Cadillac SERVICE ROUND TABLE

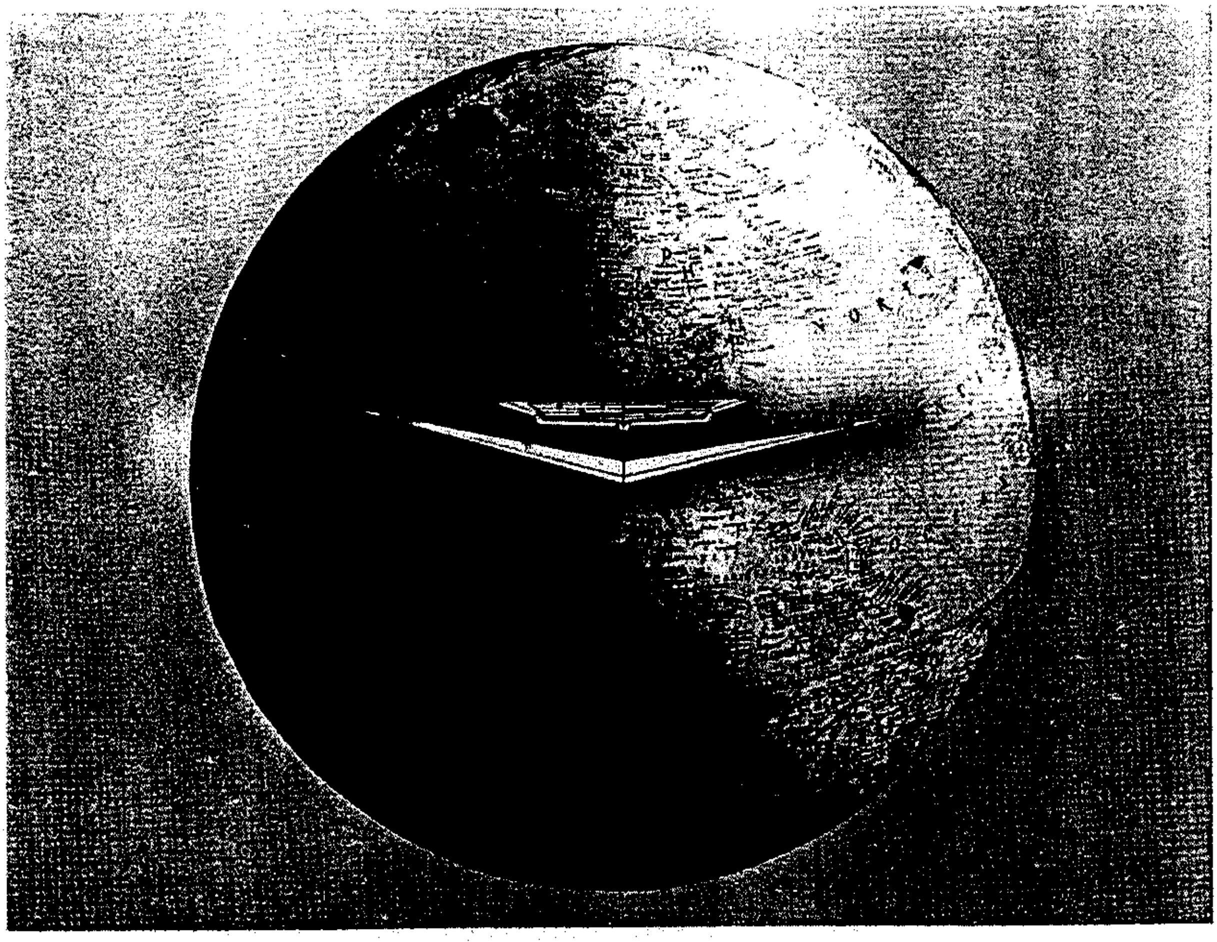
SERVICE SUMMARY

THE GRAY LIGHT OF DAWN

. . . a discussion of "booms" and vibrations

JUNE, 1962 • • • • FILM

CADILLAC MOTOR CAR DIVISION . . . . . General Motors Corporation



THE GRAY LIGHT OF DAWN

The gray light of dawn -- or the twilight zone -- is that time of day when the darkness of night has passed, but the full light of day has yet to arrive: a transition period, marked by its indefiniteness. In speech, as most of us know, we also refer to a "gray area" as one that is marked by its indefiniteness: where things aren't really black, nor really white . . . where every "yes" has limitations, every "no" has exceptions, and every "maybe" a double meaning.

And in our service world, perhaps the gloomiest part of any "gray area" or "twilight zone" occurs when someone (like an owner) brings up the subject of vibrations. This Service Summary, like the June Round Table Film, is designed to shed a little light on the subject of vibrations -- to bring it out of the twilight zone, and into the full light of day.

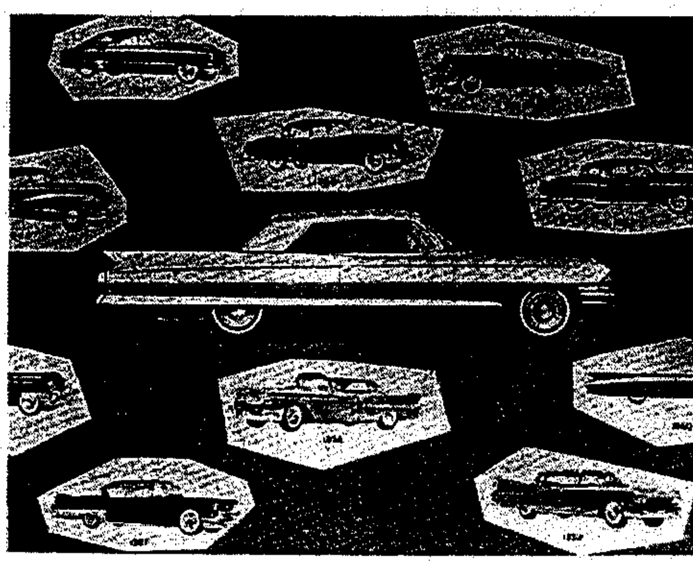
Like the film, this Service Summary will start by giving a little of the background regarding vibrations: what they are, how they are caused, why they are sometimes noticeable, etc. After this ground work, we are ready to take our first step into the broad daylight: dividing the most common types of vibrations into five general categories. And then, by taking each category one at a time, we explain the diagnosis and correction for each.

SOME FACTS ABOUT VIBRATIONS

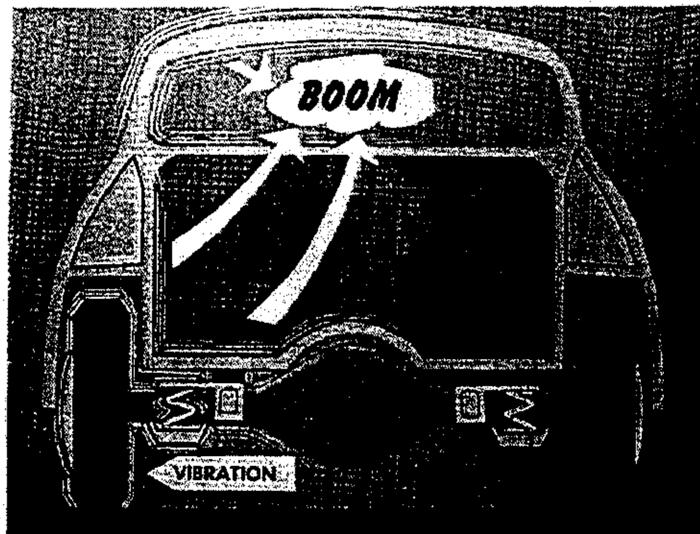
Vibrations occuring on a present model Cadillac are, of course, the exception, and not the rule. But as infrequent as they might be, when an owner brings to our attention a justifiably disturbing vibration, it is our job to minimize that vibration -- to bring it down to a level that can be considered "normal". Although it might not be possible to eliminate all vibrations altogether, there are definite steps that we can take that will reduce most vibrations to an un-noticeable or non-disturbing level.

Some of the vibrations that occur on a few of the recent model Cadillacs might seem new to us, in that we cannot remember them occurring a few years back. In truth, however, these vibrations have always been with us . . . but it's just recently that we have been able to notice them. Here's why:

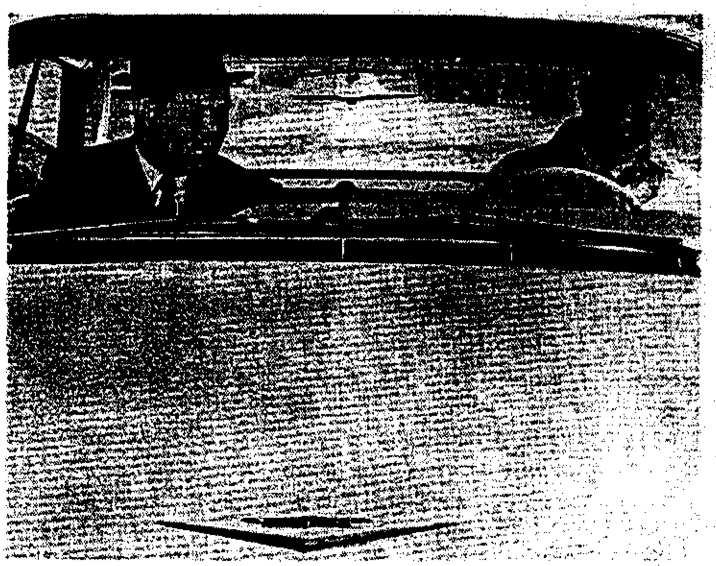
We all know that cars have become quieter and quieter over the years . . . especially Cadillacs . . . through a reduction in engine noises, transmission noises, road noises, and the like. But as these background noises dropped out, we were able, for the first time, to notice a few minor noises and vibrations. Namely, those occasional vibrations originating from a rotating part that may be only slightly out-of-balance . . . but yet, in some cars, can set up an effect that we can notice in the passenger compartment. It's more or less a case of not being able to hear the kettle-drums in an orchestra until all the other instruments have stopped playing. Sometimes we feel these vibrations . . . other times we hear them, the sound being referred to as a "booming noise" or simply a "boom".



