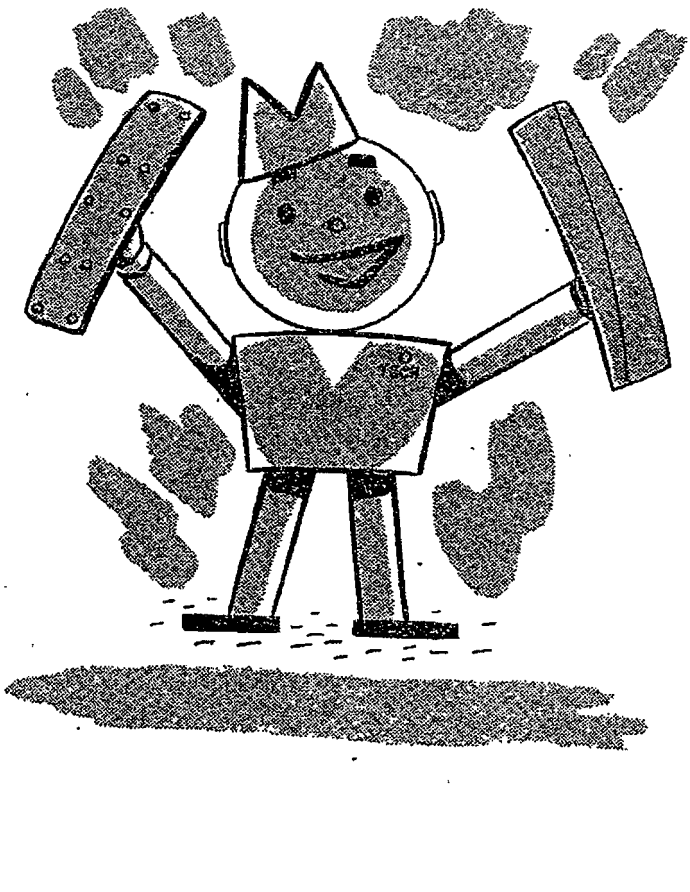
FILE NAME: Chrysler (CHRY)

DATE: 1950

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DOCUMENT DESCRIPTION: Industry Recommended Practices - Brake Shoe Adjustment & Alignment



LITHO IN U.S.A.

SERVICE REFERENCE BOOK

BRAKE SHOE ADJUSTMENT *and* ALIGNMENT



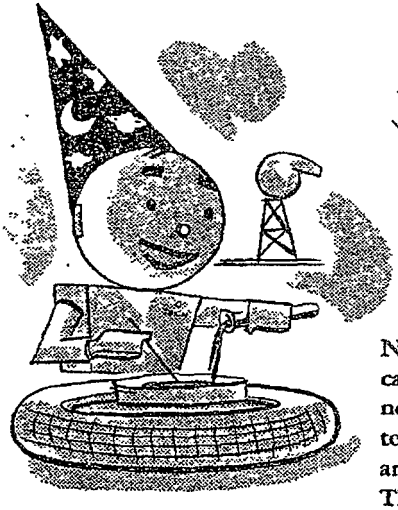
Prepared by

CHRYSLER CORPORATION
PLYMOUTH, DODGE, DE SOTO
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Vol. 3 No. 6

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PLAINTIFF'S EXHIBIT
CH-168
Blumberg No. 6113



THERE'S NO MAGIC FORMULA!

No sir! When it comes to a case of brake noise, there's no magic formula for getting to the bottom of the cause and correcting the condition. That's because the cure in one case might not be the cure in the next one you'll handle. What you have to do is inspect the brakes thoroughly to see if the shoes are adjusted and aligned properly, and have the proper torques at the various attaching points.

You'll find this reference book outlines the steps you should take in order to raise your batting average on getting rid of brake noise. And you'll also find that it's a good idea to do a *complete* job, because brake noise is sometimes caused by a *combination* of minor conditions.

So . . . let's start off this step-by-step story with the first move you'd want to make—the road test! **THE ROAD TEST**

- A WORD ABOUT THIS BOOK -

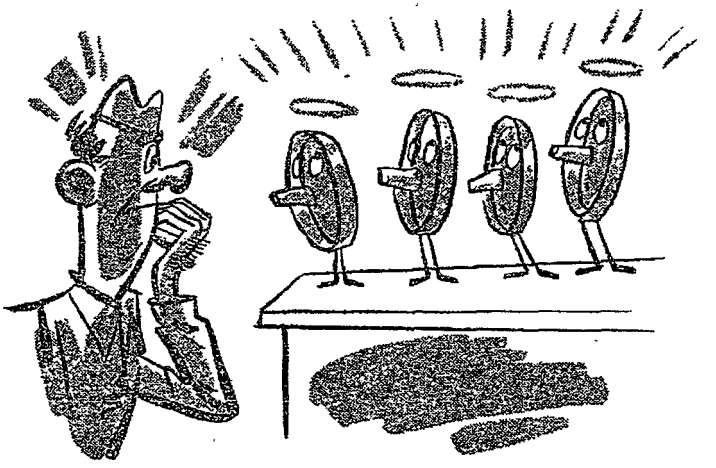
Original was made available by Bob Milbrand, Secretary of the Airflow Club of America, Inc.

Although the book was prepared about 15 years subsequent to the Airflow, the principles are valid and applicable. With regard to some of the items, they are identical with the Airflows. In most instances the tolerances or limits did not change.

