

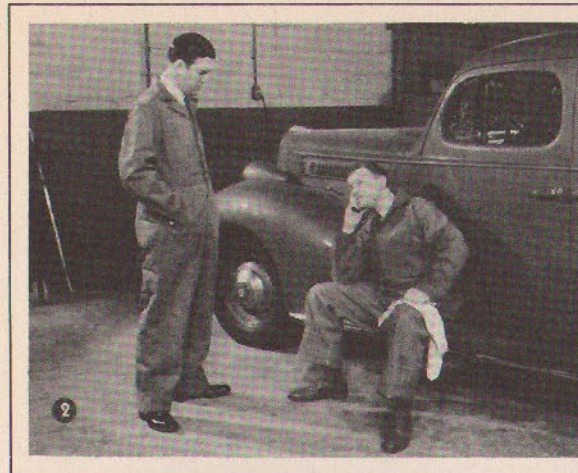
**SERVICE
TRAINING**

*Film
Supplement*



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FILM 3
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by the SERVICE PROMOTION DEPARTMENT
PACKARD MOTOR CAR COMPANY - DETROIT



WALT: Well, for Pete's sake, Speed. What're you moping about?

SPEED: Aw, leave me alone. I'm lower than a snake's heel.

WALT: What's the trouble?

SPEED: Another one of these front end jobs.



SPEED: This time it's tire wear. The other day it was steering. I'm beginning to think I don't know anything about the front end, Walt..

WALT: After all these years? Why, you ought not to have any trouble lining up a front end.

SPEED: It isn't that. If it's just misalignment, I can take care of it as quick as the next one.



SPEED: But it's these unusual ones that get me. Tire wear without any apparent reason, or steering trouble when the alignment's right up to standard.

WALT: Don't you think maybe it's just lack of thorough diagnosis?

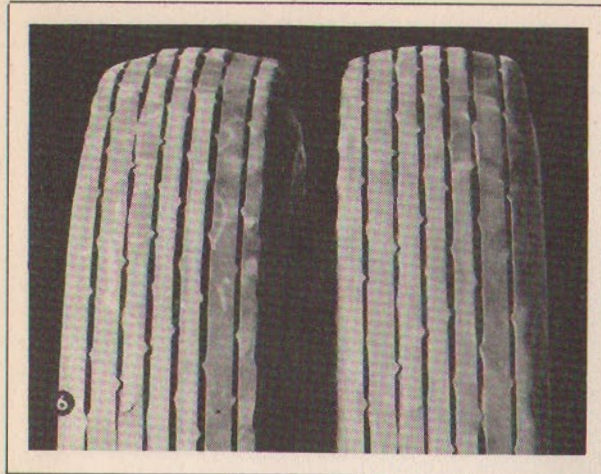
SPEED: Maybe. But I don't know what to look for.



SPEED: You've had pretty good luck in cracking those tough ones. How about giving me the low-down?

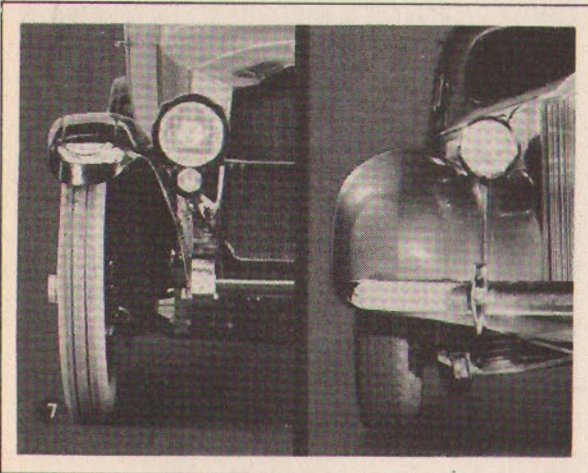
WALT: Sure, Speed, I'll do what I can. What do you want to know?

SPEED: Well, take tire wear for example.

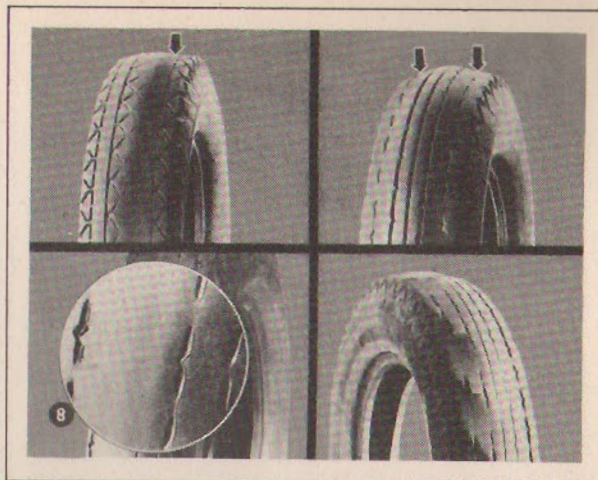


SPEED: An owner complains about uneven tire wear on the front wheels and wants you to do something about it. I don't even know where to start.

WALT: Don't let those things trip you up, Speed. If there's something wrong, there's a reason for it, but it isn't always misalignment.



WALT: Automobiles are a lot different now than they were a few years ago. They're faster and more powerful; they have larger tires with lower pressures; and they're using softer springs. All those things make a difference in the way tire wear shows up. As a matter of fact --



WALT: The kind of wear the tire shows will give you a hint of the cause. Side wear--either double or single--feather-edging, and spotty wear all come from different causes.

SPEED: How's that?

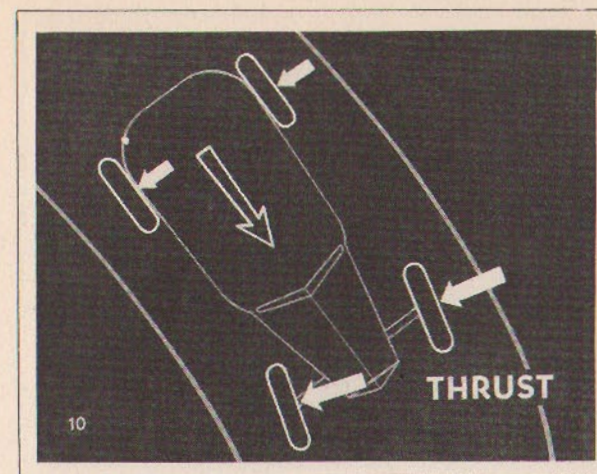
WALT: Different forces act on the tires in different ways.



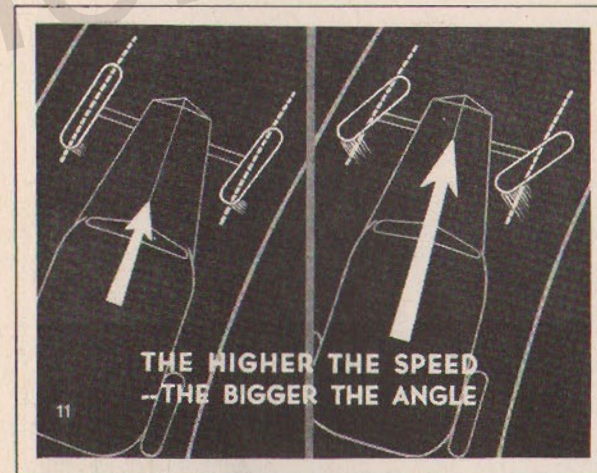
WALT: When you get side wear on both the inside and outside edges of the front tires, it's obvious it has to be something that distorts the tread; otherwise there couldn't be more wear on the sides than on the center.

SPEED: Sure, but what is it?

WALT: Highspeed cornering. You see--



WALT: When you turn a corner, the tires have to push against the road to keep the car in a curved path. The thrust is on the outside of the outer tire and the inside of the inner tire. Then, too, in order to produce this thrust, the tires slip at a slight angle.



WALT: The higher the speed, the bigger the angle has to be. So, the more wear you'll get.

SPEED: I see. That's what makes the tires squeal when you take a corner at high speed.

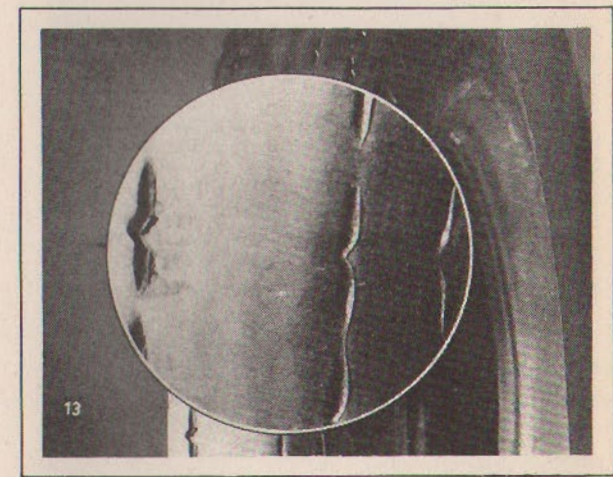
WALT: Yes, and you'll get a squeal even at low speeds, if the air pressure is low. And the squealing means the tires are wearing. This usually shows up as two-sided wear.



