THE MASTER TECHNICIAN'S

# SERVICE REFERENCE BOOK

SESSION NO. 63-10


MASTER TECHNICIANS SERVICE CONFERENCE
PREPARED BY CHRYSLER CORPORATION
PLYMOUTH · DODGE · CHRYSLER · IMPERIAL

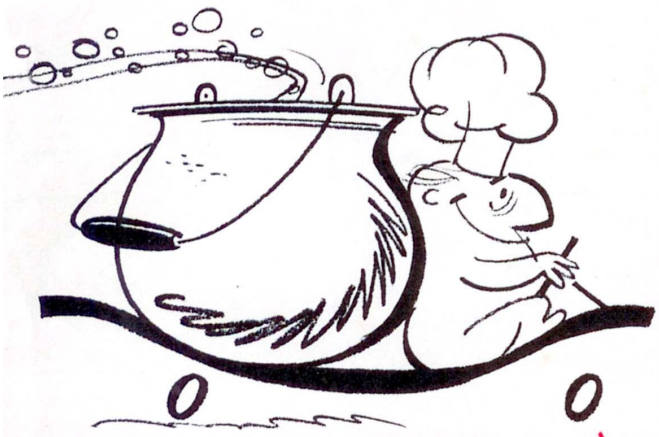
# Recipe for suspension design

Take one long, low car, with not enough room to install springs. Add three average-size people and a full tank of gas. Then:

- Make it ride smooooth.
- Give it stability under all driving conditions.
- Cushion out driving torque, braking forces and road shock.
- Make it easy to handle . . . loaded or unloaded.

"That's enough," you say.

"The devil, it is," says Mr. Customer. "I've got a bunch of kids and a pile of vacation gear to put in back and a big trailer to haul, so be sure it has lots of load-carrying capacity, too. But don't forget I drive it to work all alone, and the gas tank isn't always full, and I still expect a nice ride and good road stability."



We can't grab these nice customers by the neck and say, "Look, Buster, if you want a car, buy a car; but if you want a truck, we've got them, too." Instead, we must try to educate them about the limitations of a passenger car for truck service, and try to get them to order the necessary options for heavy-duty operation.

So study this book and find out all about loading and heavy-duty service, and then spread the news. Don't forget that everyone looks to you as the expert on cars, and what you say will usually be taken as gospel.

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## HOW THEY GOT THAT WAY

Probably the first real effort to make a passenger car ride smoothly was the introduction of the balloon tire in 1923. Until then, cars rode around on rubber-tired wagon wheels; in fact, they were originally nothing more than motorized buggies.

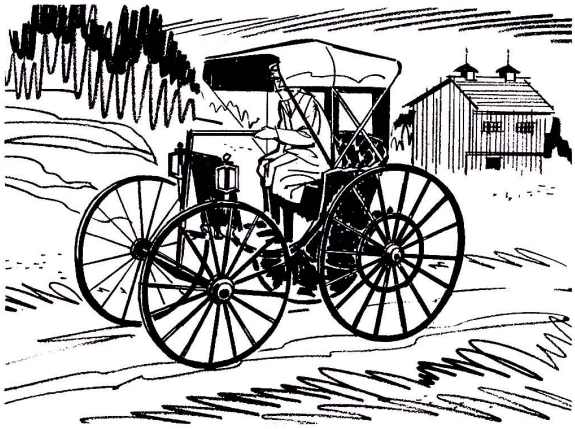

Fig. 1—Motorized buggy

But during the Twenties, as the transition was made from buggies to passenger cars, cars became heavier and speed increased. The necessity for a smooth ride and more stability under a variety of road conditions soon became apparent. Revolutionary changes in car suspension design were needed.

### RIGID AXLES AND LEAF SPRINGS

Until 1930, most suspension systems had rigid front and rear axles with leaf springs. The front springs were very stiff and the rear springs only slightly less so. Load distribution was a lot different from today. The engines and gas tanks were nearer the center of the car and the people in the back seat rode over or behind the rear axle. As much as 70% of the car weight was on the rear wheels.

### SOFTER SPRINGS

As springs were made softer to smooth out the ride, new problems of load distribution and handling had to be solved. Softer springs meant more wheel travel, so better damping devices were needed to control up and down motion of the car. Load distribution changes were needed to minimize the effects of pitching. And some means of retaining the steering precision that went with stiff front springs had to be found.

### LONGER WHEELBASE

To counteract the effects of pitching, longer wheelbases were designed into cars. The passenger seats were moved between the axles, instead of over the rear axle. Balancing of front and rear spring rates, with the front spring softer than the rear, also helped control pitch. And piston-type shock absorbers, that controlled motion in both directions, were added to both front and rear.

### INDEPENDENT FRONT SUSPENSION

Soft front springs dictated a change in front suspension design. The rigidity necessary to control steering and braking wasn't there anymore without stiff springs. Also, softer springs take up more room, and the room wasn't available in front. At that point, suspension engineers decided on an independent front suspension—one that would let each front wheel "step over" road irregularities and not transfer bounce motion to the other wheel. This made a great improvement in front-end ride and lateral stability.

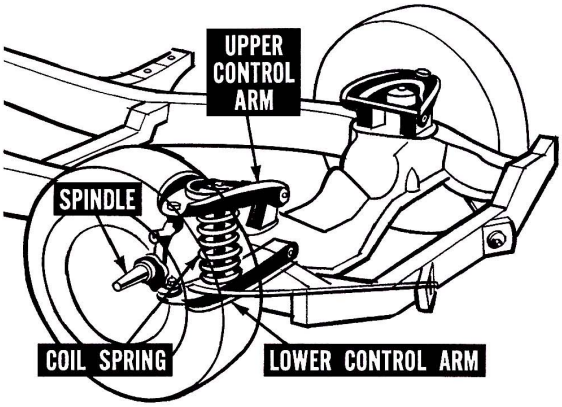


Fig. 2—Independent front suspension

In the independent front suspension, braking and steering rigidity are obtained from the upper and lower control arms which are free to move in a vertical plane only. Originally, coil springs were incorporated to support the car at the proper height and control the ride. In 1957, Chrysler Corporation introduced torsion bars—a further suspension improvement.