There is no substitute for good judgement and ingenuity. If you find this information useful, let the Club President know. If you wish more copies, write Ron Mitchell, 4636 Midsite Ave., Covina, CA 91722. Cost varies according to the number of pages and should be approx $1.00.

These books were prepared as instruction material used in connection with a mechanics school conducted by the Chrysler Corporation for the benefit of its dealers and their employees. Questions should be directed toward a Club Officer and not the Chrysler Corporation.

FIRST FIND OUT WHICH BRAKE IS AT FAULT



To begin with, it's a good idea to verify any owner's report of a brake noise by thoroughly road testing the car. If possible, road test the car with the owner. You see, taking the owner along gives you a chance to hear the noise as he hears it. Then, let him drive and stop the car several times in front of you as you stand on the curb. In this way, you can usually tell whether the noise is coming from the front or rear brakes.

Incidentally, the noise can be telegraphed across the car from one brake to the other. So it isn't easy to tell exactly which brake is at fault. That's why it's a good idea to remove *both* wheels, once you've pinned the noise down to the front or the rear brakes.

MAJOR CAUSES OF BRAKE NOISE

It's usually a minor condition—or a combination of minor things—that cause brake noise. And there really aren't as many conditions to check as you might think. In fact, you can group them under three major headings:

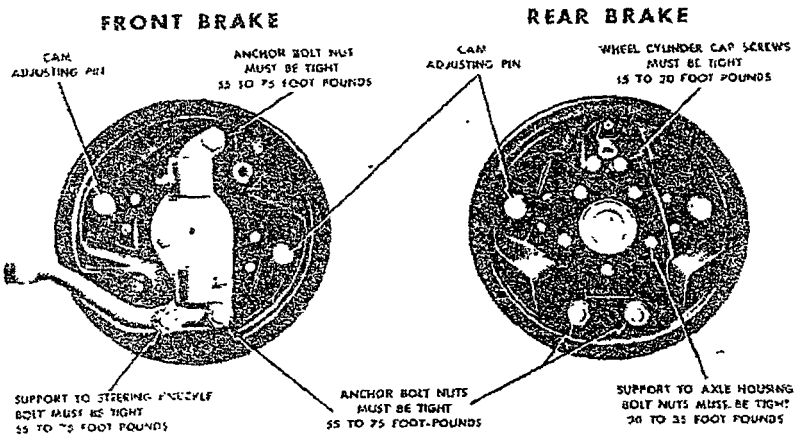
1. **Poor brake shoe adjustment.**
2. **Looseness of attaching parts.**
3. **Poor alignment of brake shoes.**

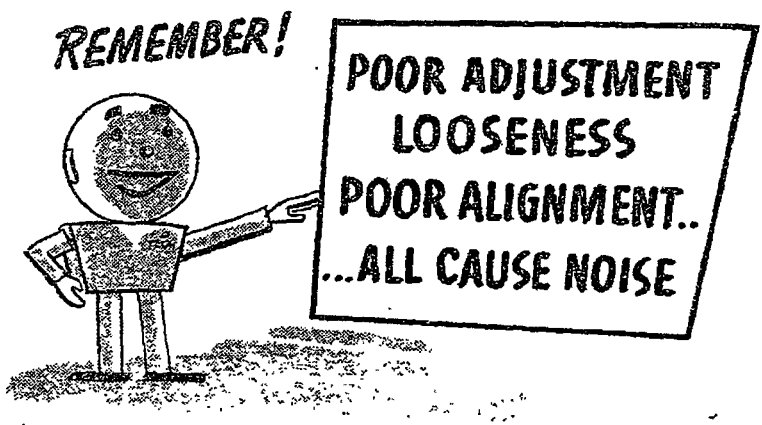
You'll find it a good practice to do your trouble-shooting in this 1-2-3 order. It's easy, it saves valuable time, and it makes for a better job. Keep these three major causes in mind this way.

POOR BRAKE ADJUSTMENT—means brake shoes do not have the proper clearances between the shoe and drum at the toe and heel ends of the shoes. This results in partial contact of the lining with the drum and causes vibration, or noise.

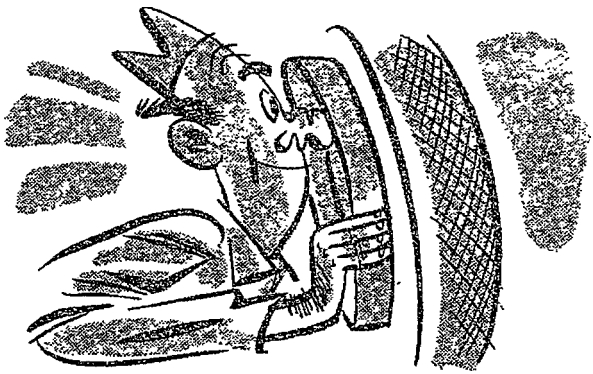
LOOSENESS—at the anchor bolts, brake support to steering knuckle bolts, brake support to axle flange bolts, at the wheel cylinder cap screws—may let the shoes shift and vibrate when the brakes are applied. A shoe which is loose on its anchor may also cause vibration.

POOR BRAKE SHOE ALIGNMENT—due to a cam adjusting pin that's too long, causing the shoe to tilt *outward*. When this happens, initial contact with the drum is made on the edge of the lining, resulting in vibration. Once in a great while a cam pin that's considerably shorter than it should be causes a shoe to tilt *inward*, resulting in a squeal. A shoe that's warped so it doesn't allow even lining contact may also permit vibration. Now . . . here's how to go after these conditions.


