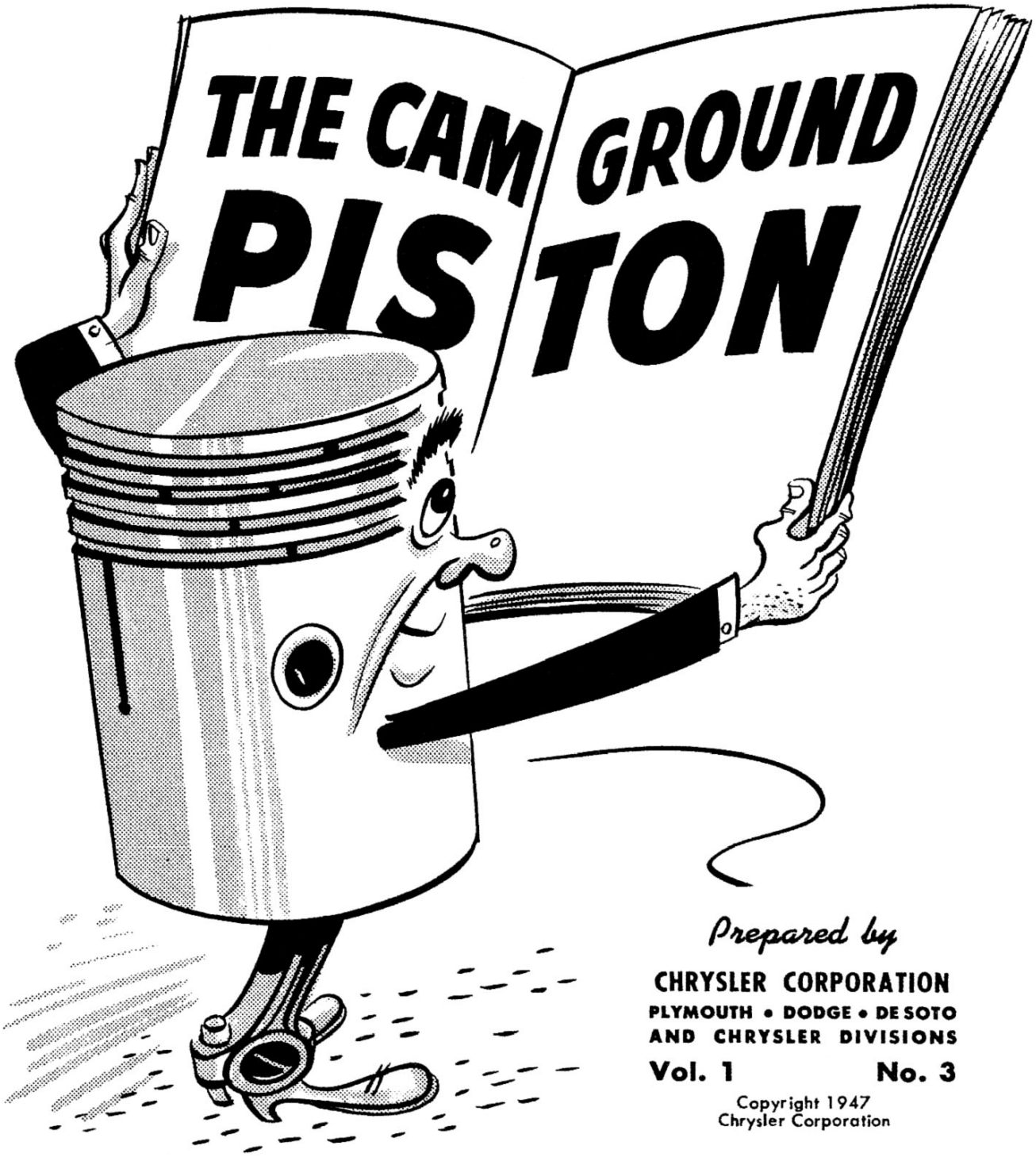
SERVICE REFERENCE BOOK

THE STORY BEHIND

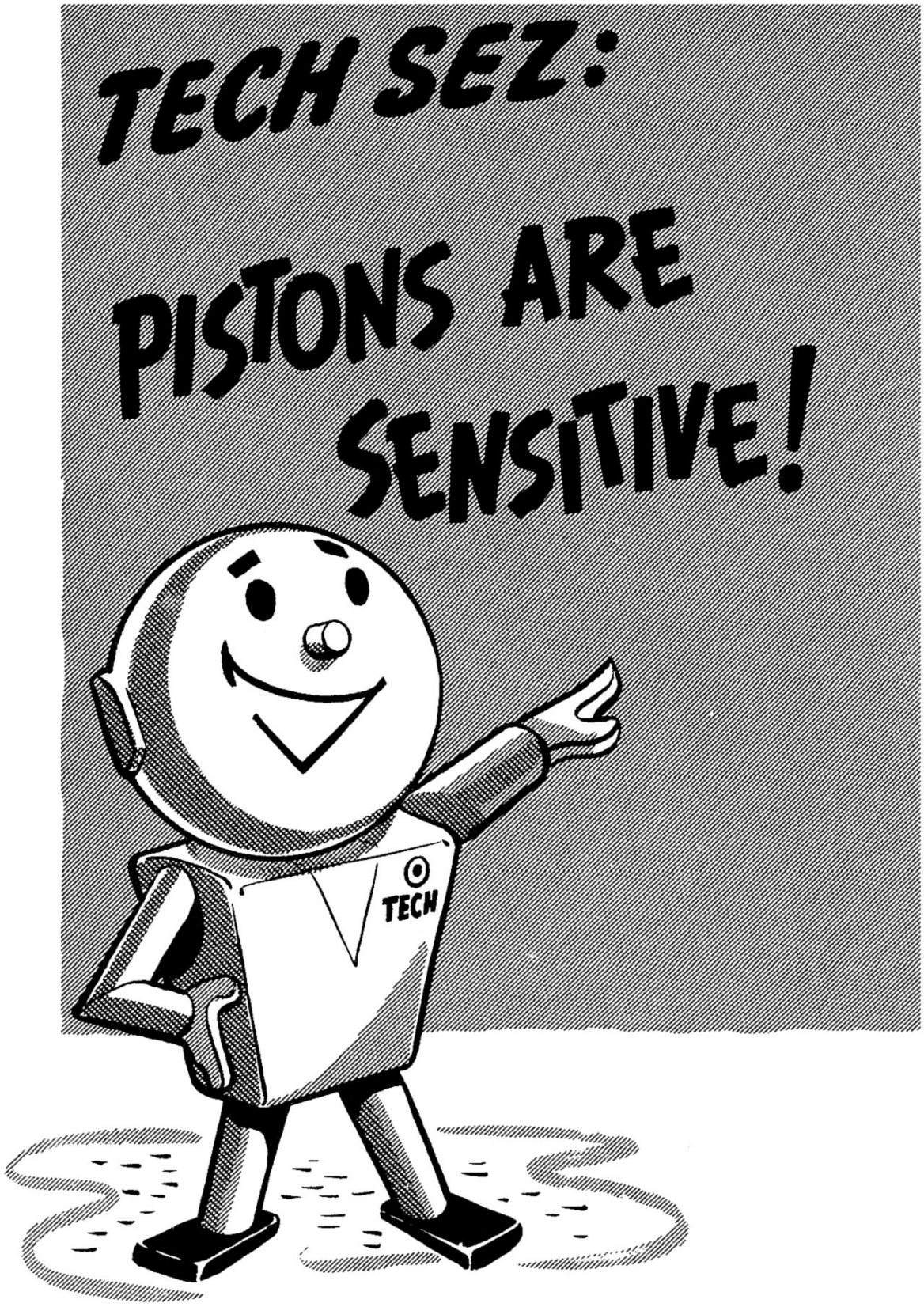


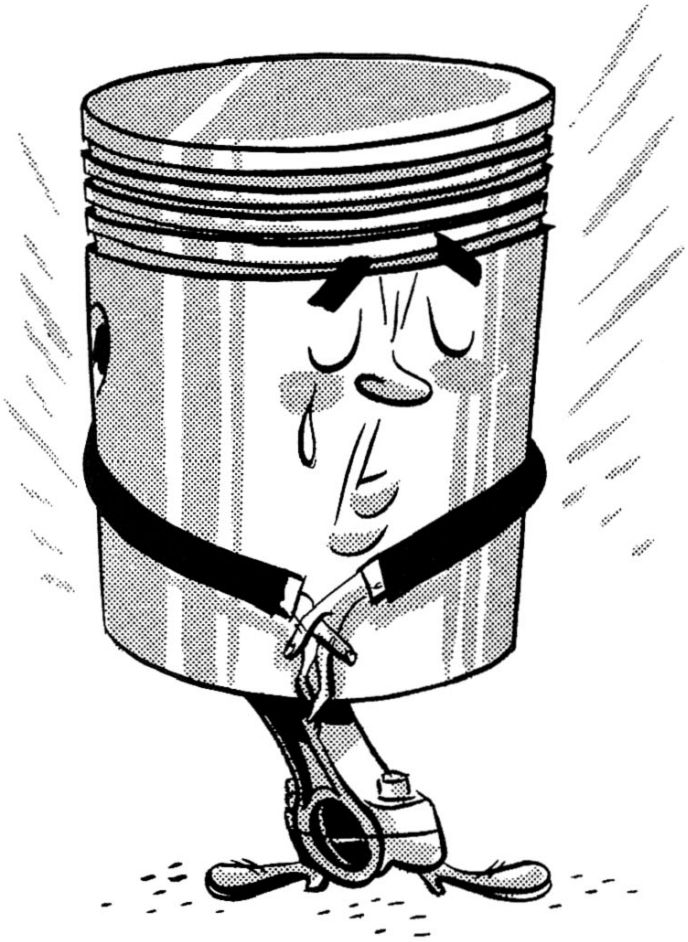
Prepared by

CHRYSLER CORPORATION

PLYMOUTH • DODGE • DE SOTO
