever the cylinder head is being tightened for any reason. We tighten the nuts to a uniform tension of from 150 to 170 on the wrench. This tension is ample to prevent gasket failure and yet will not cause cylinder distortion."

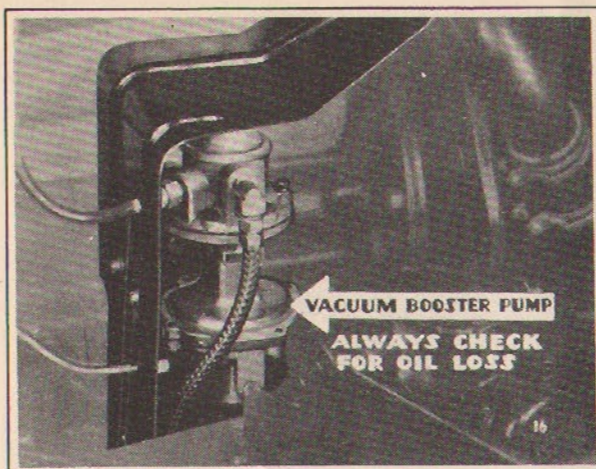
S.T. 999 - Tension Indicating Wrench - \$17.50  
 S.T. 2001 - Extension ..... - 1.15

#### CYLINDER HEAD NUT TIGHTENING



"The cylinder head nuts have to be tightened in the proper order too, Mr. Peck. We start at the center and work out to each end. That way, the head is sort of ironed out, and localized strains and buckling are prevented."

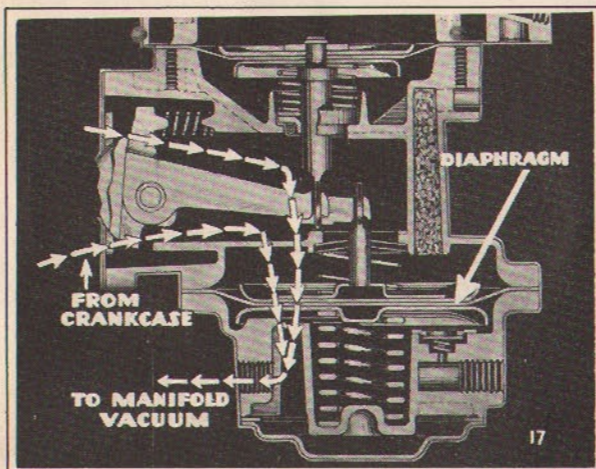




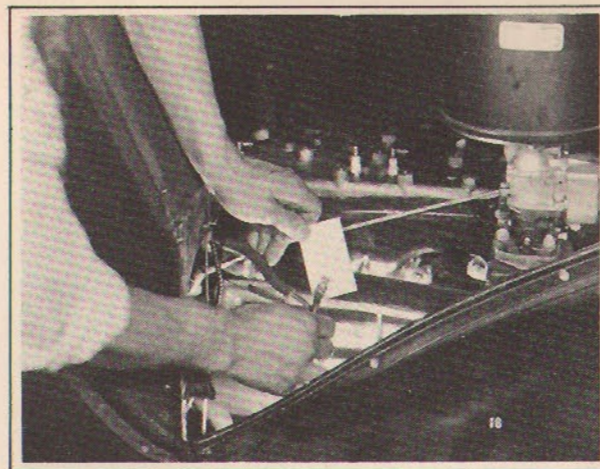
"The vacuum booster pump is a point which must always be checked for oil loss, too."

Peck: "It should? What's that got to do with oil consumption?"

Al: "One side of the diaphragm in the pump is open to the crankcase - the other side is connected to the manifold vacuum."



"A small leak in this diaphragm will allow oil spray from the crankcase to be drawn into the engine thru the intake manifold. The loss will be greatest at high speed when the vacuum booster pump is operating, and may be negligible or non-existent at low speeds. The flexing of the diaphragm causes it to wear slightly over a period of time, so we recommend replacing it after 25,000 miles just to be on the safe side."



"The best way to check the vacuum booster, aside from taking it apart and actually inspecting the diaphragm, is to disconnect the tube from the vacuum booster pump to the intake manifold, hold a white card in front of it, and race the engine a few times. Any sign of oil smudge on the card or in the pipe, indicates a leaking diaphragm. Any show up, Pete?"

Pete: "Nope - clean as a whistle."

This white card test is not infallible, although it will detect a great majority of cases of leaking vacuum pump diaphragm. Another test (though it is not infallible) is the failure of the vacuum booster pump to operate the windshield wipers, under heavy load, low speed conditions, such as on a steep hill. The diaphragm may leak only when it is operating, and in this case the leak will not show up and the exhaust will be clear when the car is idling on the service station floor. It may be impossible to get a smoky exhaust even by racing the engine. The only 100% check on the diaphragm is to disassemble the pump and make an inspection. If there is any trace of moisture on the intake manifold side of the diaphragm it is an indication of a leak and the diaphragm should be renewed."



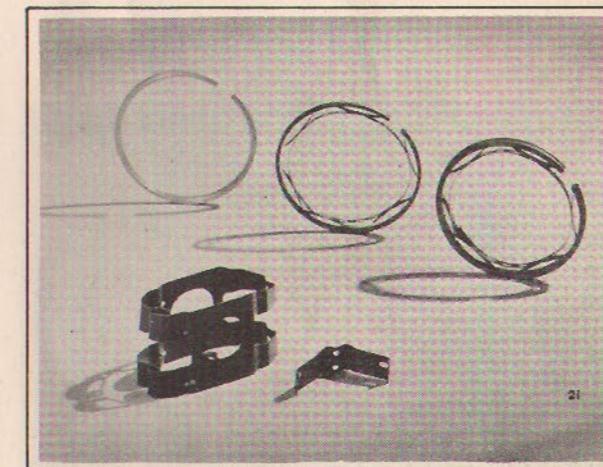
Al: "Well, Mr. Peck - there don't seem to be any external leaks."

Peck: "That means new rings, I suppose."

Al: "It looks that way. We know that the oil isn't leaking out, but is going up past the rings and is being burned."

**Check—**  
Main and Connecting  
Rod Bearings  
Pistons  
Piston Rings  
Piston Pins  
Cylinders

If oil consumption is higher than normal, oil is usually leaking out or is being pumped into the combustion chamber where it is being burned. Oil can get into the combustion chamber only two ways - past the valve guides or past the piston rings. While it is the function of the piston rings to keep the oil from entering the combustion chamber, they can do so only if all other conditions are normal. New rings cannot keep the oil down if main and connecting rod bearings are loose and excessive amounts of oil are being delivered to the cylinder walls. When replacing rings, never fail to check the connecting rod, crankshaft and camshaft clearances and the valve guides. Failure to cure the nonstandard condition of any one of these points may be responsible for failure of the installation of new rings to cure over-oiling."



"However, the thing to do is to take off the cylinder head and lower half of the crankcase, and check the Main and Connecting Rod Bearings, the Pistons, Piston Rings, Piston Pins, and Cylinders. Then we'll know definitely just what has to be done."

Peck: "Very well - if you think that's necessary, let's go ahead with it."

