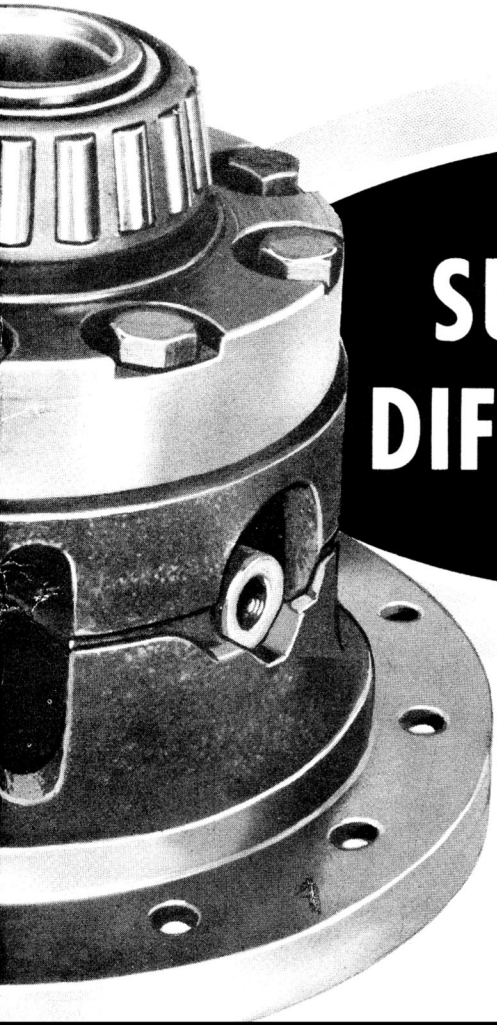
SERVICE REFERENCE BOOK

session no. 122

of the MASTER TECHNICIANS SERVICE CONFERENCE

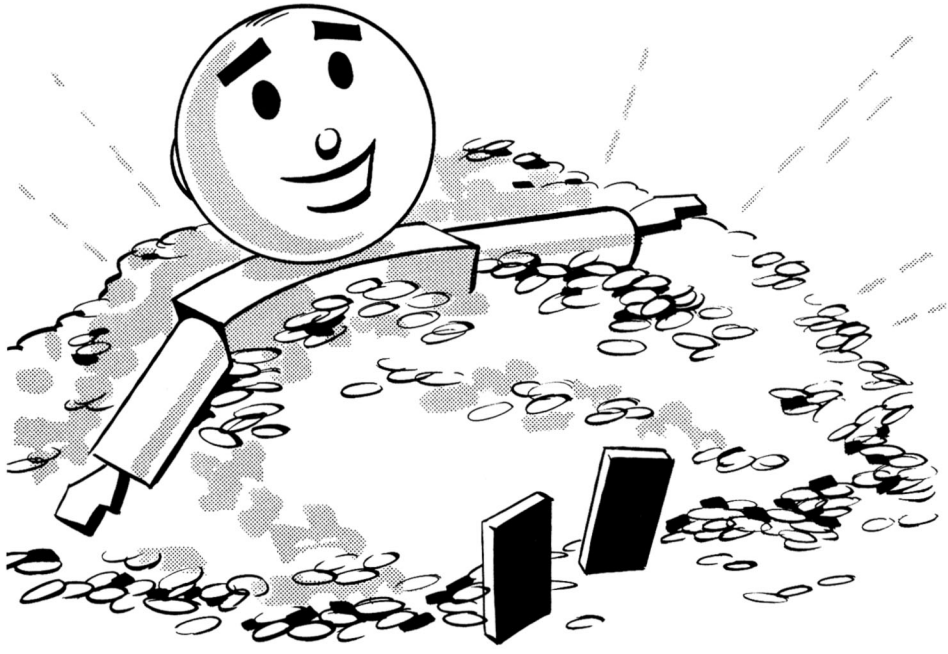


SURE-GRIP DIFFERENTIAL

Prepared by CHRYSLER CORPORATION

Plymouth • Dodge • De Soto • Chrysler • Imperial

Tech sez: "YOU'LL HIT THE JACKPOT WITH GOOD SURE-GRIP SERVICE!"



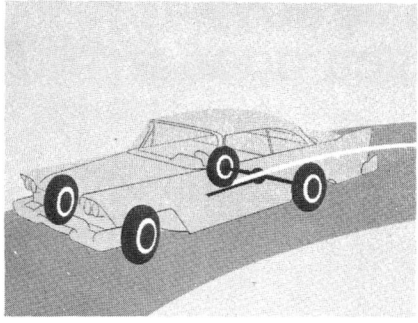
As new car features go, the 1958 Sure-Grip differential certainly has much to offer. Once our owners are aware of its many advantages, we'll be seeing more cars equipped with Sure-Grip. So, now's a good time for every technician to study the new unit so he will be ready to provide any service it may require.

Actually, maintenance on the Sure-Grip differential isn't difficult. All you need is familiarity with the new parts, their removal, reassembly, operation, diagnosis, and correction when necessary. That story, plus a helpful section on conventional differential operation is spelled out for you in this reference book.