AND CHRYSLER DIVISIONS

Vol. 1 **No. 3**

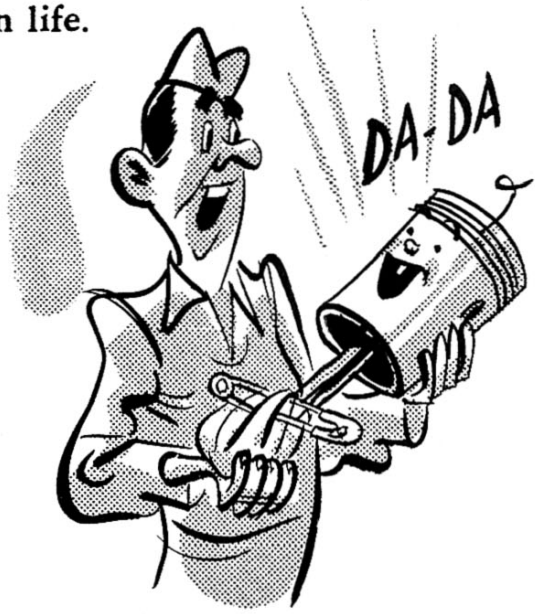




The pistons are one of the most sensitive parts of an engine. They're sensitive to heat and cold, and they're sensitive to rough handling.