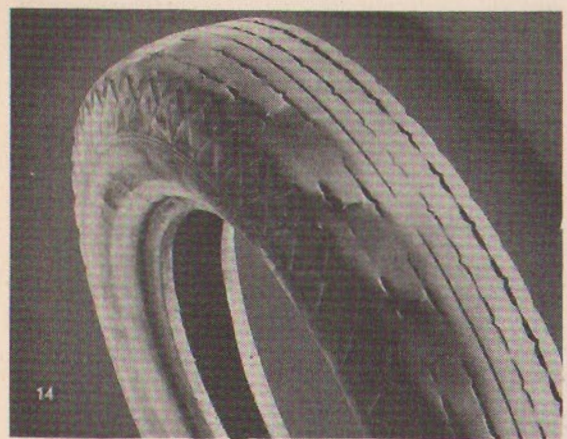
WALT: But the wear may be on only the outside edges of the tire and still be due to high speed cornering. Or it might be something else.

SPEED: Yeah, too much camber.

WALT: Yes. Camber's one thing that may cause it.



WALT: Feather-edging of the tread will come from too much toe-in, or from toe-out in the straight ahead position, or from improper turning radius. Any of these'll cause the tire to slip sideways, leaving a little edge of rubber on one side of the tread or the other--like the feather-edge of metal you get when you're filing.



WALT: Uneven or spotty wear may come from some mechanical difficulty such as uneven caster, wobbly wheels, or brake drum out of round. But usually it's under-inflation, and sometimes an out-of-balance wheel.



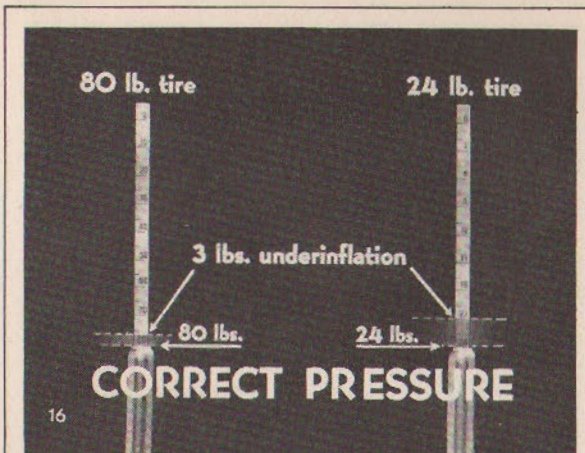
WALT: You can see how careful diagnosis narrows down your search, though.

SPEED: Yeah, Walt. But a lot of those things aren't mechanical troubles at all. You can't do anything about the way the owner drives.

WALT: No, but you can help him to minimize that wear.

SPEED: How?

WALT: By keeping tire pressures up, for one thing.



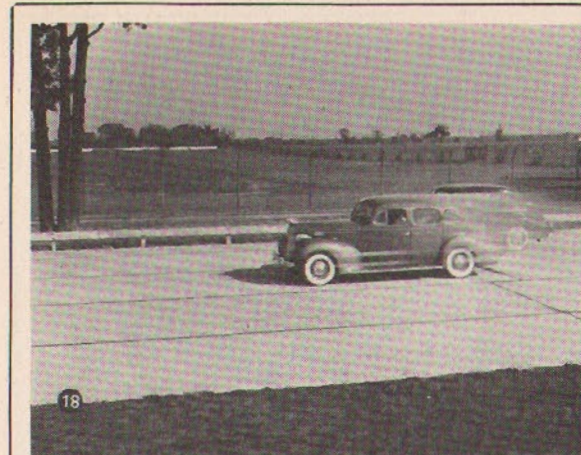
WALT: When tires carried eighty pounds pressure, a drop of three pounds was less than four percent of the total pressure. But with twenty-four pounds, such as we have today, three pounds is more than twelve and a half percent of the total. Even a one pound drop makes a tremendous difference these days.

SPEED: Yeah, pressure's important, I guess.

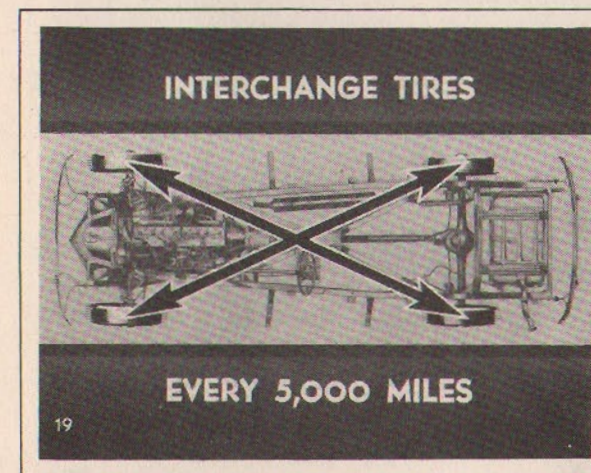
WALT: You bet it is.



WALT: Tires ought to be checked at least once a week, and the pressure should never be allowed to drop more than three pounds under the recommended pressure. Under-inflation has something to do with almost every kind of tire wear. And keeping the pressures up will reduce the amount of wear.



WALT: If the owner does a lot of high speed driving it's a good idea to suggest carrying three or four pounds more than the recommended pressure. It'll cut down on side wear from high-speed cornering, and it'll make the tires last longer. But it'll mean a harder ride. Then, of course, on every car --



WALT: -- it's important to X the tires from right to left, front to rear, every five thousand miles--oftener, if the owner does a lot of high-speed driving. That'll keep the wear equalized between the front and rear tires and it'll even up the wear on the front tires.

EXPLAIN TO OWNER

1. Cause of tire wear
2. Kind of wear to be expected
3. How to minimize tire wear

WALT: And explain to the owner, first, the cause of the wear; second, the kind of wear to expect in the future; and, third, how to keep that wear at a minimum. That'll help reduce the wear, and keep the owner from spending his money for alignment service he doesn't need.

SPEED: I see, Walt.



SPEED: That puts a new light on tire wear. A lot of it boils down to just explaining it to the owner.

WALT: Yes, as long as you know the mechanical adjustments are all right.

SPEED: That's something else, Walt. Take front end alignment.



SPEED: I know how to take care of the usual adjustments, but the whole thing's so tied up with steering and tire wear--and even ride--that I'm always getting hooked on one thing or another. It's just little things mostly.

WALT: That's just it, Speed.



WALT: It's only by watching all the little things that you can keep on top of the job. If you work accurately and carefully analyze each job as you are checking it, you won't have any trouble.

SPEED: I guess you're right, Walt. How about giving me a hand while I check over this job, to see if I'm going wrong anywhere?

WALT: Sure. You go through it, and I'll check you.

SPEED: Okay. We'll get at it right now.



SPEED: First, you bring the tire pressure up to standard on all four wheels so a soft tire won't give you a false reading.

WALT: And don't forget, the floor has to be level. It'll throw you off as much as unequal tire pressure.

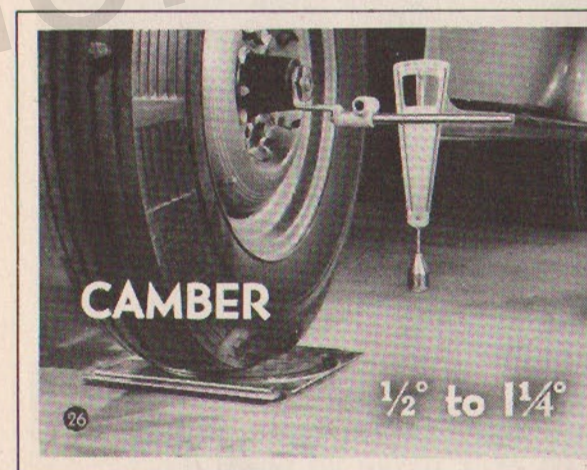
SPEED: I guess it will at that. All right --

	Front	Rear
1600-1--1700-1	24#	26#
1602--1702	26#	30#
1601-A--1701-A	28#	36#
1603	26#	30#
1703	26#	28#
1605	26#	32#
1705	26#	29#

Pressures given are for tires that are warm, having been driven for at least two miles at moderate speed. Deduct 2 pounds front and 3 pounds rear when tires are cold (normal atmospheric temperature).