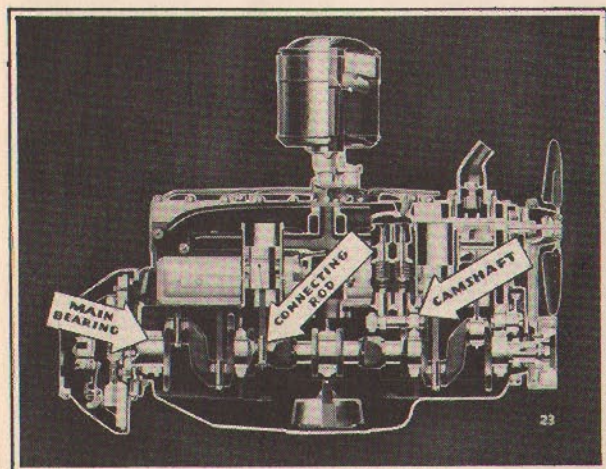
Al: "If the cylinders are not excessively tapered or distorted and the pistons are not badly scuffed or scored, we can correct the over-oiling condition by installing a set of X-90 rings and piston expanders. The new rings and expanders will not only stop the oil pumping, but also restore the original power and top speed, and will give you an engine that you can depend on for many thousands of miles of trouble-free service at a minimum of expense."





Pete: "Okeh, Al - I've got the cylinder head and oil pan off. Guess we're ready to go."

Al: "All right Pete, let's make an oil test of the bearings first. Get the bearing oil tester and fill it about two thirds full of a mixture of 50% motor oil and 50% kerosene."



"This test, Mr. Peck, allows us to observe the oil flow from the main, connecting rod, and cam shaft bearings."

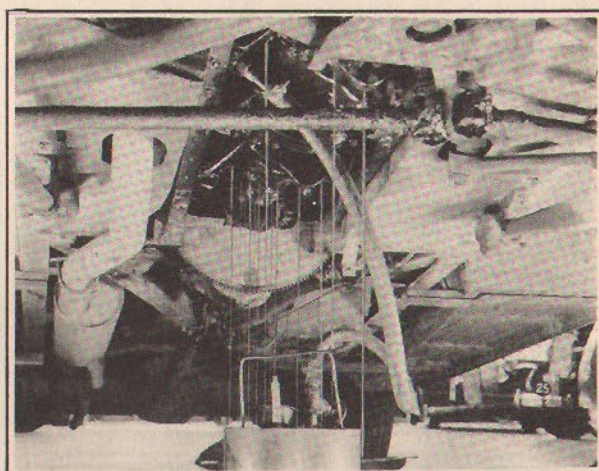
Peck: "What's that for?"

Al: "Excessive oil flow at these points will allow an over supply of oil to be thrown on the cylinder walls and the rings will not be able to pass it back to the crankcase. It will be carried on up to the combustion chamber."



"All set, Pete? ----- Okeh, now connect the oil tester at the manifold connection to the oil pump...."

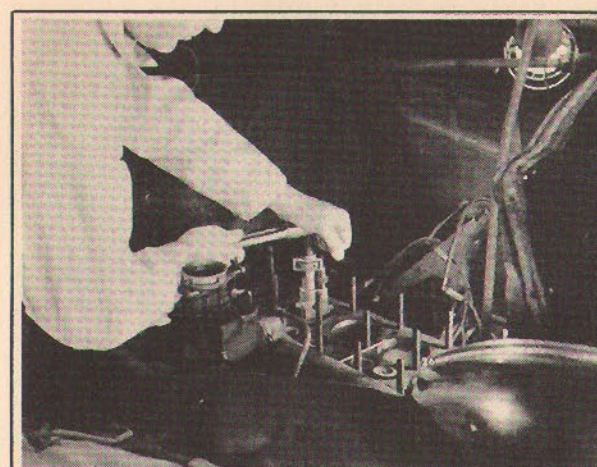
S.T. 109 - Lubricating System Tester  
Tank ..... - \$16.00



"We put thirty pounds of air pressure on the tester and then turn the engine over with the starter and watch the flow of oil from the main and connecting rod bearings. It should drop steadily from all bearings but should not flow in a stream from any of them. How does it look, Pete?"

Pete: "Too much at both the rods and the mains."

Al: "Yes, they're leaking all right. That means, we'll have to fit new undersize bearing shells in both the main bearings and connecting rod bearings."



"Before we remove the pistons, we chamfer the cylinder bores with a ridge reamer to take off the shoulder at the top of the cylinder. If this shoulder is not removed when the new rings are installed, the sharp corner of the top ring will hit the shoulder and cause a clicking noise. It might even break the ring. And Pete, be sure that the chamfer doesn't extend too far down the cylinder bore. It shouldn't go into the ring travel more than 1/32 of an inch."

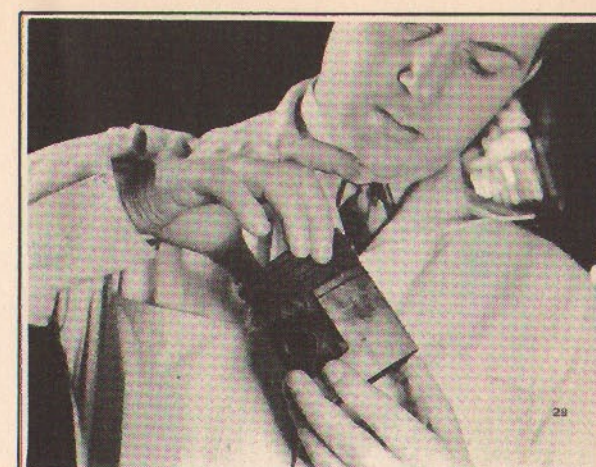
Peck: "Why do that before taking out the pistons?"

S.T. 885 - Chamfer Tool ..... - 12.50

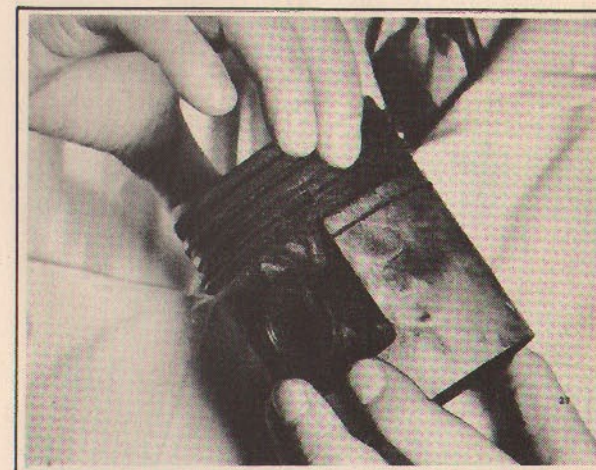


Al: "Because the cuttings from the cylinder will fall down on top of the pistons, then when Pete pushes the pistons out at the top, the rings will carry the cuttings up and out leaving the cylinder bore clean."

Peck: "Hmmp - clever, these Chinese."



Al: "Check all the pistons carefully, Pete. If the struts are noticeably loose, the ring grooves broken, damaged or worn egg-shaped, or the piston skirts are badly scuffed or scored, the pistons will have to be replaced."

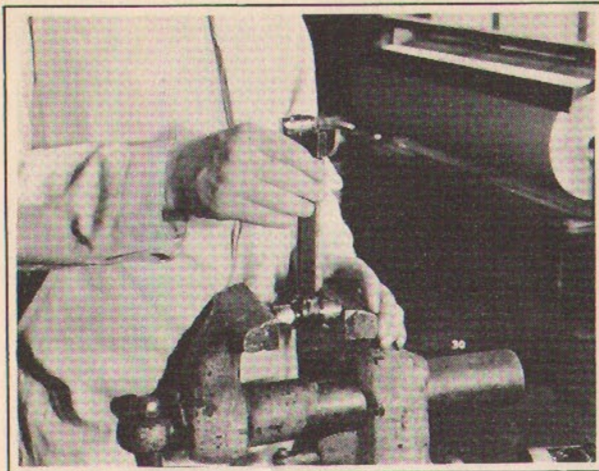


"Carbon and dirt formed in the oil often accumulates and plugs up the oil drain holes in the pistons as well as in and around the rings, causing them to stick in the ring grooves."