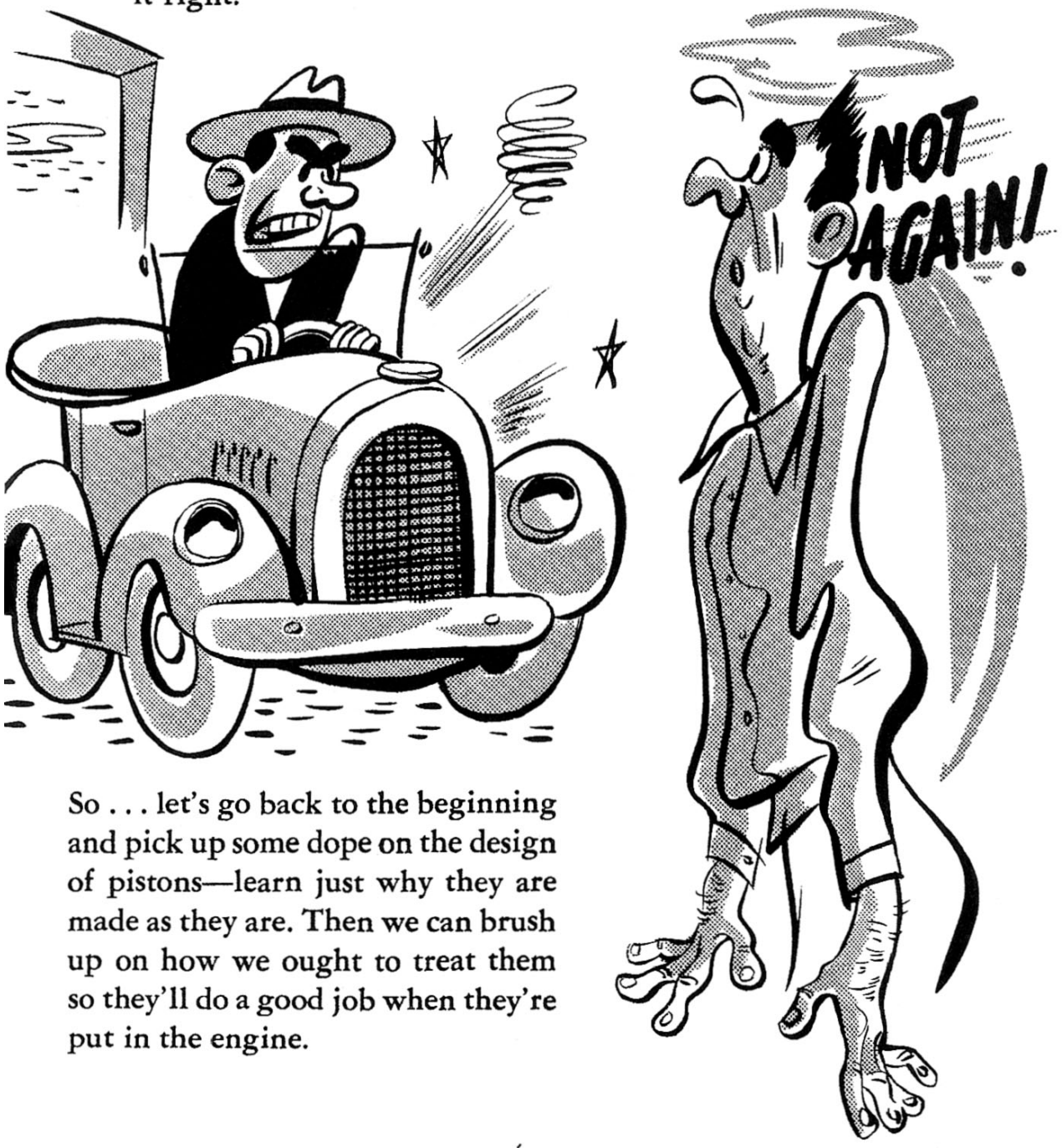
With all that, they are tough! They "have what it takes" to stand up under the terrific blasts of heat from the burning mixture just above their heads, and from the force of combustion which drives them downward. And . . . they always come back for more!

In some respects you might say they are like a child—the treatment they get when they're young (or new) determines just how useful they are going to be when they are given a job to do. That's why we have to understand them—learn how they act—so we can give them a proper start in life.



And a proper start in life, to a piston, means proper handling and proper fitting with its associated parts. If we handle them too roughly and get them out of shape, or if we fit them improperly when we match them up with the piston pins and the cylinder bores, they get off to a bad start. And that means trouble for the owner and mechanic from then on.

You've probably installed a lot of pistons at one time or another. On the whole your jobs have probably turned out all right. But . . . maybe you can remember a job or two that *didn't* turn out so good. And maybe you can remember what a lot of trouble you had with it until you finally got it right.

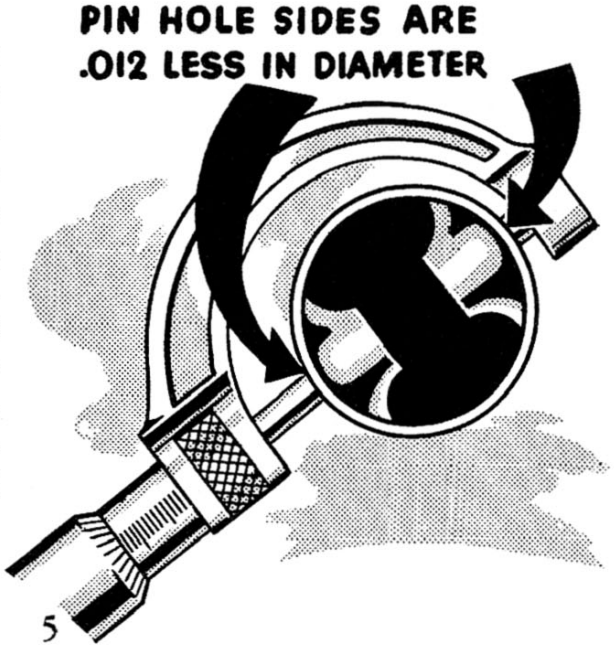


So . . . let's go back to the beginning and pick up some dope on the design of pistons—learn just why they are made as they are. Then we can brush up on how we ought to treat them so they'll do a good job when they're put in the engine.

LET'S GET ACQUAINTED WITH THE PISTON

Before we get into the meat of this subject, let's take a close-up look at this piston of ours. We want to know how it is made, and why.

First of all, our aluminum alloy pistons are cam ground. That means that instead of grinding the piston perfectly round, it is ground with high and low sides—like a cam. The high sides of the cam are the thrust faces of the piston—the low sides are the pin hole sides. When you mike a piston across the thrust faces you'll find that the diameter is about .012 inch more than across the pin hole sides.



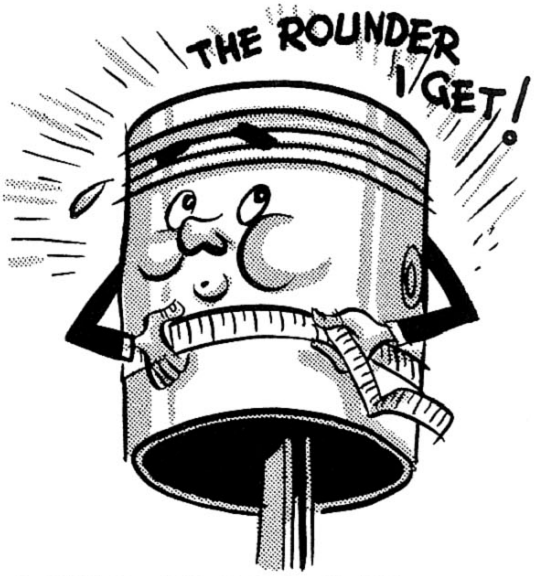
And the reason they're made like that is very simple. It's just because a cam ground aluminum piston can be fitted to closer limits than an aluminum one that isn't cam ground, without danger of scoring. And . . . the closer you can fit a piston and still have it operate satisfactorily under all conditions of temperature, the better running engine you will have.

FIT OF THE PISTON

You see, the cam ground piston has two high sides—the thrust faces. You should fit the piston in the cylinder so it will pass through the bore with a light push of the hand . . . you can stop it anywhere in the bore and it will barely hold itself in place without falling through of its own weight. Just a nice, even, light push all the way through the cylinder.