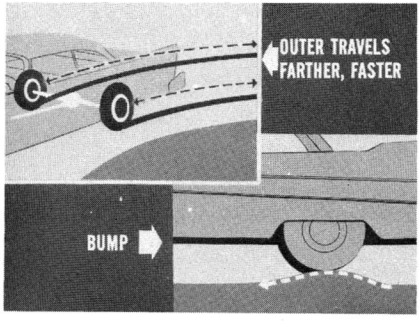
Here's how this timely service information is arranged:

WHY A CAR NEEDS A DIFFERENTIAL

Ever wonder why differentials are necessary? If you've played with a toy car, you've probably noticed that it runs only in a straight line. Usually, the front axle doesn't turn. Also, both rear wheels are rigidly attached to the same axle shaft. When one wheel turns, the other has to turn.

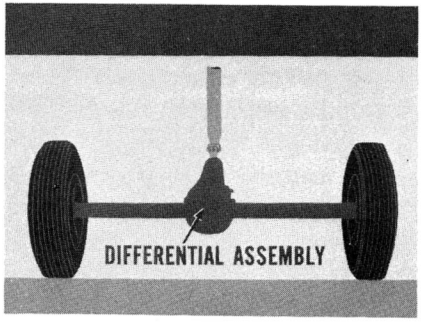


That wouldn't work out for an automobile. A single rear axle shaft would compel one rear wheel to slide—instead of roll—on curves or while traveling over uneven places in the road surface.



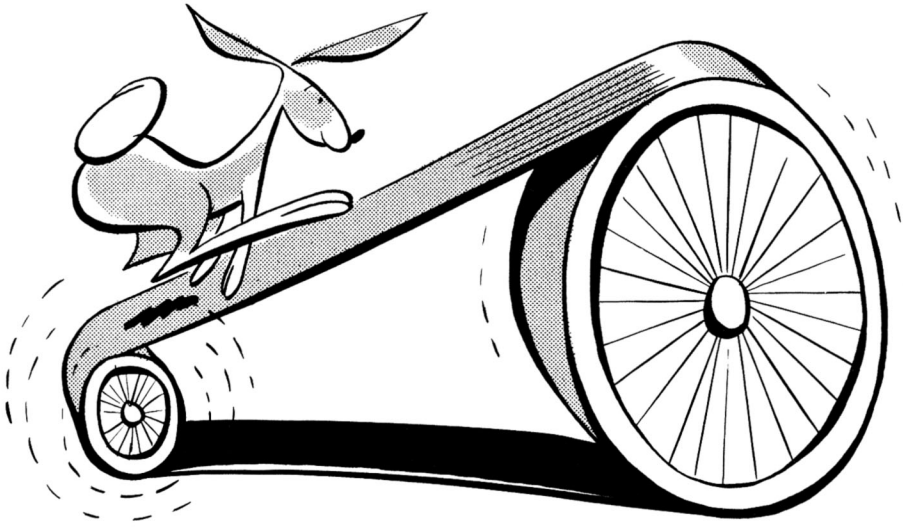
That's because the outer wheel, on a curve, travels farther and faster than the inner wheel. On a bump, or dip, one rear wheel acts the same way when it's compared with the wheel that rolls over a level surface. Even differences in tire air pressure will cause rear wheels to turn at different speeds.

To allow for travel on curves, over uneven spots, and tire air pressure differences, each rear wheel has to turn independently. So the single rear axle shaft was replaced by two short shafts. Then, the conventional differential assembly was developed and placed between the two axle shafts. What this differential does, and how it does it will help you understand Sure-Grip operation. So let's take a look at how the conventional differential operates.

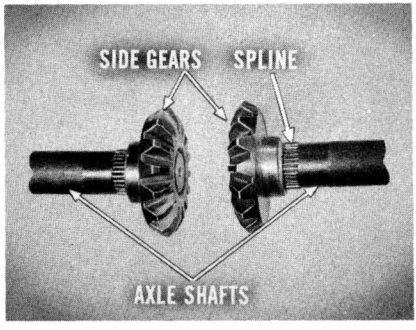


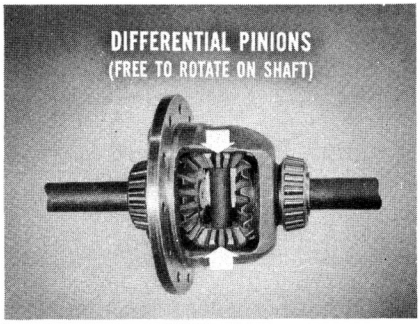
HOW THE CONVENTIONAL DIFFERENTIAL WORKS

Primarily, a conventional differential lets the rear wheels turn at *different speeds* while it divides the torque *equally* between the two wheels. How the torque is divided equally is easy to see, once you study the differential parts involved and what they do.