FRONT BRAKE
REAR BRAKE
CAM ADJUSTING PIN
ANCHOR BOLT NUT MUST BE TIGHT 55 TO 75 FOOT POUNDS
CAM ADJUSTING PIN
WHEEL CYLINDER CAP SCREWS MUST BE TIGHT 15 TO 20 FOOT POUNDS
SUPPORT TO STEERING KNUCKLE BOLT MUST BE TIGHT 55 TO 75 FOOT POUNDS
ANCHOR BOLT NUTS MUST BE TIGHT 55 TO 75 FOOT-POUNDS
SUPPORT TO AXLE HOUSING BOLT NUTS MUST BE TIGHT 30 TO 35 FOOT POUNDS


REMEMBER!
POOR ADJUSTMENT
LOOSENESS
POOR ALIGNMENT..
...ALL CAUSE NOISE

MOVE IN FOR A CLOSE INSPECTION



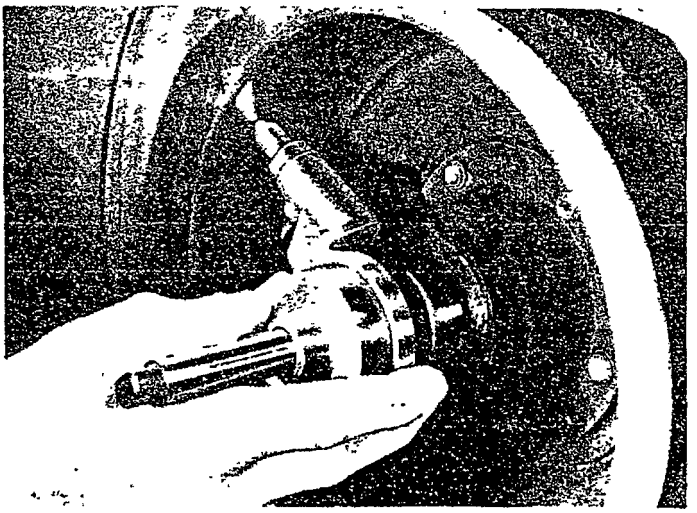
Peel your eyes and look sharp when you're ready to inspect for brake noise. You can't afford to miss a thing!

Once you've pulled the wheels, blow out the dust on the brakes and drums. Right off the bat look for signs of brake fluid or grease leaks, but don't stop there. You're looking for brake noise conditions. Grease on the linings usually causes other brake troubles like grabbing, that the owner or your road test would have indicated. Of course, if linings have grease or brake fluid on them, they'll have to be replaced. In this case you'd want to reline the brakes on the opposite wheel so both wheels will have the same braking characteristics.

Check the brake drums for scoring, worn edges, or cracks. Very bad scoring, or a crack across the drum face sometimes causes noise. Bright spots on the brake support plate mean that the drum has been rubbing against the support plate, indicating that the plate is bent. When you've completed this inspection, you're ready to check the drum diameter.

CHECK THE BRAKE DRUM

With the drum checking gauge, check the brake drum for out-of-round. Drums should be round within .005". Any drums out-of-round more than this should be resurfaced on a drum lathe to bring them within limits. Remember . . . you shouldn't cut more than .030" off a side. A cut this big increases the inside drum diameter .060". That's about all the drum can stand without becoming too thin for satisfactory performance.

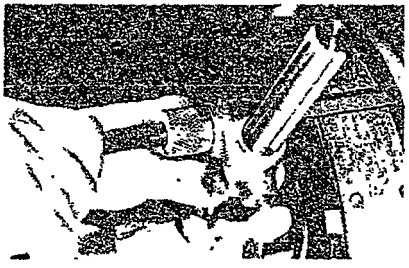


If your inspection of brake drums turns up some shallow scratches or rust, clean the drums with a fine emery cloth. But before you start this job, stuff a rag into the wheel bearings to make sure none of the emery dust gets in and scores the bearings.

NOW CHECK BRAKE SHOE CLEARANCE

You'll be right up on your toes if you check the brake shoe clearance *before* you disturb the shoe setting by any disassembly of the brake. You see, improper brake shoe clearance means that the shoe is making only partial contact with the rapidly rotating drum. Partial contact leaves the rest of the shoe free to vibrate and make noise. In fact, improper clearance, caused by poor brake shoe adjustment, is one of the main causes of brake noise.

To check clearance, put the drum gauge—set to drum radius—in the brake shoe gauge, and adjust the finger of the shoe gauge to the pin height. The word "drum" on the finger should show up on top.



Next, remove the drum gauge and mount the shoe gauge on the spindle of the wheel. Then turn the finger until the word "heel" shows up on top.

Turning the finger to put the word "heel" on top, gives you the position of the heel and toe when they have the proper .006" clearance with the drum. So, swing the finger across the heel end of the brake shoe and check the clearance there. The "toe" side of the finger is used on cars specifying a clearance of .012".

HERE'S HOW YOU WILL REALLY KNOW...

When the ends of the lining have the proper clearance, the finger of the gauge just touches the lining. If the finger's tight on the lining, it means that there isn't enough clearance. If the finger swings across the shoe without touching the lining, there's too much clearance.