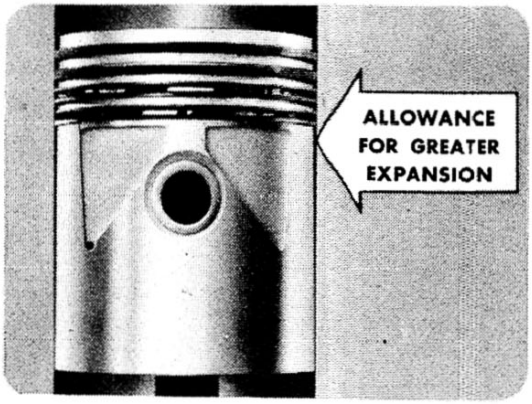
When you fit a piston that close it means that the thrust faces lightly contact the cylinder wall, and yet there is a clearance of about .006 inch on each pin hole side . . . because they are the low sides of the piston.

So...when the piston gets hot and starts to expand, it can't expand outward at the thrust faces because they are already up against the cylinder wall. Therefore, it has to expand outward at the pin hole sides because that's the only spot where there's room for expansion. The result is that the piston becomes more nearly round when it expands, and therefore fits perfectly in the cylinder bore at operating temperatures.



AND THAT'S NOT ALL . . .

That isn't the only design feature of the cam ground aluminum alloy piston. The head is .030 inch smaller in diameter than the skirt. So, if it is smaller than the skirt to begin with, it can expand more and still not actually come in contact with the cylinder wall.



And . . . the skirt is tapered—narrower at the top than at the bottom. If you'll mike the piston across the thrust faces at the bottom of the skirt, and then mike it just under the bottom ring groove, you'll find that the skirt is about .001 inch smaller at the top than at the bottom. And that's mighty important! The reason for that taper is the same as the reason for the smaller head size . . . the top of the skirt gets hotter than the bottom, so this design allows more room for expansion at the top, to prevent scuffing.

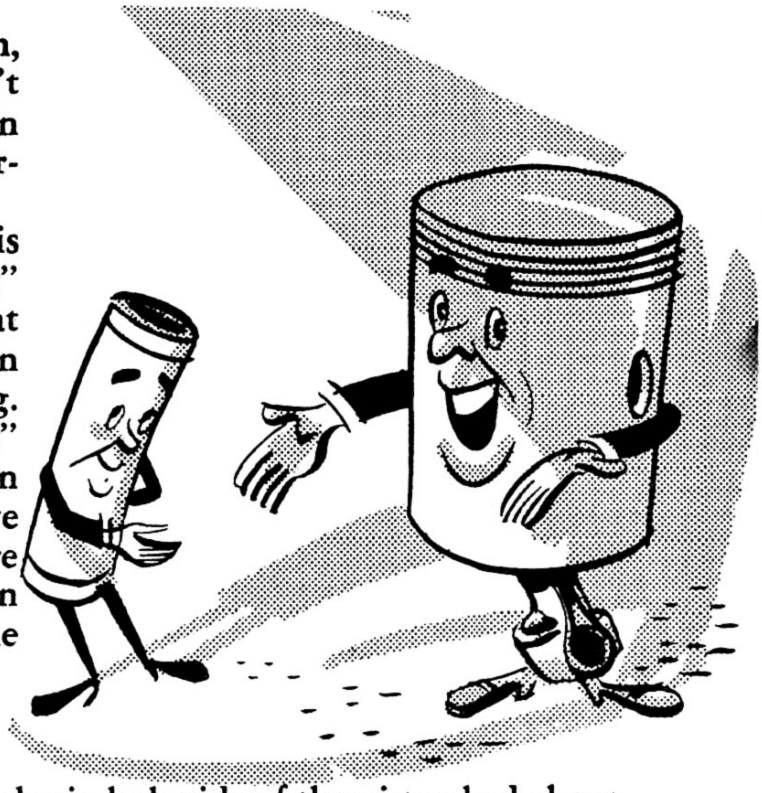
Further . . . one of the thrust faces has a U-shaped slot cut in it. That's to permit more expansion at the top of the skirt, as the piston heats up. This greater expansion at the top of the skirt is taken up by the U-slot so the piston will not seize in the cylinder when it becomes hot during operation. So you can see . . . the aluminum piston is designed with the cam ground, tapered skirt, and U-slot features to allow it to expand and give the proper fit at all temperatures.

That's why it is so important that you understand just what you're doing when you fit a piston in a cylinder. And it's another reason (if you need one) why it is so important that your semi-finished pistons be finished on a cam grinding machine so they'll have the proper shape. A type "E" cam, which will give a .012 inch cam, should be used when grinding the piston to secure the correct shape.

MEET THE PIN TOO!

Just an ordinary piston pin, you'll say. Sure! But don't overlook the fact that the pin has a lot to do with the performance of the piston.

The piston pin is what is known as a "full floating" type. That is, it's free to float or move in the piston and in the connecting rod bushing. Not only does the pin "float" in the piston, but the piston is supposed to be able to move freely on the pin—and we're interested particularly in side-wise movement of the piston on the pin.



HERE'S WHY . . .

Remember we said that each pin hole side of the piston had about .006-inch clearance from the cylinder wall, and that when the piston began to expand, the pin hole sides expanded outward toward the cylinder wall?

Well, they'll do that . . . if the piston pin bosses haven't contracted so much that the pin is seized in the pin holes. A tight fitting pin could spoil everything. Therefore, fitting the pin properly in the piston is mighty important.