Pete: "These rings are all gummed up."

Al: "Yes, they'll have to be renewed all right."



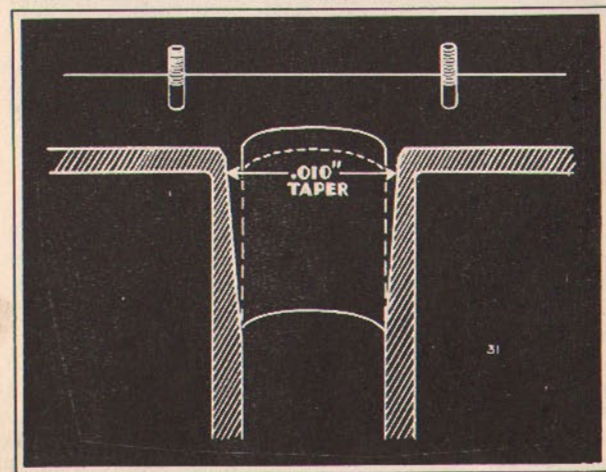


"Now, while you have the pistons disassembled from the rods, Pete, how do the piston pins and bushings look?"

Pete: "The pins are pretty well worn and loose in the piston."

Al: "Then we'd better figure on installing oversize pins, too."

Piston pin and bushing wear is not normally great and is rarely responsible for excessive oil consumption; however, they should be checked when installing new rings for the reason that worn pins which have been quiet may become noisy through the installation of new piston rings. Wear at this point may be corrected by installing oversize wrist pins and reaming piston and connecting rod bushings to fit. Renewal of the connecting rod bushings is normally required only when installing new pistons with standard size pins.



"The next thing we do is to check the cylinder for taper. If they are not more than ten thousandths of an inch tapered, new rings and piston expanders will take care of the job provided the other factors affecting piston ring performance are corrected."

Peck: "What if they were more tapered than that?"

Al: "In that case we would have to rebore and install new pistons."

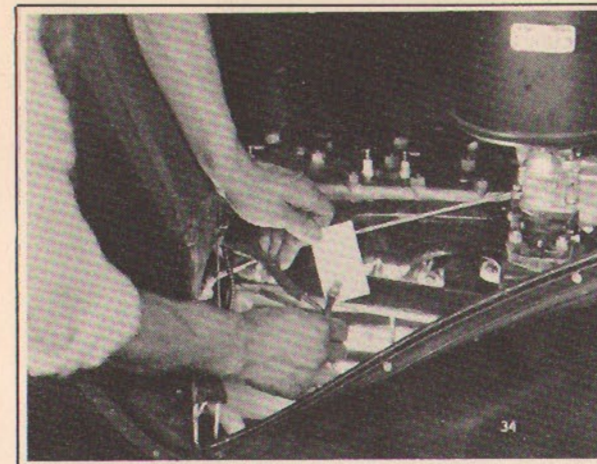


"And that, Mr. Peck, completes our inspection. Now let's see just what we did."

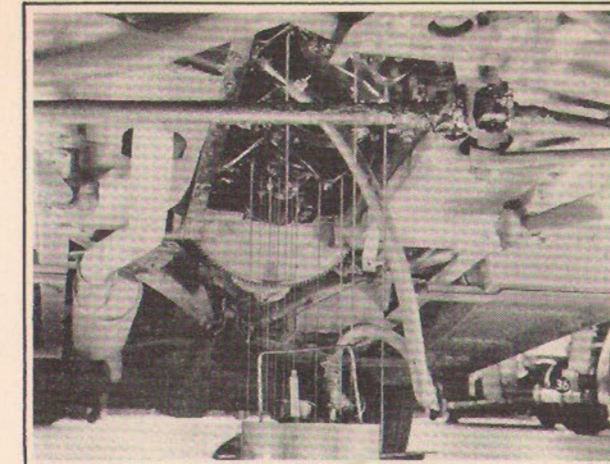
### Inspect—

Oil Pan  
Front End Plate  
Valve Cover Plate  
Oil Pump  
Fuel Pump  
Fly Wheel Housing Cover  
—for Oil Leaks

"In the first place, we made a thorough external inspection of the oil pan, front end plate, valve cover plate, oil pump and fuel pump, and for oil drip from the flywheel housing cover."



"We also checked the vacuum booster pump to make sure that oil was not being drawn through the diaphragm. We found no external leaks which showed that oil was going past the rings and being burned."



"The main and connecting rod bearings will have to be refitted with new undersized shells because our oil test showed them to be loose and leaking."

### Check—

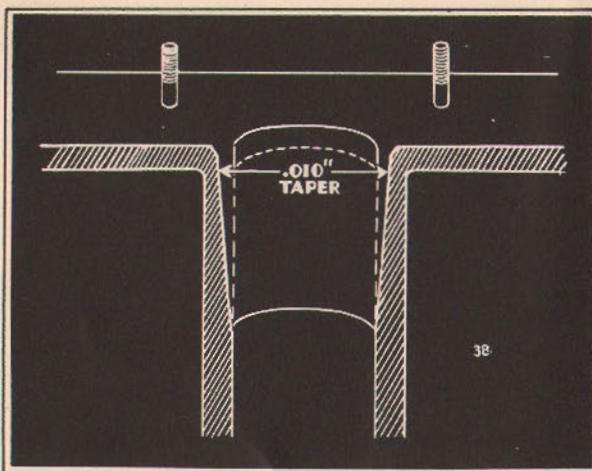
Main and Connecting  
Rod Bearings  
Pistons  
Piston Rings  
Piston Pins  
Cylinders



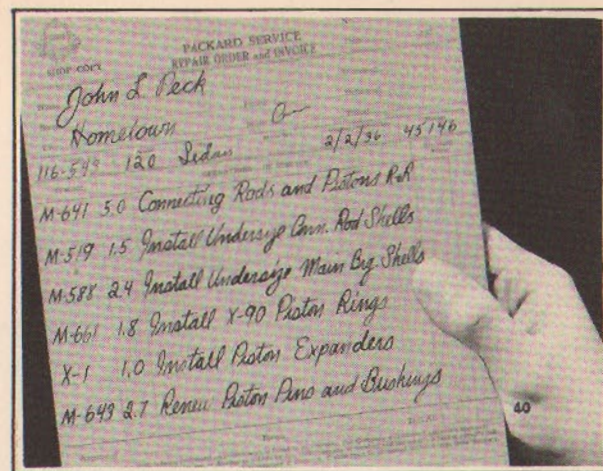
"So we made an oil test of the main and connecting rod bearings - disassembled the pistons from the connecting rods and checked the pistons for scuffs, and gummed and stuck rings - checked the piston pins and bushings for wear - and finally, the cylinder bores for taper. Now, here's what should be done..."

"You'll have to have a new set of piston rings installed because they are all gummed up and stuck as we discovered when we examined them."



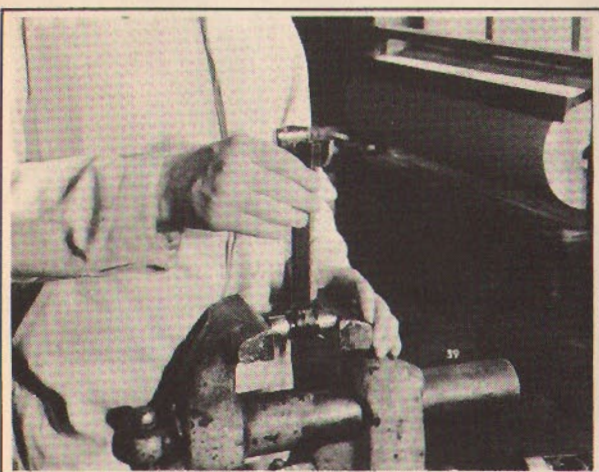


"You need a set of piston expanders to compensate for cylinder and piston wear and piston collapse. The piston expanders will restore the pistons to their original shape and cause the piston to ride square in the cylinder and follow the bore."