### HOTCHKISS DRIVE

The rear axle remained the solid type, with Hotchkiss drive and leaf springs. Instead of driving the car through a torque tube which transfers forces to the rear engine crossmember, the forces are cushioned by the rear springs.

With Hotchkiss drive, flexibility is built in, and the rear suspension becomes a part of the car's steering system. At first glance it might seem that the added flexibility would decrease road stability, but this is not true. It would take more space than we have to demonstrate this, but as the wheels go up and down, the arc of spring travel moves the wheel in motion closer to the front of the car; so as the car tilts outward in a turn, the rear wheels are doing some steering, too. If the rear suspension geometry is properly designed, then, Hotchkiss drive also adds to road stability.

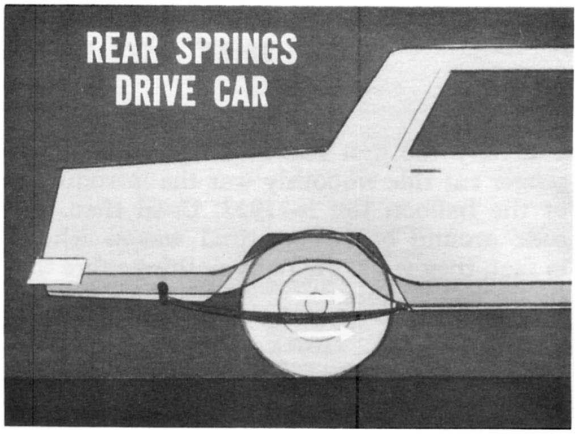


Fig. 3—Rear springs drive car

### A DESIGN PROBLEM

Today's Chrysler Corporation cars are designed for better than average stability and handling. Unlike our competitors, we have not made great sacrifices in stability or load-carrying capacity to achieve our well-controlled ride. But there are practical limitations to what the suspension designer can do, so there are definite load-carrying restrictions on our cars. To get the most trouble-free life from our products, we should recognize what these restrictions are and how to compensate for them.

## FUNDAMENTALS OF LOADING

Take a look at how many people are riding in most of the cars you see on the road today. Most back-and-forth-from-work or to-the-store driving is with no load except the driver and maybe one other passenger. In fact, the national average is something like 1-9/10 persons per car. Chrysler Corporation engineering goes this average one better in designing suspension. The design load is three passengers and a full tank of gas, but our cars perform well and ride comfortably through a load range of one to six passengers.

### THAT SOFT RIDE

As we mentioned before, there's only one way to get a soft ride—with a relatively low spring

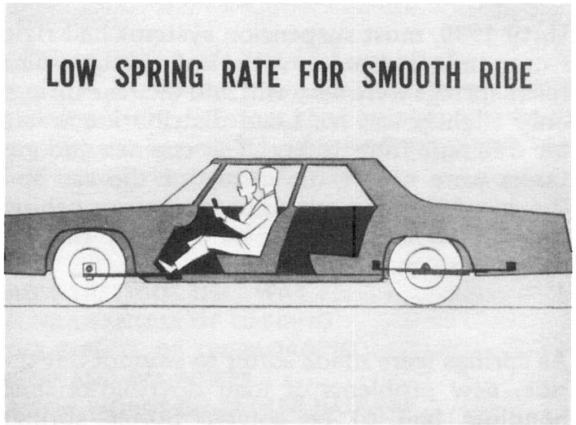


Fig. 4—Low spring rate for soft ride

rate. And that's how our standard springs are designed. Let's stop here just a minute and see what we mean by spring rate.

### SPRING RATE

Spring rate is simply the load required to move the spring a unit of distance. It is usually expressed in pounds per inch. So if we say that a spring has a rate of 200 pounds per inch, we mean that every 200 pounds we add will deflect the spring one inch.

Supposing we take a 200-pound spring out of a car and replace it with a lower rate spring, say 100 pounds. Since it only takes 100 pounds to deflect this spring one inch, every 200 pounds we add will deflect it two inches. This means low rate (soft) springs need more room to move than high rate (stiff) springs. In other words, they flex easier.

### JOUNCE SPACE

This would be no problem if we had unlimited jounce space in our cars. You all know that jounce space is the distance the wheels can move up in relation to the car before the suspension "bottoms" on the rubber bumpers. But since public preference has decreed that "the car shall be low", jounce space is limited.

### LOAD-CARRYING LIMITS

As the car is loaded, the already limited jounce space is further reduced. This means that with heavy loads, there is little spring motion available to cushion shocks. The car then frequently bottoms on bumps, to say nothing of other undesirable effects. Further on, we're going to discuss the effects of loading, but first we'll review some basic facts of load distribution.

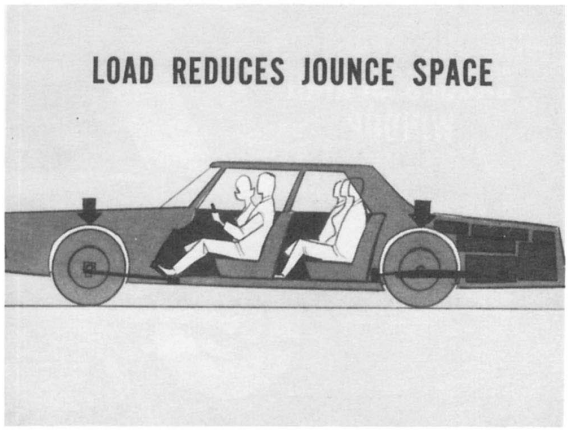


Fig. 5—Load reduces jounce space

### LOAD DISTRIBUTION

Where you put the load is just as important as the weight for its effect on ride, handling and wear and tear. A heavy load that's distributed over all four wheels, for instance, may do nothing but make the car settle a little lower. Watch out, though, if the load is all on one axle, or worse, if it overhangs the axle.

### BETWEEN THE AXLES

Obviously, the front seat area is the best place for a load if you want it to be carried equally by the front and rear suspension. The rear seat is almost as good. Loads there are also distributed over both suspension systems, but more weight is on the rear, so the rear end will be lowered more than the front.

