

YOUR AUTOMOBILE CHASSIS

By George Hill

YOU ARE interested in the chassis and running gear of your cars. I had no idea so many of you were actually aware of the poor handling characteristics in the average modern automobile chassis. Reading your letters has raised my respect for Mr. Average Motorist.

Your greatest problem is a common one. Wheel alignment shops with experienced mechanics have been unable to make the proper adjustments so necessary for correct alignment. My first article in this series (May '53) fully explained this problem and presented the only possible solution: Alignment of the front end assembly must be made by setting the spindles at the correct angle. The only shop to our knowledge equipped to do this job properly is that of George Bagge in Los Angeles, Calif.

Shop owners all over the country immediately recognized the desirable features in the Bagge technique (after reading about it in HOP UP) and so many requested the right to purchase similar gauges that George has decided to manufacture a complete line of alignment equipment. See future issues of HOP UP & MOTOR LIFE MAGAZINE for data.

To answer the flood of letters and telephone calls from readers requesting Bagge's shop address, write BAGGE & SON WHEEL ALIGNMENT SPECIALISTS, 3723 West Jefferson Blvd., Los Angeles 16, Calif.

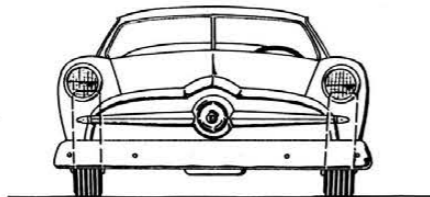
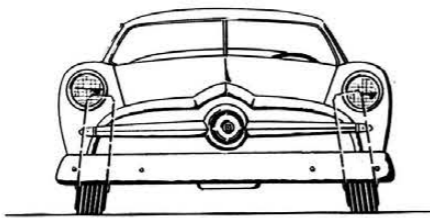
Now to answer other readers' letters and telephone calls:

LOWERING KITS

Customizing problems seem to be universal, yet in different parts of the country solutions for the same problem are discovered and applied in different ways. Ford owners, '49 through '53, in an attempt to lower the front end have committed every alignment crime imaginable. Every day I see one or two of these models displaying negative camber conditions of an extremely ridiculous state.

Front springs are shortened in various ways and no attempt is made to realign the spindles. All thoughts of safety and practicability are overlooked and the resulting tire wear and poor handling characteristics are accepted as a price that must be paid for that lowered look.

Small shops throughout the country are manufacturing lowering kits for these cars but I have yet to hear of one that will lower the car and still retain the steering geometry. At best, the steering geometry of the stock passenger car leaves something to be desired, but when some of these lowering kits are used, the re-



NEGATIVE camber, shown in the upper diagram, is result of torched or shortened springs with no thought of spindle angle while lower diagram shows how wheels appear when lowering job is done right

sulting handling characteristics place the car in the "unsafe for use on the public highways" category.

Some kits advocate the use of redesigned "A" arms and new mounts that relocate the whole suspension assembly higher on the frame. Others reverse and invert the spindle support arms. The latter method indicates that someone spent a little time to study the basic problem, one that has been overlooked so often.

While heating and shortening the springs, bending arms and relocating whole assemblies, mechanics have evidently forgotten that they are all striving for the same result—relocating the spindle to a new position higher on the spindle support arm.

Why not, then, make new forgings as replacements for the stock spindle support arms with the spindle located in this desirable position? Springs, "A" arms and all other stock components could be left as is, with the possible exception of the steering arms extended from the spindles.

If the position of this arm is changed, it must be altered so the angle of the tie rods will not be affected.

And, before designing a new spindle support arm, special attention must be paid also to the angle of the spindle as it extends from the arm in relation to the kingpin. If the spindle is moved upward on the arm and extended at the same angle as in the lower position the proper kingpin inclination angle will be lost. Remember, a vertical line drawn at a right angle to the spindle and through the center of the tire must coincide with a line drawn through the center of the kingpin at the point of contact with the road.

Lowering the car in this manner should not affect handling characteristics nor will tire wear be accelerated noticeably.

Two companies are tooling up for production of this new type spindle support arm. Complete data along with prices will be published as soon as the information is received and after we test them.

CASTER

"Will lowering blocks, when added to the rear of my car, have any effect on the alignment of the front end assembly?"

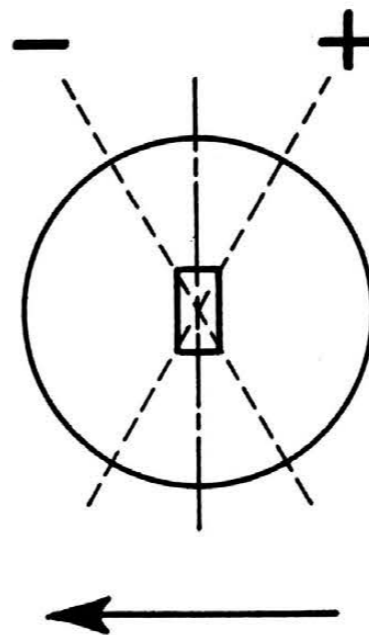
Dozens have asked this question. The amount of positive caster will be increased slightly when the rear end is lowered and this will be the only advantage. Remember that changes in the springs at the rear will not have as much effect on front end alignment as any change made to the front springs.