Title - as though Al has jotted items down on piece of paper -

Refit main and connecting rod bearings.  
Install new piston rings.  
Install new piston expanders.  
Install oversize piston pins.



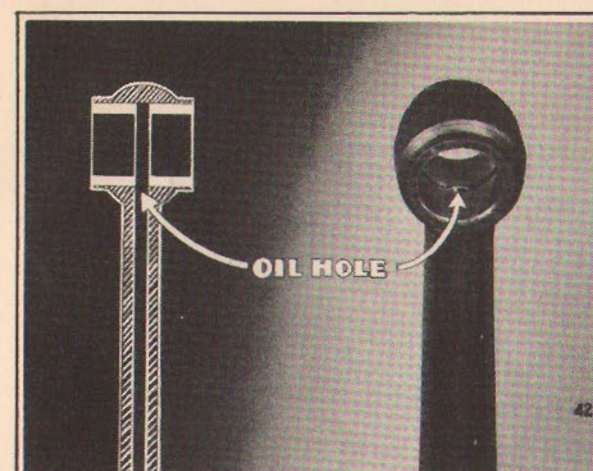
"And we had better install oversized piston pins and bushings because we found them to be pretty well worn. Here's the whole story in black and white...."



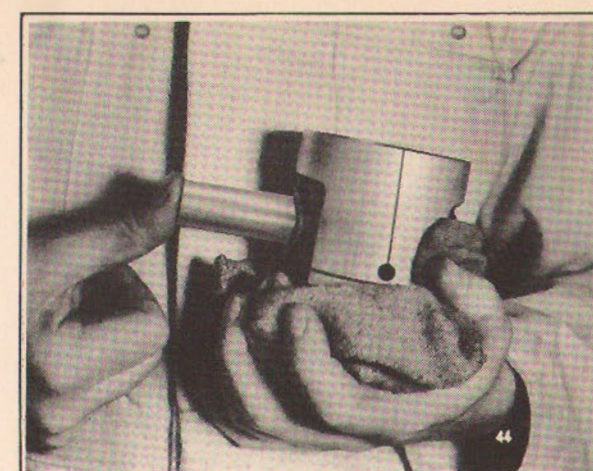
Al: "You see, it's a 12 or 13 hour job and there is considerable material involved."

Peck: "Does it take that long?"

Al: "Yes, it does. Let me explain to you what we have to do. First we fit the new wrist pins and bushings."

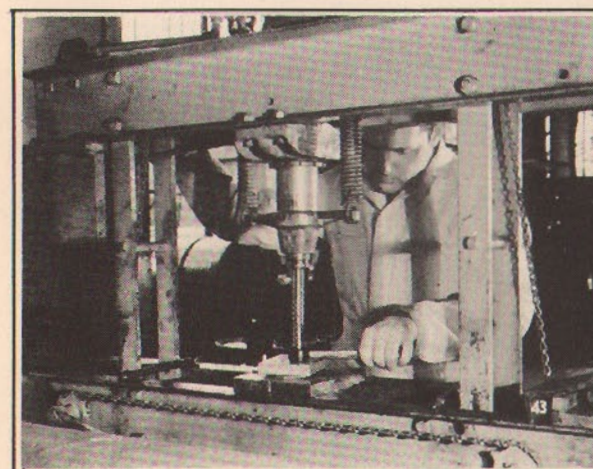


"The wrist pin bushing comes in two halves and we insert them in the connecting rod from each side, being careful that we don't cover the oil hole in the rod."



"Then we ream the piston so that it is a finger push fit on the piston pin when the piston is hot - 160 degrees Fahrenheit."

S.T. 832 - Piston Pin Bushing Reamer  
(7/8" Pin) ..... - \$ 7.75



"Then we expand them to a tight fit with the wrist pin burnishing tool. The burnisher does not finish the bearing to size so we ream it to a finger push fit on the pin."

S.T. 726 - Connecting Rod and Piston  
Assembly Pin ..... - \$ 1.00

S.T. 5008 - Piston Pin Bushing  
Burnisher ..... - \$ 5.00  
S.T. 5041 - Piston Pin Bushing  
Remover ..... - 2.20



"Connecting rods must be aligned because an out of line rod will cock the piston."

Peck: "What would that do?"

Al: "A cocked piston exerts excessive pressure on the cylinder wall in spots, and breaks through the oil film. Piston rings cannot operate at right angles to the cylinder walls and form a seal on the ring lands and cylinders, unless the connecting rods are square with the crankshaft."

S.T. 758 - Connecting Rod Aligning  
Jig ..... - \$40.00  
S.T. 5056 - Arbor Plug (120 - 120-B) - 6.00  
S.T. 5024 - Arbor Sleeve  
(120 - 120-B) ..... - 4.00  
S.T. 649 - Piston Sleeve ..... - 6.50





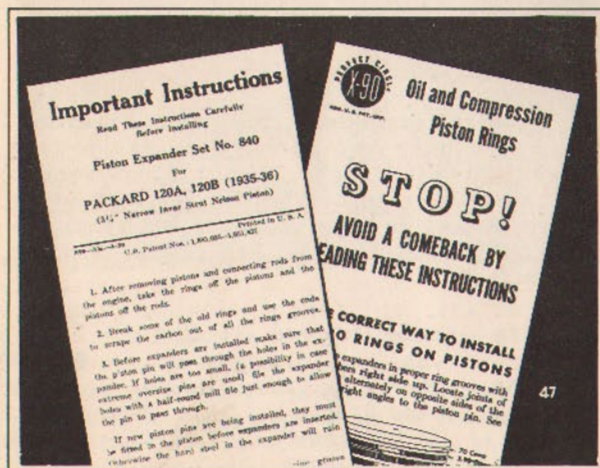
"By the way, Pete - when you install the new expanders and rings, examine the lower edge of the piston to see if it has become beveled or the sharp edge worn off."

Peck: "Suppose it were worn off?"

Al: "In that case, we would have to dress it down."

Peck: "I suppose you fellows are so used to all this you could do it in your sleep."

The lower edge of the piston acts as an additional oil scraper. The edge must be kept sharp. If your examination shows it to be rounded or dull it should be resharpened before installing the piston in the cylinder. Probably the best way for doing this is to dress the bottom of the piston with a piece of emery paper laid on a surface plate.

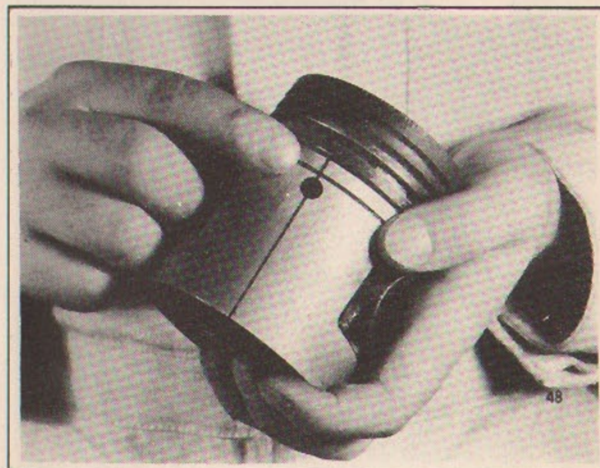


Al: "Not entirely, Mr. Peck. Instruction sheets such as these are packed in each box of piston rings. Regardless of how efficient we become at installing new rings and expanders, we always keep the instructions and refer to them simply to make doubly sure that we install them exactly as recommended."