The sound heard is simply the end result of a chain reaction set-off by a rotating part . . . such as a wheel (which may, in fact, have only the normal amount of unbalance). Here's how it happens:

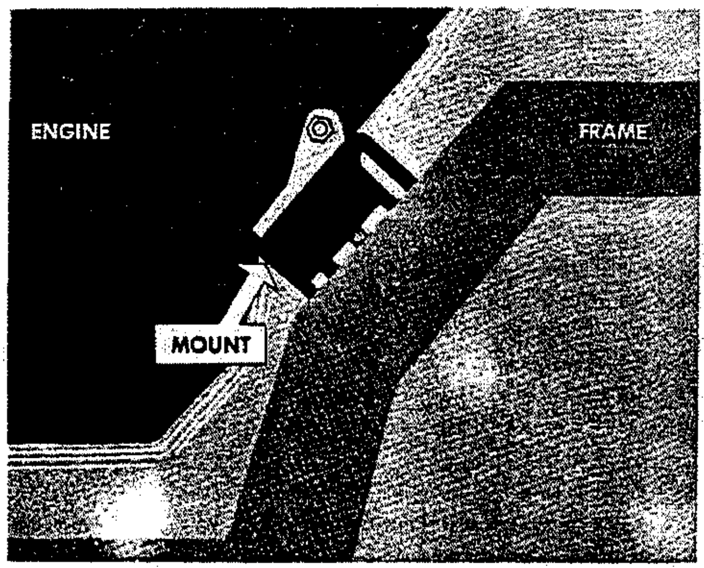


The slightly unbalanced wheel transmits its vibration to the body through the suspension, frame, and body mounts. This vibration might be felt, but it will not be heard. However, at certain speeds, this vibration may set one of the body panels vibrating . . . and the vibrating panel can reverberate the air in the body, causing the audible sensation we call "boom". Strictly speaking, then, we can only feel a vibration. The "boom" we hear is the end result of the chain reaction. It's usually the "boom", however, that the owner objects to, more than the feel.



THE PLACE TO START

Whenever we are faced with a vibration condition, we should start by road testing the car with the owner . . . to determine exactly what it is he is concerned with . . . and to determine whether the "boom" or vibration is noticeable enough to justify working on it. If you consider the car "normal", this is the time to say so. But whether this is the case, or whether you decide the vibration is justifiably objectionable and you're going to be able to minimize it, you should assure the owner that a minor vibration will not affect the car's operation or durability. This may be what the owner is really concerned about. Remember that the "boom" is not the sound of the working part itself, but is merely the end result of a vibration set-off by a slightly out-of-balance part.

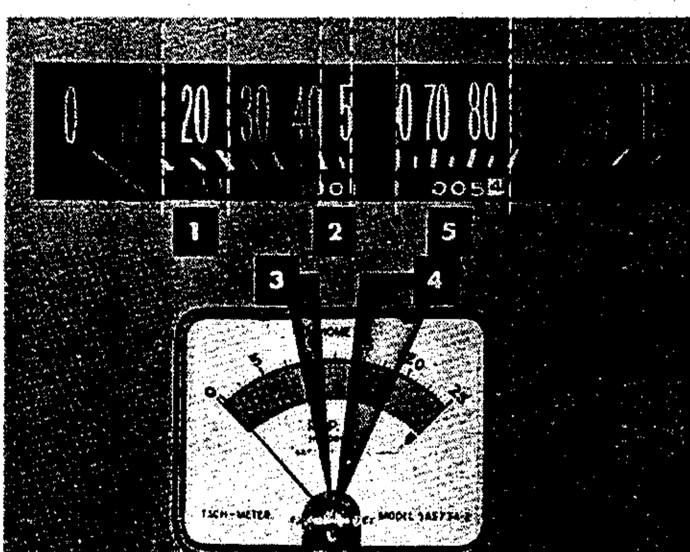


No rotating part on any automobile is in "perfect" balance. It doesn't have to be, since most vibrations, at most speeds, are isolated from the passenger compartment by means of rubber mountings -- such as the rubber engine mounts, the rubber suspension bushings, and the body mounting pads. The objective of the automotive engineers is to manufacture each part with the degree of balance necessary and practical, and within the limits of available instrumentation.

If a vibration does get through, it's usually confined to a narrow range of speeds. If the vibration is noticeable through a relatively broad range of speeds, it may indicate one of two things: first, a rotating part may be seriously out-of-balance, in which case it will probably be very easy to detect; or, secondly, the rubber mounts are being by-passed by some metal-to-metal contact, such as a grounded exhaust pipe.

DIAGNOSING A VIBRATION

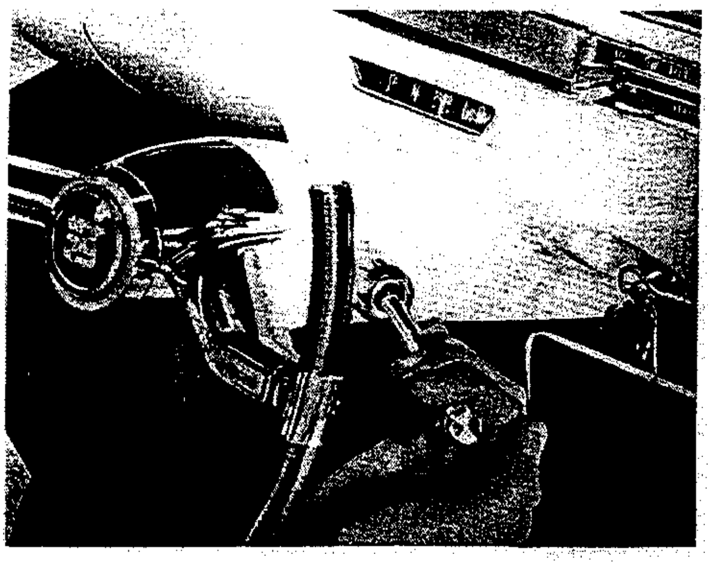
We can divide the most common vibrations into five general categories using the speed ranges at which they occur as a basis for a diagnosis. Once the vibration has been categorized, it is then possible to spell out the possible causes and corrections for each.



The five vibration categories are:

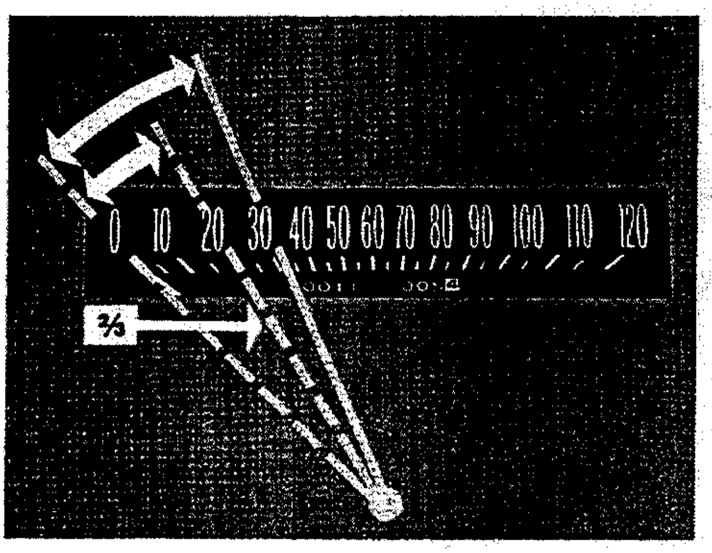
1. LOW SPEED "SHUDDER"
2. MEDIUM SPEED "THROBBING"
3. OFF-IDLE "BOOM"
4. MEDIUM SPEED "BOOM"
5. HIGH SPEED VIBRATION AND "BOOM"

When road testing with the owner, look for specific clues that will help you diagnose the vibration and place it into one of these categories . . . such as: Does the vibration or "boom" follow car speed, or engine speed? . . . Is the vibration throttle-sensitive, that is, affected by acceleration or deceleration? . . . Ask the owner if the vibration occurs only at certain passenger load conditions.

