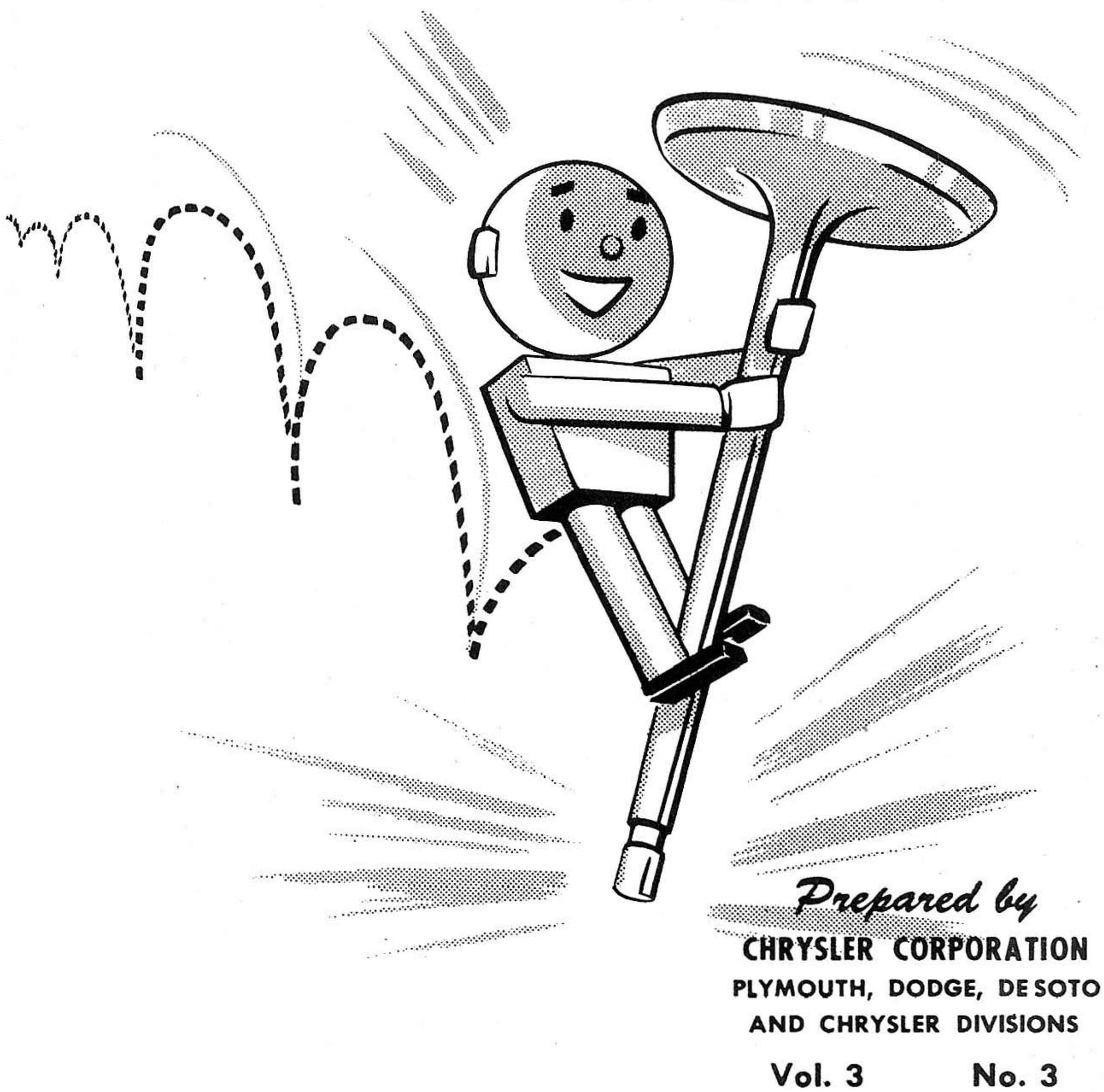
SERVICE REFERENCE BOOK

VALVE UPS AND DOWNS



Prepared by
CHRYSLER CORPORATION
PLYMOUTH, DODGE, DE SOTO
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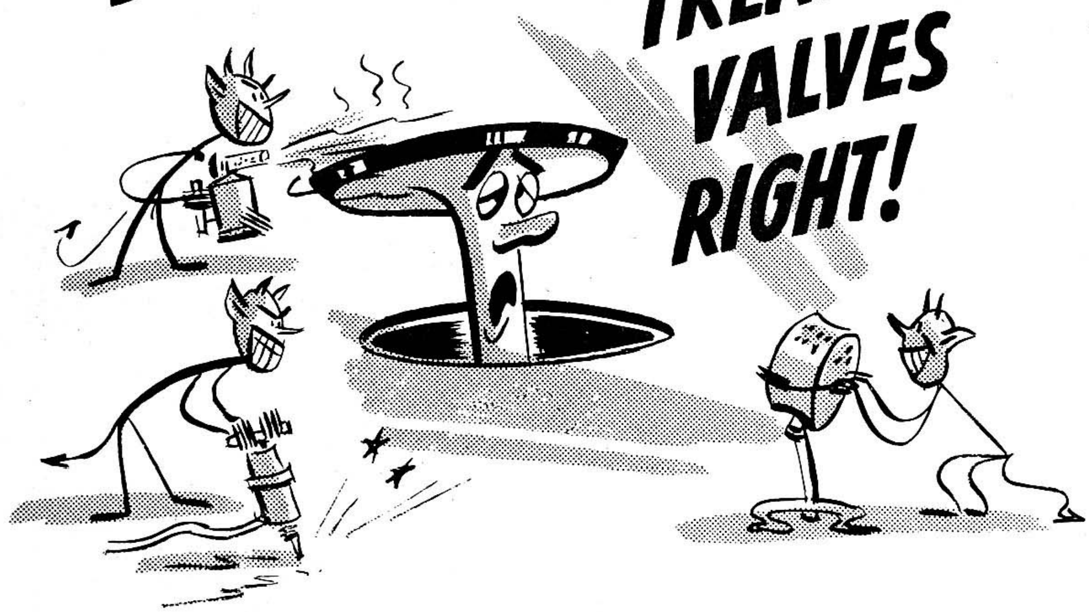
Vol. 3 No. 3

TECH SEZ: TREAT THOSE VALVES RIGHT!



Imagine having the job of working inside a blast furnace, with dynamite going off around you a hundred times a minute!

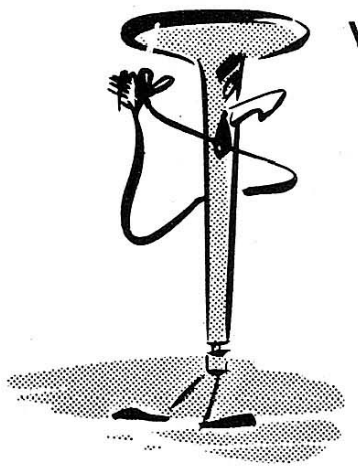
Well, that's just about what valves put up with in an engine, mile after mile. The valves do their job inside the combustion chamber, where the temperature gets as high as 4,000 degrees and the pressure hits 600 pounds per square inch!

That's why valve seats and faces have to be kept in good shape, and all the adjustments have to be *right.* A mistake in adjustment of even a thousandth of an inch or less can make the valves burn or warp so that engine efficiency is lowered.

You can see you have to keep your equipment in good condition and take careful measurements to do good valve work.

The right way "comes naturally" when you know how valves operate. So, let's get started on the "whys" and "wherefores" of valves. Just to help the newcomers out, we'll begin by introducing the different parts of the "valve family."

MEET THE VALVE FAMILY

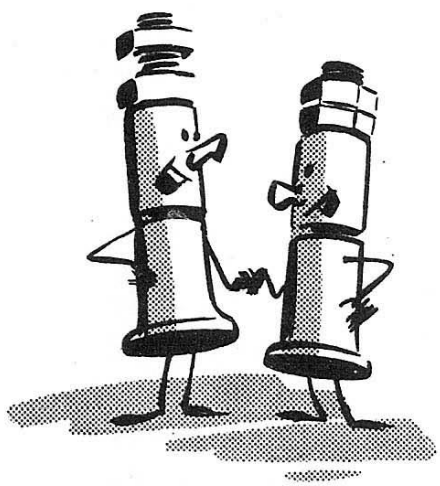


VALVES. The valves have a simple job to do, but it's a mighty important job! They have to open and close passages to the combustion chamber, to let fuel in and exhaust gas out. And they have to seal the combustion chamber *tightly* to prevent loss of pressure. That's why the valves are ground to make a perfect seal with their seats, and that's why they're made of special heat-resistant steels.