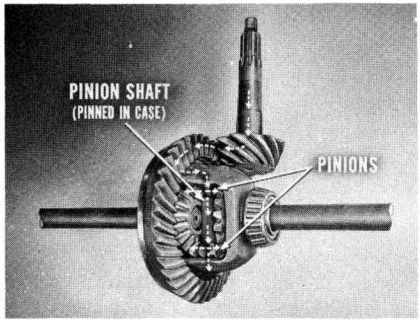
For instance, there are two differential side gears. The inner, splined ends of the axle shafts fit in these two side gears. The rear wheels are attached to the outer ends of the axle shafts. So one side gear rotates with the right wheel, the other side gear turns with the left wheel.



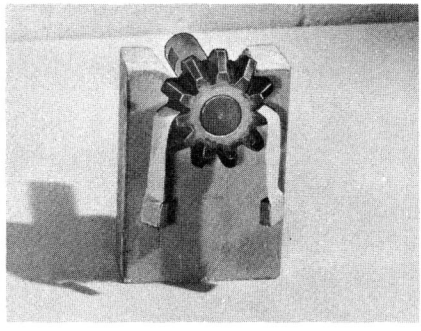


Surrounding those side gears is a cast housing, called the differential case. Pressed into this case is a small differential pinion shaft. Mounted on this pinion shaft are two smaller gears called differential pinions. These pinions are free to rotate on the pinion shaft which is held stationary in the differential case.

The side gears, as you know, are located so that both of them mesh with the differential pinions.

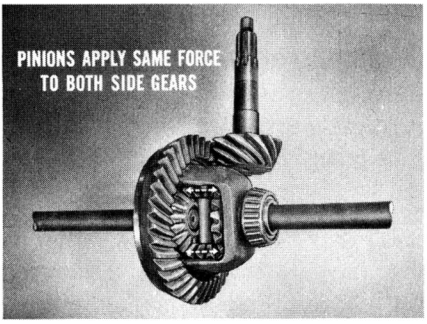


Now, the axle drive gear is bolted securely to the differential case. So, the gear torque passes directly to the case. Since the differential pinion shaft is pinned in the case, the torque is taken by the pinion shaft and applied to the bores of the differential pinions as a force.



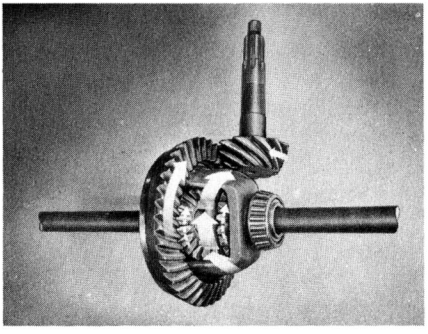
One important point to keep in mind is that each pinion is like a *balance* pivoted about its center. In other words, if you put one weight on one tooth, and another weight on an opposite tooth on the other side, the pinion would balance the weights like a small scale.

Therefore, the pinions *have* to apply the same force to both side gears. The pinions cannot apply more force to the teeth of one side gear than they can to the other. And that's why torque is divided equally between the right and left rear wheels.



Operation—Car on Straightaway. As an example, you know that the case turns with the axle drive gear when it's driven around by the drive pinion. The drive gear and case go around at the same speed and with the same torque. So, if a car were going straight ahead on a smooth road, the rear wheels would turn at the same speed.

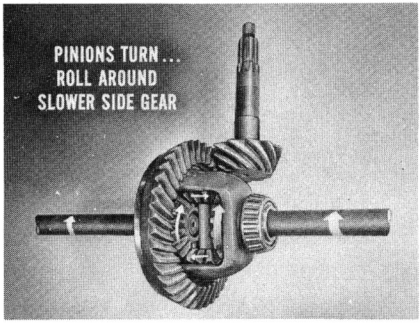
Now, when engine torque drives the axle drive gear around, the case turns with it and carries the pinions around. But, since both rear wheels turn at the same speed, the gears and pinions inside the case don't turn on each other. In other words, the pinions don't turn on their own shaft. Instead, *they're in balance!*



They *act as balance wheels,* pivoted about the center, and *apply equal force to the side gears.* As a result, the side gears turn at the same speed as the case. In fact, the whole nest of gears turns as if it were one solid unit. It goes through the same motion that would take place if there were a solid rear axle.