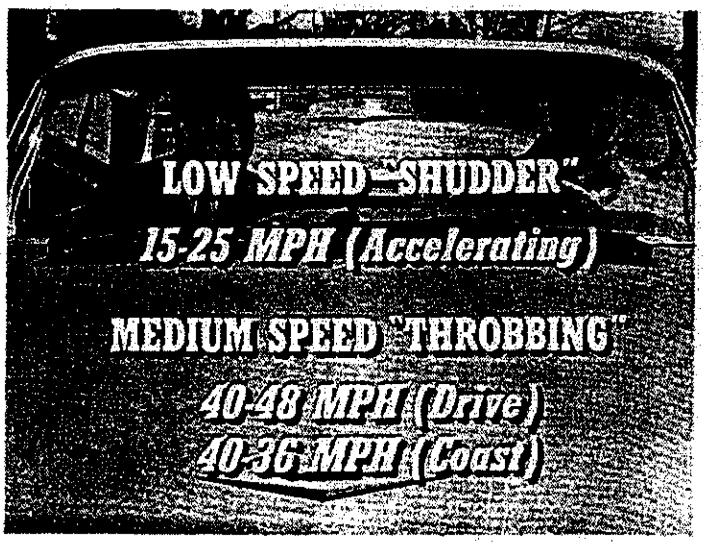


A QUICK DIAGNOSIS TOOL

A quick way to verify whether a vibration follows car speed or engine speed, when you don't have a portable tachometer with you, is to make your own portable tach, so to speak, using your right hand and the transmission selector lever. A car speed sensitive vibration should, of course, be noticeable at the same miles per hour in both the drive-three and the drive-four range. An engine speed vibration, on the other hand, should be noticeable at the same engine RPM. To test for this, drop the transmission selector lever from drive-four to drive-three, and see if the vibration goes away.



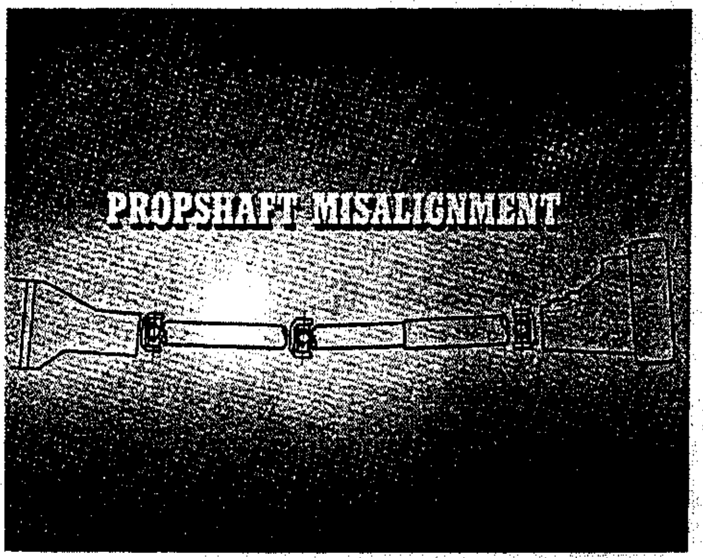
Also, keep in mind that, for any given engine RPM, the car's steady cruising speed in drive-three range is approximately two-thirds that of the car speed in drive-four range. A vibration that occurs at thirty miles an hour in fourth gear, for example, should re-occur at twenty miles an hour in third gear. When road testing, you can quickly visualize this relationship by just glancing at the speedometer. This isn't a substitute for the portable tach; but it can be used when, for one reason or another, you are road testing without one.



LOW SPEED "SHUDDER" AND MEDIUM SPEED "THROBBING"

The first vibration category, low speed "shudder", may occur when accelerating, reaching one or two peaks between 15 and 25 MPH. The second vibration category, medium speed "throbbing", occurs from 40-48 MPH when accelerating or maintaining a constant speed, or on some cars from 40 down to 36 MPH when coasting.

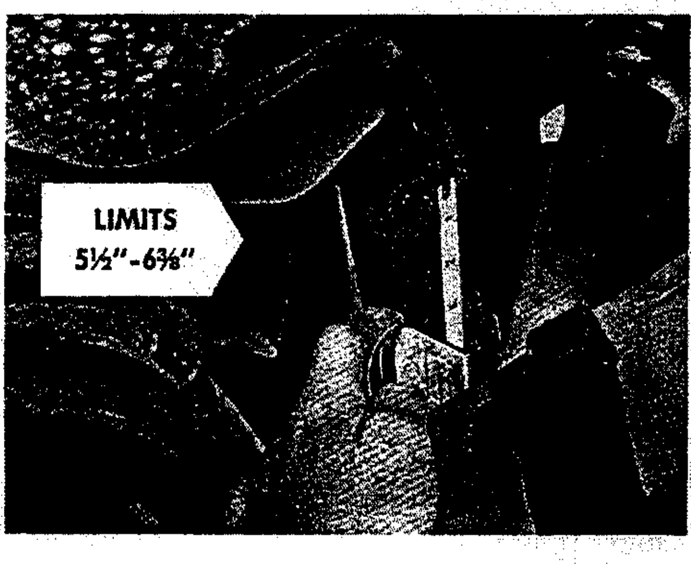
Both low speed "shudder" and medium speed "throbbing" are car speed sensitive -- that is, they follow car speed, not engine speed. Both are also throttle sensitive -- varying slightly with the degree of accelerating or deceleration. Also, both of these vibrations may be affected by the passenger load. Generally, these conditions are felt more than they are heard.



When a condition has been diagnosed as either low speed "shudder" or medium speed "throbbing", we can pretty well isolate the cause to prop shaft misalignment . . . that is, that the angles at the three universal joints aren't exactly what they should be. To correct the condition, there are five steps we should follow, in this order:

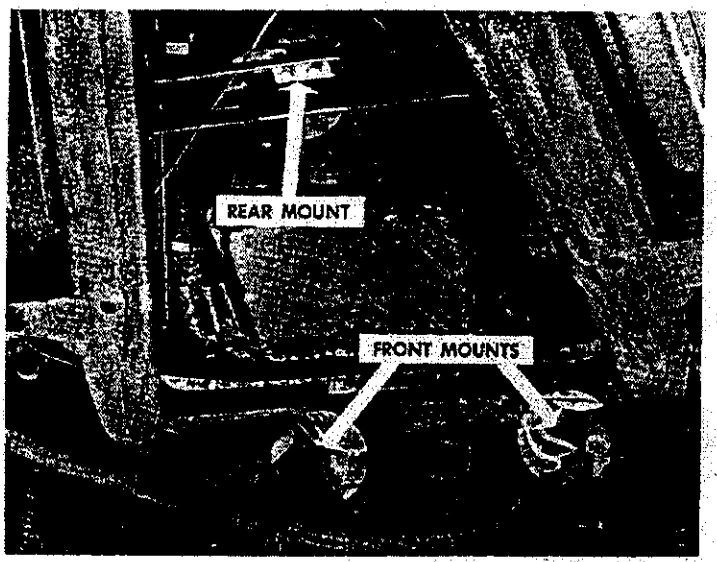
1. Check the rear standing height.
2. Check the alignment of the engine.
3. Check the rear universal joint to see that it is seated properly and free from dirt.
4. Check the alignment of the prop shaft with the special Propeller Shaft Alignment Gage Set, J-8905.
5. Custom align the prop shaft as required.

1. Check the Rear Standing Height



We should check the rear standing height of the car with no passengers, an empty trunk (except for spare tire), and a full tank of gasoline. If the standing height is below 5-1/2 inches, or above 6-3/8 inches, the rear springs should be replaced with the correct type for the body style. Then the car should be again road tested to see if the vibration has been eliminated or minimized. If it hasn't, or if the rear standing height checked out within limits, the next step is to check the alignment of the engine.

2. Check the Alignment of the Engine



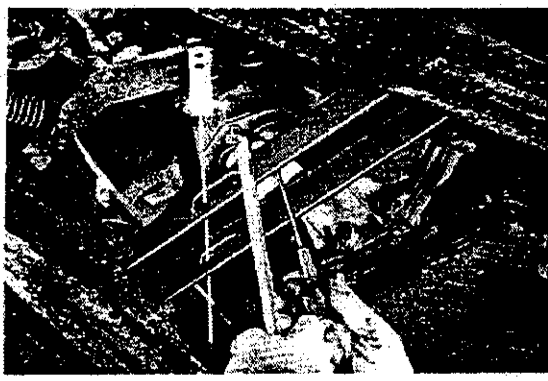
Engine alignment, as governed by the position of the three motor mounts, also affects the alignment of the prop shaft.

The front mounts govern two positions of the engine: first, they position the engine high enough to provide the right prop shaft angle at the front universal joint; and secondly, they "cradle" the engine so it leans slightly to the left -- in order to compensate for the torque developed when the engine is accelerating, which tends to rotate the engine to the right.

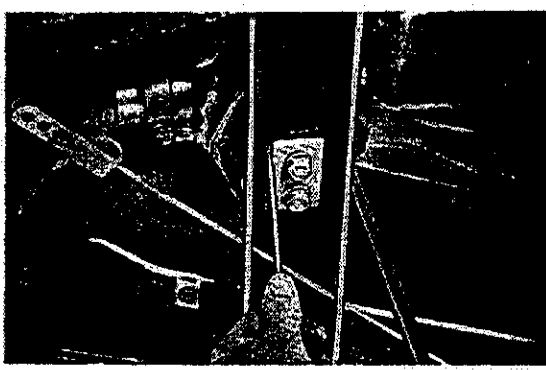
The rear mount helps to position the engine in the fore-and-aft direction, keeping it far enough forward so it does not push against the prop shaft, and so there is no strain on the front mounts.

A visual check of the front mounts will determine if the engine is leaning far enough to the left so the right hand mount is not distorted. The flange of the right hand mount should be centered around the rubber portion, so the upper and lower grooves are of equal width. This indicates there is no strain on the right hand mount. However, if the upper groove is closed up, the engine should be repositioned.