### OVER THE AXLE

A load placed well forward in the trunk or the rear floor of a station wagon is carried by the rear suspension only. Compare this with a load in the front seat. For purposes of simplicity, let's assume a 100-pound spring rate all around the car and a 400-pound weight in the front seat distributed over four wheels. This lowers the whole car one inch, since 100 pounds are effective on each spring. The same 400 pounds over the rear axle, though, places 200 pounds on each rear spring and lowers the rear of the car two inches, with no front-end change. This means there's two inches less jounce space for the rear wheels.

### OVERHANGING LOADS

Finally, we have the worst and all too common kind of a load—one that overhangs the rear axle. A load in the rear of the trunk—a luggage rack behind the rear wheels—a portion of a trailer's weight on a ball—all are overhanging loads.

This kind of load causes a teeter-totter effect that lowers the rear and raises the front. The physics are pretty complicated, but the effect is the same as transferring some of the front-end weight to the rear suspension. So rear-end lowering is worse with an overhanging load than the same weight right over the rear axle.

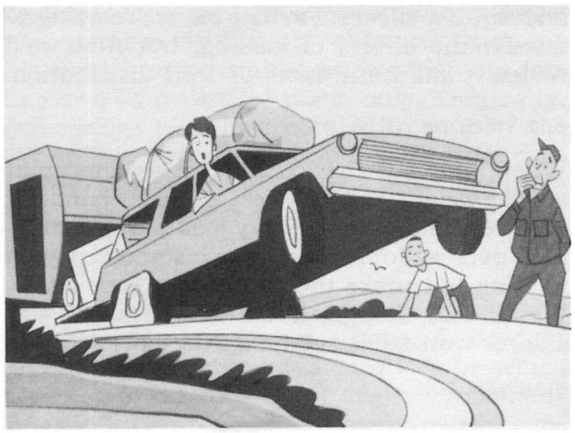

Fig. 6—Overhanging load

And the severe changes in car attitude are what cause most of the undesirable effects of overloading.

### MAXIMUM LOADS

The teeter-totter effect of overhanging loads is the reason that heavier loads are permitted in the rear seats than in the trunk. However, in a station wagon, the third seat or floor can carry more load than a sedan trunk, because of different spring design and because the load can be located close to the axle. Remember, though, that a heavy load in the back of a wagon ought to be placed as far forward as possible.

**MAXIMUM PASSENGER CAR LOADING**

| | Valiant-Dart | Dodge-Plymouth-Chrysler |
|---|---|---|
| **SEDANS** | | |
| Front Seat | 450 | 450 |
| Rear Seat | 450 | 450 |
| Trunk | 100 | 200 |
| **STATION WAGONS** | | |
| Front Seat | 450 | 450 |
| Second Seat | 450 | 450 |
| Third Seat or Floor | 300 | 450 |

The maximum loads shown in the table are just that, and they are for normal highway operating conditions. Frequent operation with maximum loads over rough roads is heavy-duty, and calls for a heavy-duty spring option.

## THE EFFECTS OF OVERLOADING

We saw in the first two sections that today's passenger cars, because of styling and the demands for a comfortable ride, have limited load-carrying capacity. We know that the best location for extra load is between the axles, but that most overloading is the overhanging type that lowers the rear severely, and tips the front end up. Let's see now why this kind of overloading is bad for safety and car life.

### REAR SPRING WINDUP

In the Hotchkiss drive rear suspension used on all our cars, all driving and rear-wheel braking forces are transmitted to the framing members through the rear springs. Torque reaction during acceleration or braking causes the

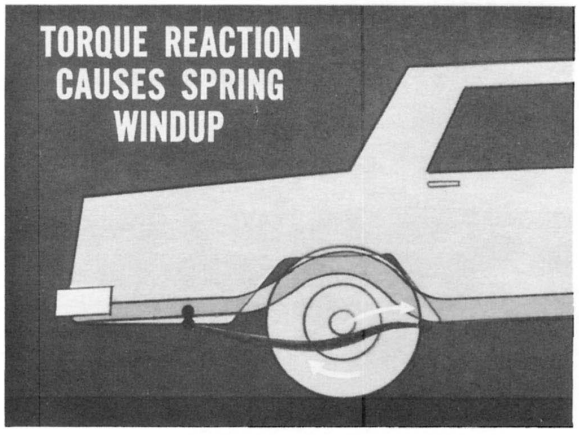


Fig. 7—Torque windup

springs to wind up. If the springs are already overloaded, the combination of static and dynamic forces may be too much for them. They might break, or take a permanent set from being stretched beyond their elastic limit.

***DIAGNOSIS TIP: Weak or broken springs at low mileage are an indication of overloading.***

Incidentally, the rear springs on our cars have negative camber under load. That is, they arch upward instead of downward. So don't let anyone tell you a spring is weak because of the reverse arch.

### DRIVE-LINE NOISES

Acceleration windup tilts the pinion carrier nose upward. With the rear lowered from a heavy load, the bumper on the carrier nose can easily strike the body. Then if the car is accelerating on anything rougher than a billiard table, the bumper will beat a tattoo on the body bracket. This can scare the stuffings out of a new-car owner who can't find any external cause for the noise when he stops.

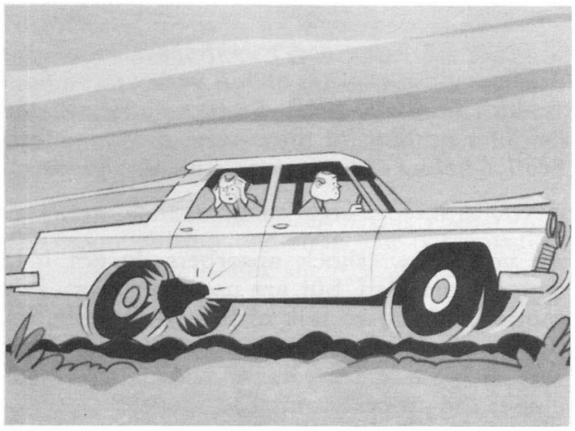

Fig. 8—Pinion carrier nose bumper

***DIAGNOSIS TIP: Shiny spots where the carrier nose bumper hits the body, or a bent bumper bracket means the rear has been overloaded and/or hot-rodded.***

*A Word About Hot-rodders:* The man who weights down the rear of his car for better traction and takes it out to the drag strip is going to hear this noise often. A common tendency is to shim the axle to move the nose of the pinion carrier down. All this accomplishes is to allow a little more spring motion before the bumper gets to the bracket. But get there it will, and the springs will get stretched worse in the process. So . . .