EXHAUST VALVE SEAT INSERTS. These are heat-resistant cast iron rings shrunk into the block. They have to be tough, to stand up under the heat of the exhaust gases! Intake valves run cooler, so intake valve seats do not have to be made of special steel. They are cut right in the block.

VALVE GUIDES. The valve guide is a sort of bushing for the valve stem and is pressed into the block below the valve seat. The guide keeps the valve moving straight up and down, so the valve head is centered on its seat.

VALVE SPRINGS. Next come the valve springs. They're big people in the valve family. They've got to hold the valve firmly closed when it's *supposed* to be closed. They allow the valves to open smoothly and keep them from bouncing. The springs push against the valves through the valve spring retainers, which are held in place by the split retainer locks.



TAPPETS. The tappets are the connecting links between the camshaft and the valves. What's more, they're equipped with adjusting screws, which make it possible to control the clearance between the top of the tappet and the lower end of the valve stem. The clearance is provided to take care of expansion caused by heat.

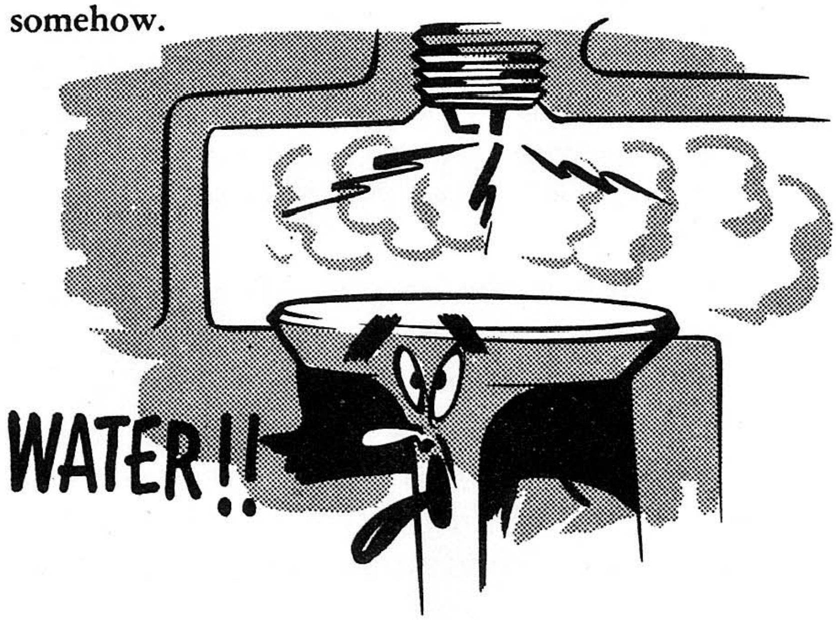
CAMSHAFT. The camshaft is "boss" in the valve family because it controls the movement of the tappets and the valves. The cams are positioned around the camshaft in such a way as to open and close the valves in the right order. To synchronize the action of the valves with the movement of the pistons, the camshaft is connected to the crankshaft by the timing chain.

PROPER SEATING IS THE SECRET OF GOOD VALVE ACTION

Good valve seating is absolutely essential to engine efficiency and satisfactory valve life. In the first place, the valves must make a gas-tight seal with their seats in order to maintain high compression, and you've got to have high compression in order to get full power from the engine.

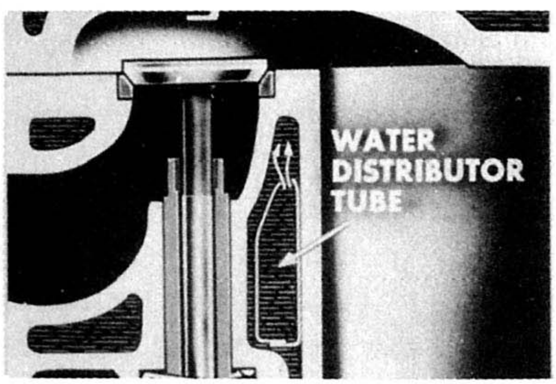
Now, the second reason for good seating is just as important: *you've got to have good seating in order to cool the valves properly!* To make this point clear, let's talk about valve cooling for a moment.

We know that the valves get awfully hot as a result of the burning fuel mixture. In fact, the temperature of the combustion chamber reaches pretty close to four thousand degrees during part of the cycle. The exhaust valves actually get red-hot because the exhaust gas passes around them on the exhaust stroke. You can see that the valve faces and seats wouldn't stand up very long if they didn't get cooled off somehow.



Of course, the answer is that the valves pass on their heat to their seats, which in turn are cooled by the water flowing through the water jacket. The exhaust valve seats get extra cooling from cool water circulated around the seats by the water distributor tube. The intake valves receive additional cooling from the incoming fuel mixture. But the important point is this: the valves have to do most of their cooling during the time they're in contact with their seats.

Okay, maybe you're saying something like this to yourself: "What's so tricky about valve seating? The springs close the valves tight. And there's clearance between the valve stem and the tappet, so that the tappet can't hold the valve open when it should be closed."



Well, you're right. Good valve seating *is* a simple proposition. It's an interesting story, so . . . let's go!

TAPPET CLEARANCES

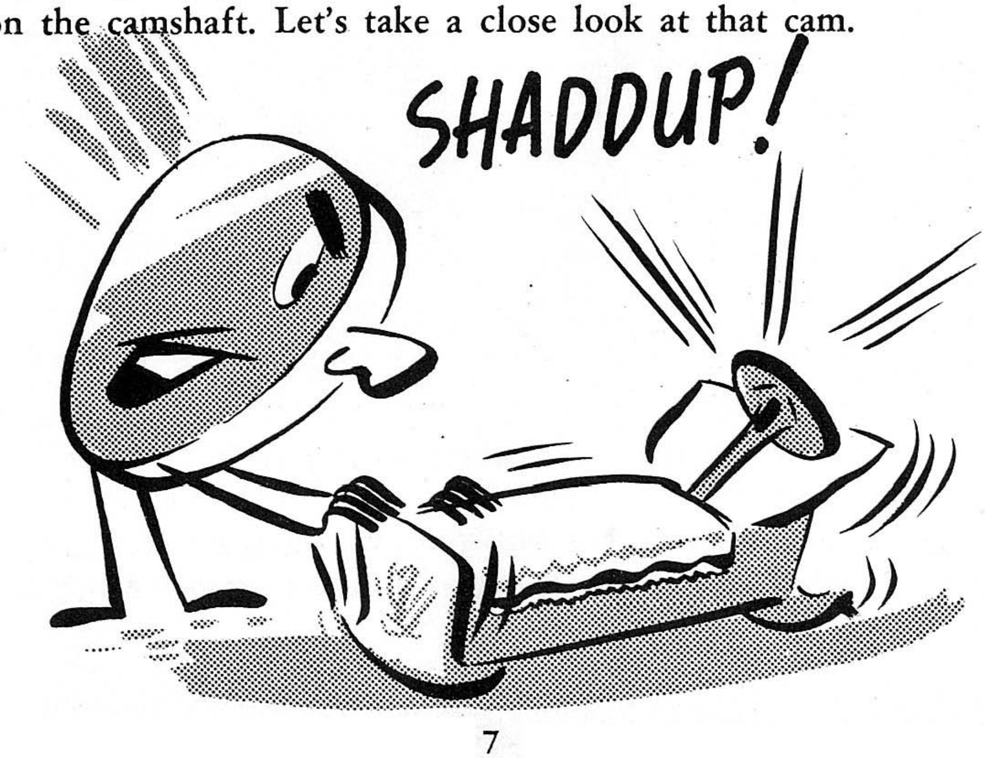
The tappet clearance is the amount of space between the tappet adjusting screw and the valve stem. Naturally, if you set the tappets to one clearance when the engine is cold, the clearance will get smaller as the engine warms up and the valve and tappet expand from the heat. Another thing, this expansion will vary a little, depending on the speed at which the car is driven, and also on other factors. That's why the clearances have to be set wide enough to provide a safety factor so that there'll always be *some* clearance, no matter how hot the engine gets.

On our cars, hot clearances are eight thousandths for intake tappets and ten thousandths for exhaust tappets. If you set the tappets to those clearances, with the engine hot and running, you can be quite sure the valves will be able to close firmly under normal driving conditions.

HOW ABOUT NOISE?

No doubt you are thinking about noise in relation to tappet clearances. It is natural to assume that the tappets will make a noise when the clearance is taken up and the valve is lifted. After all, the tappets have to get the valves open in a hurry, and it's logical to assume that they'd clatter when they hit the valve stems. Actually, that's not true at all.