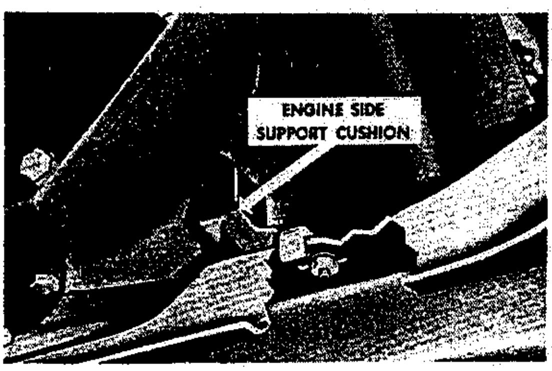
To reposition the engine, the nuts and washers should be removed from the front mount studs, and the engine shifted so the left hand mount is at the bottom of its slot, but the right hand stud a little ways up (just enough so the stud does not touch the bottom of the slot). It may be necessary to place one or two body shims between the right hand mount and the frame, to lift the right hand stud off the bottom of its slot. With the studs positioned correctly in their slots, the engine is leaning enough to the left to compensate for the torque, and is at the correct height. The nuts and washers can now be installed, and the nuts torqued down to 90 foot-pounds.



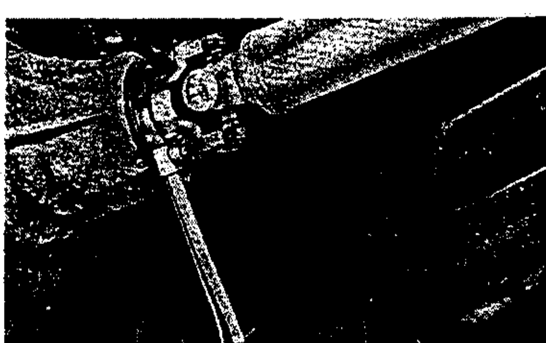
At the rear mount, the engine should be positioned so it doesn't push against the prop shaft, and so there is no fore-and-aft strain on the front mounts. To check for this, loosen the rear mount to cross member screws, and pry the engine rearward -- seeing that the prop shaft does not move with the engine. This rearward position should be marked on the underside of the frame cross member.



Then the engine should be pryed forward, and this position marked. The engine should then be positioned midway between these two marked locations, and the screws torqued to 55 foot-pounds.

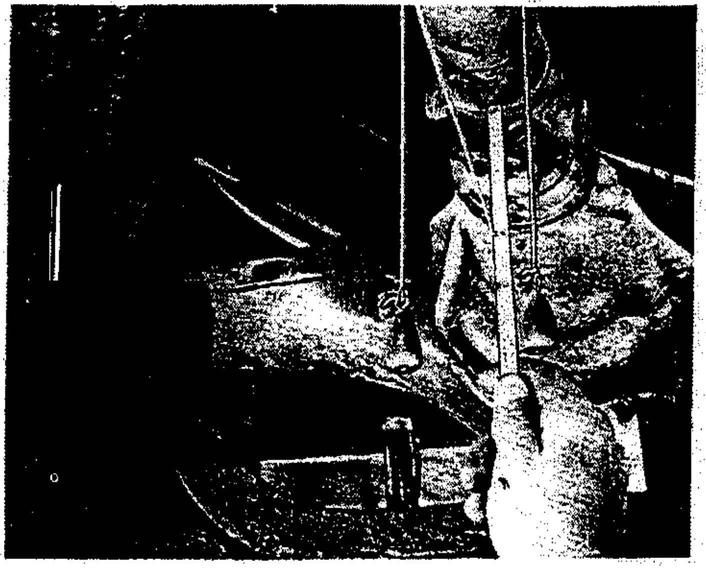


Additionally, on 1962 cars, the engine side support cushions should be positioned for the right amount of preload. The procedure is given in the September, 1961, issue of the "Cadillac Serviceman".



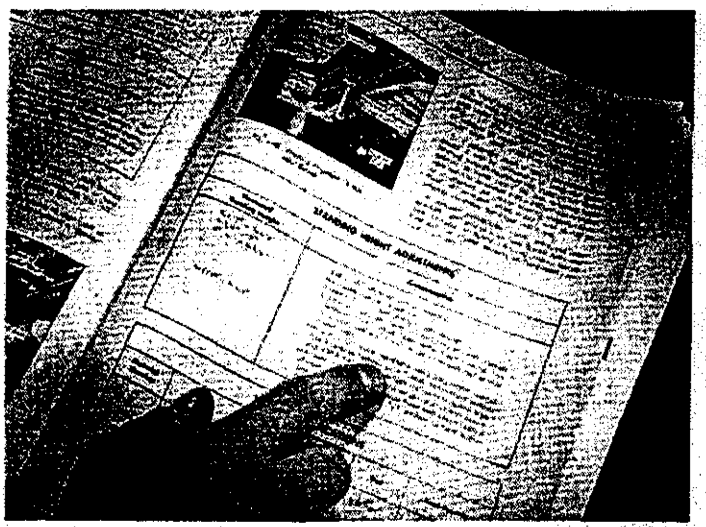
3. Check the Rear Universal Joint

After the engine is in proper alignment, and if the vibration is still present, the rear universal joint should be carefully examined to see that the two U-joint bearings are squarely seated in the pinion yoke. Just a small fleck of dirt or a metal chip between the universal joint and the yoke can produce a vibration. Also, the U-bolts should be squarely installed, and their nuts accurately torqued to 15 foot-pounds. If over-torqued, the U-joint bearings would be distorted, causing a vibration.



4. Align Prop Shaft

If the standing height, engine alignment, and rear U-joint have all been checked, and corrected as necessary, and if the vibration is still present, the next step is to align the prop shaft with the special gage set. With the car up on the hoist, and the weight of the car on the rear axle, the first step is to set the rear standing height to exactly six inches by using the spacer rods. This gives us a reference height to use the stretched cable, plumb bobs, and individual gages. The complete procedure, of course, is covered in the Shop Manual.



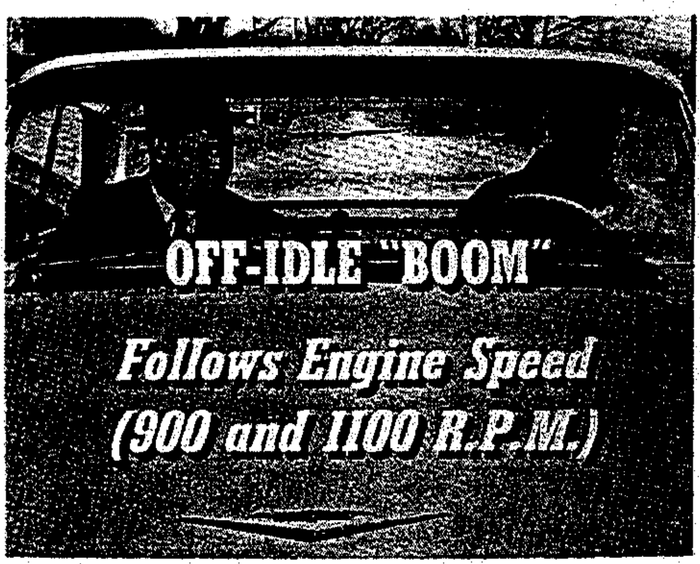
5. Custom Align Prop Shaft as Required

Once we have aligned the prop shaft using the special gage set, we are ready to customize this alignment to the standing height of the particular car we are working on. To do this, refer to the chart on page 7-13 of the 1962 Shop Manual, and determine what shims need to be changed in order to customize the vertical alignment. Once these shims have been changed, of course, the alignment will no longer match-up to the measurements made by the alignment gages. In fact, the alignment gages can actually be removed before customizing the vertical alignment, since we have no further use for them. After customizing, the prop shaft is in proper alignment for the smoothest possible operation with a three passenger load.

This alignment is usually satisfactory with the driver alone, or with a six passenger load. However, if the owner drives alone most of the time, and he wants the best possible alignment for that condition, we can further customize the alignment by removing a 1/16 inch shim from under the prop shaft center bearing mount . . . or, if you are all out of shims at this point, by adding a 3/64 inch washer under each of the two legs of the rear motor mount. On the other hand, the owner may want the best possible alignment for a six passenger load (or possibly his trunk is always heavily loaded). This would be quite rare, however, since the ride with only one passenger would be less than desirable. However, if this is the case, an extra 1/16 inch shim can be added under the center bearing mount.

By the time we've finished with the prop shaft alignment, we should have minimized the low speed "shudder" or medium speed "throbbing" condition. When correcting these conditions, however, remember to do the steps in their proper order, to save time and effort.

OFF-IDLE "BOOM"

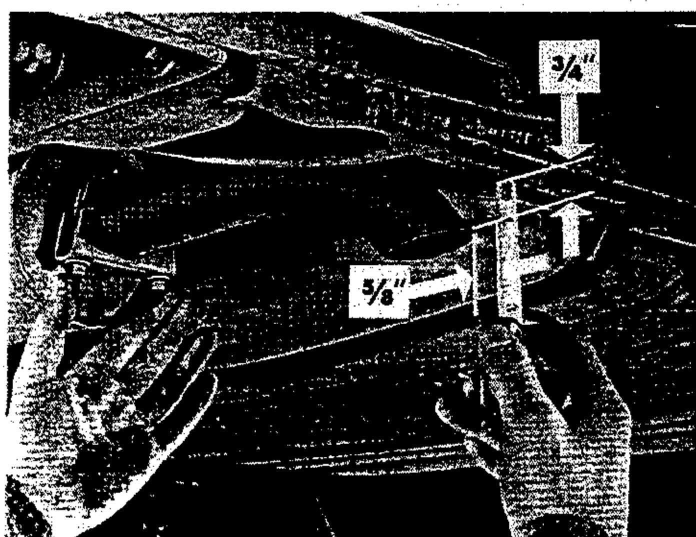


Off-idle boom, the third vibration category, is an audible condition sometimes caused by a misaligned exhaust system or by a fan belt "whip" due to improper belt tension.