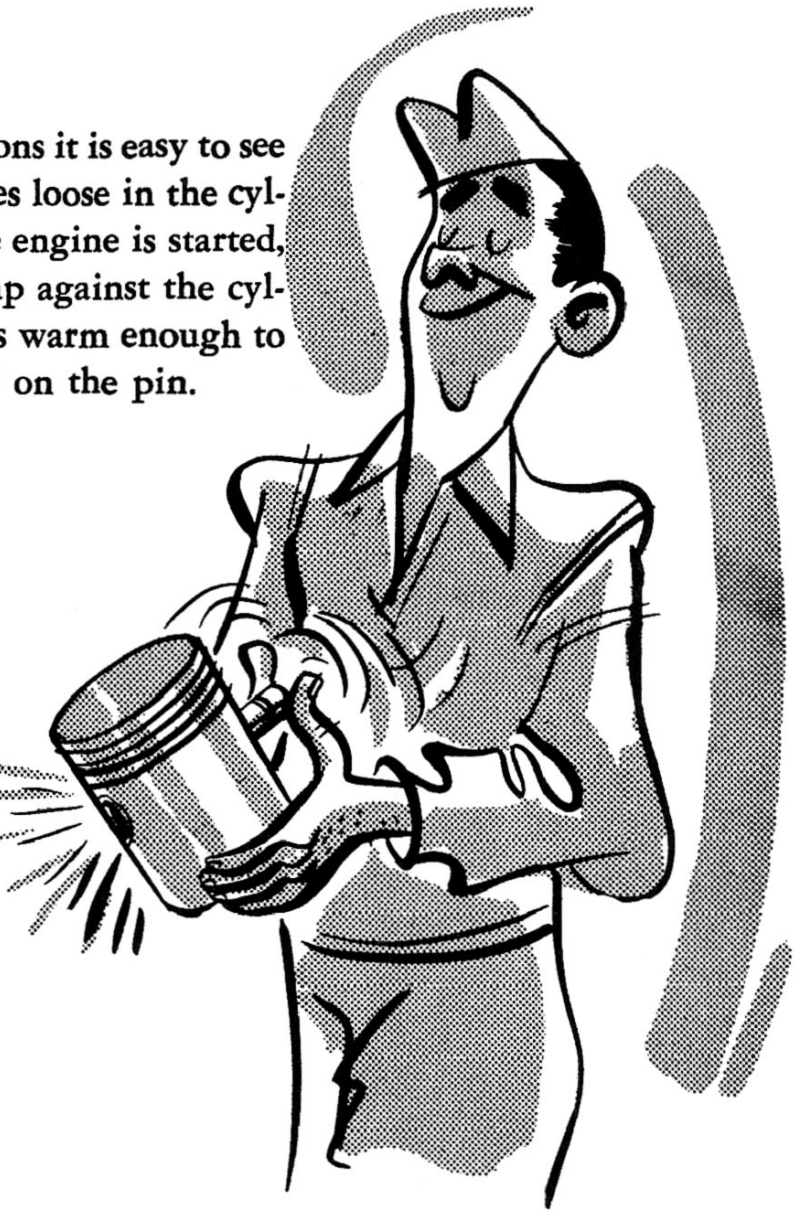
Suppose the pin is fitted too tight? What harm does it do?

There you have the real villain behind most cases of cold-engine piston slap. The pin is so tight in the piston that the piston can't contract as it should when it cools off.

This is what happens:

The piston starts to contract in the normal manner, and depends on the pin hole sides to move in and allow for normal contraction. But, if the pin is fitted too tightly in the pin holes when the pin bosses cool off well below 70 degrees they seize on the pin. The pin hole sides then are held out and cannot contract normally. Something has to give—so the thrust faces pull in, out of shape. When this happens, the thrust faces pull away from the cylinder wall, and they no longer have the light pressure fit against the wall they had originally.

Under these conditions it is easy to see that the piston becomes loose in the cylinder. Then, when the engine is started, the piston is apt to slap against the cylinder wall until it gets warm enough to expand and free itself on the pin.



So there you have the main cause of cold-engine piston slap. And the only thing you can do about it is to pull the piston at fault and enlarge the pin holes until you can push the pin through the piston with your thumbs, with the piston and pin at room temperature (70 degrees).

LOCATING THE PISTON AT FAULT

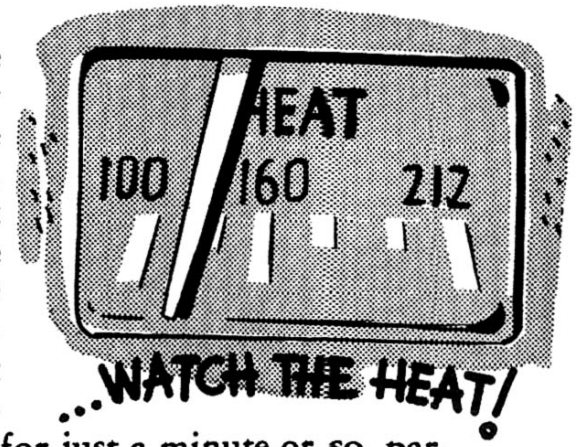
A cold piston slap is one that is hard to locate. First of all you can't hear it by the time the owner gets the car to the shop. It goes away like the toothache does when the patient arrives at the dentist's office. And yet the owner swears it's there, and thinks you're a little off the beam if you can't find it.

It's the kind of piston slap that occurs only when the engine is cold. It's a piston slap, all right—but it's usually caused by a tight fitting piston pin. And you can hear it with the engine idling—the engine doesn't have to be pulling. By the time the engine warms up the piston expands and frees up on the pin, so the knock goes away.

If you short out the spark plugs—one at a time—until you find the cylinder (or cylinders) where the noise disappears, you've located the piston (or pistons) at fault. Maybe it doesn't go away entirely, but it quiets down enough for you to be sure that the piston down below that spark plug is the one that's causing the trouble.

IT'S *YOUR* PROBLEM

Your problem, Mr. Mechanic, is to know when to operate on the engine and when to leave it alone.

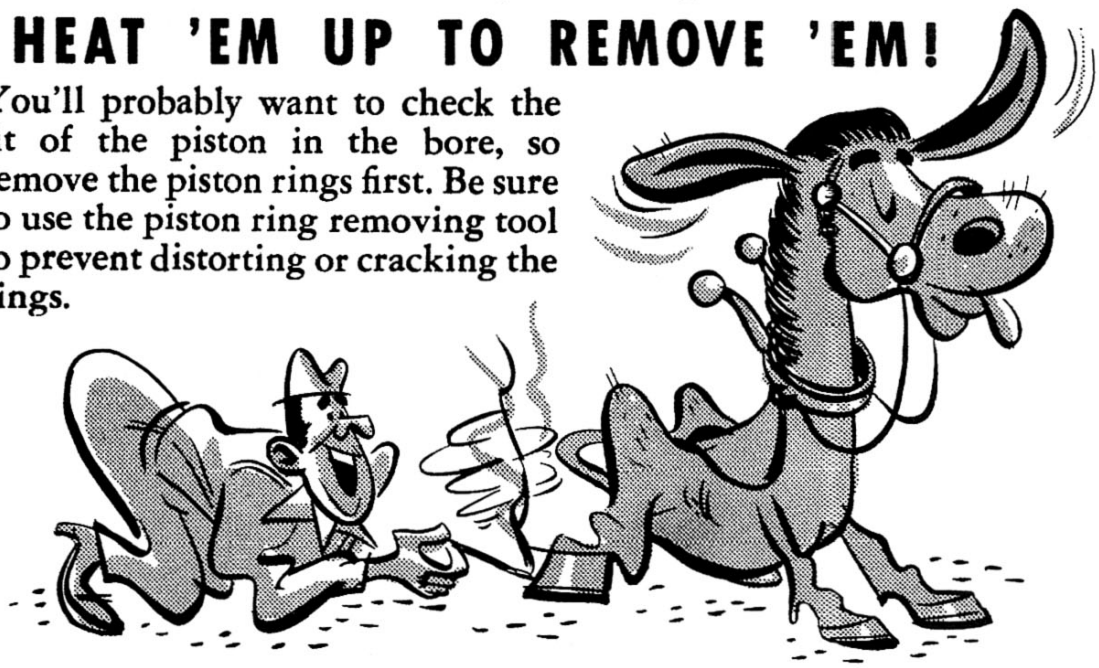


Well, here's how you can be sure. If the noise goes away by the time the heat indicator needle starts to move away from the pin, it is a pretty good indication that the trouble isn't going to cause a bit of harm. So you can tell the owner that, with a clear conscience. And you certainly don't want to pull an engine down to correct a noise that can be heard for just a minute or so, particularly when you know it isn't going to cause trouble.