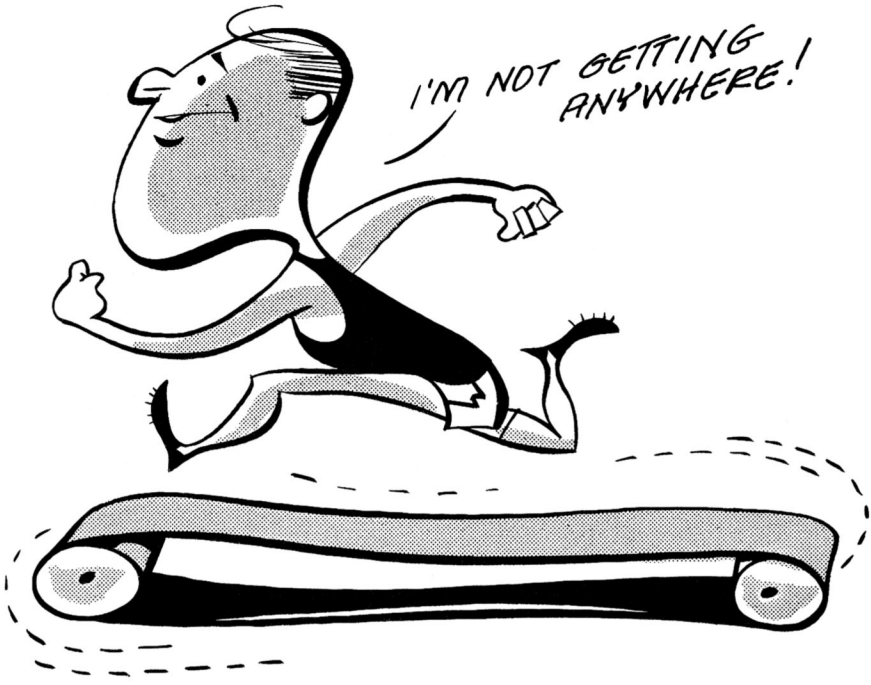
Operation—Car on Curve. When the car is traveling around a corner, the conventional differential really goes to work. First, remember that, on a curve, the rear wheels turn at different speeds. One rotates faster than the other. The inside wheel, in this example, travels *less distance* than the outside wheel.

The side gear on the inside shaft turns *slower* than the differential case. This, in turn, makes the pinions turn on their own shaft. They roll around the slower moving side gear. So the rotating pinions, in this differential action, allow the rear wheels to turn at different speeds while still keeping torque evenly divided between the two wheels.

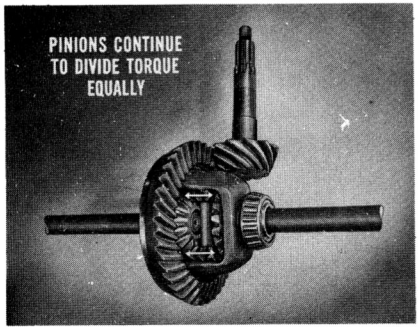


Operation—One Wheel on Ice. Now let's consider what happens when the car stands still, one wheel spinning on ice—the other standing still on dry pavement.

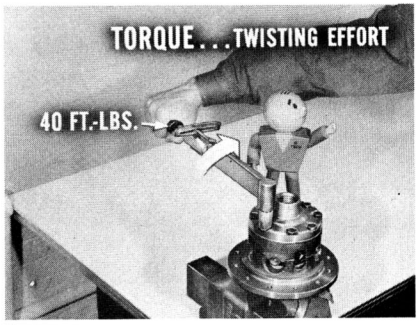
Here's the answer. When one wheel spins, the case still turns with the drive gear, carrying the pinions around. But the *total torque decreases,* and the opposite wheel stands still because there's not enough torque to move the car.



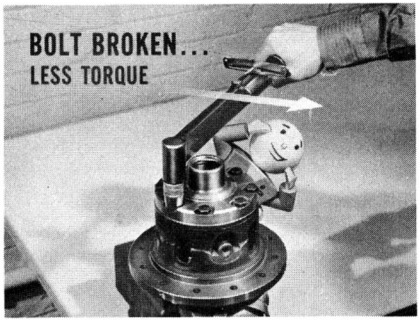
Remember . . . the pinions still *continue to divide torque equally* between the right and left rear wheels. This equal torque division is *always* going on! And . . . because the ice is *slippery,* it naturally *takes less torque* to turn the wheel that's on the ice.



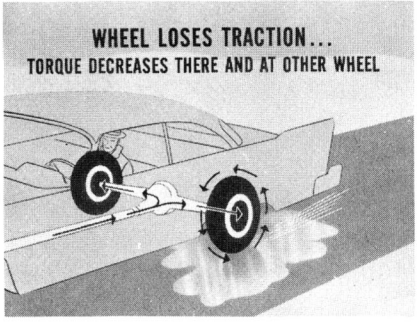
So the wheel standing on dry pavement *can't get any more torque* than the spinning wheel because of the equal torque division. Result? The car doesn't move.



Definition of Torque. Torque, as you probably know, is a *force*—a "twisting effort". As an example, you'll remember putting a torque wrench on a bolt and tightening it until you get a certain reading—let's say the indicator points to 40. Said another way, you've tightened the bolt to 40 foot-pounds.

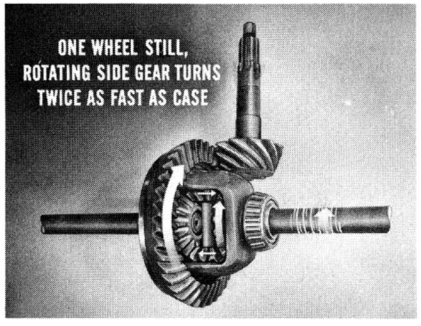


Now, tightening the bolt took effort because the bolt resisted your effort to turn it. But, if the bolt were broken suddenly so that the wrench began to *spin,* you'd be exerting *less torque.*



Something a lot like that happens when a rear wheel loses traction. *Torque decreases* at that wheel, and also at the *other* wheel because of the equal torque division provided by the differential. Speed of the spinning wheel increases, but not the torque.