When diagnosing, an off-idle "boom" is distinguishable because it follows engine speed -- occurring at 900 RPM and again at 1100 RPM.

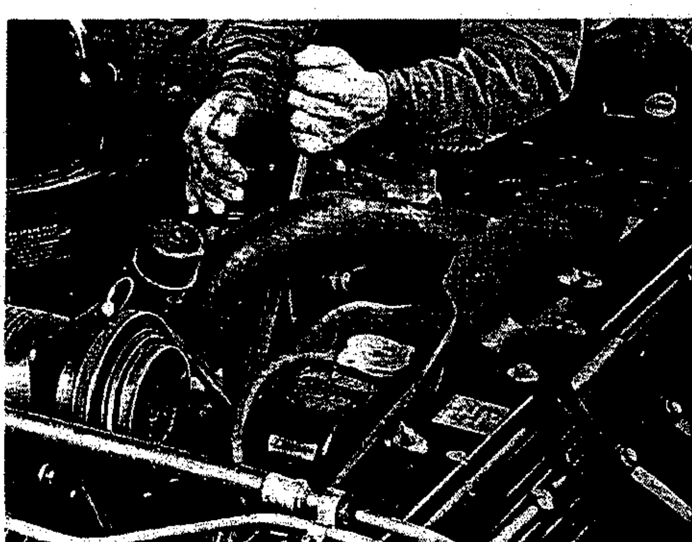
R.P.M. (OFF-IDLE "BOOM")	M.P.H. DR-4	DR-3 (⅔ DR-4)
900	18-25	12-17
1100	25-30	17-20

The critical speed for the 900 RPM off-idle "boom is about 18 to 25 MPH in drive-four . . . or 12 to 17 MPH when the transmission selector lever is moved to drive-three. Similarly, you should experience the 1100 RPM "boom" at 25 to 30 MPH in fourth gear . . . and again at 17 to 20 MPH in third gear.



1. Align Exhaust System

The first step in correcting an off-idle "boom" condition is to align the exhaust system. The system should be aligned cold on 1962 models, and hot on 1961 and prior models. On both '61 and '62 models (with the system cold) there should be a minimum of 5/8 inch length-ways clearance between the end of the tail pipe and the frame rear cross member . . . and the tail outlet should hang at least 3/4 inch below the bottom of the frame. Additionally, the intermediate hangers should support most of the weight of the system, with very little weight being carried by the outlet pipe hanger.



2. Custom Adjust Belt Tensions

Belt tensions can also be responsible for off-idle "boom" -- and when it is, you can usually notice a "whip" in one of the fan belts at the speed at which the vibration peaks. With the engine running at this critical speed, we can "custom adjust" the belt to find the tension that will minimize the belt "whip". Then, with the engine stopped, we should make sure that the belt is still within ten pounds of the desired 60 pound setting, using the Belt Tension Gage, J-7316.

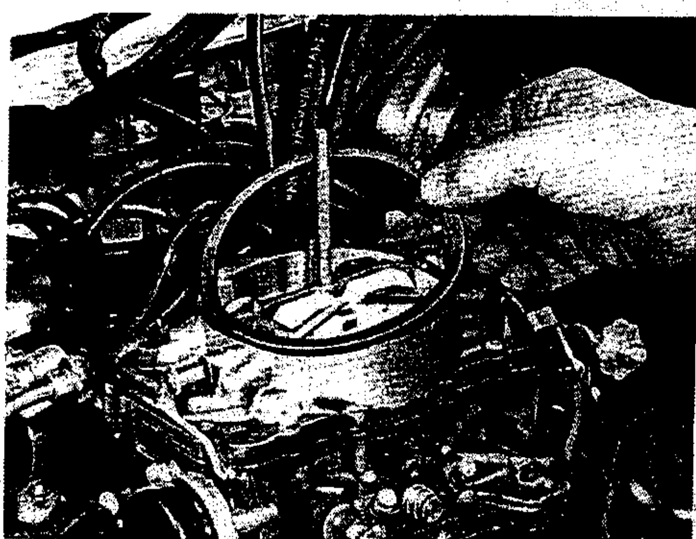
R.P.M. (MEDIUM SPEED "BOOM")	M.P.H. DR-4	M.P.H. DR-3 (⅔ DR-4)
1350-1500	33-37	23-26
1700-1900	43-50	30-35

MEDIUM SPEED "BOOM"

Exhaust system alignment and belt tensions should also be checked in the case of the fourth vibration category, medium speed "boom". A portable tachometer should be used to distinguish whether this "boom" occurs at 1350-1500 RPM, or between 1700-1900 RPM. However, since these noise conditions also follow engine speed, the drive-four and drive-three ranges can be used in the initial road test to place the vibration in this category. The 1350-1500 RPM corresponds to 33-37 MPH in fourth gear, and 23-26 MPH in third gear. Similarly, 1700-1900 RPM corresponds to car speeds of 43-50 MPH in fourth gear and 30-35 MPH in third gear.

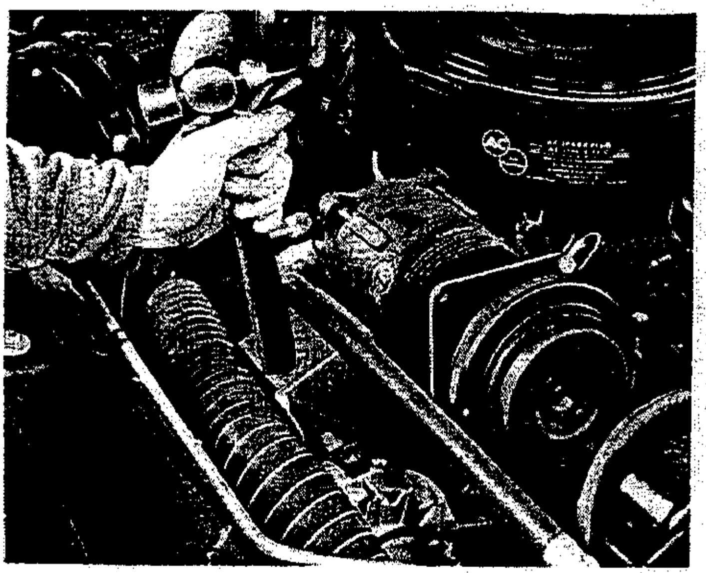
The following steps should be followed to correct medium speed "boom":

1. Check air cleaner seal.
2. Check mounting-tightness of belt driven accessories.
3. Custom adjust belt tension.
4. Align exhaust system.
5. Reposition engine.



1. Check Air Cleaner Seal

The first step in correcting either the 1350-1500 RPM "boom" or the 1700-1900 RPM "boom" is to be certain the gasket between the air cleaner and the carburetor is making a good seal . . . that the air cleaner is firmly attached by its wing nut . . . and that the air cleaner is not grounded against the carburetor.



2. Check Mounting-Tightness of Belt Driven Accessories

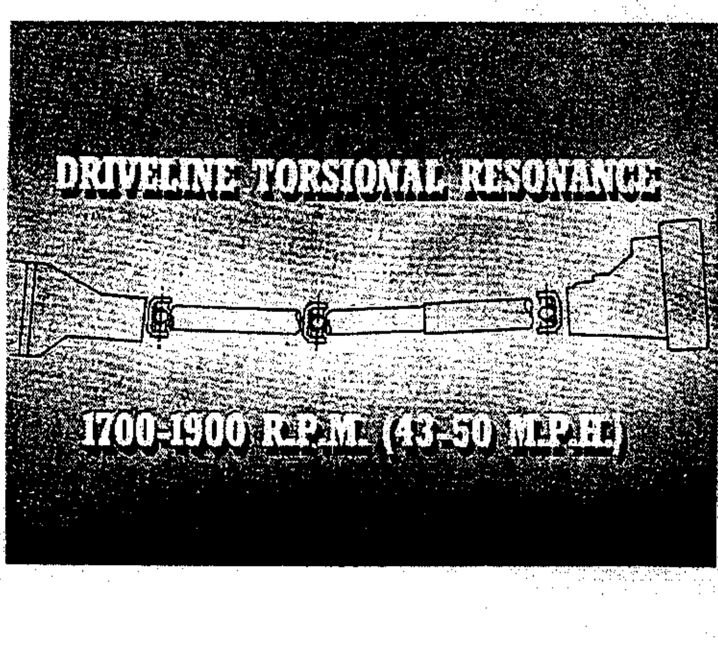
If the cause of the vibration was not at the air cleaner, the second step is to check that the mounting brackets of the three major belt-driven accessories -- the generator, power steering pump, and Freon compressor -- are solidly installed. To do this, road test the car using a wooden wedge between each belt-driven unit, in turn, and the adjacent engine valve cover. If necessary, remove each belt separately to help isolate the condition. Then check the suspected mounting bracket for a solid contact at each screw location, and torque the screws to specifications.