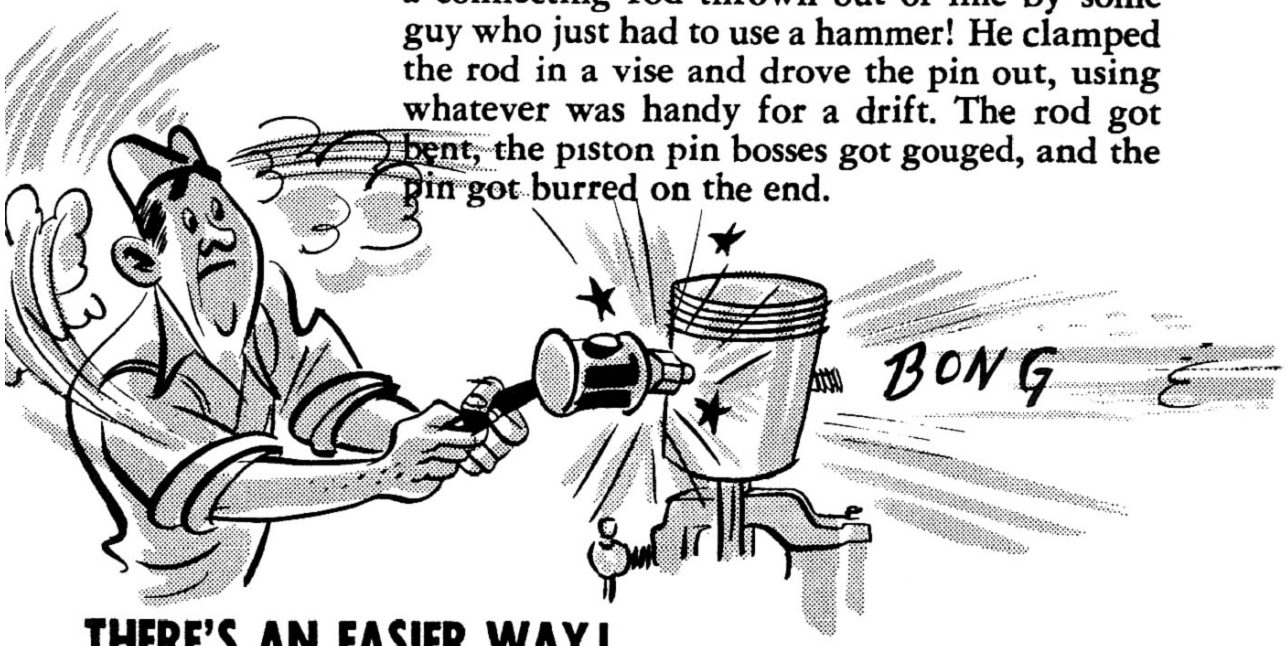
But if the noise doesn't go away until the engine reaches operating temperature, chances are the pin is too tight, and you'd better make arrangements to get the car in long enough to pull the piston and refit the pin. And when you do that . . . be sure you do it right.

HEAT 'EM UP TO REMOVE 'EM!

You'll probably want to check the fit of the piston in the bore, so remove the piston rings first. Be sure to use the piston ring removing tool to prevent distorting or cracking the rings.



Many a good piston has been ruined, and many a connecting rod thrown out of line by some guy who just had to use a hammer! He clamped the rod in a vise and drove the pin out, using whatever was handy for a drift. The rod got bent, the piston pin bosses got gouged, and the pin got burred on the end.

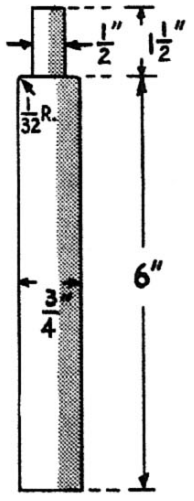


THERE'S AN EASIER WAY!

If you'll dunk the piston in a bucket of hot water after you pull it out of the engine, you'll usually be able to push the pin out with your thumb (after you remove the lock rings, of course), and you won't be taking a chance of damaging the piston or throwing the connecting rod out of line.

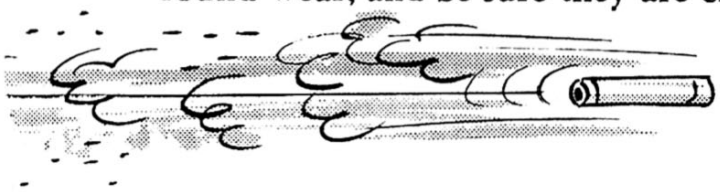
There's always the occasional job that doesn't work like the book says—maybe you couldn't push the pin out of a heated piston if you had *ten* thumbs! What do you do then? Well . . . you drive the pin out! But before you do, you make yourself a drift (if you don't have one).

Here's how a good pin drift should be made . . . and if you haven't one of your own you might want to make one just in case you might need it some time. The pilot end must be small enough to fit freely inside the pin, and the shoulder of the drift must be just a little (about a sixteenth of an inch) smaller than the outside diameter of the pin. And when you use it, heat the piston first. Then lay the piston in one hand, enter the drift in the pin, and tap the drift lightly with a hammer.