The valves are kept quiet by a special surface called a "quieting ramp" blended into the contour of the cam faces on the camshaft. Let's take a close look at that cam.

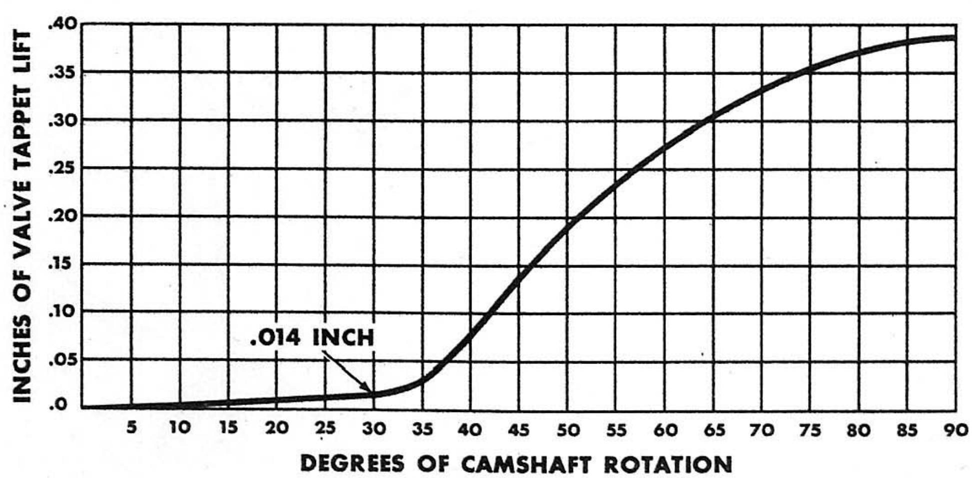


CAMS AND CURVES

Maybe it'll help you to understand the quieting ramp a little better if you refer to the chart on this page. This is a typical story written in "cam language," with degrees of camshaft rotation along the bottom, and inches of tappet lift at the side. It shows you just how much a tappet lifts during each degree of rotation of the camshaft. And, it also helps you grasp *how fast* the tappet is moving up or down at any time.

You'll notice that the black line begins at the left, at zero degrees of rotation. "Zero degrees" is a handy starting point, and it means that the tappet is at the end of the base circle, and is just starting on the quieting ramp. At that point, the tappet lift is zero, because the tappet is riding on the base circle of the cam.

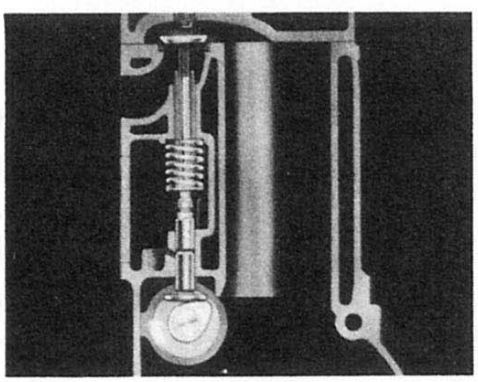
But now, let's see what happens as the camshaft turns. You'll notice that the cam lift is very slow for the first thirty degrees of camshaft rotation. In fact, the tappet only rises gradually.

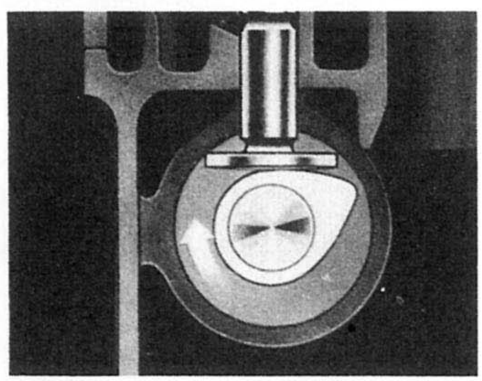


The area of the cam face that's under the tappet during the first thirty degrees of rotation is the "quieting ramp." Actually, it's just a gradual lift on the cam. Now, you can see that the quieting ramp lifts the tappet slowly until the tappet clearance is all taken up and the valve is beginning to rise off its seat.

But, once the valve is actually moving up, the tappet begins to rise faster and faster until the valve is wide open. For example, let's suppose the tappet clearance is set at ten thousandths. By looking at the chart, you can see that the tappet has been raised fourteen thousandths when the camshaft has turned thirty degrees. If the tappet clearance is ten thousandths, a total tappet movement of fourteen thousandths would mean that the clearance of ten thousandths was all taken up, and the valve had been raised four thousandths off its seat. But, during the next sixty degrees of camshaft rotation, which will bring the cam nose up, the valve is wide open. In other words, the valve has moved about three hundred and sixty-six thousandths during the last sixty degrees of camshaft rotation, whereas it moved only four thousandths during the first thirty degrees.

On the way down the other side of the cam, the tappet falls just as rapidly until the valve is nearly ready to close.



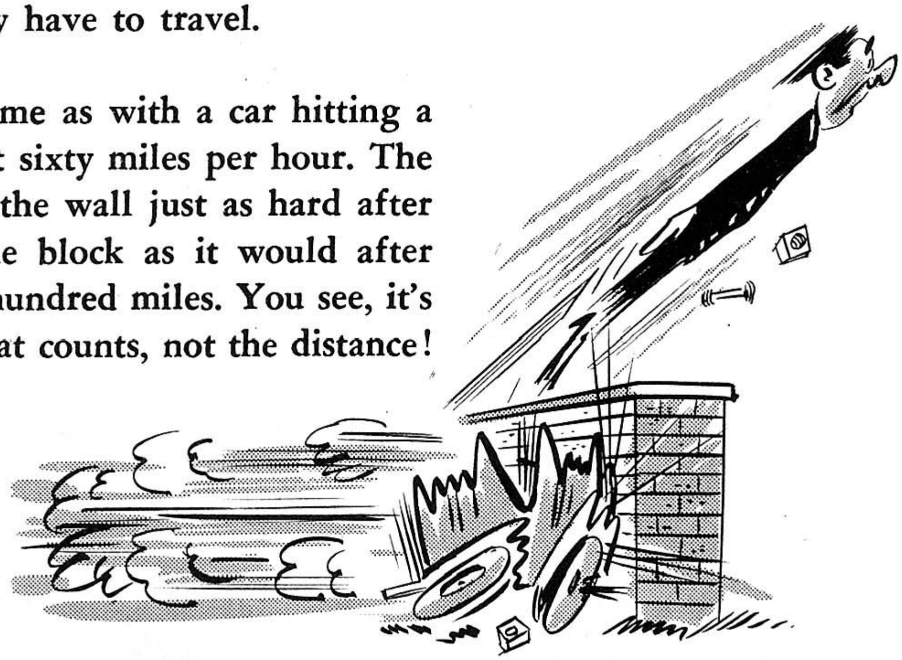


Then the quieting ramp comes into action again for the last four thousandths of valve movement (assuming that tappet clearance is ten thousandths), and eases the valve down onto its seat gently, so that it won't make noise.

NEVER ADJUST VALVES TOO CLOSE

You can see, therefore, that it won't do a bit of good to try to quiet the valve action by setting the tappet clearances closer than specifications. As long as the tappets are on the quieting ramps, they'll be contacting the valve stems slowly, and they won't go any slower if you shorten the distance they have to travel.

It's the same as with a car hitting a brick wall at sixty miles per hour. The car will hit the wall just as hard after traveling one block as it would after traveling a hundred miles. You see, it's the speed that counts, not the distance!

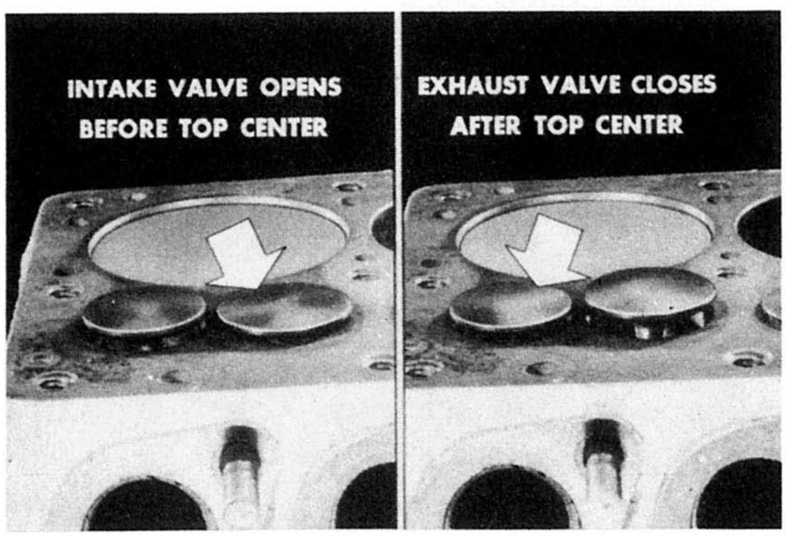


No, you can't quiet noisy valves by setting the clearances closer than specifications. You'll just burn up the owner by burning up his valves! On the other hand, you don't want to set the clearances too wide, either. That would mean the tappets would be off the quieting ramp and moving fast when they hit the valve stems. Then you'd get noise. Another thing—if you set tappet clearances too wide, the intake valve won't open wide enough, or stay open long enough to let in a full charge of gas and air. Also, if the exhaust valve tappet clearances are too wide, all the exhaust gas won't be able to get out of the cylinder before the valve closes.