SPEED: And, next, shake the wheels to see if there is any looseness that might throw the adjustment off--loose king pins or bushings, or loose wheel bearings.



SPEED: Now we install the camber gauge and take a reading. It should be from a half to one and a quarter degrees.

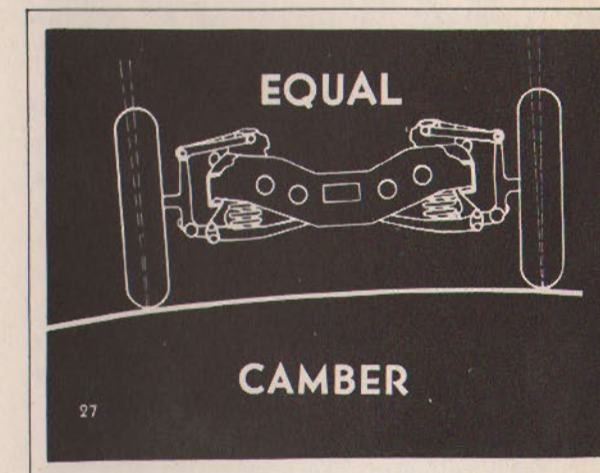
WALT: That's right for the seventeen hundred. Don't spend the owner's money unnecessarily, though, just to get it on the low limit unless you're up against some special condition. Anywhere within those limits is usually all right. However, your check has to be accurate.

S.T. 873 Camber Caster Gauge

Camber

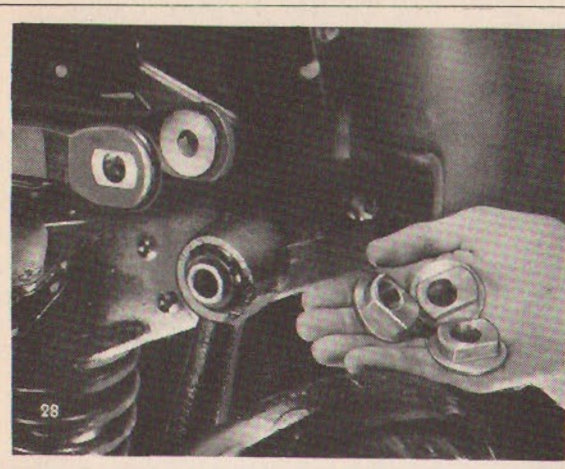
115C - 120C	$1^{\circ} \pm 1/4^{\circ}$
1500-1-2-6-7-8	$1^{\circ} \pm 1/4^{\circ}$
1600-1-2	$1/2^{\circ} \pm 1/2^{\circ}$
1603-4-5-7-8	$1^{\circ} \pm 1/4^{\circ}$
1700-1-2-3-5	$1/2^{\circ} + 3/4^{\circ} - 0^{\circ}$
1707-8	$1^{\circ} \pm 1/4^{\circ}$

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WALT: If you have to adjust it, keep it as near the low limit as possible, and keep the two wheels as near alike as possible. If you have to go a little plus or minus, put the plus on the left and the minus on the right hand side to allow for the crown of the road. You know how to adjust for camber.

SPEED: Sure.



SPEED: You just change the offset pilots in the upper end of the wheel support arm.

WALT: That's right. There are four pilots available, ranging from zero to three-sixteenths inches offset, in sixteenth inch jumps. A 1/16" offset is about a third of a degree change in camber. So you've got plenty of leeway in adjustment.

338273	Camber Washer	....	No offset
338274	Camber Washer	..	1/16" offset
338275	Camber Washer	..	1/8" offset
338276	Camber Washer	..	3/16" offset
237065	Camber Spacer	..	1/8" offset
237066	Camber Spacer	..	3/16" offset
237067	Camber Spacer	..	1/4" offset
237753	Camber Spacer	..	5/16" offset

WALT: But if you can't come within the limits with the offset pilots, it means that something is bent, and you'll have to find what it is and replace it. Don't try to bend any part of the front suspension system to make an adjustment.

SPEED: Gee, there's a lot to that, Walt. All right, now we're ready for caster.

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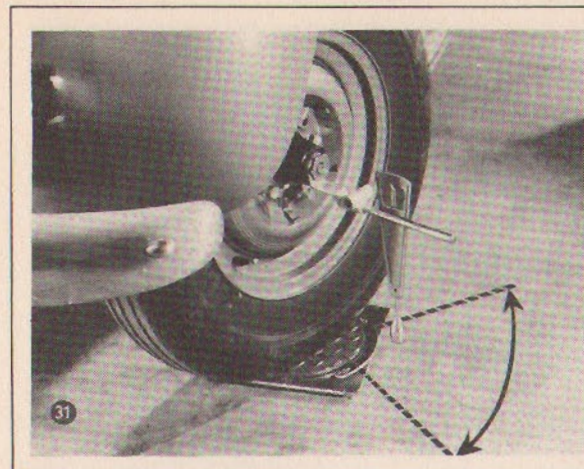
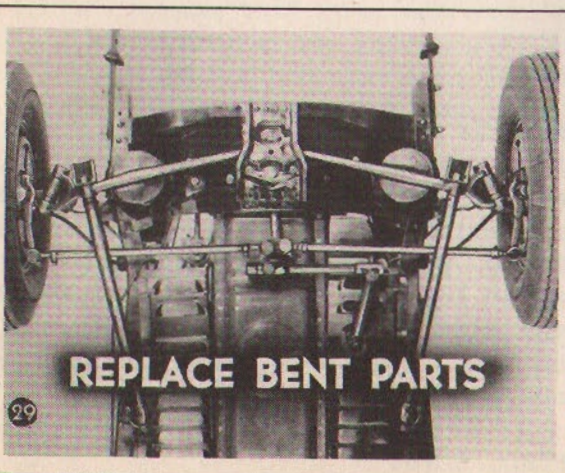


SPEED: It should be from one to two degrees. One and a half degrees is preferred, and the two wheels should be as near alike as possible.

WALT: Yes, not more than half a degree difference between 'em.

Caster

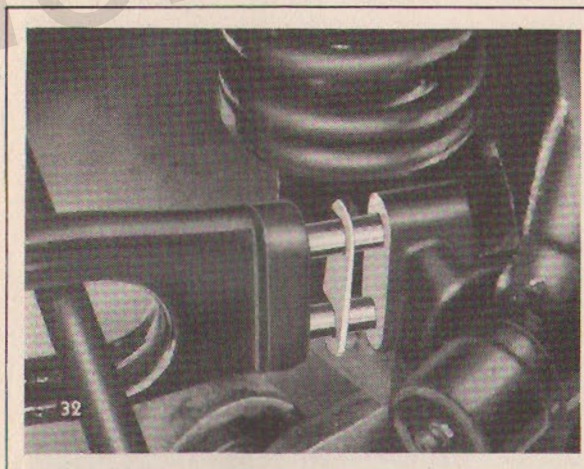
115C - 120C - 1500-1-2	....	2° ± 1/2°
1506-7-8	.....	0° + 0° - 1/2°
1600-1-2	.....	1-1/2° ± 1/2°
1603-4-5	.....	2-1/2° ± 1/2°
1607-8	.....	0° + 0° - 1/2°
1700-1	.....	1-1/2° ± 1/2°
1702-3-5	.....	0° ± 1/2°
1707-8	.....	0° + 0° - 1/2°



WALT: Be sure both wheels are resting on the turn-tables when you swing the wheels. Otherwise the tires will twist and throw your reading off. And it's a good idea to take the average of several readings to be sure you're right.

SPEED: I see —

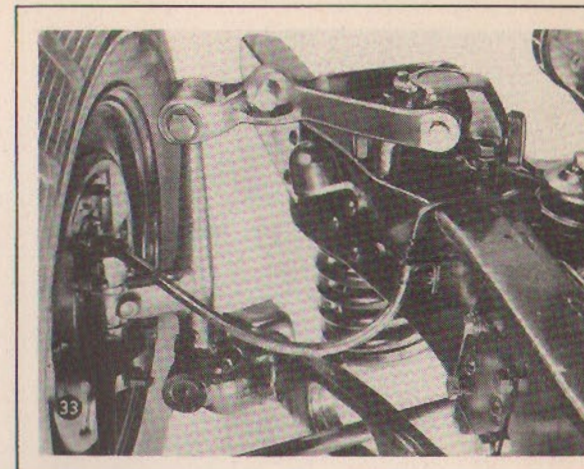
S.T. 950 Turntables



SPEED: You adjust the caster by installing the tapered adjusting shims over the torque arm studs. There are two of 'em—one with a half degree and the other with a full degree of taper. They can be installed either way. Thick end at the top decreases caster. At the bottom, it increases caster.

WALT: That's right.