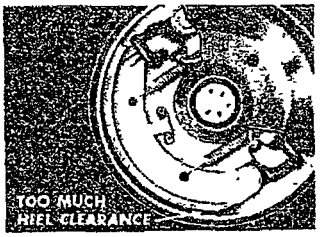


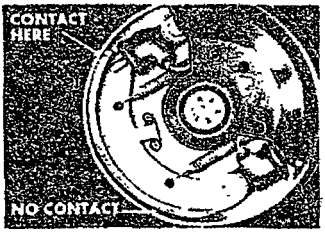
After you check clearance at the heel end of the lining, check the toe end. Then check the other shoe. Next, check both shoes on the opposite brake.

WHAT POOR BRAKE SHOE ADJUSTMENT DOES

Suppose you have a case where the brake shoe has too much clearance at the heel and not enough at the toe. That would mean the initial shoe contact with the drum would be made at the toe. In other words, the lining contacts the drum from the center of the lining to the toe, and leaves the heel end with no contact. This partial contact causes vibration and noise.

Now, if there were too much clearance at the toe end and not enough at the heel, there'd be contact from the center of the lining to the heel and the toe end would be left with no contact. Either condition may cause the shoe to vibrate.





The next step would be to check the anchors, cap screws and attaching bolts for any signs of looseness.

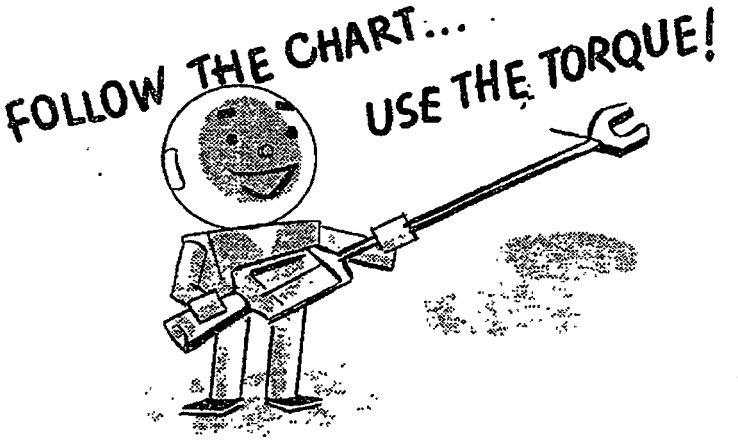
CHECKING FOR LOOSENESS

It's a good practice to put a torque wrench on anchors, attaching bolts, and cap screws to see if they are as tight as they should be. Here's a table of the proper torques:

Anchor Bolts	55 to 75 foot-lbs.
Rear Wheel Cylinder Cap Screws	15 to 20 foot-lbs.
Brake Support Plate to Axle Flange Bolts	30 to 35 foot-lbs.

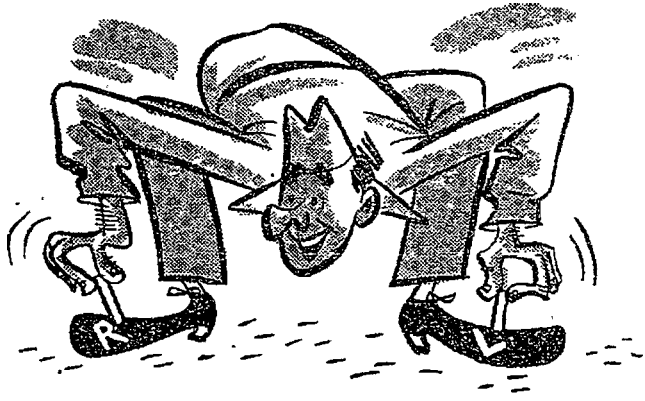
Brake support plates that are loose on their mountings and anchor bolts that are loose in the support plate may cause the shoes to shift and vibrate when the brakes are applied.

Loose shoes may also give brake noise. If there is more than .005" movement on the anchor bolts, the shoes may be loose enough to cause vibration.



NOW . . . REMOVE THE BRAKE SHOES

When you remove the brake shoes from the support plate, be sure to use the special spring pliers to remove the return springs. They're designed to make the job easy and prevent any damage to springs or linings. Incidentally . . . be sure you mark the shoes with chalk so you'll get them back where they belong.



When you've taken the shoes off, you can inspect the linings much better. You see . . . the lining wear patterns can often tell you a lot about just how the brakes were behaving during application.

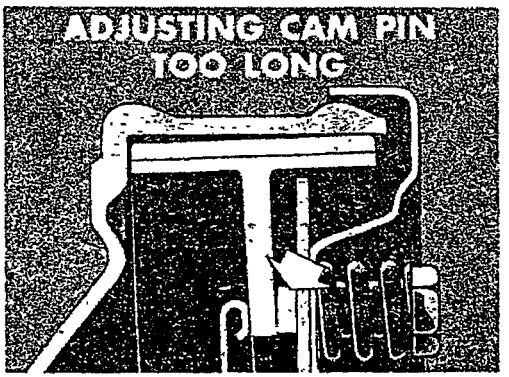
Whatever you do . . . don't take any chances on getting grease or brake fluid on the linings. Handle the brake shoes at the web. That way you'll keep the linings clean and they won't cause trouble later on.

In case you do get a little fluid on the linings by accident, use a clean, dry rag to wipe the linings off immediately.

CHECK FOR EDGE CONTACT

If the edges of the lining are worn, that usually means that the shoes have been tilting on brake application. For example . . . if the *inside edge* of a lining is worn, it means that the shoe has been tilting *outward* when pressure was first applied to the shoe. This may be caused by an adjusting cam pin that's a little too long.