VALVE OVERLAP

Perhaps you're asking yourself whether slowing down the tappet lift doesn't interfere with getting a full charge of fuel into the cylinder and getting all the exhaust gases out. The answer is "no," because of valve overlap.

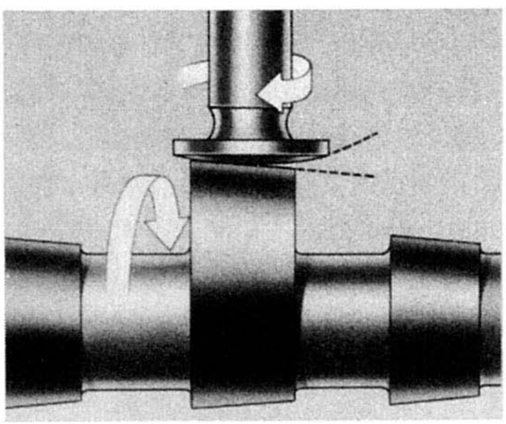
You see, exhaust valves stay open a short time *after* the piston has started down on the intake stroke, and the intake valves open a little bit before the piston has reached the top on its exhaust stroke. In other words, the intake and exhaust valves are both open for a short time at the beginning of the intake stroke. That's what's meant by valve "overlap." By staying open a little late, the exhaust valve permits the maximum amount of exhaust gas to escape. The intake valve starts to open before the piston starts down, so that a full



charge of fuel mixture can move in. Valve overlap gives us a handy method of checking valve timing, which we'll talk about later on.

CAM ANGLES

While we're still on the subject of camshafts, there's another interesting design feature we can talk about. The cam face is machined at a slight angle, sloping toward the front of the engine. And the bottom face of the valve tappet is crowned slightly, instead of being absolutely flat. Here's the reason for that kind of machining. The slanted cam face, acting on the crowned tappet face, causes the tappet to turn slightly whenever it's lifted. The rotating action helps to neutralize the effects of wear, because it prevents wear from being concentrated on any one spot on the tappet face or on the tappet body.



MORE ABOUT VALVE SEATING

So far, we've covered the whys and wherefores of tappet adjustment. However, that's not the only factor that affects valve seating and engine efficiency. There's the condition of the valve guides, for instance.

As we said, the valve guides have the job of guiding the valves straight up and down, so there'll be no chance of their getting cocked and striking their seats off-center or sticking. That's one reason why the guide clearances have to be maintained at specifications.

Another reason for maintaining guide clearances at specifications is *to prevent the formation of carbon, and to prevent excessive oil consumption.* If intake valve guide clearances are too wide, oil may be drawn up through the guide to the combustion chamber, where it's burned up wastefully.

Excessive exhaust valve guide clearance is bad, too. It permits exhaust gas to leak into the crankcase, where it contaminates the oil.

Of course, the general condition of the valve parts has a lot to do with valve seating, also. To make a good seal, the valve faces and seat faces must match, and they've got to be free of pits or burned spots.

And naturally, the springs have to be strong to close the valves firmly and smoothly, without fluttering.

Now, as you know, valves don't stay in perfect condition indefinitely. Improper adjustment, accumulation of deposits, excessively heavy driving or plain neglect can cause improper seating and lowered engine efficiency. That's why it's important for every mechanic to understand how to adjust valves properly and how to recondition them when they need service.

We're going to talk about that shortly, but first—let's see how we can spot valve trouble when it occurs.

DIAGNOSING VALVE TROUBLES

You've got reason to suspect valve trouble when an engine is hard to start, operates roughly, or misses or backfires. Of course, some of these conditions can be caused by improper ignition timing, carburetor difficulties, or worn piston rings. But, vacuum and compression tests will help you decide which one you're dealing with.

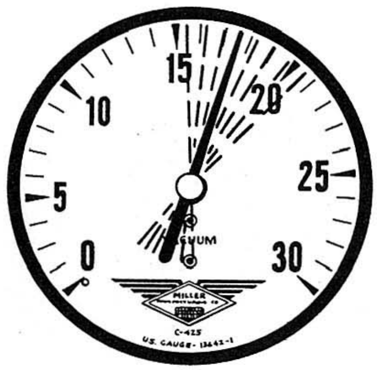
Valve Leakage. If a valve is sticking, or is burned so it does not make a tight seal against its seat, the vacuum gauge needle will show a steady drop of three or four points each time that particular cylinder operation is recorded.

To pin the trouble down more definitely you can make a compression test. If the compression is low in a cylinder, and stays low even after the rings in that cylinder have been sealed with oil, it is a pretty good indication that the valves in that cylinder are leaking.

Sticking Valves. If the vacuum gauge needle shows an intermittent drop of three to four points, and the drop seems to be in time with the firing of a particular cylinder, you would immediately suspect the valves in that cylinder to be sticking in their guides.

You can double-check on sticking valves by squirting a little penetrating oil through the spark plug hole and onto the valves. Or, you can try pouring a valve-freeing compound into the carburetor throat while the engine is running. If the valves show signs of freeing up, you can be pretty sure that the trouble was caused by gummed or carboned valve stems or guides. This procedure affords only temporary relief, however.

Worn Guides. When the vacuum gauge needle vibrates rapidly while the engine is idling you can be pretty sure that the trouble is caused by worn intake valve stem guides. This is because air is being drawn in between the valve stem and the guide, reducing the vacuum in that cylinder.



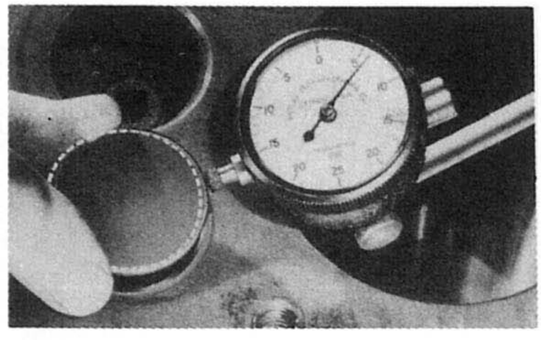
Weak Springs. You can spot weak or broken valve springs by speeding the engine up to about two thousand r.p.m. If the springs are weak, the vacuum gauge needle will fluctuate rapidly between about twelve and twenty-four inches of vacuum. Of course, if a spring is broken, the needle will fluctuate rapidly every time that valve attempts to close.

NOW . . . THE RECONDITIONING JOB

Once you've satisfied yourself that a reconditioning job is necessary, you can remove the head and the valves and make a thorough inspection. Give the cylinder head, piston heads, valves and valve seats a good "brush-off" with a wire brush to remove all the carbon. And . . . here's a tip that'll save you trouble—a wooden rack with twelve holes will come in handy for keeping the valves in the proper order. They're bound to give better service if you get the valves back in the same guides they originally occupied.

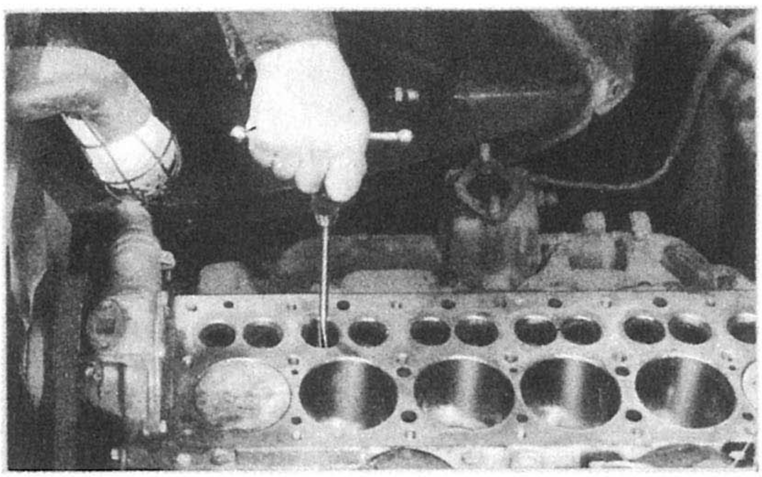
MAKE SURE THE GUIDES ARE REALLY "GUIDING"

The most practical way to check valve stems and guides for wear is to put the valve in the guide after the carbon has been cleaned out, and measure the amount of side-to-side movement of the valve with a dial indicator. To get good results you want to make the test with the valve at its fully opened position. Remember, clearances are different on intake and exhaust guides, and clearances are different on different models. So, be sure you "guide" yourself by specifications when you're checking guides. Also check for scuffed valve stems which might damage new guides if the scuffing is not removed.