***SERVICE TIP: Don't shim the axle to change the spring seat angle or tilt the carrier nose down away from the body. As a matter of fact, drag racers add spacers under the nose bumper bracket so it will be bottomed. Then the springs don't get such a workout on acceleration.***

### U-JOINTS AND DRIVE-LINE ANGULARITY

Another undesirable effect of overload is the change of drive-line angularity. Slight angles are necessary at the driveshaft ends so there will always be some U-joint action to prevent brinelling and premature failure. The angles are carefully engineered for minimum shudder and vibration.

### DRIVE-LINE VIBRATION

If excessive loading or a combination of load and torque windup cause severe changes to the angles, shudder and vibration result. And if the pinion carrier nose is tipped up against the body, the whole car becomes a sounding board for the noise.

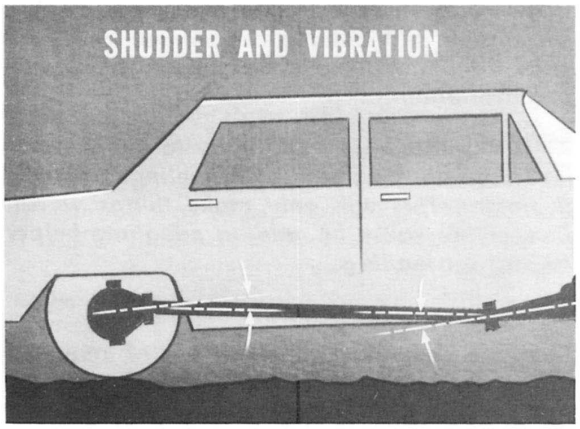


Fig. 9—Drive-line angularity changed

***DIAGNOSIS TIP: Unusual noise or vibration on acceleration sometimes points to overloading. The noise will not necessarily sound as if it is coming from the rear.***

Noise can be tolerated, but the danger of fatigue failure from overload and vibration can-

not. Don't be trapped into seeking measures to eliminate the results of overloading. Instead, correct the cause, either by lightening the load or by appropriate spring options.

### FRONT SUSPENSION AND STEERING

Back to the teeter-totter effect of an overhanging load, and this time what it does to the front end.

First, the effective transfer of some of the front-end weight to the rear upsets the car's balance and stability. If this isn't bad enough, the steering geometry gets completely messed up, too.

You know how fussy the instructions are about front-end alignment from MTSC Session No. 172—careful checking of front-end height and no load in the car except a full tank of gas. And if you remember that lesson on steering geometry, you'll recall that raising the front end is the same as running the wheels in rebound, so there are tricky effects on caster, camber and toe-in. This can cause all kinds of problems—wander, hard steering, poor returnability, low-speed shimmy—you name it. However it shows up, the car just isn't going to handle very well in that condition.

***DIAGNOSIS TIP: When the front-end geometry, suspension and steering components check out okay on a handling complaint, suspect rear-end overloading.***

***AND A SERVICE TIP: Don't try to compensate for rear-end overload by tinkering with the geometry. This will only make things worse. Correct the cause by adding adequate helper springs for loading.***

### HEAVY-DUTY SPRING OPTION

Most of the undesirable effects of rear-end overloading can be overcome by stiffening the rear springs. But to get the best combination of ride, appearance and load-carrying ability, the factory option includes matched heavy-duty rear springs, front torsion bars and heavy-duty shock absorbers.

### CAR HEIGHT AND ATTITUDES

Suppose you add extra support to the rear of a car in the form of auxiliary springs. Best chances are, when the car is unloaded, the rear

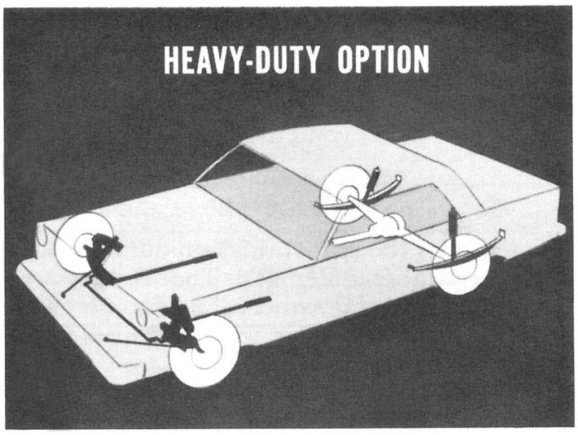


Fig. 10—Heavy-duty spring option

end will be way up in the air. This not only doesn't look good, but it also affects front-end geometry. The factory spring option, on the other hand, is designed for very nearly the same front- and rear-end height as with standard springs. Then with loading, the car attitude doesn't change as much because of the higher rate springs.

***SERVICE TIP: Front-end height specifications for the heavy-duty spring option vary up to about ⅜-inch from standard. Be sure to adjust the height according to the service manual specification before setting caster, camber and toe-in.***

### HEAVY-DUTY SHOCK ABSORBERS

As you know, shock absorbers do not help support the load, but are used to control ride motion. When we talk of heavy-duty shocks, we mean shocks that are matched to higher rate springs—and the factory spring option includes the properly matched shock.

***SERVICE TIP: It is not usually necessary to replace shock absorbers in pairs. Their action does NOT change with use as may happen with overworked springs. Replace a shock only if it is broken or leaking (not just damp). Be sure to use the same replacement part as the original equipment.***

### MoPar LOAD LEVELERS

MoPar Load Leveler shocks are a special breed. They have auxiliary springs to help support the load. The advantage of MoPar

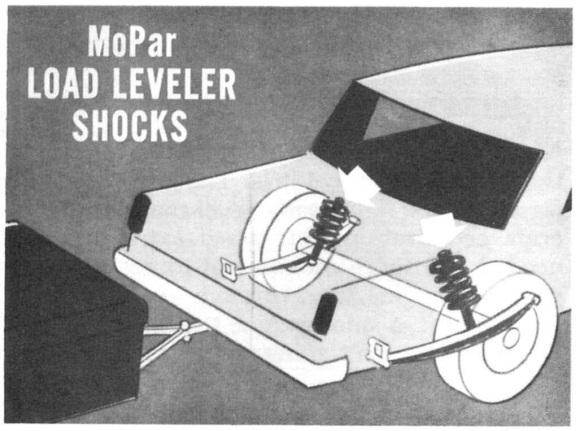


Fig. 11—MoPar Load Levelers

Load Levelers is that they can be installed easily in the shop and provide all the extra spring support needed for moderate loading. As we mentioned before, though, auxiliary springs at the rear tend to hold the car in a tail-high attitude when it's unloaded.