Peck: "Check and double check - eh?"

Al: "That's right...."

It is the attention to small details that makes or unmakes a piston ring job. To operate satisfactorily, piston rings and piston expanders must be installed right side up and the gaps properly spaced. Failure to do so will very likely cause the job to be unsatisfactory. The surest way of observing every detail every time is to check yourself with the instructions which come packed in each box of rings and expanders.



"Now when putting expanders in these narrow invar strut pistons, used on all models except the Packard Six, we must be sure to saw the vertical slot up into the horizontal slot at the top of the skirt just below the lower ring groove."

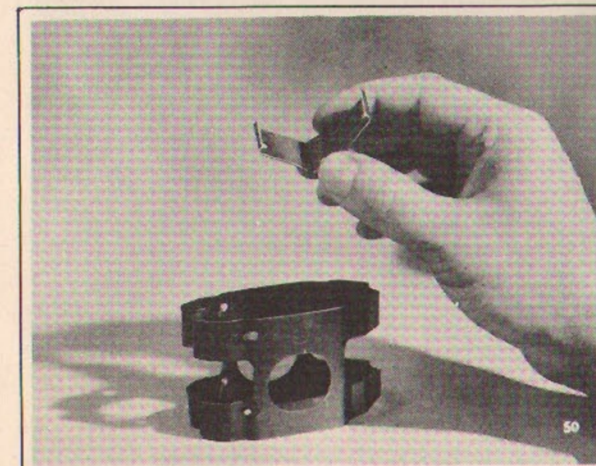
Peck: "What's that for?"

Al: "If we didn't do this, the expander could not operate effectively on the top part of the skirt."



"It's very important to use the proper expanders, because they are engineered for each individual piston design. Installing them is quite a trick and it must be done correctly or the expanders won't do the job."

All aluminum pistons have different operating characteristics. Perfect Circle piston expanders are individually engineered for the pistons in which they are to be used. Two pistons of the same size may look alike, yet they may require entirely different pressures applied at different points to restore them to their original efficiency. Just any Perfect Circle piston expander for a 3-1/4" piston will not do for the Packard 120. Packard Perfect Circle piston expanders are packed in boxes distinctly marked "Packard", and the surest way of getting the correct piston expander is to order through the factory Service Stores Division.

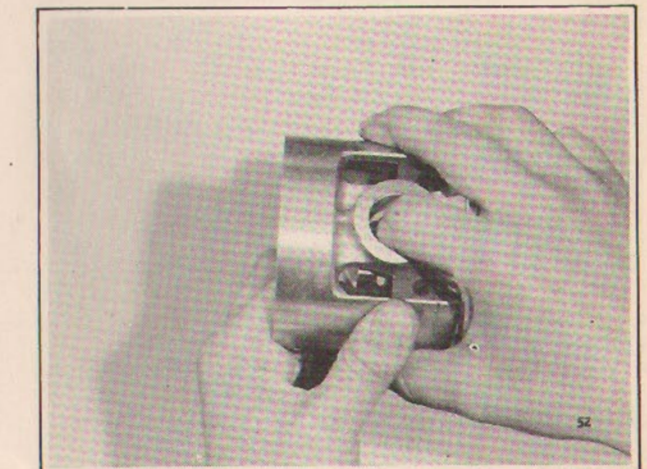


"This small 'U' shaped spring is a head stabilizer and is installed in the solid half of the piston opposite the vertical slot to tighten the struts."

The Perfect Circle piston expanders are made up of two units -- the expander proper and the head stabilizer. Satisfactory results cannot be expected unless the entire equipment is used. Don't fail to install the head stabilizers.

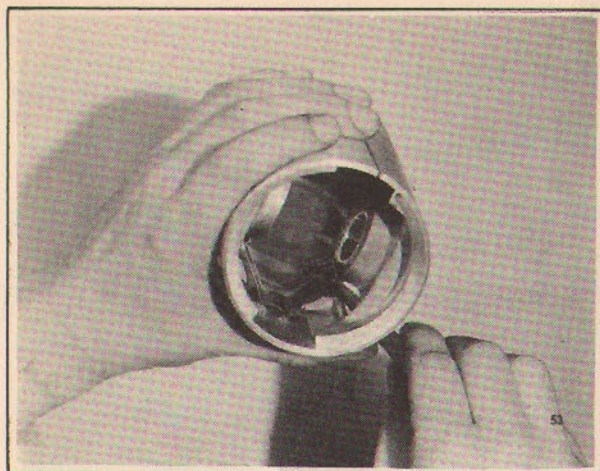


"When installing it, the end of the stabilizer that has the small round hole, is placed against the left invar strut, back of the pin boss. Then the other end is sprung toward the center so that the outside rests against the face of the right pin boss. It is held in position with the finger through the pin hole."



"We locate the stabilizer up and down in the piston so that when it is finally installed, the ends will fit flush around the bosses, and it will not have to be moved. We examine both sides of the piston to see that both the round hole and the elongated hole are visible. We also make sure that the back of the stabilizer fits squarely against the piston skirt."

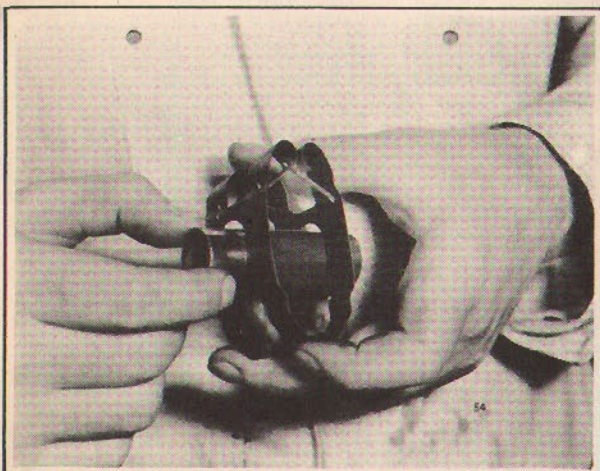




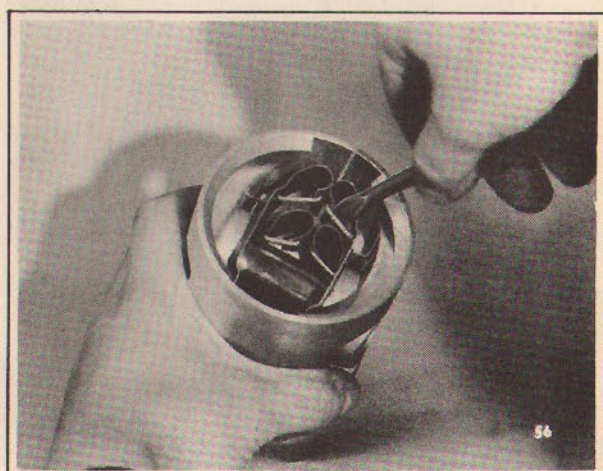
"Next we draw the stabilizer back into the piston far enough to insert a small drift punch through the elongated hole and we hold it there as we pry the stabilizer into position. Then we check it again to make sure the stabilizer fits squarely against the piston skirt."



"Then we insert the expander proper into the piston with the mark 40 toward the bottom of the piston and with the rolled, or open end of the expander against the slotted side of the piston. We use a dummy pin to line up the holes in the expander with the piston pin holes, and check to see that the head stabilizer fits securely between the upper and lower sections of the expander - and that the back side of the expander fits squarely against the inside of the piston skirt."