REPLACING GUIDES

If there's too much wear in the guides, you can drive them out and replace them with new ones. The replacement guides are supplied with undersize bores so you can mike the valve stem diameter and ream the guides to fit. Here's one place where a couple of easy cuts are better than one heavy one. Don't try to hog out too much metal with one cut.



When you're replacing guides, be sure to drive them in to the exact depth specified for the model you're working on. You see, it's important to get the guide in to the proper depth in the block. You can scale off the specified depth and mark it on the driver, so you'll know how far down to drive the guide.

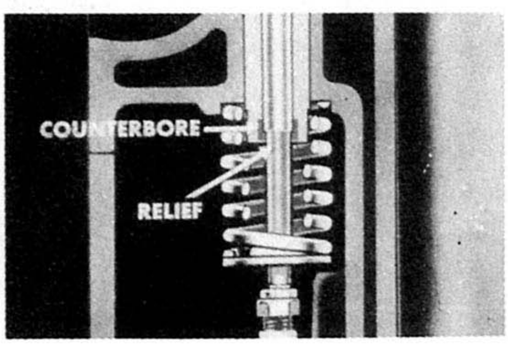
COUNTERBORE UP OR COUNTERBORE DOWN?

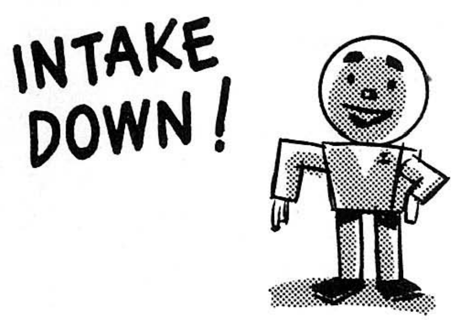
Actually, the valve guides used for intakes and exhausts are the *same*—but are *installed differently*.

You may have noticed that intake valve guides are installed in the block with the counterbore toward the bottom, while exhaust guides are installed with the counterbore up. And you've probably noticed that intake valve stems are relieved (or undercut) at the bottom, while exhaust valves are relieved at the top. Naturally, there's a good reason for this.

The guides for the exhaust valves are installed with the counterbore up so that the guide can act as a shield to protect the valve stem from the hot exhaust gas. And—the relief on the valve stem makes a ridge which helps to scrape carbon out of the guide.

The intake guides are installed with the counterbore down to provide a shield against excessive oil reaching the valve stem. This keeps an excessive amount of oil from traveling up the stem. The edge of the relief on the valve also helps to scrape oil back down the stem.





GIVE THE VALVE THE BEST SEAT!

There are a couple of good points to keep in mind when you're refacing valve seats. For one thing, be sure to clean the carbon out of the valve guides with a valve guide cleaner.

Another thing, remember that light pressure on the grinder will give you the smooth surface you want. Don't take any chances on chattering the stone by bearing down too hard. And, be sure the stone is clean and true, so you'll be taking a clean cut.

Remember to keep the width of the seat within proper limits. Seats should be between a sixteenth and three thirty-seconds of an inch wide. If they're too wide, you'll have a hard time getting a good gas seal. You can trim down a wide seat by relieving the edge with a twenty-degree finishing stone.

You can check the seat for run-out after you've cut it, by using an indicator. Run-out shouldn't be greater than .0015 inch.

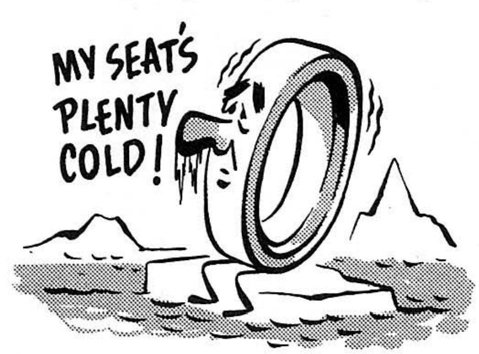
CAUTION: Make sure the indicator pilot fits snugly inside the guide, so there's no chance of its wobbling and giving a false reading.

GET A SNUG FIT ON VALVE SEAT INSERTS

Once in a while you may come across inserts that are cracked, or too badly burned or pitted to be refaced. In this case, you'll have to replace them to get a good gas seal. You can pull the old inserts the easiest and safest way by using a special jaw-type puller.

Now, the new insert can't conduct the valve heat to the water jacket unless it makes a good tight fit in the counterbore. So, if the insert is loose in the block, counterbore the block and install a ten-thousandths oversize insert.

You can get a perfect fit by boring the counterbore from two to four thousandths of an inch *smaller* than the oversize insert. Then, to get the insert in without putting the "squeeze" on it, you can chill the insert with dry ice and use a driver to drive it in squarely and to the full depth. When that insert warms up and expands, it'll be in to stay!



By the way, in order to make sure that the upper edge of the insert won't stick up above the block, you'll want to make the counterbore about two to four thousandths deeper than the height of the insert. In any case when you're replacing inserts, be sure you remove all burrs. In other words, get a snug fit, so the insert can cool properly.

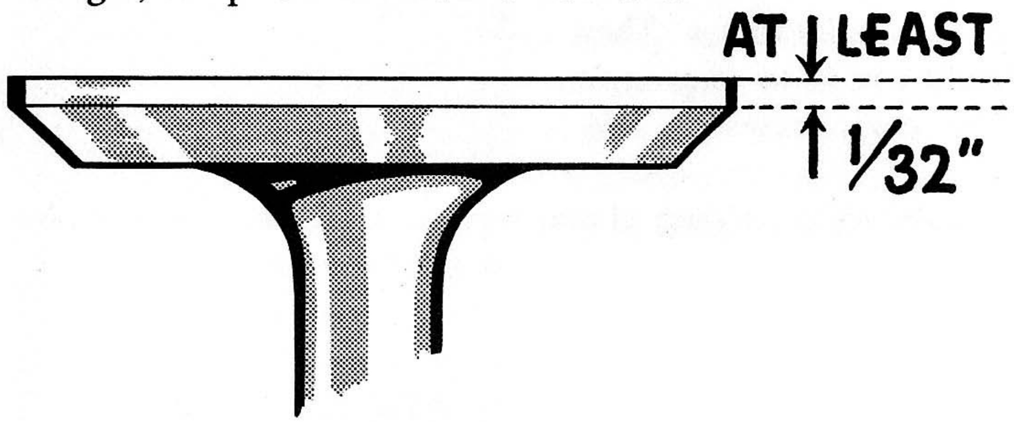
Replacement inserts have to be re-faced after they're installed, in order to provide the proper seat.

CHECK YOUR EQUIPMENT BEFORE REFACING VALVES

It's not smart to try to reface valves that are cracked, badly burned or warped. You can usually tell if a valve is going to clean up properly by observing if it runs true in the grinder chuck. But—keep this in mind—your refacing job isn't going to be any better than your equipment. So make sure your grinding equipment is in good shape, and make certain the valve runs true in the chuck.

Another thing—make sure your wheel is square and true, and *clean.* If you use a dull wheel you might scratch the valve face.

Now, all you want to do when you're refacing is to remove enough metal to clean up all pits and burned spots so you have a smooth, even surface that'll make a good seal with the valve seat. *Don't* cut down so far that you leave a knife edge at the top of the valve. You should have at least a thirty-second of an inch margin between the upper edge of the face and the top of the valve. If you didn't have enough margin, the valve would be weakened and it would quickly burn or warp. If a valve won't clean up and still leave that margin, scrap it and install a new one.



In order to avoid scoring or scratching, smooth up the lower section of the valve stem with crocus cloth before reinstalling it. And it's smart to oil the valve stem before replacing the valve, so as to make sure the valve starts out properly lubricated. Take a good look at the end of the valve stem, too. If the end is badly worn, grind it down flat to prevent an inaccurate valve tappet clearance adjustment later on.