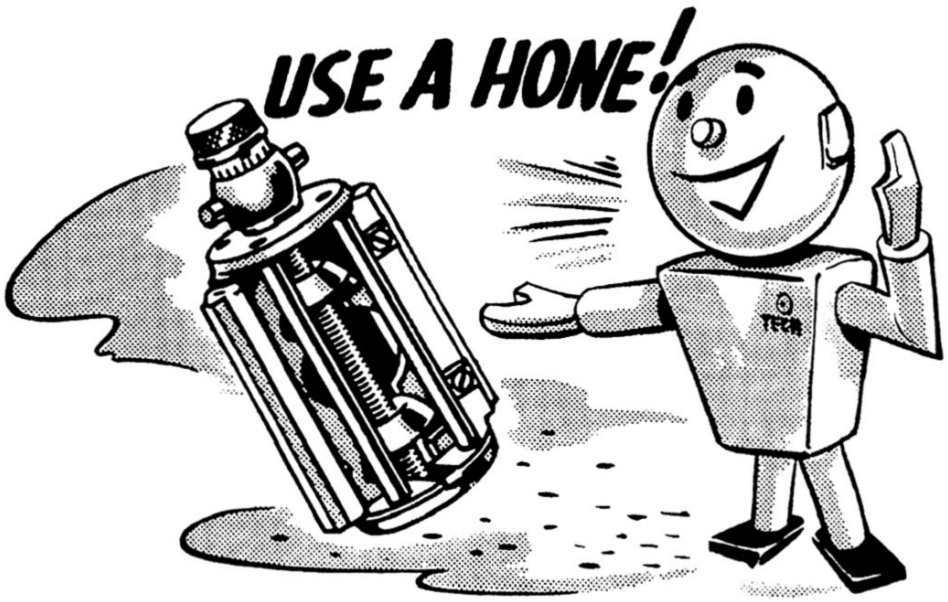


DON'T BE A CYLINDER TERMITE!

When you've got those pistons out you're going to look at the cylinders, of course, to see what should be done to them before the proper fitting pistons go back in or new pistons are fitted. You'll look for scuff marks, mike the walls for taper and out-of-round wear, and be sure they are clean.



Just because there may be a few scuff marks or maybe a scratch or two on the walls, don't start chewing out a lot of metal just to smooth up the cylinder. Nine times out of ten a little teamwork with a hone will do the job, and you won't have to rebore. You know a hone can be used to take out up to about five-thousandths of an inch of metal, and cylinders have got to be pretty bad to need more than that to smooth them up.



On an older job, where there is a lot of wear, you'll have to rebore and finish the job with a hone. When you do that kind of a job, your work should be held to within a half-a-thousandth of true, both for taper and for out-of-round.

HOW TO FIT A PISTON

Now, if that piston slips through the bore of its own weight, it means that you've got to try the next oversize piston. But . . . first you'll want to check the bore for taper and out-of-round with the dial indicator.

If bore is within limits the piston and bore should be wiped thoroughly with a clean cloth. Be sure the bore and the piston are perfectly dry. Then try the new piston in the bore the same way you did the old one. If it's too tight, and won't go into the bore beyond the head and ring land section, the bore will have to be honed out. Now . . . before honing, be sure to cover the crankshaft to prevent the honing dust from settling on it. Hone the cylinder a little at a time until the right fit is obtained. Be careful not to hone out too much.

KEEP IT CLEAN!

Clean out the cylinder after you hone it. How? . . . Soap and water, and a brush! And wipe it dry with a clean rag. Clean that piston, too, before you try it in the cylinder. It doesn't take but a speck of dirt or honing dust to give you a wrong answer—make the piston seem too tight when actually it may be too loose. And don't oil the piston or the wall, either, because that will make the piston seem too loose when actually it may be too tight.

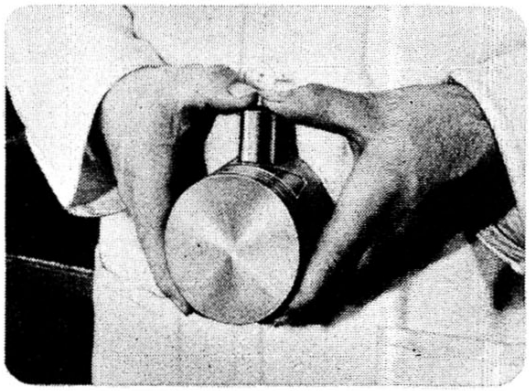
HOW TO FIT PISTON PINS

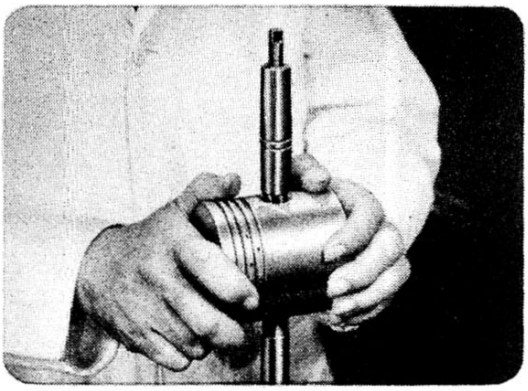
GET 'EM TOGETHER!

There's one thing sure . . . the piston and pin have to work together, so they've got to be properly mated. So, here's the story on fitting the pin in the piston.

Try pushing the pin through the pin holes in the piston, with both parts at room temperature (70 degrees), applying only the amount of pressure you can exert by using both thumbs. If you can't do it, the pin holes are too small.

Enlarge the holes with an expansion reamer. But be careful! Take a very light cut with the reamer — you don't want that pin to be too loose! Ream, and try the fit . . . ream again, and try the fit . . . until you can push the pin through the holes by pushing with both thumbs. When you get it to fit like that you won't have to worry about pin noise . . . and you won't have to worry about the kind of piston slap that is caused by a tight pin. It's a job that requires a little patience, but it's worth it when you make the owner happy.