When a cam pin is too long, it holds the brake shoe *out* and keeps it from contacting the drum squarely and evenly. As you know, the wheel cylinder moves the shoe *into* contact with the drum and the shoe tries to straighten up. But the pressure of the shoe web against the cam pin isn't strong enough to bend the support plate. Yet . . . the shoe keeps trying to straighten up and this sets up a vibration.

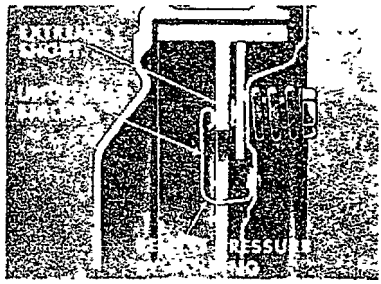


If the *outer edge* of the lining is worn, it means that the shoe has been tilting *inward.* That may be caused by a cam pin that's too short and a guide spring that's unusually strong. But a short cam pin isn't as critical as a long pin.

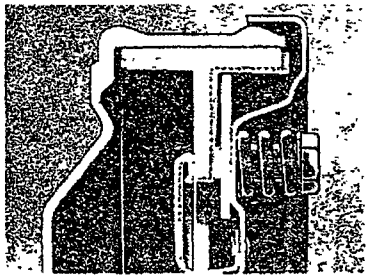
Here's why.

When the pin's too short, the guide spring pushes the shoe toward the support plate. When the brakes are applied, the shoe straightens up because it can usually push the guide spring back. In other words, a short pin will let the shoe right itself faster.

The guide spring, incidentally, should exert about 25 to 35 pounds tension on the shoe web. You can check this tension with an ordinary pull scale.



Here's a tip. In a case where the cam pin is too short, and the guide spring is causing the shoe to tilt, bend the spring outward to relieve its pressure. But be careful *not* to relieve the spring so that it has less than 15 pounds tension.



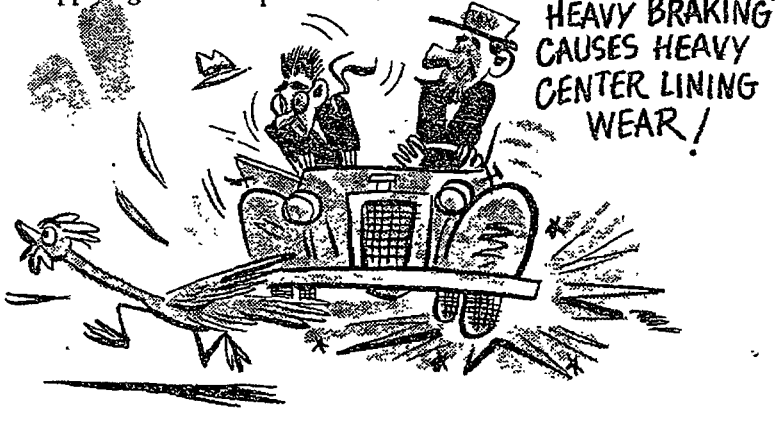
WHEN YOU FIND A DIAGONAL WEAR PATTERN

Now, there are other wear patterns that can be clues to a brake noise condition. For instance . . . a *diagonal wear pattern* usually means that the shoe is twisted, or bent. But remember—this clue can be rubbed out during several hard brake applications.

If a diagonal wear pattern is fairly evenly spread out, the shoe is twisted only slightly. But if the wear is heavily concentrated at extreme opposite corners, it means the shoe is badly twisted.

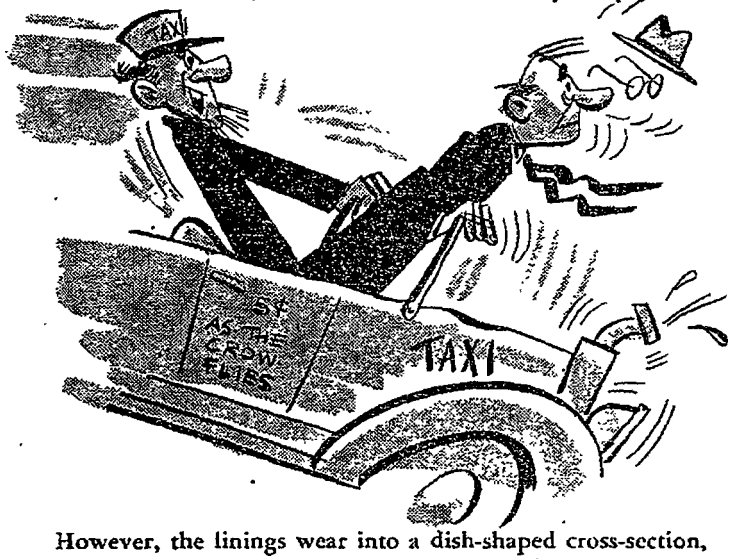
HEAVY CENTER CONTACT

When cars are put to harder-than-normal use, such as taxi service, you may run into cases where the center of the lining is worn more than the edges. This is caused by repeatedly applying the brake pedal hard.



During these extremely heavy brake applications, the wheel cylinders put a heavy pressure on the middle of the brake shoes, right along the shoe web. This pressure is so high that the center of the lining contacts the drum the hardest, while the pressure on the edges is less.

Naturally, the wear in this case is mostly on the center of the lining. Now, as long as the driver keeps on using the brakes severely, the shoes will flex enough to give a fairly even contact surface, and the brakes will usually be quiet.