Lapping Valves. Lapping valves into their seats is sometimes done in order to get a perfect gas seal. Since you just want to put the final touch on the valves, without removing metal, you'll find it's best to use a fine lapping compound and apply light pressure. You'll have better control over the lapping operation if you put a light coil spring under the valve head.

And—here's an important caution—*never pound the valve against its seat!* Pounding will damage the seats and cause pitting of the valve face. When you finish, wipe out all the compound to prevent any of it working into the guides.

Always check the springs in a testing fixture and replace any that don't come up to specifications. They should test 40 to 45 pounds when compressed to 1¾ inches.

While we're talking about springs, remember, it doesn't make any difference which end of the spring is up when you install it.

VALVE SPRING BREAKAGE

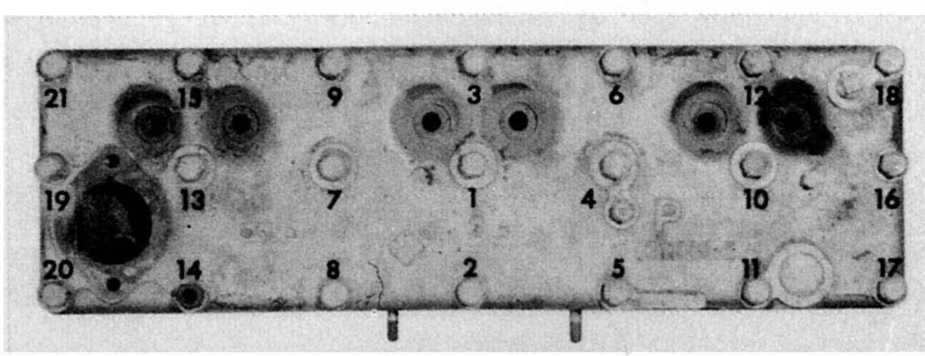
It's a long way from the crankcase to the valve chamber, but it's a fact that the condition of the engine oil has a big effect on the length of life of the springs. As you know, vapor condenses on the walls of the engine when it cools off. Normally, this vapor is drawn out by the crankcase ventilating system when the engine warms up to full operating temperature. But—if the engine *doesn't* warm up fully, that condensation is allowed to mix in with the lubricating oil, where it forms acid and sludge. Naturally, the acid will form most readily when a car is operated on short runs in cold weather, or under stop-and-start driving conditions. The acid "etches" the outer surface of the springs, and ultimately weakens them enough to cause breakage. It also affects other parts of the engine which may result in failure.

In order to prevent damage to springs, bearings and other parts, stop-and-start drivers should change oil and oil filters more frequently, or make occasional long runs that will warm the engine up enough to vaporize the condensation. In some cases, you might want to install a 180° thermostat, to make the engine run warmer.

THAT FAMOUS TORQUE WRENCH

The torque wrench is a mighty handy tool for any job that requires tightening to close torque specifications. You've probably used it often to make sure you got parts down tight, without taking any chances on distorting or warping something. Well, a torque wrench is just about essential when it comes to tightening down the head after a valve job.

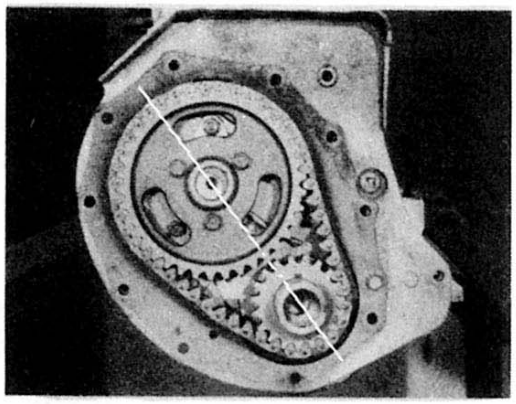
You've got to use a torque wrench if you want to get the head down tight, *without distorting the block.* That would keep valves and rings from seating properly! So, don't ruin a good valve job by last-minute carelessness. Use the torque wrench and tighten the head cap screws or stud nuts in the proper sequence to the specified torque. And that sequence is important—by following it, you sort of "iron out" the head on the top of the block. In case you've forgotten, here's a diagram giving the proper order for tightening the head.



VALVE TIMING

As we said before, valve timing is controlled very accurately by the timing chain. Consequently, you won't have to adjust the valve timing unless someone has set it up incorrectly. But—just to give yourself that feeling that the job is perfect—you'll want to check the valve timing before you install the head.

You can check the timing very easily by turning the engine over and watching the valves and pistons. The timing is okay if the intake valve opens just a little before top center on the exhaust stroke and the exhaust valve closes just after. Simple, hey?



With the head on, you can check the timing easily with the valve timing gauge. All you have to do is set the intake valve tappet clearance at fourteen thousandths, and turn the engine over until the intake valve tappet just touches the valve stem. Then, you can read piston travel on the gauge and check it against specifications for the model you're working on. Now, in case you ever have to adjust valve timing, remember that when the timing chain is installed, the two marks on the sprockets should be together, and in a straight line with the centers of the camshaft and crankshaft.

WHAT TO DO ABOUT WORN TAPPETS

Here are a few pointers to keep in mind if you ever have to replace tappets because of looseness or excessive wear. In the first place, remember to get the tappets out of the way of the camshaft lobes when you're pulling the camshaft. You can protect the camshaft from nicking or scratching by holding the tappets up with spring clothes pins or some other kind of holder. And—rotate the camshaft as you draw it out, so as to clear the tappets.

If new tappets fits too loosely in the guides, you can ream the guides oversize and install oversize tappets. Tappets are available in one, eight, thirty and sixty thousandths oversizes.

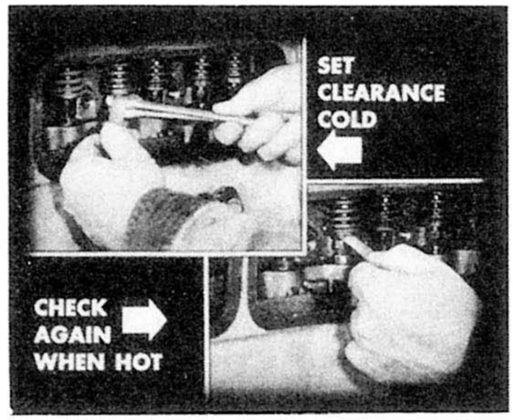
It's a good idea to check the mushroom faces of the tappets for pits or scratches that might damage the cams. If the faces are pitted or scratched, replace them. And—to protect the new tappets—check the cam lobes for signs of roughness or chipping. Also make sure that the tappets are rotating.

TAPPET ADJUSTMENT

As a preliminary cold setting, you can adjust tappets to nine thousandths for intakes and twelve thousandths for exhausts. Of course, to get an accurate cold setting, you'll have to adjust each tappet when the cam nose is *down*. That's when the tappets are farthest down on the cam. If you set the clearance when the tappet was part way up the quieting ramp, you'd have excessive clearance when the tappet came down again.

Another thing, be sure the feeler stock you're using is flat and of the proper thickness. Old feeler stock that's bent or torn can easily throw your valve adjustment off enough to cause trouble.

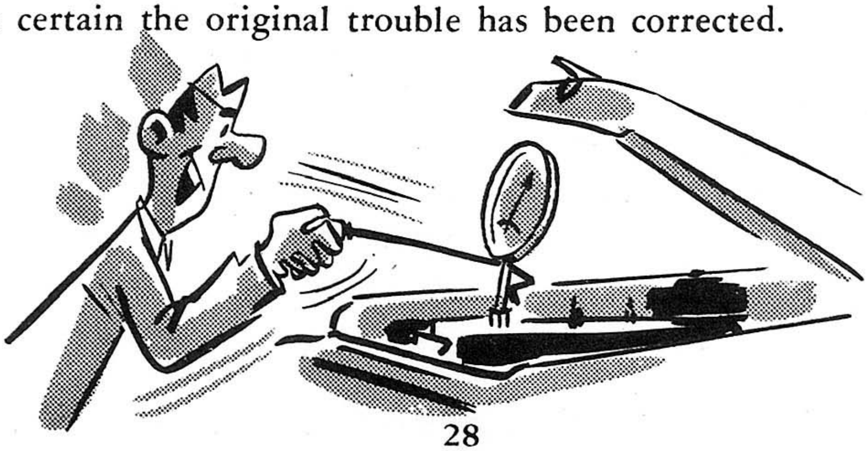
Danger! Never omit the hot check! Always finish up by checking tappet clearances with the engine warmed up to normal operating temperature, and running at normal idling speed. You see, it's the running clearance that's important. So, be sure the tappet clearances are *right.* (Intakes, eight—exhausts, ten.)