3. Custom Adjust Belt Tension

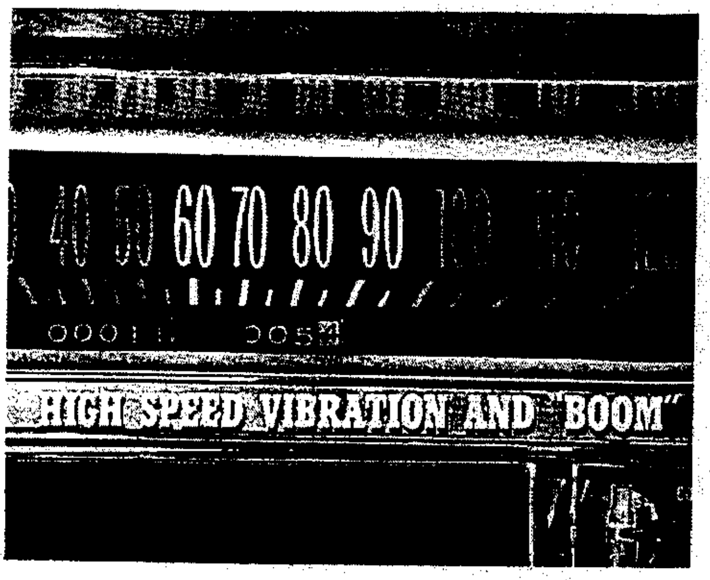
4. Align Exhaust System

5. Reposition Engine

If neither the air cleaner nor the mounting-tightness of the belt driven units is at fault, we can use some of the corrective measures previously described: custom adjusting the belt tensions; aligning the exhaust system; and, as a final step, repositioning the engine.



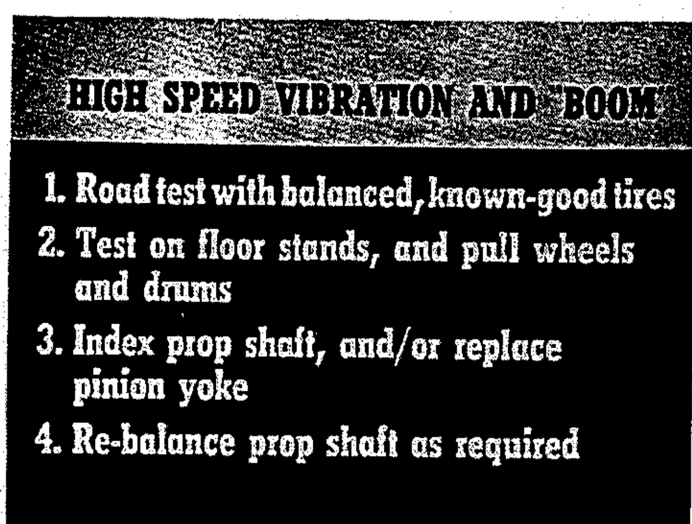
In a few cases, all of these five steps may still not eliminate the medium speed "boom". If this is the case, and if the "boom" occurs at 1700-1900 RPM, the vibration is probably caused by a condition called "driveline torsional resonance". This vibration originates from the firing impulses of the engine, and is heard over a narrow range of engine speeds. The condition usually becomes less and less noticeable during the first thousand miles of driving, but beyond that there is little we can do to eliminate it -- except to make sure we have tried all the other corrective measures for medium speed "boom".



HIGH SPEED VIBRATION AND "BOOM"

The fifth and final vibration category, high speed vibration and "boom", is a car speed sensitive vibration and "growling" noise that may occur at various speeds between 60 and 90 MPH. The noise can either be a steady sound, or can come-and-go as the car maintains a constant speed. Whether the condition is steady, or fluctuating, there may be one or more peaks within the 60-90 MPH range.

If the high speed vibration or "boom" is worse in the rear seat, chances are there is some sort of tire disturbance. Other possibilities include an unbalanced condition in the rear wheels, tires, or drums . . . or an unbalanced prop shaft (especially if the vibration or "boom" is worse in the front seat). A misaligned prop shaft is hardly ever the cause of a high speed vibration, especially if there is no corresponding low speed vibration. In any case, any tire disturbance must be eliminated for further diagnosis, so this is the place to start .

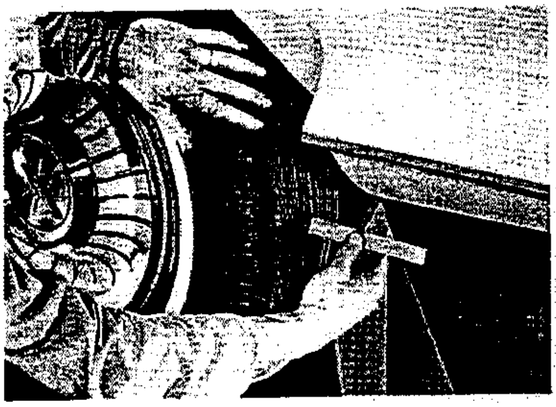


1. Road Test with Balanced, Known-Good Tires

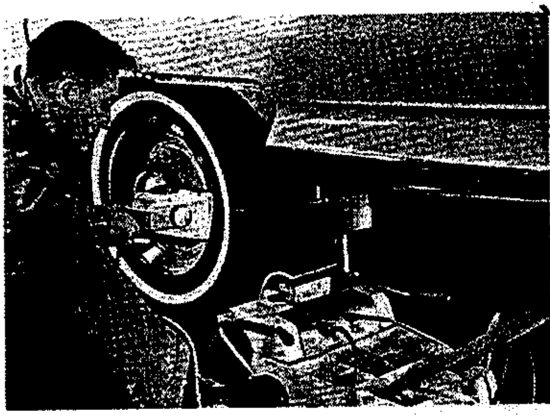
There are three things that can be wrong with the wheel, tire, brake-drum system:

1. The tire tread can have either radial or side-ways runout.
2. The wheel-tire-drum assembly may be out of balance.
3. There can be a sort of in-born roughness in the tire carcass.

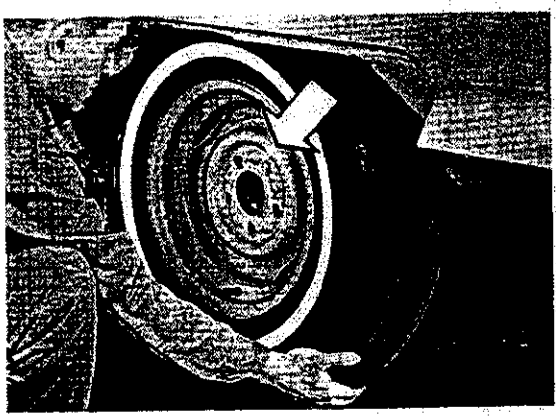
Since the third item -- tire roughness -- cannot be checked directly, the place to start is with runout and unbalance.



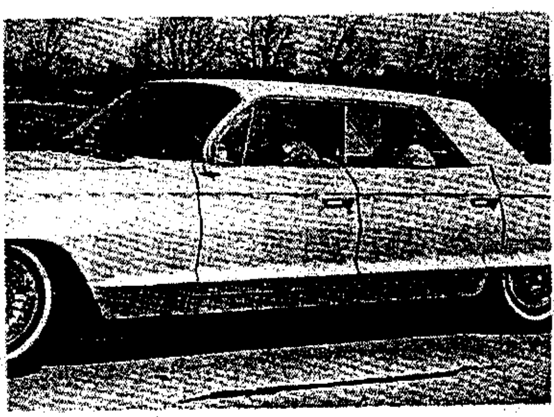
The permissible limit of tire runout is .047 inch (3/64 inch). However, if runout is over this limit, remember that part of the total runout may be due to the wheel rim. Therefore, before condemning a tire, try remounting it on the wheel in another position, to see if the tire runout and the wheel runout can be made to off-set each other. Also, if it is a borderline case, try switching tires with another car. A borderline runout condition that may be felt on one car, may not be noticed on another.



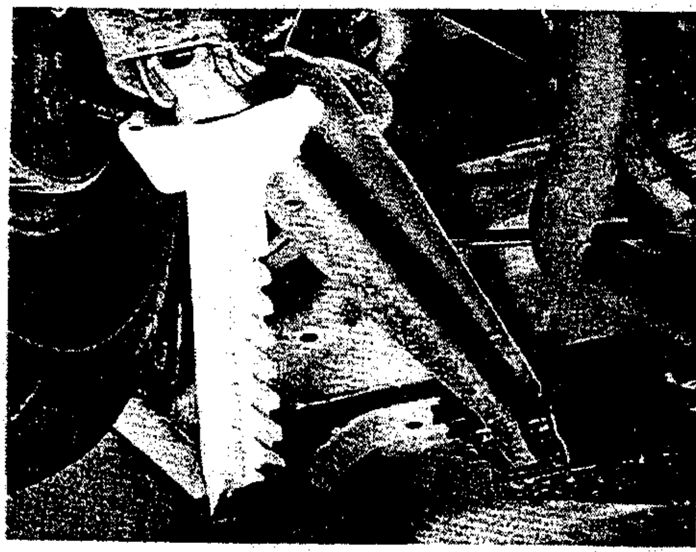
If runout is not at fault, check the balance of the wheel-tire-drum assembly with an on-car wheel balancer. Correct the dynamic as well as the static unbalance, and re-test.



If the vibration is still present, replace the rear tires, wheels, and drums with a known good pair -- one from a car that is free of vibrations. It is not necessary to re-balance them <u>if</u> you retain the same relationship between the wheel and the drum when transferring them from one car to another. This can be done by marking one stud on each brake drum, and placing another mark on the wheel adjacent to the marked stud. If, on the other hand, you use a pair of wheels and tires kept on hand for test purposes, it is very important that they be balanced <u>on the car</u> before road testing.