As a matter of fact, when one wheel stands still, the rotating side gear of the spinning wheel turns *twice as fast* as the differential case. With one wheel still, the pinions have to turn on their shaft. Since they're in mesh with the side gears, they just run around the stationary gear.

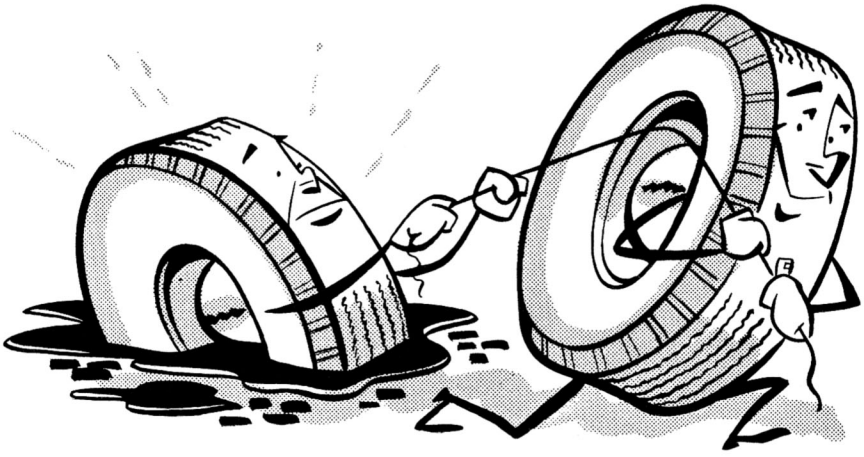


The side gear on the spinning axle turns faster because the pinions are turning on their shaft. The extra *speed* of the pinions is added to the side gear, in addition to the *speed* of the case. So, the free axle of the wheel with no traction turns exactly twice as fast as it would when both wheels have the same traction.

With the conventional differential setup, then, when one wheel loses traction, there's a *gain in speed,* but *a loss in torque.* The good traction wheel doesn't get enough torque, and the car doesn't move out of its difficulty.

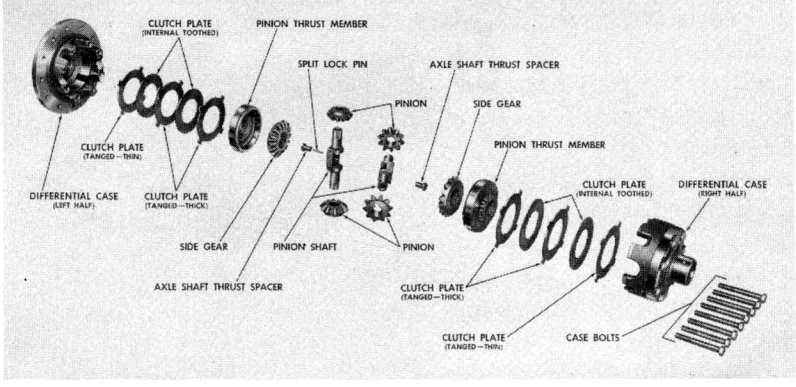
THE SURE-GRIP DIFFERENTIAL

Advantages. Knowing what you do about how the conventional differential works, you can easily understand why so many people are enthusiastic about the Sure-Grip differential. The Sure-Grip unit eliminates waste of torque that can take place when traction is unequal. Instead, the Sure-Grip differential redirects unusable torque from the wheel with poor traction to the wheel which has the better traction.

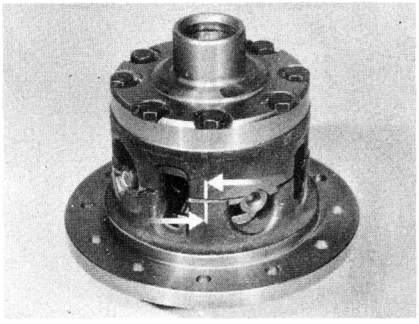


By making use of torque that a conventional differential would waste in spinning, the Sure-Grip unit enables the car to pull out of its difficulty. It's one of the most exciting features available on our 1958 line of cars.

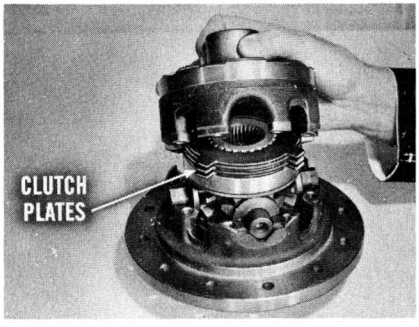
Disassembly. You remove the Sure-Grip differential from the rear axle carrier the same way you remove the conventional differential. No new tools are needed. When you pull the wheels to remove the differential, however, remember to use only the approved wheel puller. A knock-off type tool can damage the Sure-Grip unit! Next, clean off the lubricant.