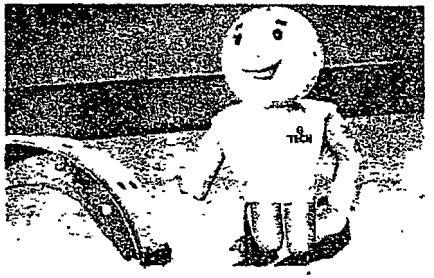


However, the linings wear into a dish-shaped cross-section, with the center of the lining low and the edges high. As a result, when the brakes in a case like this are applied *lightly*, the edges of the linings may contact the drum *before* the center, causing vibration. There isn't much you can do for this condition except to regrind the lining a little with a grinder to get a flat surface.

AFTER CHECKING ALIGNMENT, LOOK AT THE CHAMFER

Besides wear patterns, the shape of the chamfer on the ends of riveted linings is important. This chamfer should extend to the middle of the first row of rivets on each end of the shoe.

If the chamfer doesn't quite reach the first row, grind or file the chamfer until it does. Be sure to leave a lining thickness of about 1/16" at each end.



SEE THAT THE SHOES ARE STRAIGHT

Using a surface plate, you can check the shoe for straightness. Support the anchor bolt end of the shoe web on the plate. Then, holding it flat, test the shoe by swinging the toe end up to the plate. If the shoe is flat, the web at the toe end will slide across the plate without binding. But if the shoe is twisted, the web will either strike the plate or ride above it.

If a surface plate isn't available, you can use a connecting rod aligning fixture or a flat piece of plate glass for this test. If you find the shoe *is* bent, replace the shoe and stay on the safe side.

CHECKING CAM PIN HEIGHT

There's no secret about checking the height of the adjusting cam pin. You already have the necessary gauge, but you may have to fix it up a little. Here's what we mean.

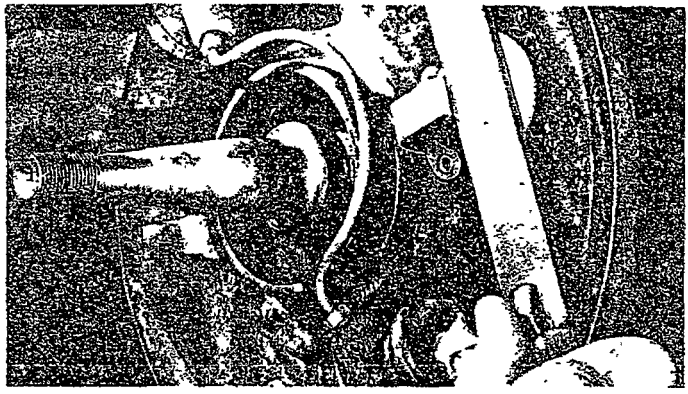
If the gauge holder of your brake shoe checking gauge doesn't have a wing screw in it already, drill and tap the holder so you can put in a ⅜"-16 wing screw. This will hold the gauge holder tight on the adapter bushing which is mounted on the spindle during the cam pin checking operation. You'll find that current model gauges are equipped with this wing screw.

Use the brake shoe checking gauge to see if the adjusting cam pin is the proper height. Proper height means that the surface of the cam pin should be the same height as the surface of the wheel cylinder mounting lug. So . . . mount the gauge on the spindle and set the end of the finger against the flat surface of the mounting lug.



Tighten the wing screw so the gauge holder will be held securely on the adapter bushing. The adapter bushing itself has to be held tightly against the shoulder on the spindle at all times. Then swing the gauge around to see if the finger will pass over the end of the cam pin.

If the pin's too long, lift the flat guide spring and give the pin a couple of good swipes with a flat mill file. Avoid taking off too much metal. Use the gauge to recheck the height of the pin. Remember . . . the finger should just clear the top of the pin.



On rear wheels, as you know, there's only one wheel cylinder and no mounting lug. To check pin height, mount the gauge on the rear axle shaft and adjust the finger to the height of the flat spacer under the anchor bolt. Then swing the gauge to check the pin height.

WHEN THE PIN'S TOO SHORT

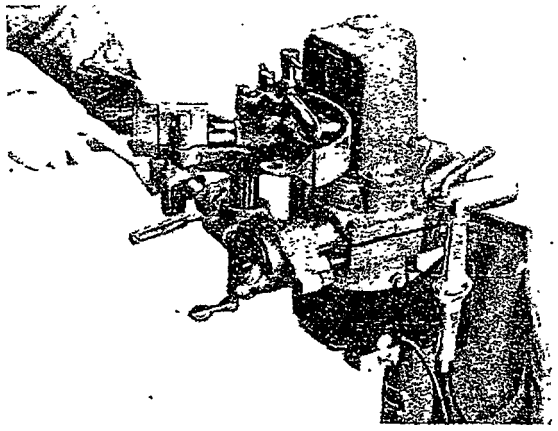
If the pin's too short, you needn't worry unless the pin is more than .020" below the surface of the mounting lug on the wheel cylinder. If you come across a pin that's .020" to .030" too short, you can bend the flat guide spring outward a little to relieve pressure on the shoe. But take it easy or the spring steel guide spring might break.

GRINDING SHOE LININGS

There are several good reasons why brake linings should be ground. First, grinding removes any glazed spots that sometimes cause brake noise, and it gives you a true, flat surface. Next, it helps you get a good brake shoe adjustment, and a better "break-in" period.