### TIRES ARE AFFECTED, TOO

The tire story is a lot like the spring story. Tires also are required to support the load and to contribute to a soft ride. And like springs, the design tendency has been more toward cushioning the ride, with limitations on load-carrying capacity.

Let's see what happens to a tire as it rolls over the ground with a load on it. The bottoms flatten and sidewalls flex slightly. All the load at any instant is supported by the patch area; that is, the actual tread area in contact with the ground.

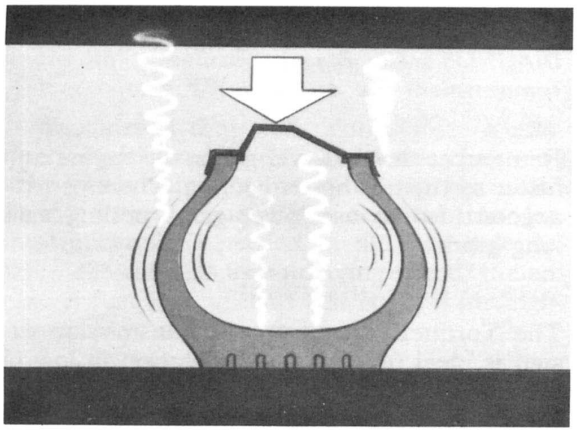

Fig. 12—Flexing generates heat

With the proper patch area, the tire sidewalls are relatively straight and don't flex much. But if the patch area is increased, the sidewalls bulge. There's a lot more flexing as the tire rolls over the ground and heat is generated. This kind of operation is just begging for early failure.

There are two ways to increase the patch area —underinflation or overloading. In other words, an overloaded tire is subject to the same stresses as an underinflated tire. It runs a little flat, causing wear of the second ribs and heat.

***DIAGNOSIS TIP: Underinflation wear, with normal tire pressure means too much load on the tire.***

### ADD AIR

If more than the normal load is placed on a tire, the tire needs more pressure to return the patch area to normal. Four psi extra is the recommendation for loading. Thinking back to the last section, you can see that the load distribution will decide whether all four tires should be overinflated or just the rear.

Remember, too, that tire pressure increases as the tires heat up. The normal 24 psi recommendation for low-pressure tires should be 27 psi when the tire is warm and 29 psi when it is hot. For heavy duty, add four psi more.

***SERVICE TIP: Don't bleed a hot tire because the pressure is over 24 psi. The tire got hot because it ran at high speed and the extra pressure is needed to prevent sidewall flexing. It will soften again when it cools.***

### LARGER TIRES

Sometimes extra inflation is not enough to handle the load. So oversize tire options are available on some models. If you install oversize tires in the field, watch out for the possibility of not enough wheel clearance, speedometer error or incorrect wheels. Remember that as tires get larger, the required rim width also increases. If a tire is mounted on too narrow a wheel, the sidewalls will bulge and flex, inviting early failure. So again it's best to order the factory option.

## STOP AND GO POWER

So far we have dealt with the parts of the car involved in supporting a load. But a load that is supported by the car also must be accelerated and stopped. This means we must also consider the power train (engine, transmission and rear axle), engine cooling and brakes.

Now a few hundred extra pounds in the car that would call for some spring help won't necessarily mean that extra power or extra brake capacity is needed. Short of hauling a heavy trailer, the need for power train and brake options is determined by how the car is driven—the terrain and what kind of performance the owner wants. Just remember that extra weight to pull means more torque, and there are only two ways to get it—gear reduction or more engine power. And stopping the extra weight means taking a good look at the brake power requirement.

### USE A BIG ENGINE

The standard engines used on our cars provide plenty of power for normal passenger use. But an owner who is going to pull a trailer weighing as much as the car, or who loads his car up and does a lot of driving in hilly country, will easily recognize the need for more power. So when we mention heavy-duty, we're talking about full-size cars with eight-cylinder power, and the transmission, axle and cooling system to go with it.

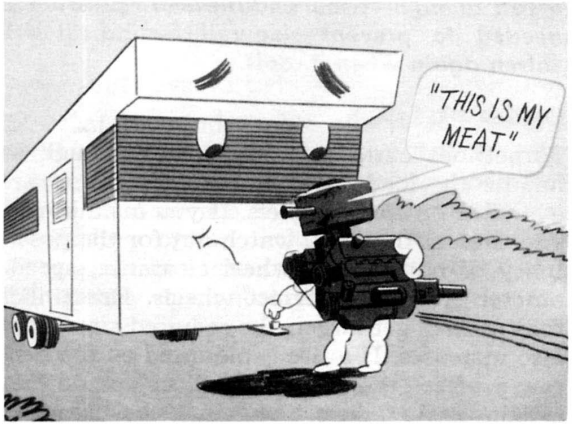


Fig. 13—Eight cylinders for heavy-duty

Many people think that the smaller the engine, the more economical it is. This may hold true for light cars, light loads, level roads and moderate acceleration. But when extra torque is needed, it's more economical to get it from a powerful engine than through gear reduction. Let's face it, a small engine that's straining all the time just isn't going to be economical.

### KEEPING IT COOL

Load pulling puts more BTU's into the engine coolant, so cooling can be a problem, too. Extra cooling capacity for medium duty can be obtained with a high-capacity fan. A 16-psi radiator cap is included with this option to raise the temperature at which the coolant boils, thus preventing overheating from loss of coolant.

For more severe service, a heavy-duty radiator and fan shroud are added to the high-capacity fan and 16-psi radiator cap. The heavy-duty radiator is the type used with air conditioning and has a higher cooling capacity.

### COOLING SENSE

Incidentally, regardless of the cooling equipment in the car, the driver is going to have to use some discretion in very severe conditions, such as pulling heavy trailers up and down hill or in heavy traffic on a hot day. Air conditioning, too, adds to the load on the cooling system, so it may be necessary to leave the air conditioning off in some severe conditions.