Another good question about caster: "Although positive caster has much to be desired in terms of increasing steering stability, I was wondering if the setting of one degree positive caster in a suspension designed for zero degrees caster would have any undesirable effects?"

The only thing undesirable I can see is that the countless rubber and composition bushings and fittings in the front end assembly will wear out a little faster with a positive caster setting. Automobile manufacturers, in their attempt to produce a front end assembly that will ride like a boat on smooth water, have designed an assembly so susceptible to shimmy that negative caster had to be set into the front ends to minimize road shock.

You must then decide between slightly accelerated deterioration of the front end assembly or a smaller safety margin while

driving your car on the highway. With positive caster applied to the front end, parts will wear more rapidly, but there is less chance that your life or your family's



Positive caster is the rearward tilt of the kingpins at the top, negative caster is the forward tilt of kingpin

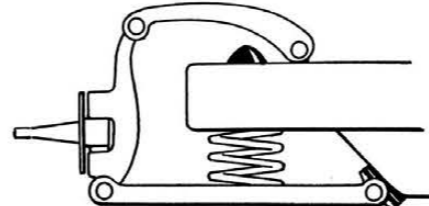
lives will be endangered because you possibly lost control of your automobile. Many, many accidents are recorded with the following police comment: "Driver obviously lost control of the vehicle." You be the judge. Parsimony here may lead to great losses in the future.

USE OF SHIMS

"When having my car's front end aligned, the mechanic used shims between the frame and the lower 'A' arm to decrease the amount of positive camber. I read your article to him (HOP UP, August '53) where you say not to allow the use of shims. He told me that the stock adjustments did not allow enough movement to set the camber properly and the only way he could set the camber was by using shims. Can you tell me the proper way to set the camber without the use of shims?"

The answer to this question, if heeded, will cause a lot of extra work for wheel alignment men who have become accustomed to the practice of using that time-

SHIMS can be used to induce negative caster but will lower position of arms so that spring tension actually decreases



saving device, the shim, when adjusting the alignment of passenger car front ends.

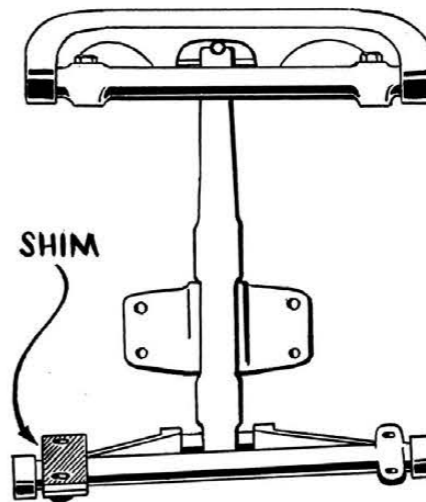
Shims should never—I repeat, never—be used for front end alignment.

If the camber adjustment will not allow enough change for the proper setting, your only recourse is to bend the spindle support arm. Bend it far enough to bring the stock adjustment cams into range and then use that adjustment for the final setting. Do not bend these arms cold. Bagge has found that in almost every case where spindle support arms have been bent cold, the arm has cracked. Heat the upper portion of the arm, between the upper kingpin boss and the "A" arm joint, make the necessary bend and allow to cool normally.

Remember also that the lower "A" arm is mounted at the crossmember on a plane not perpendicular with the road surface. Therefore, when applying shims between the arm and the crossmember, the arm is actually lowered and the main suspension spring allowed to relax slightly. This spring will then have less tension than the one on the other side of the automobile and one side will tend to lean more than the other when turning.

The addition of shims to the front end of any automobile is a short cut used by many mechanics because they are more interested in the quantity of work they turn out rather than the quality.

Some even use shims to adjust caster, by inserting a shim at either end of the



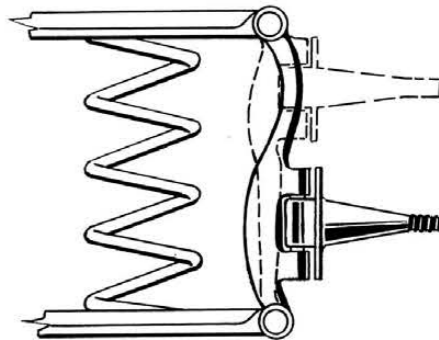
BINDING of "A" arm shafts when shims are used on one side only will accelerate deterioration of bushings, assemblies

lower "A" arm mounting shaft. This will make a difference in the caster readings but it also bends all the shafts and arms in the assembly. Bushings will wear quickly and unevenly and the binding action will restrict movement of the steering units, sometimes so much that steering assemblies have been known to freeze up solidly. Shims will only speed up the deterioration of your front end.