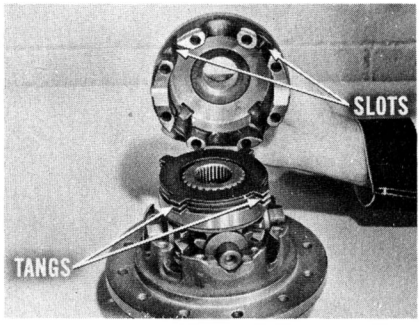
Now, before you go any farther, make a note of the index marks on case sections . . . and on the ends of the pinion shafts and their case ramps. This will insure getting the parts back in their original order. As you'll also notice, the Sure-Grip differential case is made in two halves, held by eight specially hardened bolts. These bolts are identified by six spoke marks on the heads. Use no other bolts.

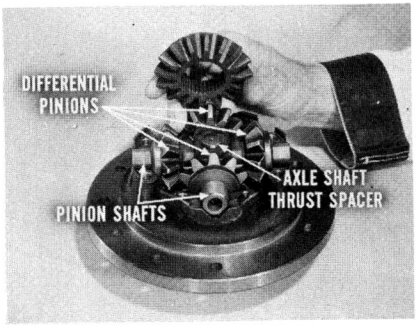


Once you remove the bolts and take off one half-section, you immediately see one of two packs of five clutch plates. Another clutch pack is on the bottom of this assembly.

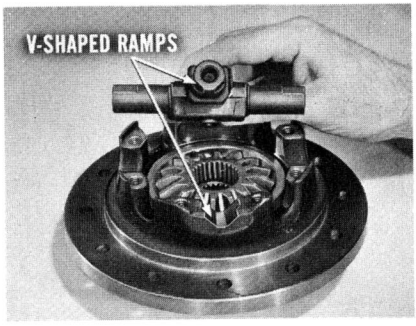


External tangs on three of the clutch plates fit into slots in the differential case. The other two clutch plates have internal teeth which engage external splines in the pinion thrust member. The clutching is done between the pinion thrust member and the differential case.

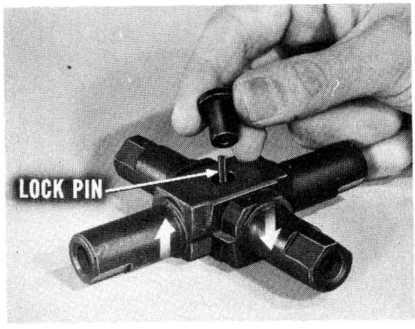




Right under the pinion thrust member is a differential side gear, like the side gear in a conventional unit. And when you lift the differential gear, you see four differential pinions. These pinions are on two pinion shafts that are loosely connected at right angles to each other by means of an axle shaft thrust spacer.

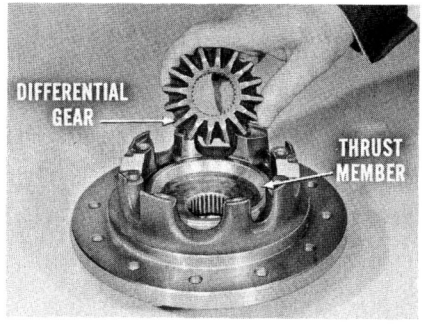


Both ends of each pinion shaft have two flat surfaces, or V-shaped ramps. These mate with identical ramps in the two differential case sections. One reason for marking the pinion shaft ends is to get them back on the same ramps during reassembly.

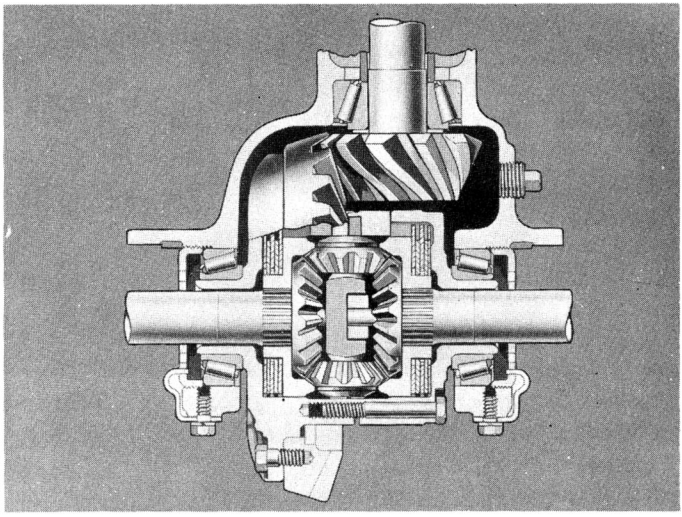


The axle shaft thrust spacer, which connects the two pinion shafts, is a two-piece part. It's fastened with a split, hollow lock pin forming a spool-like connection so a slight sidewise movement of the pinion shaft is permitted.