Here's something else. When the linings are properly ground, the machine grinds the lining on an arc smaller than the arc of the drum. In other words, the ends of the lining are ground thinner than the center of the lining. Of course, you have to be sure to set the grinder to make its cut a few thousandths *under drum diameter.* The exact setting, naturally, will depend on the type of equipment you happen to have.



And when the linings are ground this way, they make a full, even contact with the drum. Here's why. As the wheel cylinder applies pressure against the toe end of the shoe, the shoe is crowded against its anchor. With the center of the shoe contacting the drum—and high pressures applied at both ends—the shoes and drum tend to assume the same shape, giving even contact over the entire lining area.

In short . . . grinding the ends slightly thinner than the center has the effect of preventing excessive heel or toe contact, and improves the lining contact. This helps prevent brake noise.



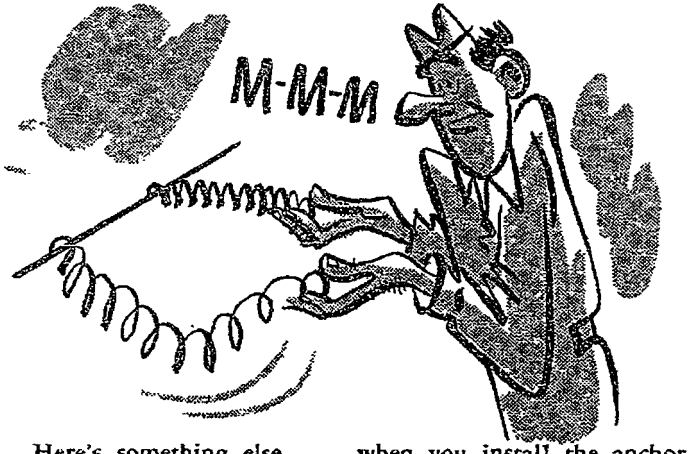
Accuracy in setting the grinder is important in order to get the proper shape of the lining. Your grinder should therefore be in good working condition. Any looseness due to wear of grinder parts may result in a poor grinding job. This, in turn, would make it hard to adjust the brake shoes properly.

If a grinder has been in service for a long time and shows signs of wear, chances are its accuracy may be questionable. You may find it very wise to recondition or even replace the grinder.

INSTALL THE BRAKE SHOES

Just before you install the brake shoes, back off the cams so you won't have to stretch the brake return springs too far . . . and so you can adjust the brakes a lot easier. Then inspect the brake return springs.

An easy way to test the return springs for proper tension is to compare them with new ones out of stock. Just make sure they are not overly stretched, bent, or otherwise distorted.



Here's something else . . . when you install the anchor bolts, be sure they are placed so the arrows point *away* from the heels of the shoes they control. If they point toward the heel of the shoe they control, and should become loosened in service, there's a chance that they might turn and lock the shoe against the drum.

Install the shoes and be sure to use the special spring pliers to reinstall the springs. They make the job easier, and they keep the ends of the springs from being damaged.

BRAKE SHOE ADJUSTMENT

Set the shoe gauge to drum radius and install the gauge on the wheel spindle (or axle shaft). Make sure that the word "heel" on the finger is on top. Start setting the clearances at the heel end of the shoe.

You can bring the heel of the shoe up to the gauge by turning the anchor bolt so the point of the arrow turns *toward* the drum. And if the heel is too tight against the gauge, you move the shoe away from the finger by turning the anchor bolt so the point of the arrow turns *away from* the drum.

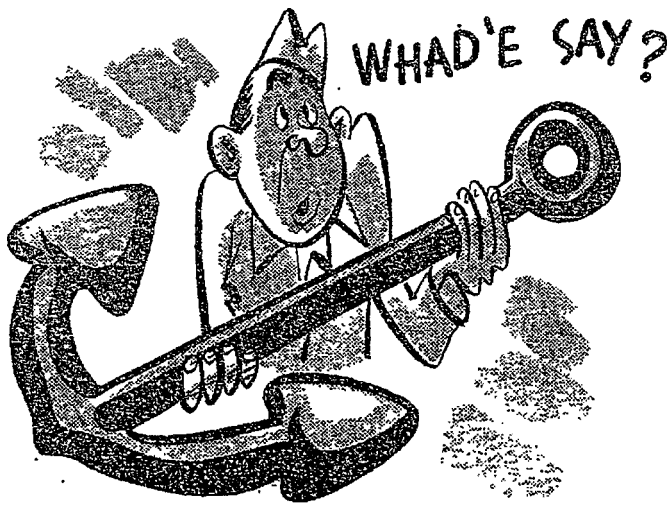
After adjusting the heel ends of the shoes, tighten the anchor bolts snug—not tight—just snug. Then move the finger of the gauge across the toe end of the shoe and check the clearance there.





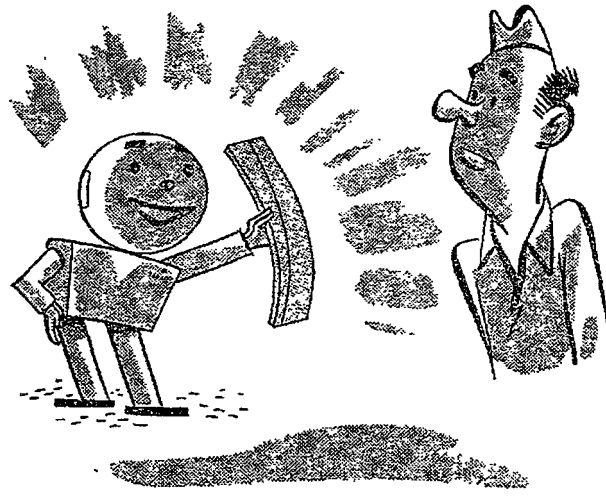
Clearance at the toe end of the shoe is controlled by the adjusting cam. If you have to move the toe end up to the gauge finger, *pull down* on the wrench to turn the cam *toward* the shoe. If you have to move the toe end away from the gauge, *push up* on the wrench to turn the cam *away from* the shoe.