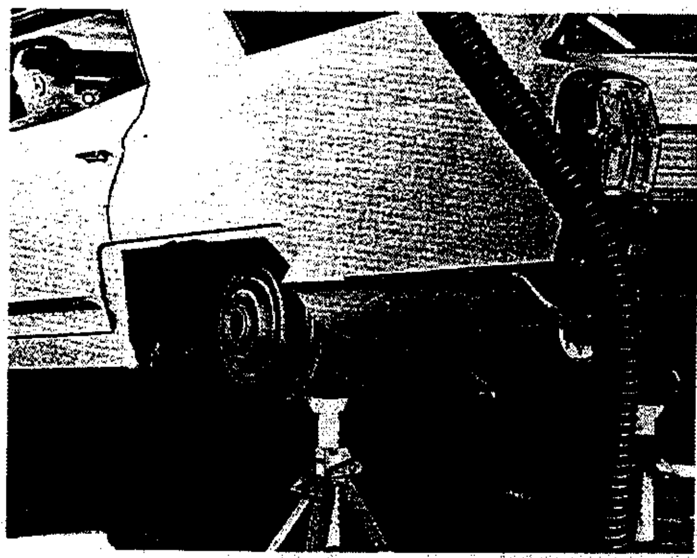


If, when road testing the car over the same route, the high speed vibration and "boom" are gone, you know you have isolated the cause in an orderly manner that will help you deal with the tire dealer, if this should become necessary. If the vibration is still above the normal limits, make note of the car speed at which the peak of the vibration occurs, and reproduce the vibration in the shop.

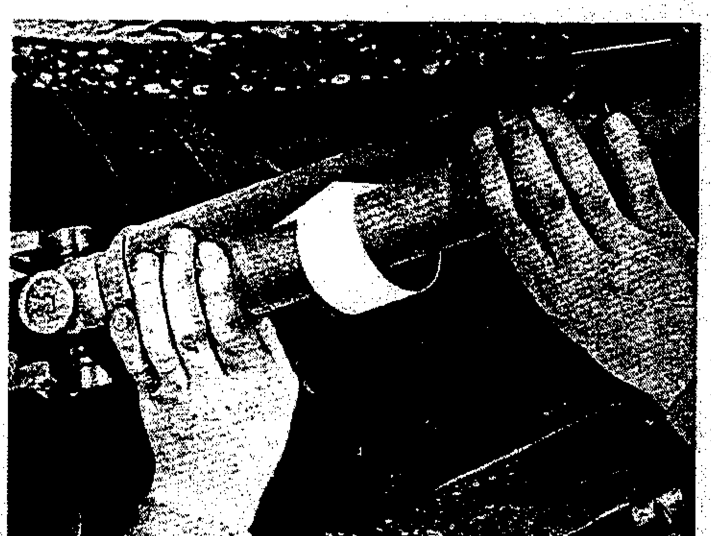


2. Test on Floor Stands, and Pull Wheels and Drums

To reproduce the vibration in the shop, set the car on floor stands, locating the stands under the rear lower links, so they do not touch the axle housing brackets. By this means, the rear axle housing is supported through the lower link rubber bushings, and the floor stands do not interfere with any tendency for the axle housing to vibrate. This freedom of the axle housing could not be obtained with the car on a hoist. Once the car is set-up on floor stands, finding the vibration is a process of elimination.

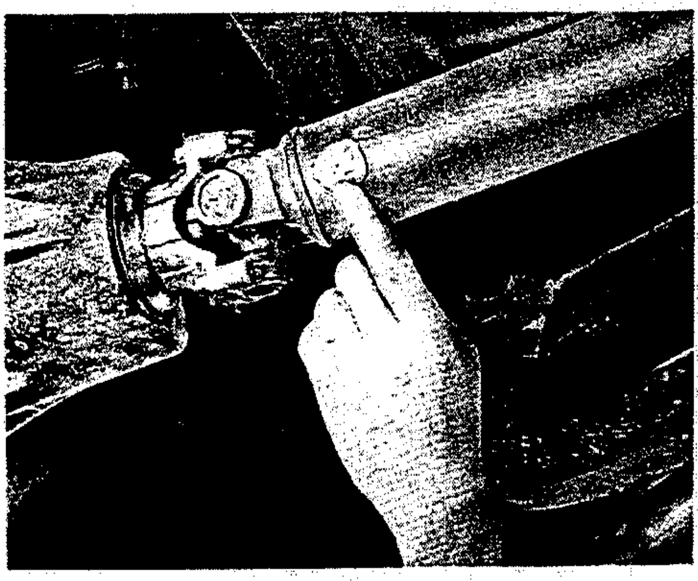


Once the vibration has been reproduced at the same speedometer reading noted in the road test, the wheels should be pulled, and the car re-tested to see if the vibration was affected. If not, the drums should be pulled, and the car again tested. If the vibration is still present, you have once again confirmed that the wheel-tire-drum assemblies are not at fault . . . and you should then pull the axle shafts.



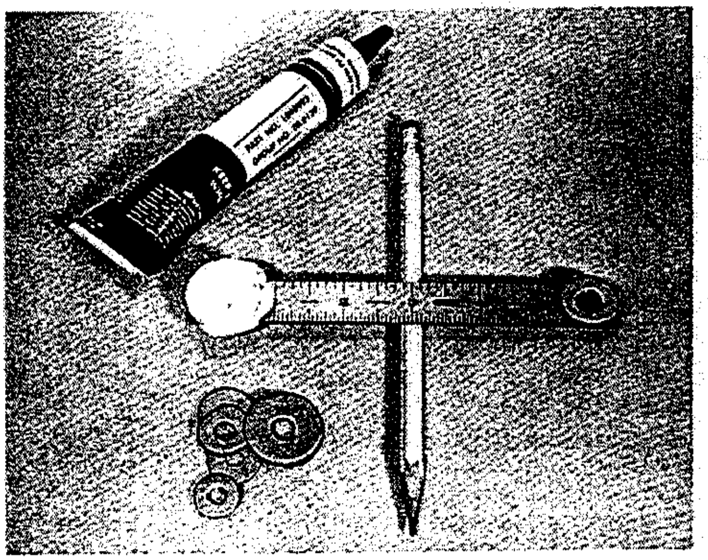
3. Index Prop Shaft and/or Replace Pinion Yoke

If the vibration is still present, disconnect the prop shaft from the rear axle pinion yoke, turn it 180°, and re-install it. If both the shaft and the yoke were a little out of balance, indexing the prop shaft half a turn might let one unbalance off-set the other. If this makes it worse, however, try replacing the pinion yoke. Then, if the high speed vibration is still present, prop shaft unbalance is the only remaining item.



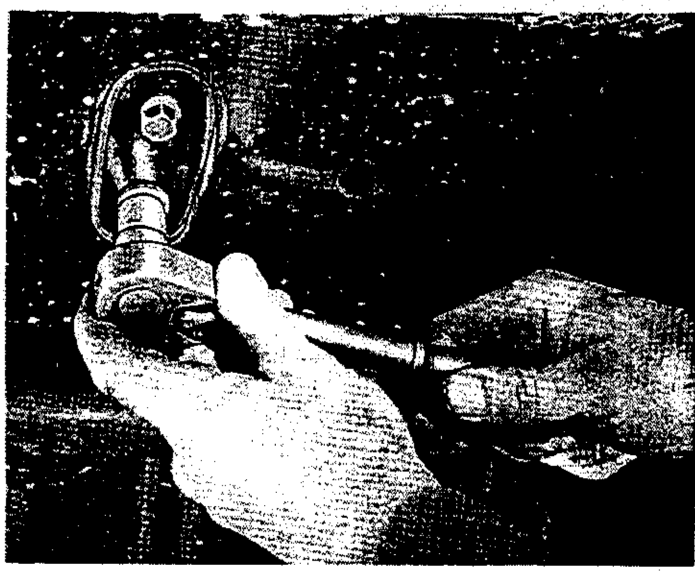
4. Re-Balance Prop Shaft as Required

Prop shaft unbalance can be tested for, of course, by substituting a shaft from a known-good car. However, a little modeling clay will also work. Stick a little of this modeling clay on the rear end of the prop shaft (about enough to equal the size of half a walnut). The clay should stay in place long enough for you to re-test the car, and see if the vibration is affected. Try the lump of clay in two or three positions around the shaft, re-testing after each trial. When the right position of the clay has been found (that is, the position causing the least vibration), scrape away a little at a time, until the right amount is determined. When the vibration is smoothed out as much as possible, you are ready to substitute a permanent weight for the clay.

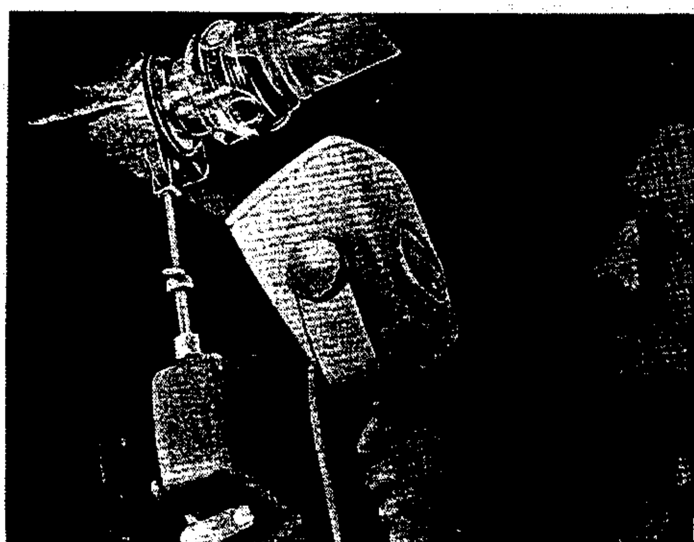


You can make your own weighing scale with a six inch rule and a pencil. Select a washer that balances the clay, and glue it on, using Transmission Cooler Pipe Hose Cement, Part Number 1098993. This cement will attach the washer as securely as if it were spot-welded, provided the paint on the prop shaft is first scraped off at the point where the washer is to be attached. A strip of tape should hold the washer in place while the cement sets, so the car can be driven around the shop. It takes about an hour for the cement to be hardened enough for highway driving.