304698	Caster Shim	.....	1°
304699	Caster Shim	.....	1/2°
239342	Caster Shim (twelve)	....	1°
239343	Caster Shim (twelve)	..	1/2°



WALT: It's a good idea to loosen up the shock absorber mountings before you install caster shims. It'll make the job easier, and it'll give the shocks a chance to line up with the new position. Lining up the bushings is important because of friction lag.

SPEED: What do you mean by "friction lag?"

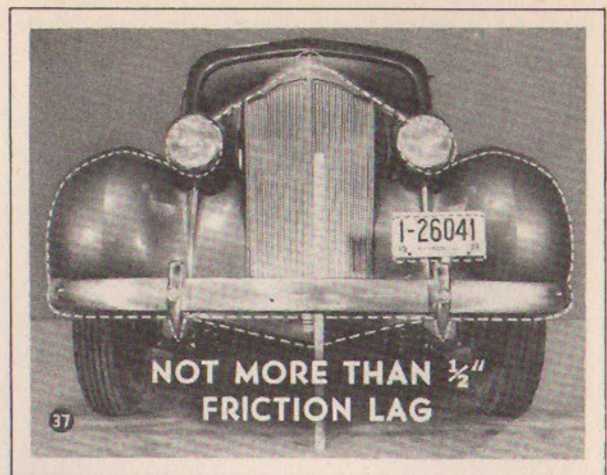
WALT: It's this way.



WALT: Changing the position of any of the front suspension parts is apt to put a bind on the bushings that'll put a lot of extra friction in the front suspension and interfere with the free movement of the front end. That'll give you a hard and choppy ride. We call it "friction lag." Get hold of the bumper there, and I'll show you how to check it.



WALT: Work the front of the car up as high as it'll stay and measure the distance from the floor to a reference mark you made on the radiator shell. Be careful to let loose of it slowly, or it'll jolt down and give you a false reading.



WALT: There should not be more than a half to five-eighths of an inch between the highest point it'll stay by itself and the lowest point. The less there is the better. Now, let's see what we've done so far.



WALT: Then work it down as far as it'll stay and measure it again to the same mark. Again, be careful how you let go of the bumper or it'll spring upward.

ALIGNMENT CHECK

PRELIMINARY CHECK: Tire pressure -- worn bushings and king pin

CAMBER: Adjust by changing offset pilots, keeping as near low limit as possible

CASTER: Adjust by changing shims, keeping both wheels as near alike as possible

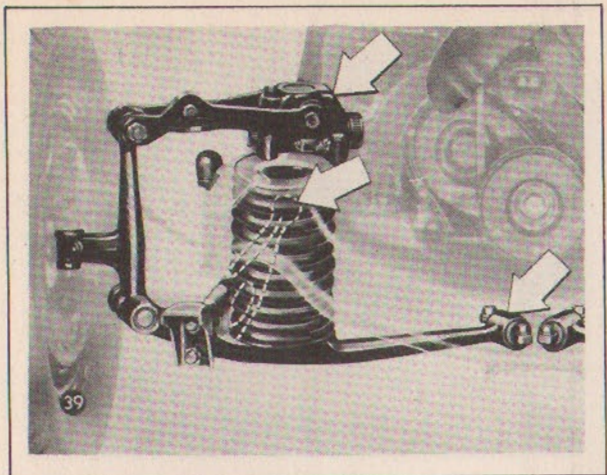
FRICTION LAG:

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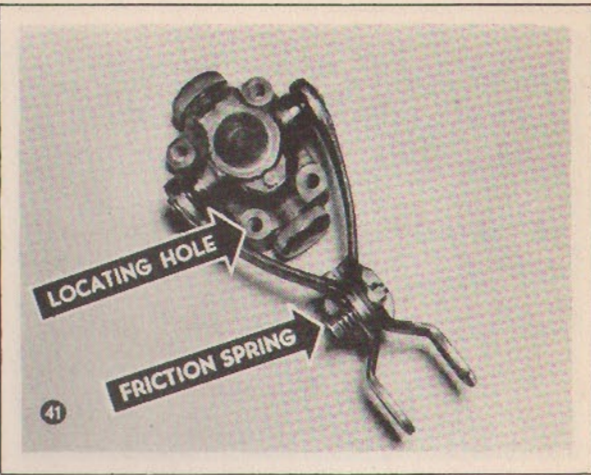
WALT: Here's a list. Let's look 'em over ---

SPEED: All right, now we've checked friction lag. If the front end has to be lined up ---

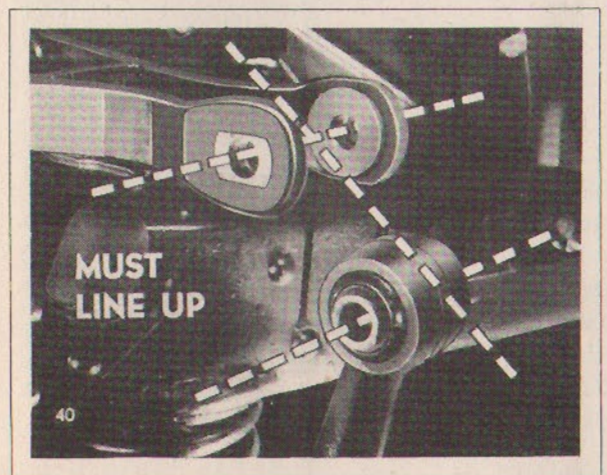


SPEED: --- we just loosen the shock absorber at the frame, the cap at the rear of each torque arm, and the lower support arm inner bushing bolts. Let 'em take their centers, and then tighten 'em.

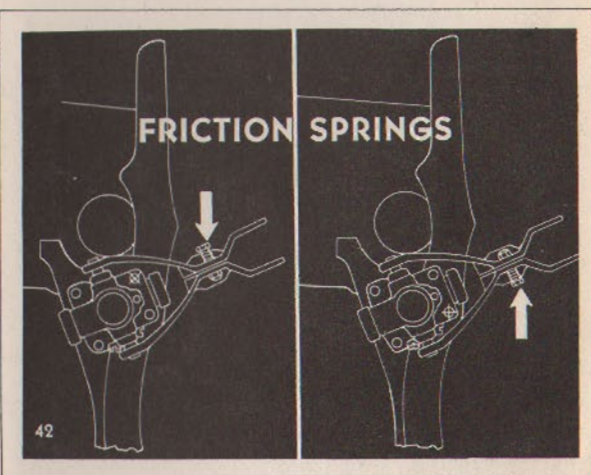
WALT: That's right, Speed. The point where you're most likely to get the friction lag is in the upper support arm. So give the shock absorbers special attention.



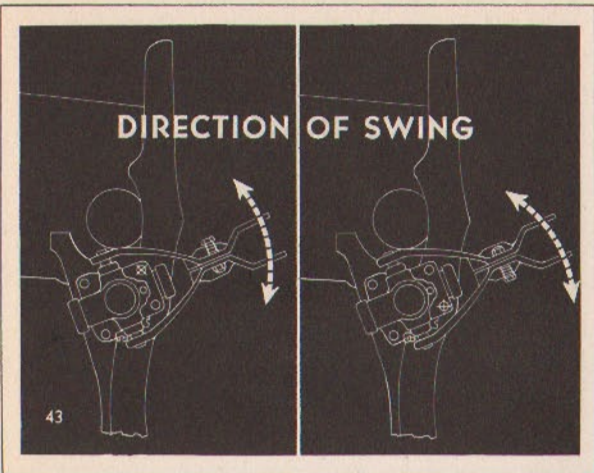
WALT: One of the mounting holes is a ream fit on the bolt and serves as the locating point in lining up the shocks. The locating hole is toward the outside of the car, on the same side as the friction spring and bolt. Be sure you know how to recognize that hole.



WALT: The holes in the shock absorber arms have to align with the bore of the wheel support arm bushings. If they don't line up, loosen the shock absorbers and shift 'em into alignment.



WALT: In production, the shock absorbers have been mounted two ways; so the friction spring and bolt points toward the front on some cars and toward the rear on others. As far as the operation of the shocks is concerned, it doesn't make any difference which way they're mounted ---



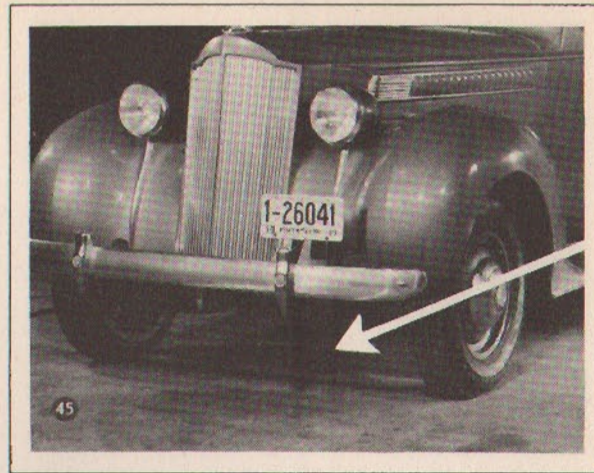
WALT: But reversing the shocks throws the locating hole in a different place, and you get a different arc to swing the shocks through in lining 'em up. In some cases you might get better alignment by reversing the shocks to put the locating hole in the other position.