Be sure to recheck the heel clearance after setting toe clearance to see if it changed during the toe adjustment. Chances are you'll have to jockey back and forth a couple of times before you get the right clearances at both ends of the shoe.



Finally . . . hold the anchors while you tighten the anchor bolt nuts *55 to 75 foot-pounds*. Then recheck the shoe adjustments to be sure they haven't changed during the tightening. Of course, you'll road test the car as a last step to see that you've done a good job.

ABOUT THOSE CYCLEBONDED LININGS . . .



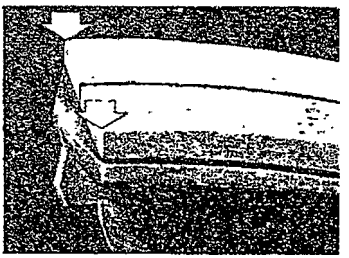
Correcting brake squeaks on cars with Cyclebonded linings calls for a different treatment. Besides proper grinding and checks on alignment, adjustment and looseness, there are a few other points to keep in mind.



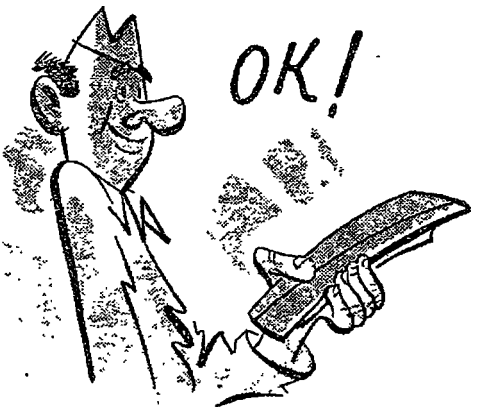
For one thing . . . when you're removing or installing shoes with bonded linings, use the new brake return spring removing and

installing tool. It prevents damage to the lining and simplifies the whole operation. What's more . . . it can also be used equally well for riveted linings.

Here's something else. The ends of Cyclebonded linings should be finished off squarely. In other words—*no chamfer.* At the toe end, the linings should be flush with the end of the shoe. If necessary, trim the end of the lining by cutting it with a back saw.

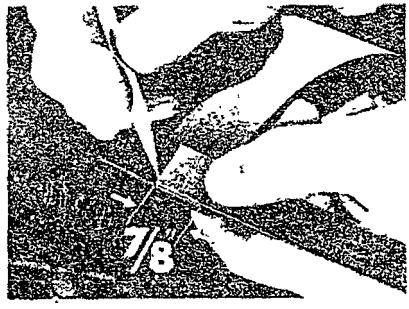


Another thing . . . if the Cyclebonded linings do r diagonal grooves, be sure to put them in. Here's ho go about doing that.



GROOVING THE BONDED LININGS

Cutting the groove in Cyclebonded lining is easy. Just put the brake shoe in a vise. Make a mark in the lining 7/8" from one side at the toe end. Then make another mark 7/8" from the opposite side of the lining on its heel end. Connect the two marks with a pencil so you can saw on the line.



Use one blade in a hack saw frame to cut through the lining to the face of the shoe. Then—add one more blade to the frame—and recut the groove to widen it evenly. Sandpaper the cut edges and blow out the dust.



AN ADDED PRECAUTION ON CYCLEBONDED LININGS

You'll find it's a good idea to install a set of dampener springs on the drums of any car that has bonded linings. These springs help to dampen out occasional vibrations.

To do this, remove the tire and wheel assembly. Hook the eyes of the dampener spring together. Place the looped spring on the outside of the drum. Then, with two small tire irons or flat pieces of steel, expand the spring into position on the drum. *Do not over-stretch* the spring. That's because the dampening effect of the spring depends upon its tension against the drum.

On cars, other than 8-passenger, equipped with brake drums not grooved for these dampener springs, here's what you do. Lift the spring away from the drum and install four retaining clips, equally spaced, as shown below.



JUST FOR THE RECORD . . . LET'S SUMMARIZE THE MAIN POINTS

Whenever you work on a brake noise, keep these main points in mind. How successful you will be depends a great deal on how carefully you look for the source of the noise. Remember . . . there are three main things at which you should look very closely:

1. Brake shoe adjustment,

2. Tightness of attaching parts, and

3. Brake shoe alignment.

Any *one* of these conditions— or a combination of them— can cause vibration and noise. Look first for evidence of improper clearances at the toe and heel. Next, look for looseness in the support plate attaching bolts or brake shoe anchor bolts that might let the shoes shift on their mountings. And last . . . look for signs of shoe misalignment. In this case, remember that the wear pattern often tells the tale.

If you find any of these conditions, try to do each corrective operation as carefully as you can. Besides going a long way toward eliminating the brake noise, you'll be lining up a lot of future business for yourself by creating satisfied customers.

Airflow NEWSLETTER

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