***DIAGNOSIS TIP: Glycol splashes in the engine compartment are a clue that the car has been run overheated.***

Remember that in lower gears, the engine runs faster so there is better cooling. Therefore, it's a good idea to use lower gears pulling up a long grade.

### TORQUEFLITE TRANSMISSION

The TorqueFlite automatic transmission design is ideal for extended operation in low or intermediate gear. In fact, it's better over-all than a heavy-duty manual transmission for heavy-duty operation.

For one reason or another, many people think heavy-duty means manual transmission. Perhaps they've had a sad experience with a competitor's automatic that wasn't designed for heavy-duty. Or perhaps they just don't understand why TorqueFlite is superior to most manual gear boxes. Whatever the reason, let's get the record straight. The A727 TorqueFlite used with our eight-cylinder engines is a heavy-duty unit in every respect. It has big clutch and band areas and big bearings, and it's water-cooled to prevent overheating.

## THREE SPEEDS AND CONVERTER

In operation, TorqueFlite has many advantages over a manual transmission, and other automatics, too. Unlike some competitors' automatics, TorqueFlite is a three-speed transmission and it always starts in low gear. The added converter ratio means real performance for breakaway and load pulling.


Fig. 14—Heavy-duty TorqueFlite

## LOWER AXLE RATIO

It also means that with TorqueFlite a relatively high-speed axle can be used; that is an axle with a numerically lower ratio. By multiplying more torque in the transmission, less multiplication is needed in the rear axle. So when the car gets up to driving speed, the engine is just loafing, and this is good for highway driving and economy.

## TORQUE LOADS CUSHIONED

With heavier loading and higher torque, there is more shock encountered in the drive line.

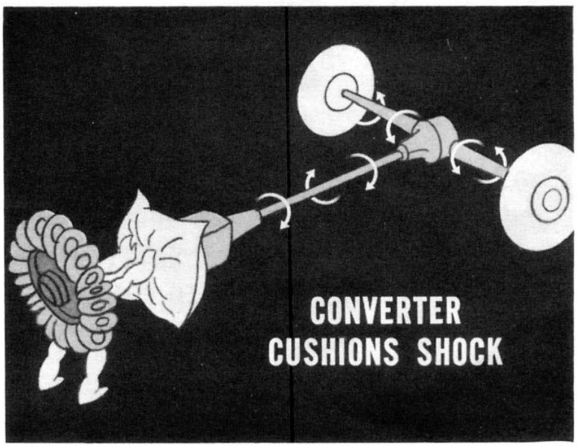


Fig. 15—Converter cushions shock

This shock is cushioned in the converter instead of being transferred to the gears, clutch and engine crankshaft.

## GEAR RATIO SELECTION

Automatic selection of the gear ratio is another TorqueFlite plus. With the "D" button pushed, the transmission selects the best gear for the driving condition, permitting the engine to run at the most efficient speed. But when the driver wants to override the transmission—for downhill braking, for uphill pulling, for getting out of a tight spot in traffic—it's as simple as pushing a button.

The number one button prevents upshifting to intermediate and the number two button prevents upshifting to high.

What about this business of running around in low and intermediate? Heavy-duty operation creates all sorts of conditions where lower gear operation is desirable or even necessary; but most people have been taught not to use the lower gears except to get into high, or when absolutely necessary for braking or engine pulling. With standard shift, this is still true, because the gears aren't designed for prolonged use in first or second.

## PLANETARY GEAR SET

But the husky planetary gear set in TorqueFlite is ideal for this kind of operation. Look at the difference in gear tooth contact between a manual transmission and TorqueFlite gears.

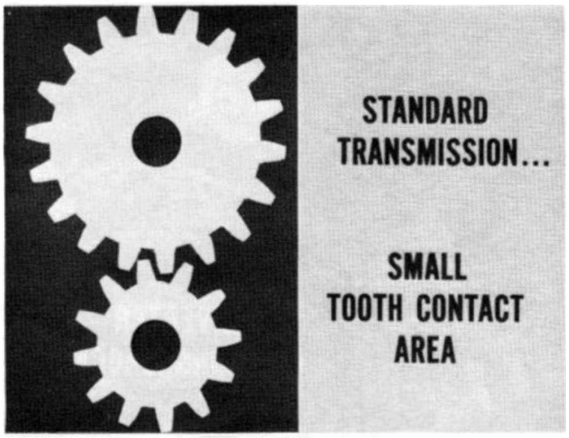


Fig. 16—Standard transmission gears

In the manual transmission, there is very little tooth contact and torque imposes side loads on the shafts. With a planetary gear set (same type of gears as in overdrive), though, there is lots of tooth contact, and no side loading. So you don't need to be afraid to run TorqueFlite for prolonged periods in low or intermediate, as you do with a manual gear box. In fact, it's a good idea to use the TorqueFlite gears for engine braking, for better engine cooling, and to help transmission cooling.

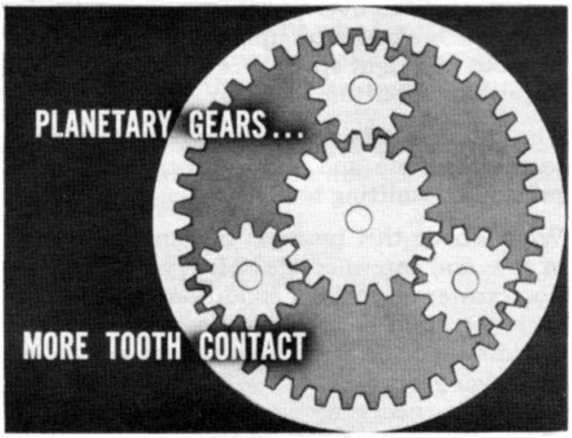


Fig. 17—Planetary gears

## REAR AXLE

At the beginning of this section, we said that heavy-duty usually calls for eight-cylinder power. The rear axles used with our eight-cylinder engines are heavy-duty units, with larger ring gears and pinions—in other words, they're built to handle the torque of the engines they go with. These heavy-duty axles also are available as an option if the customer insists on a six-cylinder engine.

Axle ratio usually is increased for heavy-duty, but as mentioned before, with TorqueFlite it is practical to use a lower axle ratio than with a manual transmission.