MORE ON CAMBER

"I write about the Wheel Alignment article by George Hill in the July issue of HOP UP & MOTOR LIFE. Neither he nor the Bagges seem to know that the camber on all cars changes according to the load conditions and that negative camber must be compensated for by toe out and positive camber by toe in. I think they should give the Detroit boys a boost for working it out so well."

This letter was written and signed by a service manager working in an authorized new car dealer's shop. If you live in his neighborhood, he is the man assigned to diagnose your automobile's ailments

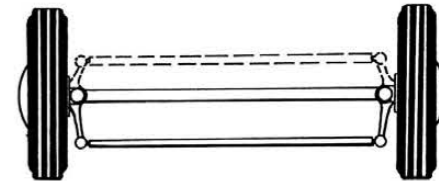


SOLID lines show stock spindle support arm. Dotted lines show outline of a new support arm designed to lower front end of late model Fords and Mercs correctly

and direct repair operations in his shop.

He is so wrong in his statements about camber I wonder if he could possibly have been thinking of something else. If the camber of the front wheels is negative (leaning in at the top), the inside of the tire tread will be subjected to abnormal wear and if the wheels are in a toe-out position they also are subjected to abnormal wear at the same place of contact, the inside edge of the tire tread. Therefore, instead of one condition compensating for the other, they are both working towards the same end, abnormal wear at the inside edge of the tread.

The same situation will be present if the wheels toe in when positive camber is accentuated, except that both condi-



DOTTED lines show how front mounted tie rod can cause wheels to toe in on turns

tions will cause abnormal wear to the outside edge of the tire. Again, how can one compensate for the other?

Why give engineers credit or praise for (Continued on page 64)

CHASSIS

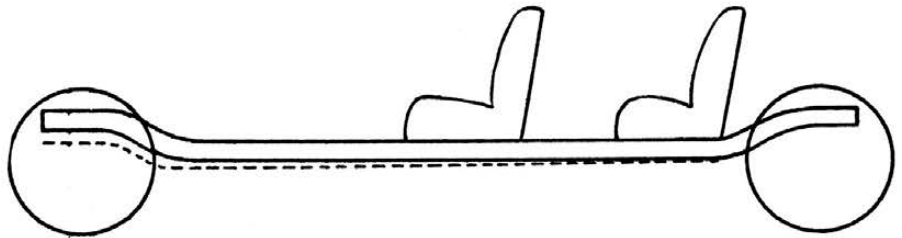
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making an obvious mistake if they have made this mistake?

I think we will find as well another mistake made in his statements.

Bagge finds that when weight is added to certain late model cars the camber angle becomes negative and the wheels toe in, not out, as stated by this service manager. The exact amount of added toe-in when the car is laden makes me shudder, but the high price of correcting this condition forces me to drive mine as is.

Today I received a call from George Bagge. He said, "George, I'm so mad I could bite nails. This car I have just finished aligning was so far out I can't



Weight applied to the rear seat of a modern passenger car has little or no effect on the front end alignment, weight added to the front seat does affect it, however

understand how it was ever allowed to leave the factory. It is a new (blank) and the fourth new car I've had this week that has needed torch work before any of the regular alignment adjustments in the chassis assembly could be made."

George then told me about these four

cars, three (blank) and one (blank). The (blank) all were afflicted with an extreme negative camber ailment.

One had two degrees negative camber in the right front with one degree negative caster. The left front spindle had one degree negative camber and two degrees negative caster. This was a brand new car and none of the adjustments showed signs of having been touched with a tool since being first painted in the factory. The other two cars were almost as bad and the (blank), lo and behold, had a positive caster reading in the front end. The left front had one and a half degrees positive caster and one degree negative camber. The right spindle had one-quarter of a degree positive caster and a reading of one degree positive camber. These cars left the factory in this deplorable state and were serviced by new car dealers before being sold to customers. These same dealers receive an allowance from the factory to cover the cost of servicing each new car. Wheel alignment is listed on new car service check sheets and in each of these four cases had been checked off as if the cars had actually been inspected and found serviceable.

The (blank) had positive caster in the front end, which was quite a surprise. It was the first new (blank) to enter Bagge's shop in the last two years without negative caster. Bagge set the front end up with one and three-quarter degrees positive caster in the right spindle and left the left side with one and one-half degrees as set on the assembly line.

I took this car for a trial spin and the first thing I noticed was the absence of tire squeal when rounding street corners at normal speeds. This car, with positive caster in the front end, is probably one of the best-handling cars on the road.

The mass-produced foreign car sold in this country probably has as many mistakes and misaligned assemblies as any of our automobiles. The Jaguar has a tie rod mounted in front of the front end so designed that the wheels toe in on turns instead of toeing out as they should. The M.G. has no adjustments for camber and caster settings whatsoever.

Space considerations limit this month's study of your automobile chassis but in the next issue we will attempt to solve more of the problems that are costing the average motorist extra dollars each year to operate his family vehicle.



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