"Then, we make sure that the piston pin will pass thru the holes in the expander. Sometimes these oversize pins bind in the hole, and if they do, we file the expander out with a half round mill file just enough to let the pin pass thru."



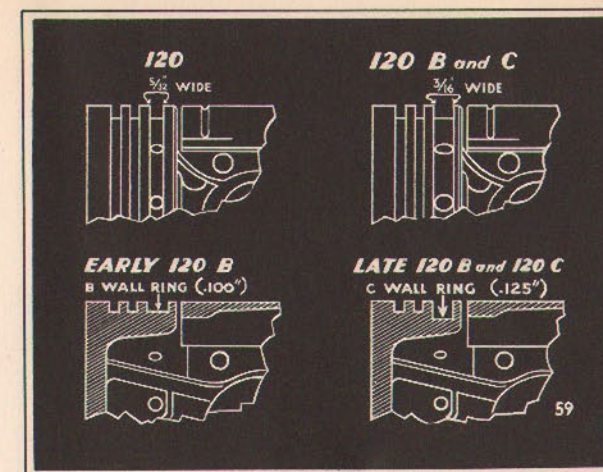
"And then with everything lined up, we remove the four wire retaining clips at the open side of the expander. There are four clips on each expander, two at the bottom and two at the top. It's important that they are all removed, otherwise there's no tension on the expanders and they don't do any good."



Peck: "Well, that does sound rather tricky."

Al: "It's a case of following instructions carefully, knowing the correct procedure, and becoming proficient through practice."

Peck: "Yes, I suppose so."



"When we come to install the rings, the first thing to be sure of is that we get the right rings for the job -- particularly the X-90 oil rings. The 120 uses an oil ring 5/32 of an inch wide and the 120-B and C a 3/16 ring. There are two depths of ring grooves used on the 120-B so we must always check the ring groove depth to be certain we have the correct ring."

Peck: "Yes - I suppose that is important."



Al: "Before installing the rings, the first thing is to clean all the carbon out of the ring grooves and to clean out the oil drain holes. We must be careful not to scratch or damage the ring lands, and when we use a drill to clean the drain holes, we use a drill 1/32 smaller than the ring groove width, using great care not to touch the ring lands."

It is hard to believe that anyone would install a 5/32" ring in a 3/16" ring groove, and expect the job to operate efficiently. Yet, in several instances, where it had been reported that the installation of new rings failed to correct an over-oiling condition, inspection showed that a 5/32" ring had been installed in the 3/16" groove. Great care must also be used in seeing that the X-90 oil rings are of the proper wall thickness for the piston on which they are to be installed. 120-C and the late 120-B pistons require a 3/16" C wall (thick) oil ring, and the early 120-B will require a 3/16" B wall (thin) ring. A C wall ring installed in an early piston will have too much spring tension and will freeze in the cylinder, and a B wall ring installed in a late 120-B or 120-C piston will not have full spring pressure. The motor number at which the change went into effect in the 120-B production is not available, and therefore each ring will have to be checked to make definitely sure that you have the proper wall thickness.





Al: "The proper ring combination for this job is a Perfect Circle Number 200 compression in the top groove, an X-90 compression in the second groove, and the X-90 oil in the lower groove."

Peck: "How do you make sure that you have the proper rings?"

Al: "X-90 piston ring sets containing the proper type and number of rings for each model Packard, come in individual cartons marked with the model number and ring size."

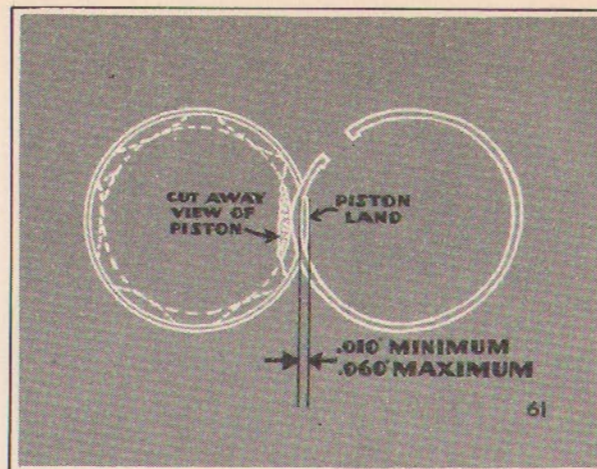
It is recommended that, wherever possible, rings be bought in sets. These sets include the new No. 200 compression ring, the X-90 compression ring, and the X-90 oil ring. The new No. 200 compression ring is now used in production and, as of today (July 1937), is not available through Service Stores except in boxed sets. Later, however, it will be. In cases where the new No. 200 compression ring is not available, the use of No. 70 compression ring will be entirely satisfactory.

#### Model 120

324822 Motor piston ring set-std. to .010" over  
324823 Motor piston ring set-.010" to .020" over

#### Model 120-B

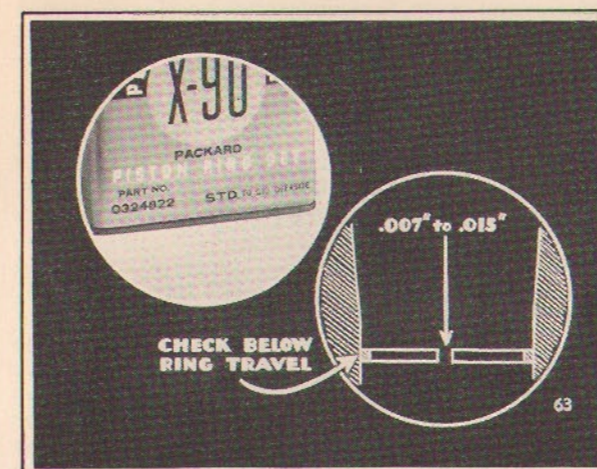
324824 Motor piston ring set-std. to .010" over  
324825 Motor piston ring set-.010" to .020" over



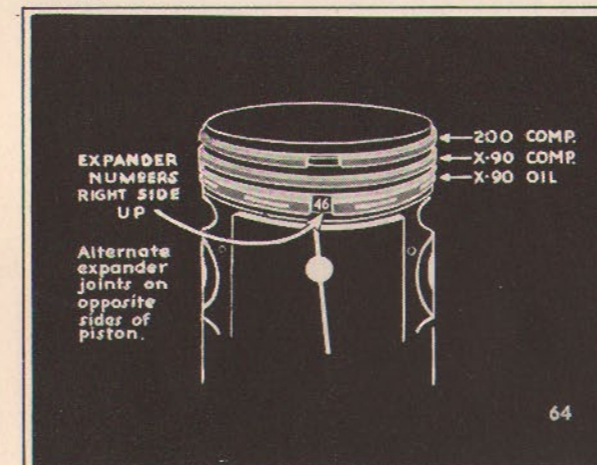
"When we have all the carbon out of the ring grooves, we place the X-90 expanders in their proper grooves with the numbers right side up. Then we check each ring in its correct groove. The total thickness of the ring plus the expander must be at least .010 less than the groove depth, and not more than .060. If this operating clearance is less than .010, we use a thinner wall ring; and if the clearance is more than .060, we use a thicker one."