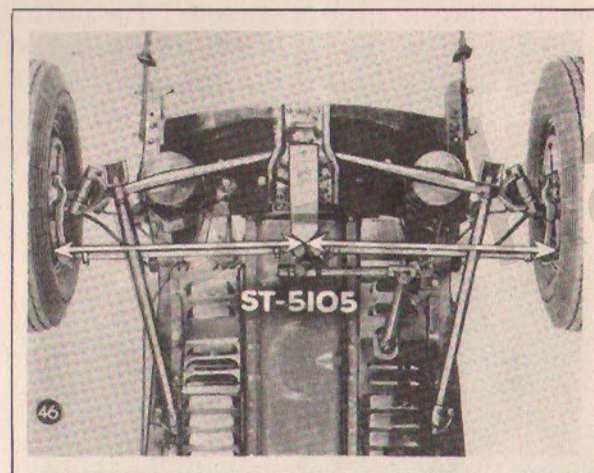
WALT: You can enlarge the inside mounting holes to get a wider swing, and use the special five thousandths shims under one side of the shocks, if you have to. But don't enlarge either outside hole. If you enlarge the locating hole, you'll spoil the locating point. And, if you enlarge the opposite hole, you may cut into a fluid passage and spoil the shock.

SPEED: Okay, Walt. Thanks for the tip. And now for toe-in.

303943 Shim005"



SPEED: First, you put the steering wheel in mid-position—with the steering gear on the high spot—and roll the car straight ahead to get the normal straight-ahead position of the wheels. Then you check to see that toe-in is the same on both wheels.

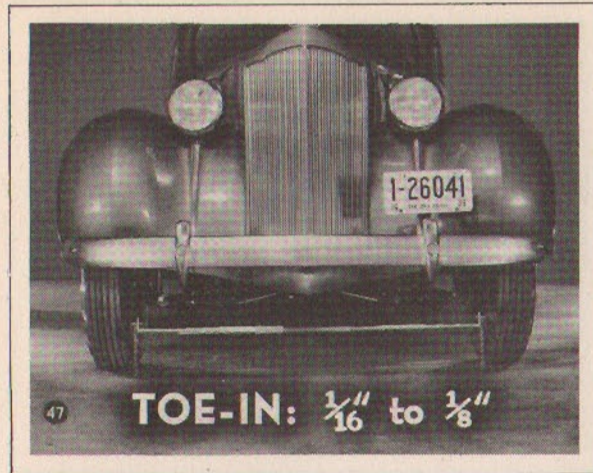


SPEED: You locate the centering gauge in the two holes in the frame cross-member, directly under the steering crank; then measure the distance between the brake backing plate and the centering gauge on both sides. You can adjust the steering cross tubes to make it the same.

WALT: That's it, Speed. Then you check for total toe-in with the toe-in gauge.

SPEED: Yes --

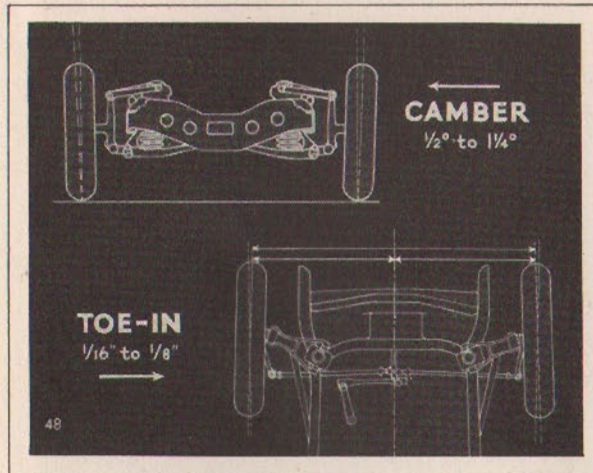
S.T. 5105 Steering Crank Aligning Gauge



SPEED: The total toe-in should be from one sixteenth to one eighth of an inch—but equally divided between the two front wheels. If you have to make any adjustment, you turn each cross rod an equal amount.

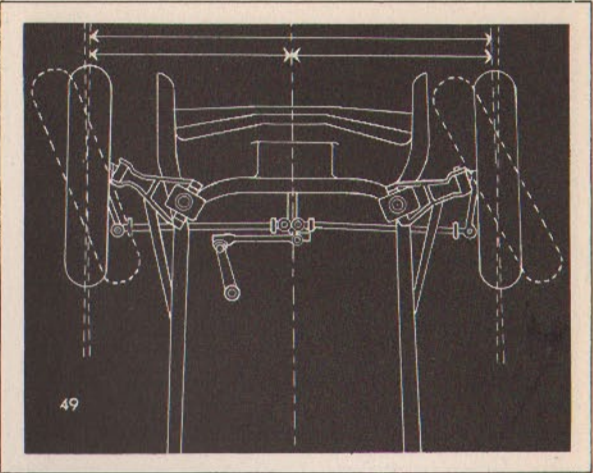
WALT: Right. Keep the total toe-in as close to the low limit as you can get it.

S.T. 128 Toe In Gauge



WALT: Of course, camber and toe-in are closely related. And, if you've adjusted the camber near the upper limit for any reason, the toe-in should be closer to its upper limit. You know how to adjust toe-in.

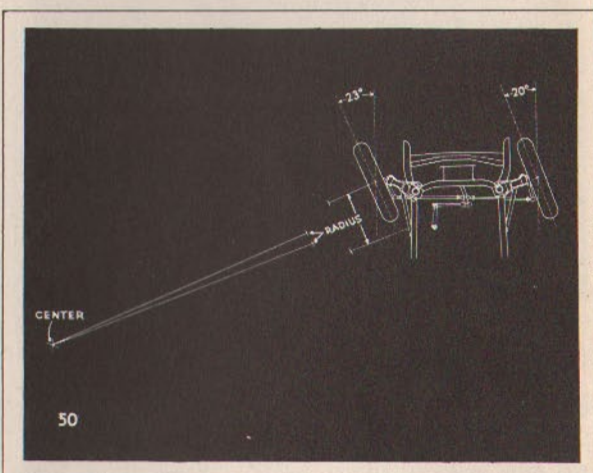
SPEED: Sure.



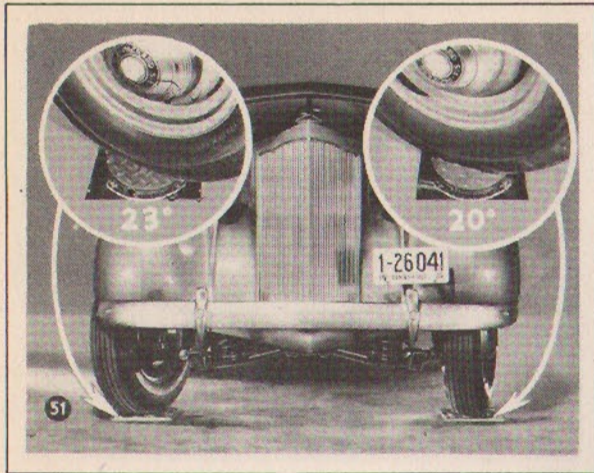
WALT: That's the toe-in for the straight ahead position. But if the steering arms are bent, you may get a scuffing action on the tires on turns, even though the toe-in is okay. So it's a good idea to check for bent steering arms by measuring the turning radius.

SPEED: What's turning radius mean?

WALT: Just this --



WALT: -- when you turn a corner, both wheels turn around the same center point. But since the inside wheel is nearest the center point, it has to be turned at more of an angle than the outside wheel to make the turn without scuffing. The steering arms control the amount of the angle.



WALT: On Packard cars, when the outside wheel is turned at an angle of twenty degrees, the inside wheel should show an angle of twenty-three degrees. It should be checked on both a right and left turn. If the reading is any different, one or both of the steering arms are bent and should be replaced.