But, as we said, if you know a car is going to be operated at high speeds for long periods of time, you can increase valve life by setting the exhaust valves at twelve thousandths, engine hot and running.

WINDING THE JOB UP

Before you turn a car back to the owner, make sure the engine is showing the results of the work you've done on it. You can double-check yourself by making a final vacuum test to be certain the original trouble has been corrected.



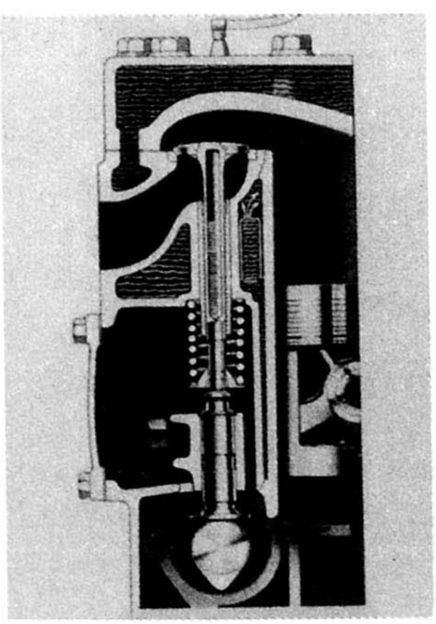
Also, it's smart to check the ignition timing and clean up or replace the points. The carburetor should be checked and adjusted, if necessary.

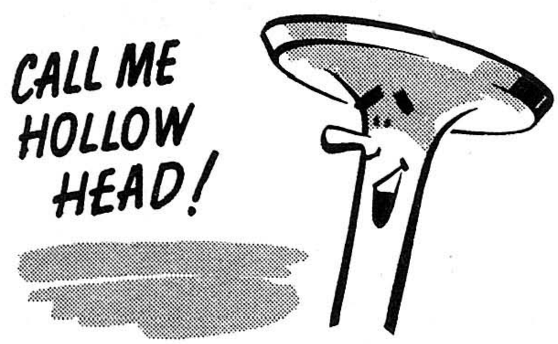
TRUCK VALVES

Truck engines carry heavier loads and operate under more severe conditions than most passenger car engines. That's why truck valves are given protection against high temperatures and wear. Special valves are sometimes used in some truck engines in order to give top operating efficiency.

SODIUM-COOLED VALVES

You've probably heard that sodium-cooled valves were used in wartime fighter-plane engines because of their ability to "take it" when the going got tough. Sodium-cooled exhaust valves are used in heavy truck engines for the same reason. Sodium valves are hollow in the head and stem. The hollow is filled part-way with sodium, which melts at 207°.





When sodium-cooled exhaust valves warm up, the sodium melts and sloshes up and down inside the valve, helping to carry heat from the head down to the seat and stem. Sodium-cooled valves last a lot longer under harsh operating conditions because of their efficient heat transfer.

Sodium-cooled valves are also protected against heat and wear by a facing of Stellite, which stays hard even when it gets extremely hot.

Now, you've got to protect yourself against sodium-cooled valves! That sodium powder explodes as soon as it hits the air. *So—don't let anybody cut open one of those valves!* And, when you dispose of worn-out valves, *bury them* where they won't be dug up by people who don't know how to handle them.

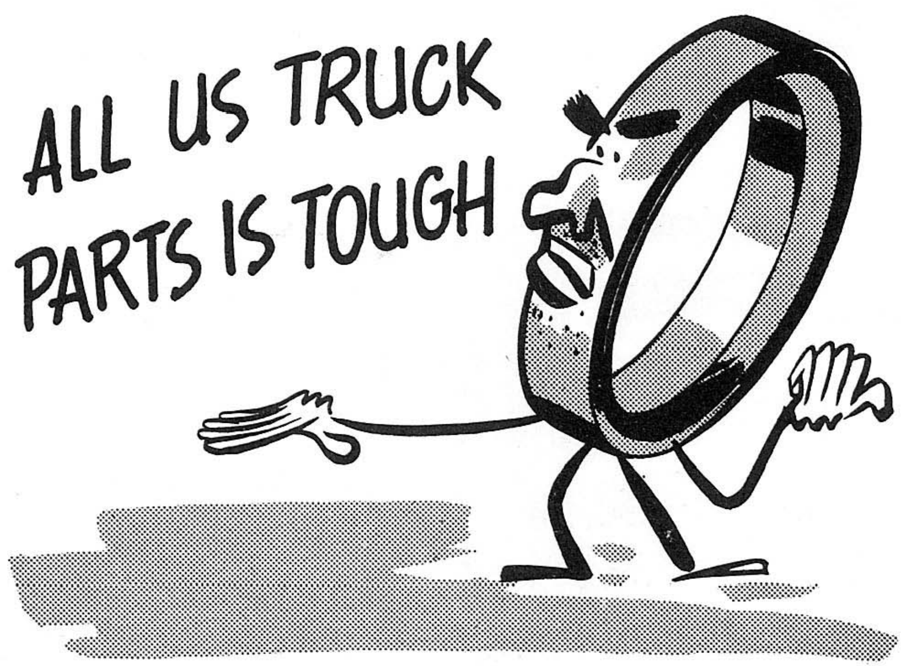
When sodium-cooled valves are used, hot tappet clearances should be eighteen thousandths for exhaust valve tappets and ten thousandths for intakes. When solid stem exhaust valves are used the clearance should be fourteen thousandths.

HEAVY-DUTY VALVE PARTS

In order to increase valve life, truck engines are equipped with special wear- and heat-resistant valve parts. Two-and-a-half and three-ton truck engines are fitted with Stellite-faced exhaust valve seat inserts. On these same trucks you'll find special valve guides which are grooved as an aid in lubricating the sodium-cooled exhaust valve stems.

Also, on many two-ton trucks equipped with sodium-cooled valves, bronze guides are used because of their superior cooling properties. You can improve cooling on some truck engines by installing these guides as replacements in case the engines have sodium-cooled valves but cast iron guides.

Intake valves are tougher, too. Special Silchrome-alloy steel is used for intake valves on some trucks equipped with sodium-cooled valves. Also, these trucks are equipped with Silchrome-alloy intake valve seat inserts.



KEEPING 'EM ROLLING

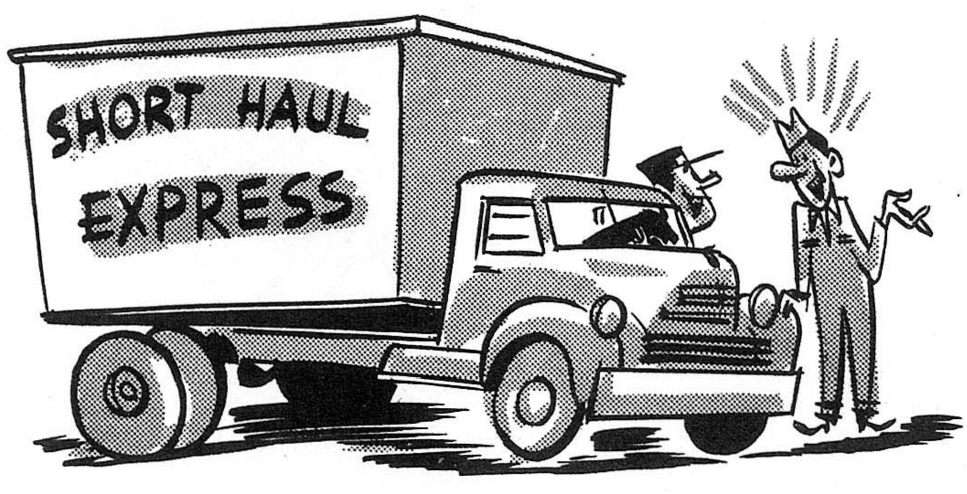
Regular maintenance is very important in the case of truck engines. The tappet clearances should be checked and adjusted —*hot*—every ten thousand miles, at least. Also, the cooling system should be kept free of scale or corrosion that might interfere with proper cooling of the valves.

MoPar Rust Inhibitor comes in handy for reducing scale and corrosion when anti-freeze isn't being used.

Watch that carburetor setting, too! A lean mixture heats up the engine and a rich mixture creates carbon deposits in the combustion chamber and on the valve heads and stems.