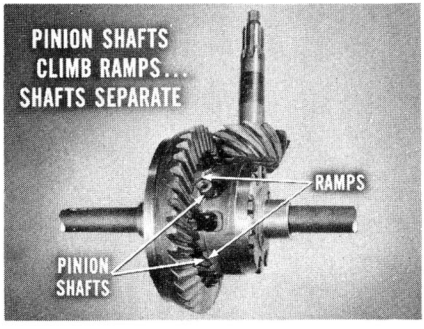
Under the differential pinions and pinion shafts is another differential gear. Then a pinion thrust member, and clutch pack . . . just the reverse of the parts on the other side.

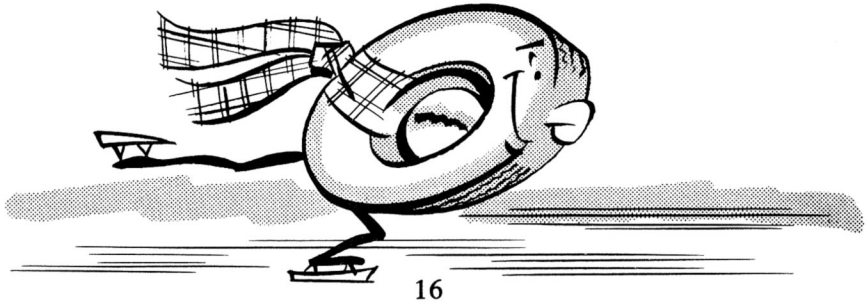


Operation. Under normal conditions, the Sure-Grip differential works a lot like the conventional unit. But when the rear wheels turn at different speeds, here's what takes place. Instead of dividing torque equally between the two wheels, the Sure-Grip differential sends the greater share of torque to the slower moving wheel.

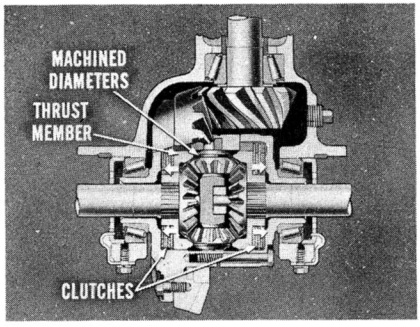


Operation—One Wheel on Ice. Let's assume the car is standing still, one wheel on ice and the other wheel on dry pavement. When an attempt is made to drive the car, drive gear torque in the differential case will cause the pinion shafts to climb the case ramps. The pinion shafts will separate, as allowed by the axle shaft thrust spacer.



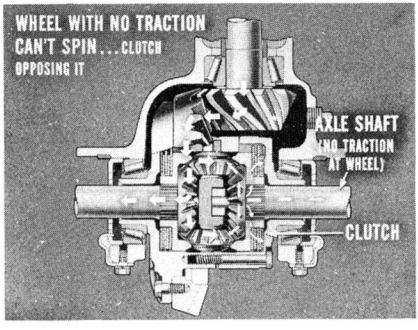


The pinions on these separating pinion shafts have machined diameters which roll against the pinion thrust members and exert pressure. That compresses the clutches.

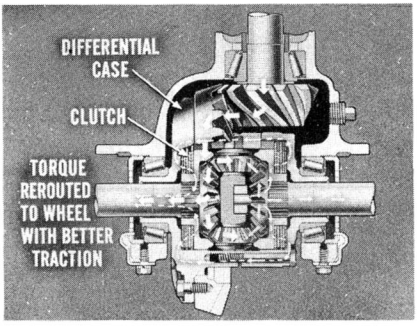


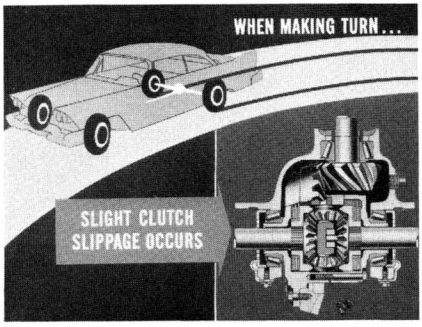
Both clutches, by the way, engage at the same time. In fact, any time there is torque applied to the Sure-Grip differential, the clutches are engaged to some degree. Differential action in itself doesn't actuate the clutches.

When both clutches are in engagement, the axle shaft of the wheel with no traction can't spin because it finds the engaged clutch opposing it.