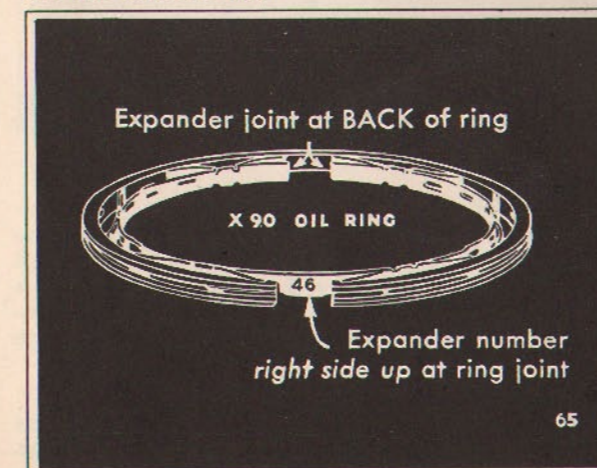
"We check the edge clearance of each ring in its groove. They should have from 1-1/2 to 2-1/2 thousandths clearance. If the ring grooves are worn so as to give more than .007 clearance, the pistons should be renewed. We never re-groove pistons or chamfer ring lands or grooves."



"The basic cylinder size for which the rings are intended is marked on the box. However, we always check the ring gap in the smallest part of the cylinder, below the ring travel. The gap should be 7 to 15 thousandths."



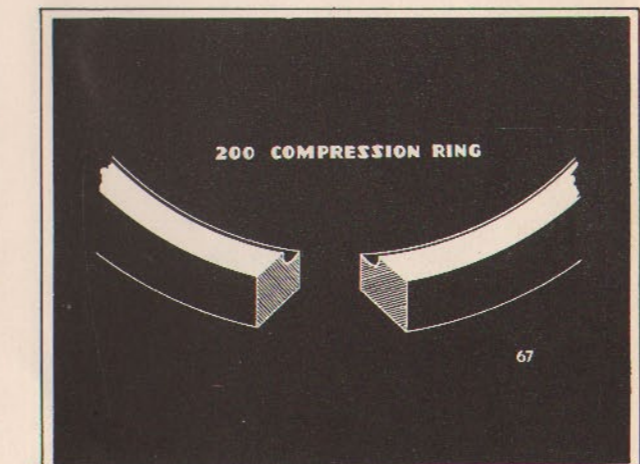
"The numbers in the ring expanders must be right side up. The joints are located alternately on opposite sides of the piston at right angles to the piston pin. The top and bottom rings are located with the joint toward the cam shaft side."



Al: "We install the X-90 oil ring first, and then the X-90 compression with the groove on the lower side, locating the ring joints opposite the expander joints. Then we check to make sure the expander numbers show through the open ring joints with the top of the number toward the top of the piston."



"Each ring is then compressed with the fingers until the ends of the expander springs, on each side of the number, snap into the notches next to the ring joint."



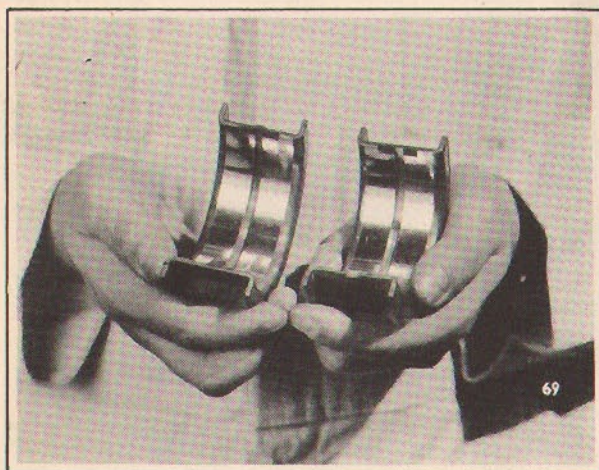
"The number 200 compression ring is placed in the top ring groove with the groove on the inside edge up toward the top of the piston. We never use an expander behind the top rings."





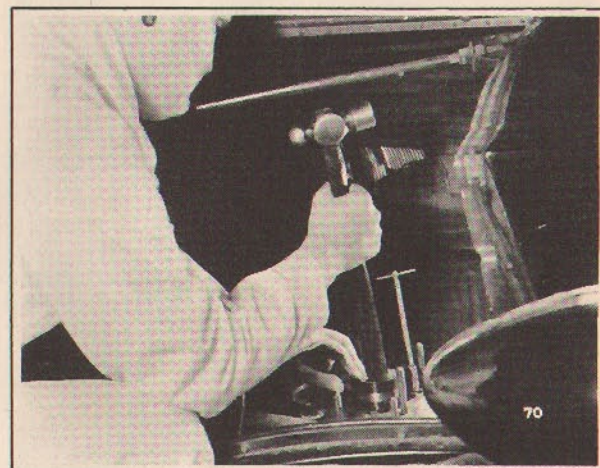
"We next assemble the piston on the connecting rod with the slotted side toward the cam shaft. And when we put in the piston pin lock wires, we make sure that the lip is turned in toward the piston pin to prevent end-wise movement of the pin."

Before installing the pistons in the cylinders, it is a good idea to break the glaze on the cylinder bores so that the new piston rings will seat quicker and require less running in. The Ammco resurfacing hone removes the shiny glaze of the worn cylinder, but does not remove any appreciable amount of the metal. While this operation is not absolutely essential to the success of the job, it is highly recommended. A resurfacing hone is carried in the factory Service Tool stock under S.T. 980.



"Before we put the pistons in the cylinders, we install the proper undersize main bearing shells to give a 1-1/2 thousandths clearance on the crankshaft."

Under size main bearing and connecting rod shells are furnished in .001" and .002" undersize. When fitting these to the shaft, the proper shells should be selected to give .001" to .0015" clearance. You may find instances where crankshaft wear has left a groove around the main bearing which binds on the edge of the bearing shell oil groove. In such cases the edge of the oil groove should be relieved so as not to bind on the ridge on the shaft. In cases where the oil leakage from the main bearings is excessive, yet the wear is not enough to permit the use of the .001" undersize shell, and in cases where more than a .002" undersize shell is required and an exchange crankshaft cannot be sold, satisfactory repair can be made by dressing down the bearing cap and shell with emery paper on a surface plate. Great care should be taken not to dress the cap more than necessary to provide proper clearance. Bearing caps are not renewable, and once a cap has been dressed it is not then possible to go back to a standard size shell as would have to be done if an exchange crankshaft were to be installed later.

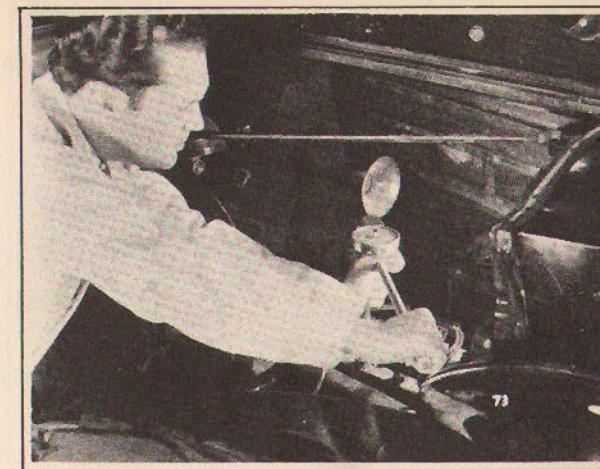


"After washing and oiling the pistons thoroughly, they are inserted in clean cylinders. The rings are compressed carefully, and to avoid the expander springs snapping out of the notches at the ring joints, the ring compression should not be released, once tension has been applied."