S.T. 950 Turn Tables



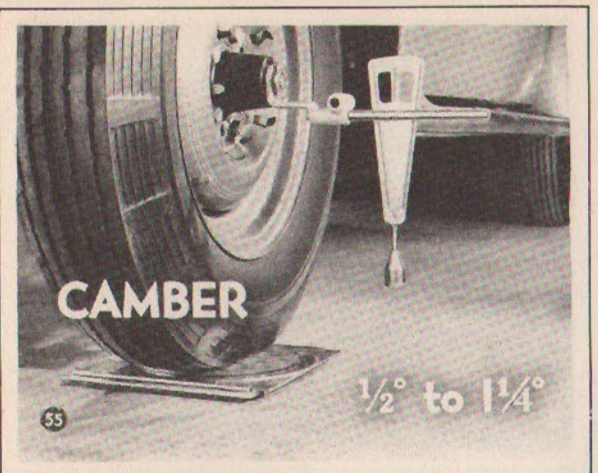
WALT: That finishes the job, I guess.
SPEED: Gosh, Walt. You've given me a new slant on wheel alignment. I can see where I've been missing a lot of those little things you brought up.
WALT: Those little things sometimes make all the difference in tire wear, steering and ride. Have you got 'em straight?
SPEED: Sure.



SPEED: First, shake the wheels to see if there's any looseness in king pins, bushings or wheel bearings.

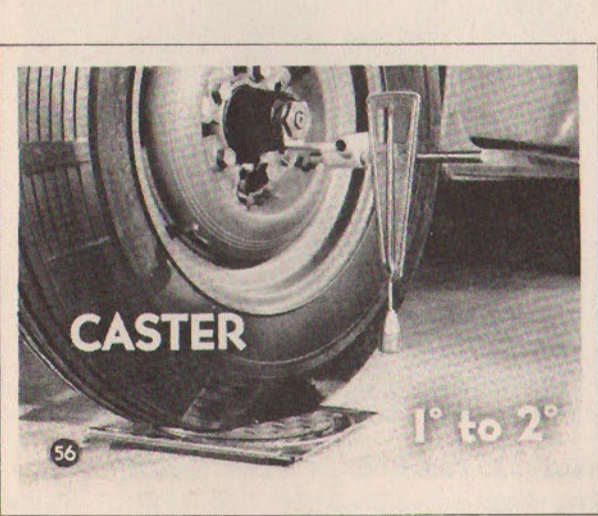


SPEED: Second, inflate all four tires to the correct pressure. And be sure the car's on a level place on the floor.

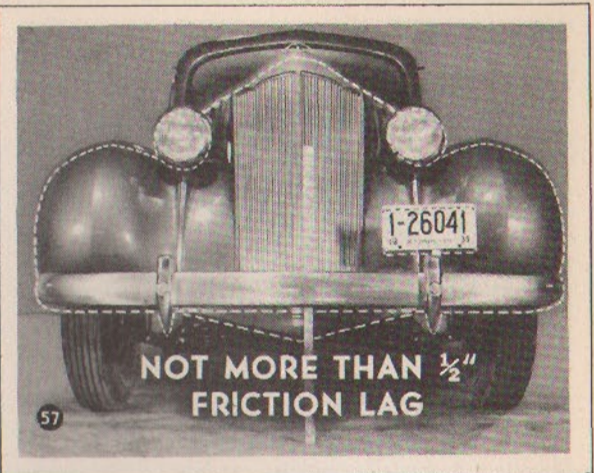


SPEED: Then adjust for camber—putting the high limit on the left hand side, if there's a choice, but keeping the adjustment as near the low limit as possible.

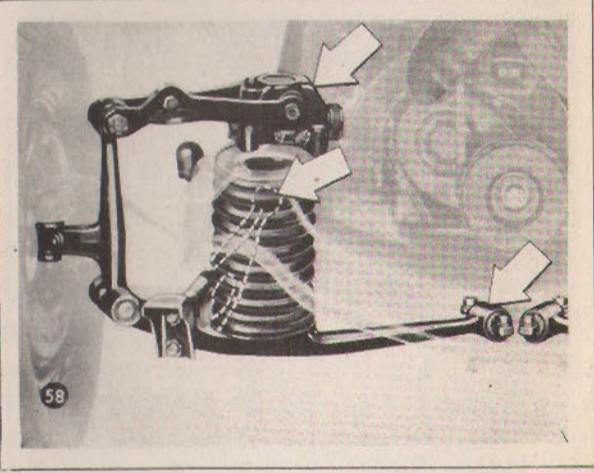
WALT: Right!



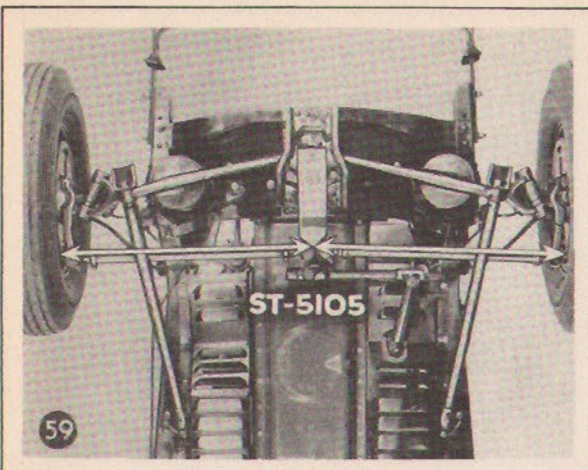
SPEED: Next, adjust for caster—an equal amount on both wheels.



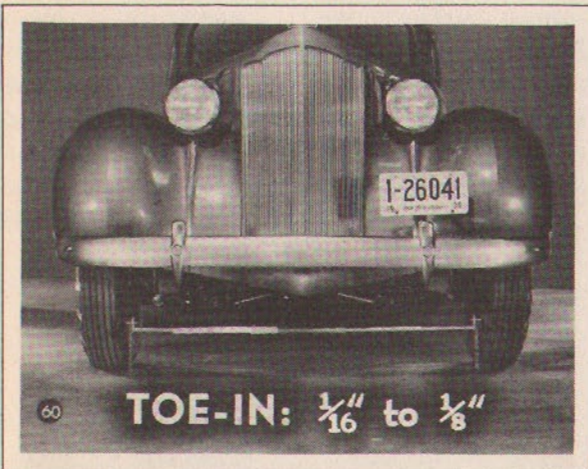
SPEED: Check friction lag by measuring the position of the car at its highest and lowest points. And —



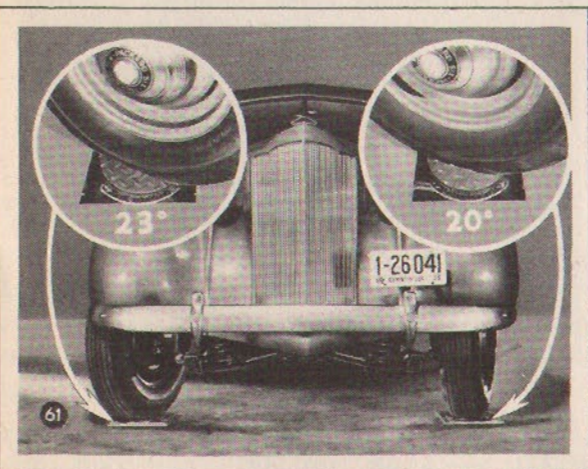
SPEED: — line up the bushings by loosening the shock absorber mountings, the torque arm cap and the support arm inner bushing bolts and letting 'em find their own centers.



SPEED: Adjust the steering cross tubes for equal toe-in on both wheels --



SPEED: -- and check the total toe-in. It should be kept as near the low limit as possible --



SPEED: -- and check for proper turning radius.

WALT: Atta-boy, Speed.



WALT: When you've checked the front end as thoroughly as that, you can be pretty sure the alignment is okay.

SPEED: That's swell, Walt. That ought to help me take care of some of these steering troubles that don't answer to the usual cure.

WALT: Steering troubles are not always caused by misalignment, Speed.



WALT: I remember a high speed steering shake I ran into one time. Sure had me puzzled. I'd checked the front end from start to finish, and there wasn't a thing wrong with it. Lucky for me, Jack Linden, the service supervisor, was around. It was this way --

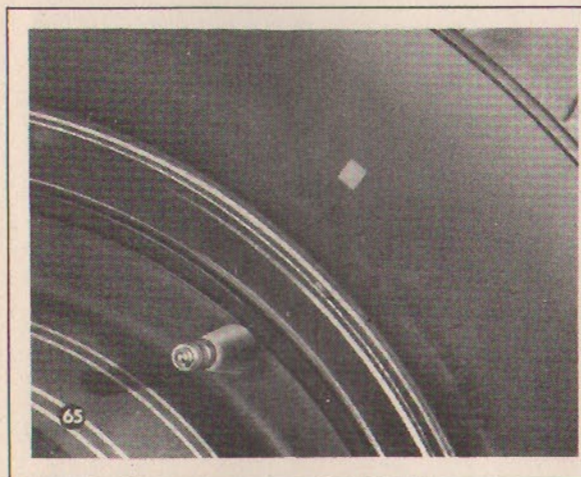


JACK: What's the trouble, Walt?