## MATCHED POWER TRAIN

So the whole power train of the car is affected by extra duty considerations, and the recommended options take into consideration an engine, transmission, axle and cooling system matched to do the job that's necessary.

## AND A WORD ABOUT BRAKES

Cars that are operated with constant loading or consistently under stop-and-go conditions need extra braking capacity. Heavy-duty, police-type brakes are available for Dodge, Plymouth and Chrysler cars; on Valiant and Dart, power brakes should be incorporated.

Sometimes a little driver education is needed regarding brakes, too. For instance, it is very important not to ride the brakes to slow a car coming downhill. This generates a lot of heat and causes brake fade. The only cure is to stop the car and wait for the drums to cool.

## ENGINE BRAKING

Better to prevent it by using the engine for downhill braking. This also will make the engine run faster and increase cooling, so some of the heat that was added to the cooling sys-

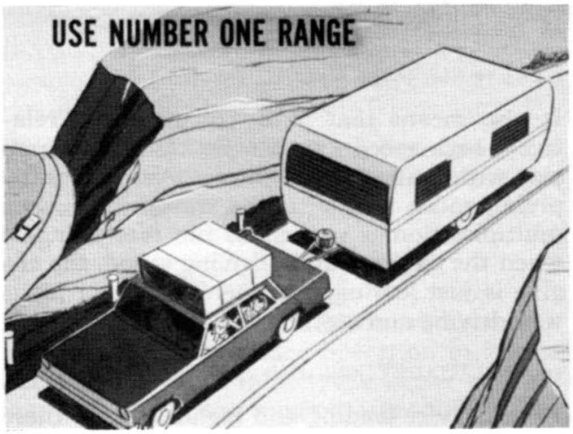


Fig. 18—Use number one range

tem going up the mountain can be dissipated coming down.

You should know, too, that heavy-duty brakes are not enough to also handle braking for a heavy trailer. Many owners will be pulling trailers as heavy as their cars, and even heavy-duty brakes don't have the stopping power or fade capacity to do double service. So the trailer must have its own brakes and they must not be connected to the car's braking system. Usually the trailer will have electric brakes that are designed to apply at the same time as the car brakes.

The subject of trailers deserves separate treatment, since almost all trailer hauling is heavy-duty operation and there are several important considerations that do not apply to other types of loading.


Trailer hauling is a special kind of heavy-duty operation. It can add up to five- or six-hundred pounds to the weight the car's suspension must support and up to 2½ tons to the weight that has to be pulled. Definite power and load-carrying options have been made available for trailer hauling, so let's see what these are before we get into the subjects of hitches and trailer accessories.

### VALIANT AND DART TRAILER HAULING SUGGESTIONS

*For Trailers Up To 1,500 Pounds:* The 170-cubic-inch engine, TorqueFlite and a 3.55 axle ratio is an acceptable power-train combination. An even better combination would be the 225-cubic-inch engine and TorqueFlite with: a 2.93 axle for lighter trailers and level roads, a 3.23 ratio for better performance on hills, a 3.55 ratio for mountainous terrain. The high-capacity fan and 16-psi radiator cap should be used and MoPar Load Leveler shocks should be installed.

*For Trailers Up To 3,500 Pounds:* The 225-cubic-inch engine and TorqueFlite combination is recommended. Axle ratio selection will depend on load and terrain. For minimum weight and level roads, the 2.93 axle would be acceptable. The 3.23 axle ratio is better for maximum load and the 3.55 ratio may be desirable for extremely hilly terrain or mountain driving. The heavy-duty radiator with shroud, high-capacity fan and 16-psi radiator cap is recommended. Heavy-duty springs and shock absorbers should be ordered and power steering is desirable.

### PLYMOUTH AND DODGE TRAILER HAULING SUGGESTIONS

*For Trailers Up To 2,000 Pounds:* The very minimum power-train requirement for level terrain is the six-cylinder engine, heavy-duty manual transmission and clutch, and heavy-duty rear axle with 3.55 ratio. The six-cylinder engine, TorqueFlite and 3.23 axle ratio would be even better. A V-8 engine, TorqueFlite and 3.23 axle ratio is heartily recommended although the heavy-duty manual transmission with heavy-duty clutch and 3.23 axle ratio is considered adequate. Regardless of power train chosen, the following equipment should be ordered:

- High-capacity fan and 16-psi radiator cap
- 7.50 x 14 tires and 5½" wheels
- Heavy-duty brakes
- Load Leveler shock absorbers

*For Trailers Up To 4,500 Pounds:* The minimum power-train combination is a six-cylinder engine, TorqueFlite and heavy-duty axle with 3.23 ratio. However, this combination will not provide much acceleration or hill-climbing performance. A V-8 engine, TorqueFlite and heavy-duty axle with 3.23 ratio would be much better. The advantages of one of the optional higher output V-8 engines should be considered for hills or mountains. The following heavy-duty equipment is required:

- High-capacity fan, shroud, high-pressure radiator cap and heavy-duty radiator.
- 7.50 x 14 tires and 5½" wheels

- Heavy-duty suspension option
- Heavy-duty brakes

### CHRYSLER AND DODGE 880 TRAILER HAULING SUGGESTIONS

*For Trailers Up To 2,500 Pounds:* Eight-cylinder engines are standard equipment on Chrysler and Dodge 880. For better performance, TorqueFlite and 3.23 axle ratio are recommended, though a lower axle with TorqueFlite will be satisfactory on level terrain. The following options should be ordered:

- High-capacity fan and 16-psi radiator cap
- Heavy-duty brakes
- Load Leveler shock absorbers

*For Trailers Up To 5,500 Pounds:* The eight-cylinder engine is standard equipment. It should be used with TorqueFlite and a 3.23 axle, and the following options:

- High-capacity fan, shroud, high-pressure radiator cap and heavy-duty radiator
- Oversize tires (8.50-14-6 on 880 and Newport sedans and 300 Sports Series; 9.00-14-6½ on 880, New Yorker and Newport Wagons)
- Heavy-duty brakes
- Heavy-duty suspension option

### TRAILER LOADING

How a trailer is attached to the car and how it is loaded have significant effects on the car's attitude, height and handling stability. If a trailer is properly loaded, about 10% of its weight will be on the hitch. This much weight is desirable to provide stability, but it will contribute to lowering of the car and this may be undesirable if the lowering is excessive.