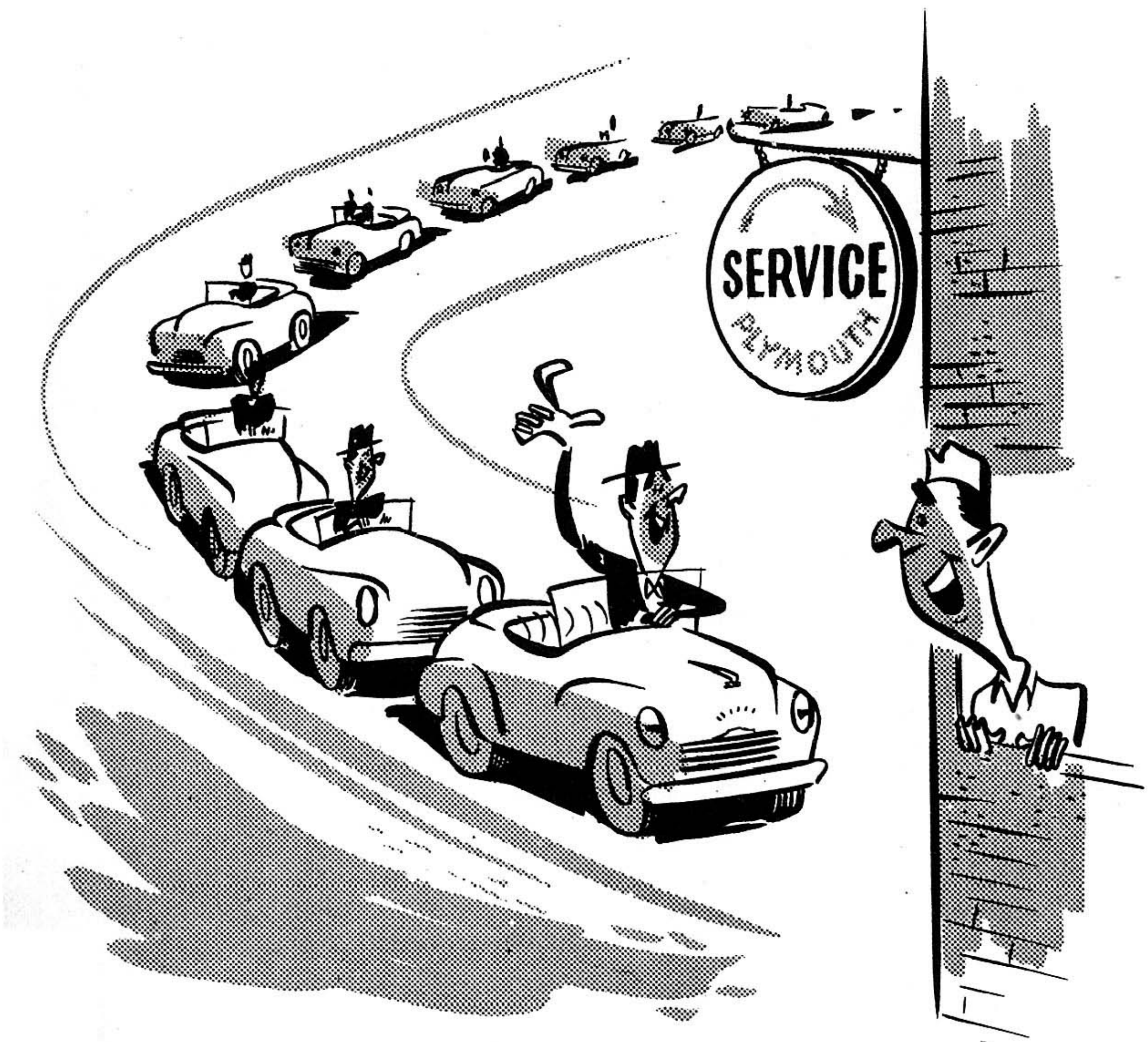
Ignition timing should be kept "on the button," also. Early timing or improper distributor operation may increase engine heat and perhaps warp or burn the valves.

Remember that we said acid and sludge form in the oil when an engine is operated for short periods without getting a chance to warm up fully? That's your tip to recommend more frequent oil and oil-filter changes for trucks that are operated under stop-and-start conditions.



No-load engine speed has a lot to do with valve life. So, be sure you've got the top engine speed controlled according to specifications if the truck is equipped with a control governor.

When you're reconditioning truck *or* passenger car valves, remember that care and precision workmanship are the biggest factors in the kind of work that brings customers back. If you give the valves the care they deserve, the customers will repay you in the only way that counts—by bringing you increased service business.



VALVE CLEARANCE, VALVE TIMING and CYLINDER HEAD TIGHTENING SPECIFICATIONS

Valve tappet clearance—hot Exhaust Intake	 .010 inch .008 inch	 All Models
Tappet clearance for valve timing	.014 inch	All Models
Valve stem to guide clearance Exhaust Intake	 .002 to .004 in. .001 to .003 in.	 All Models except P-15, which is .003 to .005 in. All Models
Valve guide distance, top of guide to top of block. Exhaust Intake	 7/8 inch 7/8 inch	 All Models except C-37, which is 1 inch; C-39, C-40, C-46, C-47—1 3/32 in. All Models except C-37, which is 13/16 in.; C-39, C-40, C-46, C-47—1 in.
Valve spring pressure, when compressed to 1 3/4 in.	40 to 45 lbs.	All Models except C-37, which is 52 to 58 lbs. at 2 1/32 in.
Valve spring pressure, when compressed to 1 3/8 in.	107 to 115 lbs.	All Models except C-37 which is 129 to 137 lbs. at 1 21/32 in.
Valve timing; intake valve opens BTDC (degrees of crankshaft rotation)	17° to 5°	All Models except C-37, which is 11° BTDC to 1° ATDC; D-29, 30, which is 12° BTDC to TDC.
Valve timing; intake valve opens BTDC (piston travel in inches)	.122 to .011 in.	All Models except—P-15, 17, 18 which is .125 to .011 in. D-29, 30 which is .065 to TDC C-37 which is .057 to TDC C-45 which is .135 to .012 in.
Cylinder head cap screws torque tightening tension—ft.-lbs.	65 to 70	All Models except D-24 stud nuts, which are tightened from 52 to 57 ft.-lbs.

VALVE CLEARANCE, VALVE TIMING and CYLINDER HEAD TIGHTENING SPECIFICATIONS

Valve tappet clearance—hot Exhaust Intake	 .010 inch .008 inch	 All Models
Tappet clearance for valve timing	.014 inch	All Models
Valve stem to guide clearance Exhaust Intake	 .002 to .004 in. .001 to .003 in.	 All Models except P-15, which is .003 to .005 in. All Models
Valve guide distance, top of guide to top of block. Exhaust Intake	 $\frac{7}{8}$ inch $\frac{7}{8}$ inch	 All Models except C-37, which is 1 inch; C-39, C-40, C-46, C-47—$1\frac{3}{32}$ in. All Models except C-37, which is $\frac{13}{16}$ in.; C-39, C-40, C-46, C-47—1 in.
Valve spring pressure, when compressed to $1\frac{3}{4}$ in.	40 to 45 lbs.	All Models except C-37, which is 52 to 58 lbs. at $2\frac{1}{32}$ in.
Valve spring pressure, when compressed to $1\frac{3}{8}$ in.	107 to 115 lbs.	All Models except C-37 which is 129 to 137 lbs. at $1\frac{21}{32}$ in.
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Cylinder head cap screws torque tightening tension—ft.-lbs.	65 to 70	All Models except D-24 stud nuts, which are tightened from 52 to 57 ft.-lbs.

TEST YOURSELF WITH THESE TEN QUESTIONS

1. Setting tappet clearances closer than the specifications will make valve action quieter.	RIGHT ☐	WRONG ☐
2. Valve seats should be between a sixteenth and three thirty-seconds of an inch wide.	RIGHT ☐	WRONG ☐
3. Valve seat run-out should not be greater than .0015 inch.	RIGHT ☐	WRONG ☐
4. Valve springs should test 25 to 35 pounds when compressed to 1¾ inches.	RIGHT ☐	WRONG ☐
5. Valve springs can be installed either end up.	RIGHT ☐	WRONG ☐
6. The quieting ramp comes into operation only when the tappet is being raised.	RIGHT ☐	WRONG ☐
7. The guide for the exhaust valve is installed with the counterbore up so the guide can shield the valve stem from hot exhaust gas.	RIGHT ☐	WRONG ☐
8. The bottom face of the valve tappet is flat so that it can contact the cam evenly.	RIGHT ☐	WRONG ☐
9. Always check tappet clearances with the engine warmed to normal operating temperature and running at idle speed.	RIGHT ☐	WRONG ☐
10. A torque wrench should be used to tighten head cap screws or stud nuts to the specified torque and in the proper sequence.	RIGHT ☐	WRONG ☐

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