WALT: Steering shake at about sixty. It's got it bad. But I've checked the front end alignment and there's not a thing wrong with it anywhere.

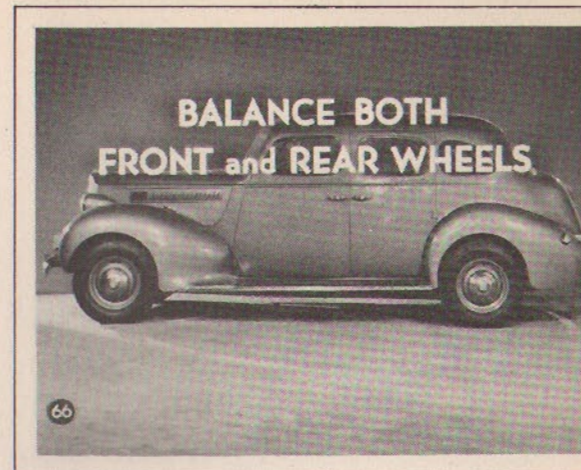
JACK: Might be wheel balance. That causes it sometimes.

WALT: Not this time.



WALT: The balancing dot lines up with the valve stem--on both front tires.

JACK: You can't always tell by that, Walt, especially on a car that's had some miles put on it. We'd better check it on the balancing stand --



JACK: -- all four tires--both front and rear.

WALT: Why all four tires?

JACK: Because, with low pressure tires and flexible springs, an out of balance rear tire can cause a steering shake at high speed.



WALT: And, Speed, when we checked 'em on the stand, sure enough, one of the rear wheels was out of balance. That was the cause of it all along.

SPEED: How come? Tires are all balanced at the factory, aren't they?

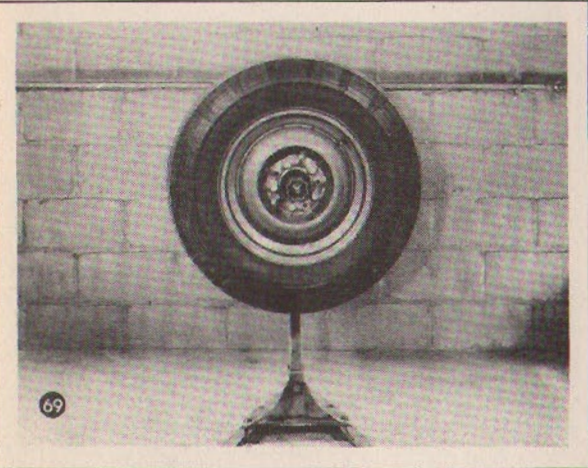
WALT: Well, on that car, it was because of a heavy patch used to repair a puncture. But Jack told me a lot of things might cause it.

**OUT OF BALANCE
CAUSED BY:**

- 1. Uneven wear
- 2. Boot in tire
- 3. Repaired spot in casing
- 4. Patch in tube
- 5. Unbalanced replacement tires

WALT: He said uneven wear on the front tires might cause it, a boot, a repaired spot in the casing or a big patch on the tube. And you want to watch out for replacement tires. Often they aren't balanced at all, or not up to Packard standards. The only way to be sure is to balance the wheel and tire on the stand. You know how, don't you?

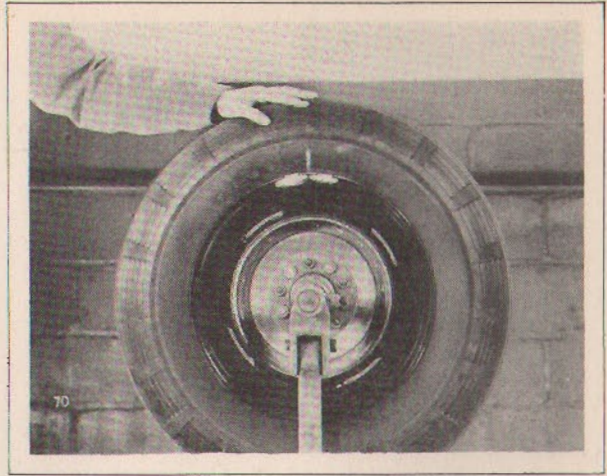
SPEED: Sure.



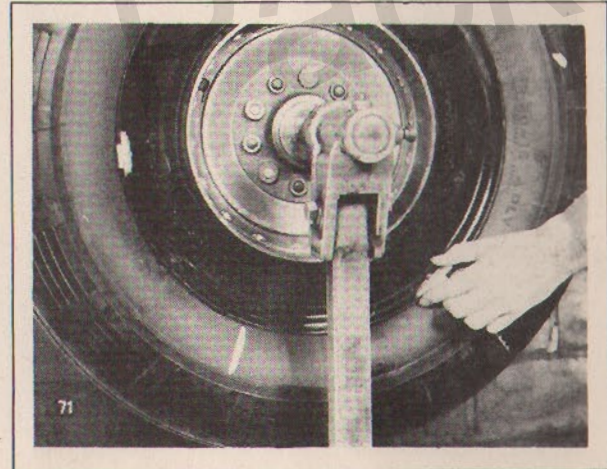
SPEED: Mount it on the stand and turn the wheel. When it comes to rest, the light spot will be at the top. You install a weight at the light spot --

WALT: Oh no you don't, Speed. You can't balance it that way. Here's how the tire people do it.

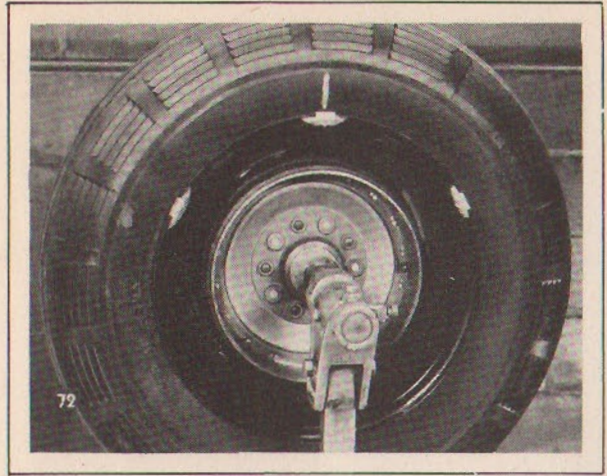
Note: Write Special Tool Department for prices and literature on wheel balancing equipment.



WALT: First, they mark the light spot with a chalk mark. Then they put two balancing weights on the rim, one on each side of the chalk mark. Next, they turn the wheel a quarter turn, and let it rotate whichever way it wants to go.



WALT: If the weighted side goes down, they move the weights wider apart—but an equal amount on each side of the chalk mark. And they keep on moving 'em until the wheel will stay in any position.



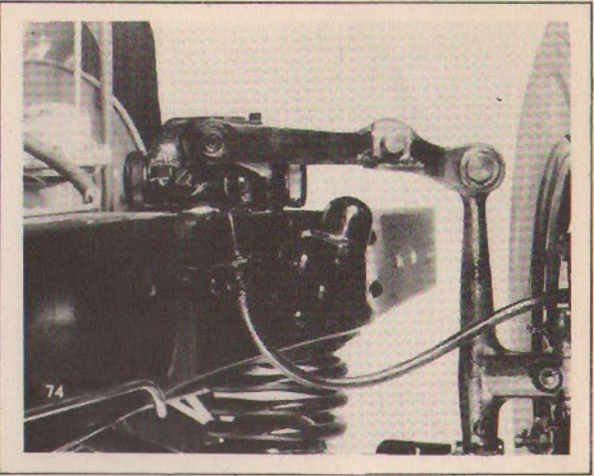
WALT: But if the marked spot goes up, you need a third weight right on the chalk mark. And you move the other two wider apart until you get it exactly in balance.



WALT: That's the way Jack Linden and I did it. And it sure got rid of that shake.

SPEED: That's worth remembering, Walt. But, say, what about a low speed steering kick? How do you fix that?

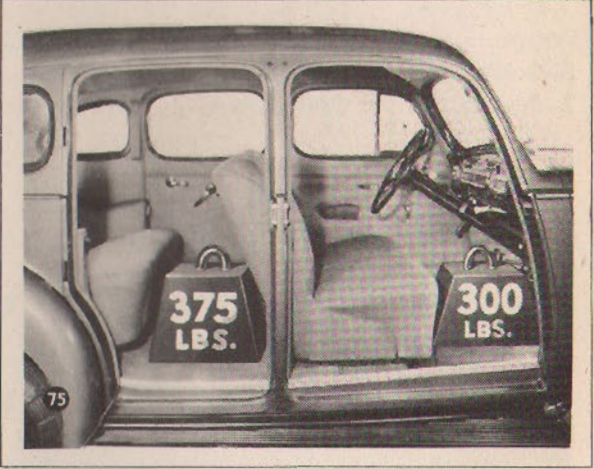
WALT: There are several things to check.