Remembering our discussion of an overhanging load, you can see that a 4000-pound trailer that transfers 400 pounds to the hitch ball is imposing a much higher load on the axle, probably in the nature of 800 to 1000 pounds. This is too much load, even for heavy-duty rear springs, and would cause poor stability, axle deflection, and poor drive-line angularity.

### EQUALIZING HITCH

The only way a trailer of this much weight can be tolerated is with an equalizing hitch that will divide the load between the front and rear springs. Such a hitch is mounted to the heavy frame members of the car and has a mechanism to pull both the front and the rear ends of the car down when the trailer is attached. Thus, for the trailer just described, an equalizing hitch would distribute the load so each wheel would carry an extra 100 pounds.

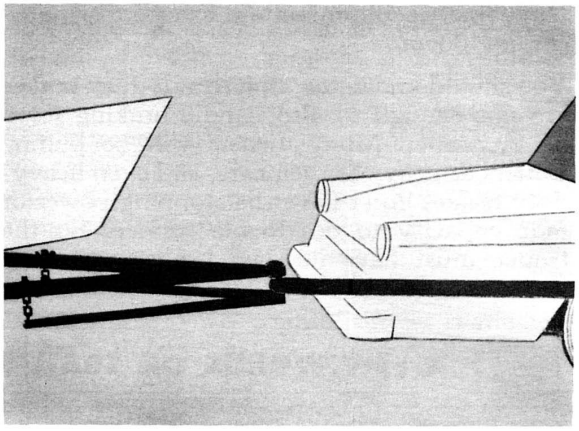

Fig. 19—Equalizing hitch

Under these conditions, a heavy-duty spring package would probably not be strictly required, though it might be desirable.

If an equalizing hitch is not used, the load at the ball as a rule should not be more than half the maximum rated trunk load for the type of springs the car has. For instance, on the Dodge sedan, the maximum trunk load with standard springs is 200 pounds. Thus the load at the ball should be no more than 100 pounds, or some spring assist will be needed.

### OTHER HITCHES

A plain bumper hitch is suitable only for intermittent use of a very light trailer. Anything else requires a permanent-type hitch attached to the car's heavy underbody structure. NO HITCH SHOULD EVER BE ATTACHED TO THE REAR AXLE HOUSING OR TO SUSPENSION COMPONENTS. This will place severe stress on the axle and bearings and will interfere with suspension action.

You probably don't handle or install trailer hitches. But you do have a responsibility to your customers to check that they do have

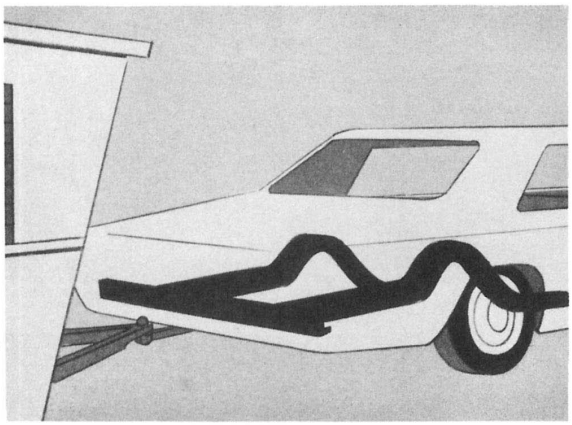

Fig. 20—Attach hitch to frame

the right kind of hitches properly installed for the trailers they are hauling.

### SPECIAL EQUIPMENT FOR TRAILER HAULING

Since the trailer turn signals will be connected with the car's, a heavy-duty flasher is desirable. A special outside rear-view mirror probably will be needed because of the trailer width.

An emergency flasher unit can also be connected with the turn signals to flash all the signal lights at once when parked at the roadside for rest or repairs. The heavy-duty flasher is included in this option.

Most hitch dealers can install a quick-connect plug at the car's rear to provide proper connection of the trailer accessories and brakes to the car electrical system.

### HEAVY-DUTY ELECTRICAL SYSTEM

A lot of stop-and-go driving or a trailer with electric brakes and other accessories will impose more of a load on the electrical system. The alternator, which is standard on all our cars, delivers more current at lower speeds than a conventional DC generator. In many cases, this will offset extra needs, but where very heavy demands are expected, a heavy-duty alternator (higher output) and heavy-duty battery are available.

### SURE-GRIP DIFFERENTIAL

It would be well here to also mention the Sure-Grip differential, available on all 1963 cars except Valiant and Dart. While this doesn't fall in the category of a trailer essential, it is very helpful in some of the conditions encountered in trailer hauling. By maintaining traction during acceleration or with one or both wheels on mud or ice, this feature qualifies as a real convenience and extra safety factor.

### POWER STEERING

Power steering falls in the same category. It doesn't support or pull any of the load, but really adds to driving convenience and safety for trailer hauling.

### MORE DRIVING SENSE

A few simple rules followed carefully will insure driving safety and longest service life of the car. It is important to recognize that a trailer can make significant changes in the car's attitude and handling. The headlights should be checked with the trailer attached and adjusted, if necessary, to prevent blinding other drivers. Trailer lights should be checked regularly, as should tire pressures. (Tires should be inflated an extra 4 psi for *any* trailer hauling duty.) The driver should accustom himself to the handling characteristics of the car before taking it out on the road.

No one should try to reduce hitch loads by loading the trailer heavily in the rear. This leads to serious handling problems. The trailer oversteers and becomes unstable; it "whips". It can be very dangerous at highway speeds, especially if there are gusty crosswinds.

On the road, the same courtesy rules followed by the truck drivers apply. Keep to the right except when passing, and make sure you have plenty of room before attempting to pass. Help other faster, more maneuverable cars to pass. Remember that you need more room to pass, to brake and to turn.

Sudden braking should be avoided by anticipating conditions ahead. It is desirable to use the engine as a brake as much as possible. Engine overheating, which can cause serious damage, should be avoided by cooling-system maintenance and judicious driving.

Finally, the trailer owner should recognize that the car is being subjected to more severe service and follow a more frequent maintenance schedule. See Service Reference Book titled "Lubrication Service", Session No. 63-5.

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