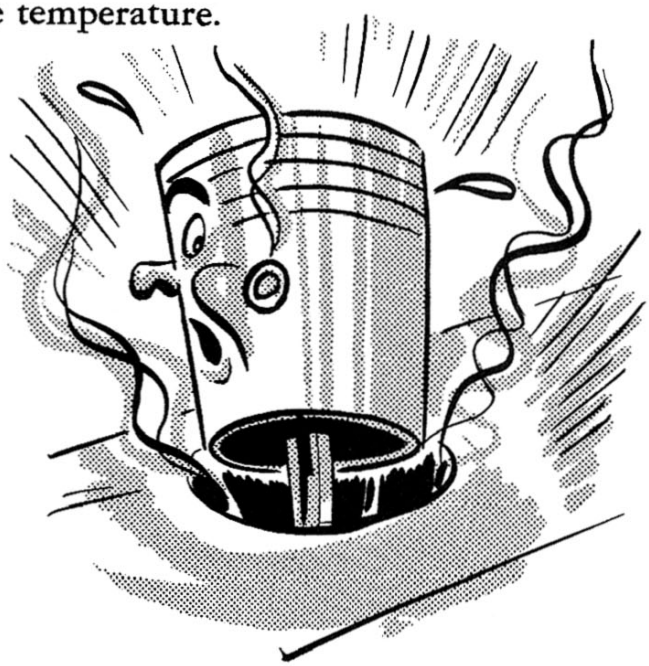


DO'S AND DON'TS

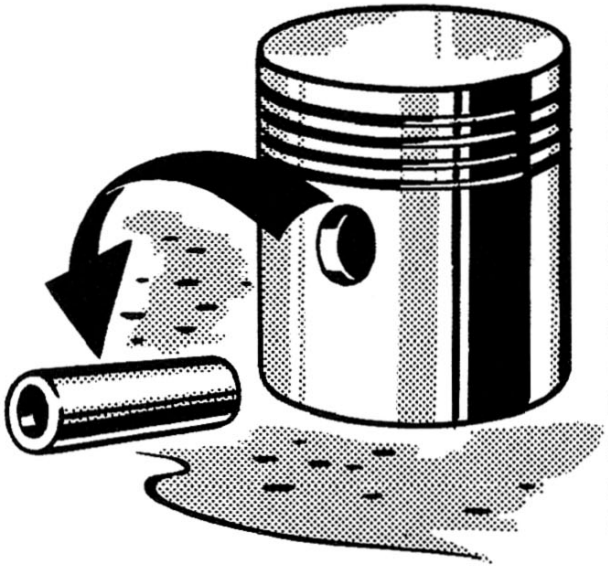
To get the best results, fit the piston to the cylinder when both are at room temperature—and 70 degrees is considered to be room temperature. That doesn't mean that you can't fit pistons in a shop that is colder or hotter than 70 degrees. But be sure that the block and the piston are at the same temperature.

For Example . . .

Honing the cylinder bore produces heat, and makes the cylinder expand. If you fitted a piston to it at that temperature, the piston would be a little on the tight side when the cylinder cooled off.

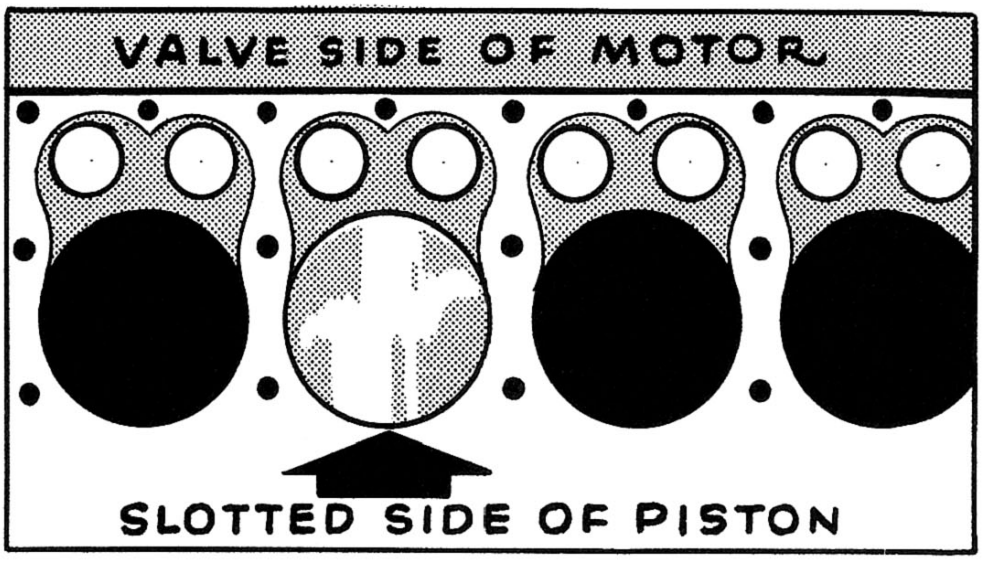


REMOVE THE PIN



Don't fit a piston which has the pin installed. Remove the pin; then you'll be sure that the piston is not distorted. We know the piston expands and contracts, moving side-wise on the pin. If you fitted a piston that happened to have a pin that was fitted on the tight side, the piston might be held slightly out of its normal shape. Then you'd get a wrong impression of the fit of the piston in the cylinder.

It hardly seems necessary to mention this, but just in case a fellow might forget—be sure the piston is inserted in the bore with the slotted side of the piston *away* from the valve side of the engine. The smooth side of the piston is the major thrust face, and that side is always toward the valve side of the engine.



TRY THIS FOR SIZE

When you mike the piston, remember it is cam ground and tapered. Check it for approximate size by measuring across the thrust faces, ¾ of an inch above the bottom of the skirt. If you think the skirt may have collapsed, measure the piston at the top and bottom on the thrust sides . . . there should be not over .0015 inch difference in these measurements, the largest measurement being at the bottom of the skirt.

THE FINAL TOUCH

After everything is done, and you're ready to button the job up for keeps, don't get careless!

A lot of guys try to hurry it through at the last minute, and often they spoil what might have been a first-class job.

In other words, don't pull the cylinders out of shape by tightening the head down too tight, or unevenly. You *can* do that, you know.

So play it safe—tighten the head with a torque wrench, 65-70 pounds-feet for cap screws, 55-60 for stud nuts.

TEST YOURSELF
ON THESE QUESTIONS!

1	Aluminum pistons which are cam ground and tapered can be given a closer fit in the cylinder with less possibility of piston seizure and scoring.	TRUE ☐ FALSE ☐
2	Cold engine piston slap is of short duration, and has no detrimental effect on engine parts.	TRUE ☐ FALSE ☐
3	If the piston slap disappears when the temperature gauge needle starts to move, you don't have to replace pistons.	TRUE ☐ FALSE ☐
4	When fitting pistons in the cylinder, the temperature of the cylinder and the piston should be approximately 70 degrees.	TRUE ☐ FALSE ☐
5	When assembling the connecting rod to the piston, the metered oil hole should be toward the slotted side of the piston.	TRUE ☐ FALSE ☐
6	When fitting aluminum pistons by the feel-in-the-bore method, they are considered to fit properly when they will move through the bore with a very light hand pressure, and stop moving when the hand pressure is removed.	TRUE ☐ FALSE ☐
7	When disassembling piston and connecting rod assemblies, the piston should be heated in hot water before removing the pin.	TRUE ☐ FALSE ☐
8	When a cylinder bore has become scuffed, it is always necessary to rebore the cylinder.	TRUE ☐ FALSE ☐
9	When fitting piston pins in aluminum pistons, the pistons and pins should be at a temperature of approximately 70 degrees.	TRUE ☐ FALSE ☐
10	Soap and water should never be used to clean a cylinder bore.	TRUE ☐ FALSE ☐