S.T. 956 - Piston Ring Compressor .... - \$ .85  
S.T. 872 - Piston Ring Compressor - 12 - .85

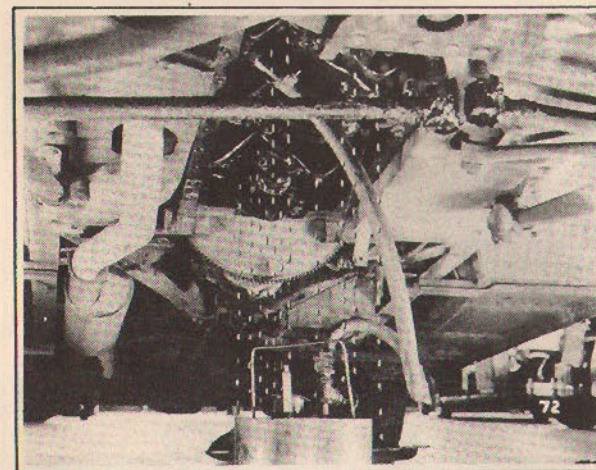


"When we put the caps on the connecting rods, we install the new undersize bearing shells and check them with a feeler gauge one at a time to make sure they have the correct 1-1/2 thousandths clearance."



"When we put the cylinder head back on, we use a new gasket and coat it and the cylinder head studs with Perfect Seal paste. Then we tighten down the cylinder head nuts to the right pressure, and in the proper order, with the tension nut wrench."

Always coat cylinder head gasket and cylinder head studs with Perfect Seal gasket paste as described in Packard Service Letter insert, April 15, 1936, before installing the cylinder head. This will insure a gas and water tight gasket seal without the necessity of excessive cylinder head nut tension, and it will also insure against corrosion of the cylinder head around the studs and water passages, thus making future removal of the cylinder head much easier. When tightening cylinder head nuts, always use the Tension Indicating Wrench, and tighten the nuts to a uniform tension of 150 to 170 on the dial. Uneven cylinder head nut tension may cause cylinder block distortion, sufficient to prevent the rings from seating and thus be responsible for the failure of the new ring installation to correct a condition of over-oiling.

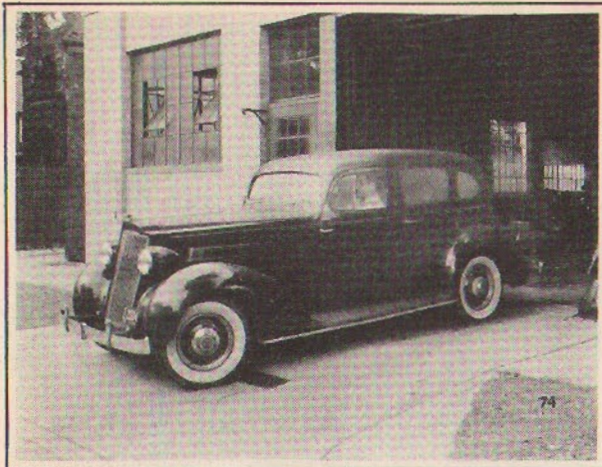


"And then we make another oil test before putting the lower half of the crankcase back on."

Peck: "Why do that again?"

Al: "It simply gives us a final check to make sure that the bearing clearances are right and the oil flow is under control."





"Finally we take the car out and give it a road test to make sure that everything is all right."



Al: "There you are, Pete - another customer's oil consumption balanced - a nice little profit for the shop - and a satisfied owner."

Pete: "Yea - Say, he's not such a bad duck after all. Gee - he thinks we know our stuff."

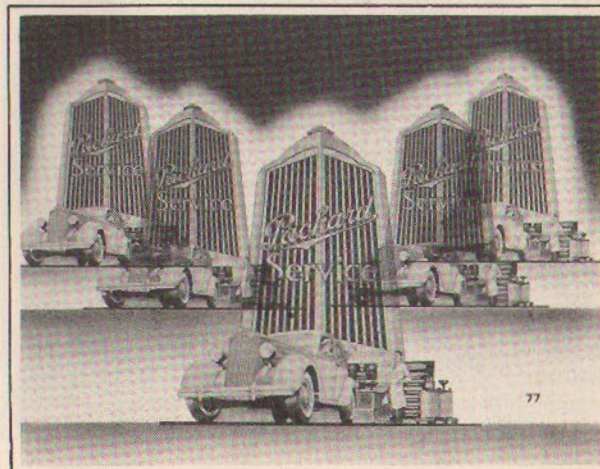
Al: "Well, we do know our stuff. The thing is, to let our customers know we do. And we can do that by selling the job when it's needed, and by doing the job right the first time - every time!"



"So you see, Mr. Peck, it does take time, a considerable amount of work and the proper mechanical knowledge and equipment to do the job right and to assure you of many thousand miles of trouble-free driving."

Peck: "Yes, I guess you're right. I didn't realize there was so much to the job. You seem to know what's required all right. When can you have it done?"

Al: "We'll have it ready for you tomorrow afternoon about five o'clock."



"CONSTANT PROTECTION" - "ASK THE MAN WHO OWNS ONE!"

## CONCLUSION

The film shows in considerable detail the steps to take in locating and correcting the causes of excessive oil consumption.

Dealing with oil consumption is not entirely a matter of fixing the automobile. There is also the problem of handling the owner in such a way as to satisfy him that the condition of his car is normal considering the mileage he has had from it and the conditions under which it has been operated.

Most owners are oil conscious and are inclined to make comparisons regarding their cars which are not always fair comparisons. An engine may be considered economical if it uses less fuel and oil, and costs less to keep in repair than other engines of similar type producing the same power and operating under similar conditions.

If an owner is inclined to brag about the performance of his car, he will mention only its good qualities and will call attention to all the objectionable features of other cars, thus serving to set up a too high standard of performance.

If, however, the owner is registering a complaint with the service department, he will almost invariably take the opposite viewpoint - overemphasizing the objectionable features and very carefully avoiding any reference to or admission of good points in the car's operation. This latter attitude is especially true in cases of so-called excessive oil consumption.

In considering what is proper oil consumption, it is impossible to set up any standard figures of performance.

During the first several thousand miles of operation the current series cars should give about 2000 miles per gallon under average touring conditions. For average about town driving, they probably will not require any oil to be added between changes. For sustained high speed operation 1000 miles per gallon is probably all that can be expected.

As the mileage on the car becomes higher and the piston ring and cylinder wear becomes greater the oil mileage figure is reduced until at some

undetermined mileage the piston rings are worn out and the oil consumption becomes excessive. There is no fixed mileage at which piston rings should be renewed any more than there is any fixed miles per gallon of oil which a car should deliver. Each case must be handled individually, taking into consideration mileage, driving conditions and all those things which are known to affect oil mileage.

The 5000 miles between 20,000 and 25,000 miles is the danger zone of satisfactory piston ring performance, and a check on car mileage is the first step to take in determining if the piston rings should be renewed. If the mileage is in the vicinity of 20,000, if the oil consumption is excessive for the particular driving condition, and the gasoline mileage has gone steadily down, then the piston rings are worn out and must be renewed.

This film lists in order all the steps of checking for the cause of excessive oil consumption. It does not mean that we must necessarily make a correction at each point. It is imperative, however, that each point be definitely checked. Failure to make a necessary correction at any one point may result in the failure of the entire job.

The reconditioning material and procedure described is the result of the work of Packard and Perfect Circle engineers augmented by the cumulative experience of the Packard field service organization.

There are a number of piston rings and piston expanders on the market all of which have their individual points of merit. In selecting reconditioning piston ring and expander equipments more is required than simply oil control at moderate speeds. Acceptable reconditioning equipment must also give favorable results in respect to gasoline mileage, effective life and freedom from breakage, rate of cylinder wear and blow by control at all speeds.

Other ring combinations or variations of the recommended combination may apparently give better results under certain conditions as regards one or more of these requirements. For uniformly good results in all respects and under all conditions, we recommend that you use both piston rings and expanders, and piston head stabilizers as recommended.

HALF-WAY MEASURES . . . . . will produce only . . . . . HALF-WAY RESULTS!!!



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