While prop shaft unbalance is most disturbing at the rear end, this same re-balancing method can also be used at the center or front end of the prop shaft, if necessary.



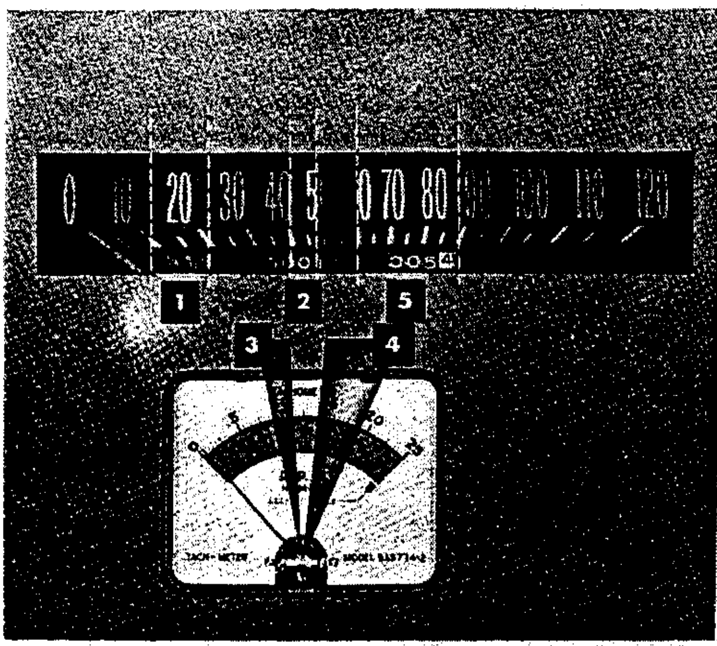
To check for prop shaft unbalance at the center bearing, back off the two center bearing mounting screws while the shaft is spinning at the speed at which the vibration peaks. If the man in the car notices a reduction in the vibration, the clay-balance method can be tried near the center bearing. If not, move on to the front end of the prop shaft.



If a strobe light type wheel balancer is available, determining both the position and the amount of clay balance-weight is considerably easier than by the cut-and-try method. However, either method can be used with the same good results.

While re-balancing the prop shaft is a new idea, it is not very difficult, and it may be just what the high mileage owner needs to smooth out those vibrations that sometimes follow car speed.

By following the four-step corrective procedure given here for high speed vibration and "boom", this condition should be eliminated, or at least minimized to what can be considered a normal level.



And there you have it -- five types of vibrations -- each with its own diagnosis procedure . . . and each identifiable by observing whether the vibration and "boom" follow engine speed or car speed, and making note of the speed at which the vibration peaks.

1. LOW SPEED "SHUDDER"
2. MEDIUM SPEED "THROBBING"

The two lower speed vibrations follow car speed. Low speed "shudder" occurs from 15 to 25 MPH and medium speed "throbbing" occurs at 40-48 MPH when accelerating or maintaining a constant speed, or may occur again when coasting at speeds from 40 down to 36 MPH. Both these conditions are felt more than they are heard; and both are caused by prop shaft misalignment, for one reason or another.

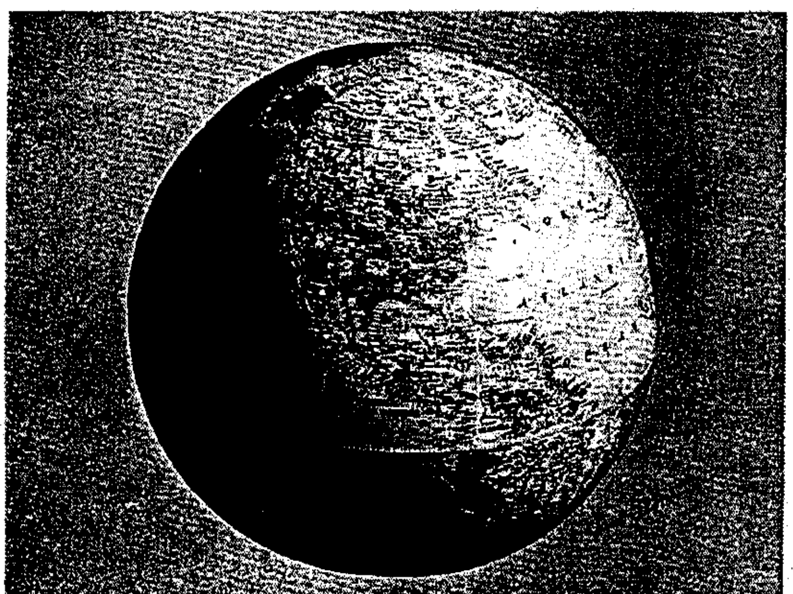
3. OFF-IDLE "BOOM"
4. MEDIUM SPEED "BOOM"

Both these conditions follow engine speed. They are usually audible. The correction usually involves the mounting of the engine, its belt driven accessories, or the exhaust system.

5. HIGH SPEED VIBRATION AND "BOOM"

This condition follows car speed. It may have one or more peaks between 60 and 90 MPH. Causes usually involve rough tires . . . or an out of balance condition in the tires, drums, or prop shaft.

With all five vibration categories, a good diagnosis is the best and only means to finding the cause. And this diagnosis starts with a road test with the owner -- to make certain we know exactly what it is he is concerned about, and to determine whether or not the condition is objectionable enough to justify working on it. Also, we should assure the owner that any vibration heard or felt over a relatively short range of speeds will not hurt his car or affect its durability.



By following the diagnosis and corrective measures outlined in this Service Summary, we can move those occasional vibrations out of the indefinite gray area we called the "Twilight Zone" . . . and bring the whole subject into the broad light of day. And that's the way that both us -- and our owners -- will be the happiest.

CADILLAC CERTIFIED CRAFTSMAN'S LEAGUE

Examination No. 4, 1962

Instructions

1. Read each question and the possible answers carefully:

   EXAMPLE:

   Question Z; What is the capacity of the gas tank on 1962, 6039 styles?

   1. 16 gallons
   2. 26 gallons
   3. 17 gallons
   4. 22 gallons

ANSWER
Z-2

2. When you have selected the correct answer to the question, turn to the Answer List on Page E, and insert your answer in the space provided.

3. After all the questions have been answered detach the answer sheet and return it to the factory Service Department.

CADILLAC CERTIFIED CRAFTSMAN'S LEAGUE EXAMINATION -- NUMBER 4, - 1962

A. Which of the following statements best defines the cause of a "boom" (the noise that sometimes accompanies a vibration)?

   1. The sound of a vibrating, rotating part.
   2. The end result of a chain reaction set-off by a rotating part.
   3. The sound resulting when the metal part vibrates against another metal part that is not vibrating.
   4. The sound resulting when one metal part vibrates against another rotating metal part.

B. At what time should we determine whether a vibration is noticeable enough to consider working on it?

   1. Any time before we actually start the work.
   2. Only after all the corrective steps have been tried.
   3. When the vibration has been correctly diagnosed as driveline torsional resonance.
   4. Right at the start, when road testing with the owner.

C. If a vibration is heard through a relatively broad range of car speeds, which of the following is probably not the cause?

   1. A rotating part that is seriously out-of-balance.
   2. A rotating part that is only very slightly out-of-balance.

V. What is the most likely cause of a transmission gear whine that occurs when decelerating to a stop from 15 MPH?

1. Noisy output shaft ball bearing.
2. Noisy front unit planetary gear set.
3. Noisy rear unit planetary gear set.
4. Governor drive gear snap ring too tight.

W. How many valve spring shims for use after a valve grind job on a 1962 car below Engine No. 027755, or any 1949-61 model, are contained in each Shim Kit, Part No. 3632098?

1. 1 shim.
2. 10 shims.
3. 16 shims.
4. 25 shims.

X. Before replacing a windshield wiper blade for smearing or skipping, what correction should first be tried?

1. Add extra solvent to the washer jar.
2. Replace the rubber portion of each blade assembly.
3. Wash glass with a cleansing agent, then rinse thoroughly.
4. Replace windshield wiper arms.

Y. What precaution should be observed, when cleaning the surface of a differential pinion yoke with 400 grit paper and kerosene as a part of seal replacement?

1. Use circular motions, to prevent spiraled marks.
2. Use twisting motions, to create spiraled marks.
3. Use lengthways motions, to create parallel marks.
4. Use crossways motions, to create circumferential marks.

Z. When using Installer J-9480 to press the Air Conditioner compressor clutch plate and hub assembly into the shaft, why is it important to leave 3/32 inch clutch plate clearance?

1. Because this is the final operating clearance of the clutch when disengaged.
2. Because the shaft might be pulled out of the swash plate if the clutch bottoms against the pulley.
3. Because the clutch might slip if the air gap is set too close.
4. Because shaft seal leakage might be caused by letting the clutch plate touch the pulley.