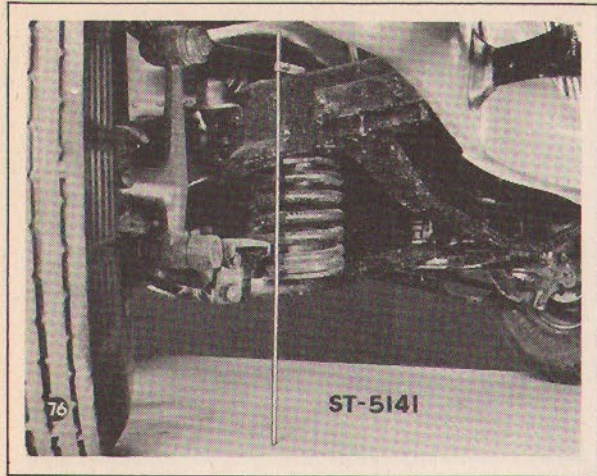
WALT: The first thing to look into is the shock absorbers. Make sure the fluid level's up and make sure there are no air bubbles in the fluid.

SPEED: Yeah, I know that's the first thing you check.

WALT: Yes, and the next thing is riding height of the front springs. That's one thing that's often overlooked.



WALT: First, load the car with sand bags, or have somebody sit in it to give you the load specified. Naturally the springs are compressed when the car is weighted down, and you want to take your readings in the standard position for which they're figured. The shop manual gives a set of specifications for loading the various body types.

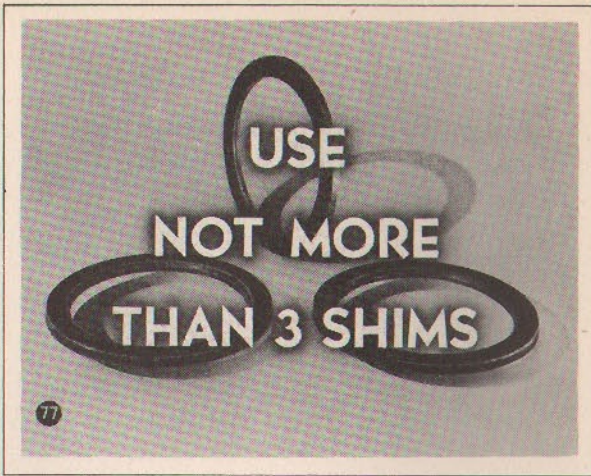


WALT: Then, with the car loaded, measure the distance from the top of the frame side rail to the floor to get the riding height. If it's not within the specifications given in the shop manual, you're not going to be able to get an accurate reading or to make an accurate adjustment of the alignment.

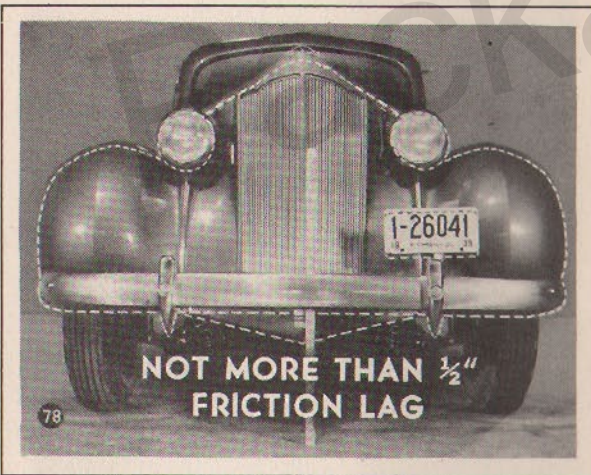
S.T. 5141 Riding Height Gauge

Body Style	Front	Rear
Coupe	300 lbs.	225 lbs.
5-Sedan	300 lbs.	375 lbs.
7-Sedan	300 lbs.	675 lbs.

Riding Height	Model	Spacer	Insulator
17-5/8"--3/8"	115C	341051	300982
18"--3/4"	120-120B-120C	341051	300982
18-3/4"--3/8"	1600-1700	326836	326706
19-1/4"--3/8"	1601-21701-21703-5	326836	326706
20-1/8"--3/8"	1500-1-21603-4-5	341051	300982
20-1/2"--3/8"	1507-81607-81707-8	341052	232010



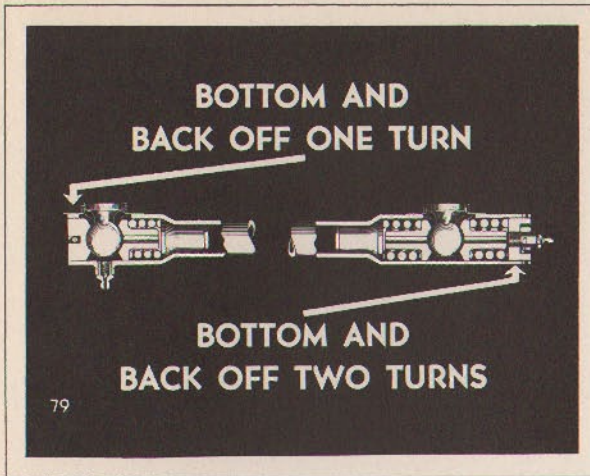
WALT: If the springs have sagged a little, you can install quarter-inch shims between the frame and the spring to raise the riding height up to specifications. Each shim raises the frame about three-eighths of an inch. But if it takes any more than three shims, you'll have to replace the springs instead.



WALT: Another thing to check is friction lag. We went into that a little while ago.

SPEED: Wouldn't misalignment cause it, too?

WALT: Yes, that's another thing to check.



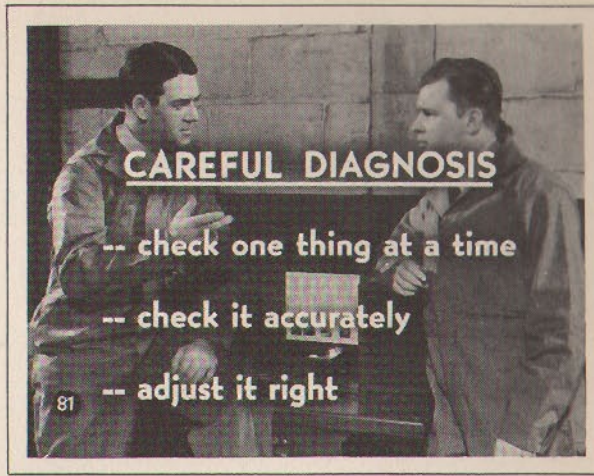
WALT: And the steering drag link adjustment might be at the bottom of it. The plug on the steering gear end--the one with the single ball and spring--should be tightened until the spring bottoms, and then backed off a single turn. The plug at the opposite end--the one with two springs--should be bottomed and then backed off two full turns.



WALT: The shocks, riding height, friction lag, alignment, and drag link adjustment. You're pretty sure to find it in one of those.

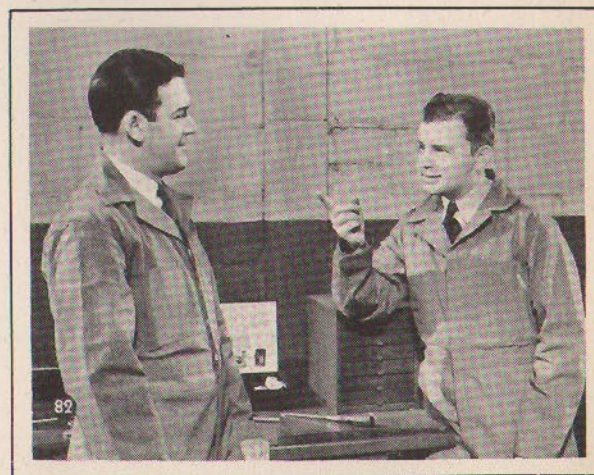
SPEED: Gosh, Walt, if I could get at the bottom of things the way you do, I'd be all set.

WALT: There's nothing impossible about it, Speed.



WALT: The most important thing is careful diagnosis. Then check one thing at a time--check it accurately and adjust it right before you go on to the next possibility. That way, you'll get to the bottom of any difficulty.

SPEED: If you know all the little things to look for. But thanks a lot, Walt. You've given me a different slant on tire wear and steering that'll help a lot. As a matter of fact --



SPEED: You've given me a new line on wheel alignment.

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