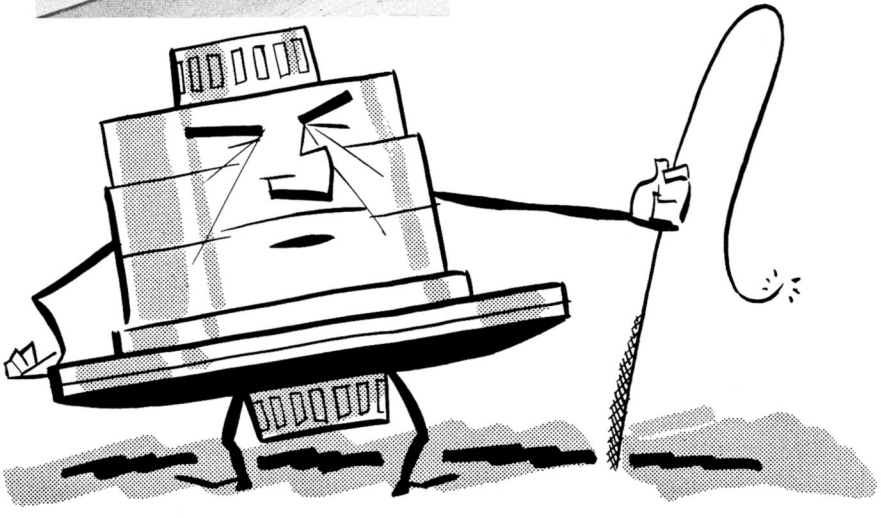
As a result, most of the torque going to the tractionless side is rerouted through the differential case and through the clutch on the other side where the axle shaft is driving the slower moving wheel. This slower wheel, of course, has the better traction. Therefore, the car is moved out of its difficulty.





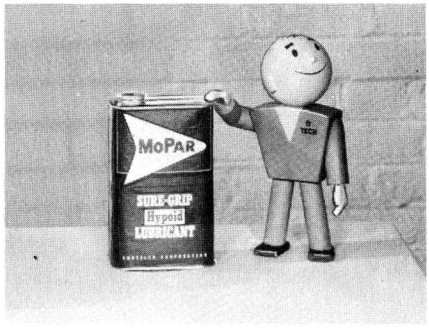
Operation—Car on Turn. Now, when a car equipped with the Sure-Grip unit is making a turn, a slight amount of clutch slippage occurs. This limited slippage is equal in each pack. In this way, differential action is allowed to take place to let the outer wheel on the turn travel a greater distance at a faster rate of speed.

But if one wheel on that turn should hit loose gravel, or ice, and *try* to spin, Sure-Grip won't let it. Instead, Sure-Grip quickly provides resistance to prevent excessive one-wheel speed-up, and keeps the car under control.



Lubrication. Proper operation of the Sure-Grip differential demands the proper lubricant. *There is no substitute!*

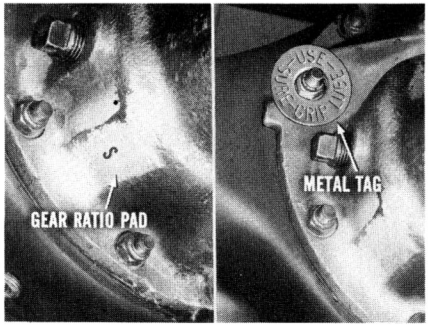
NOTE: *Use only Sure-Grip Hypoid Lubricant, Part No. 1879414!*



It is compounded with special ingredients designed for proper lubrication of all axle parts. Its greater cushioning action also prevents clutch plate chatter. Never mix in kerosene or other lubricant as that will destroy cushioning properties. Sure-Grip Hypoid is suitable for *all temperatures* in which the car may be operated.

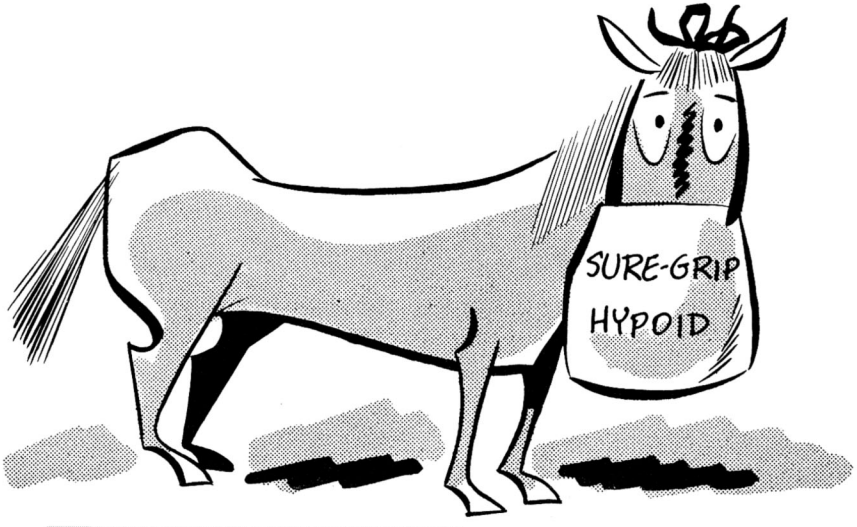
Capacity. Six-cylinder cars with Sure-Grip units require 3¼ pints, (U.S. Measure). Eight-cylinder cars require 3½ pints (U.S. Measure). Use a suction gun to remove the old lubricant, and then refill as specified.

Cars equipped with the Sure-Grip differential have the letter "S" stamped on the gear ratio pad on the right side of the carrier housing. In the future, a metal tag may be attached to one of the carrier bolts to identify the Sure-Grip differential.

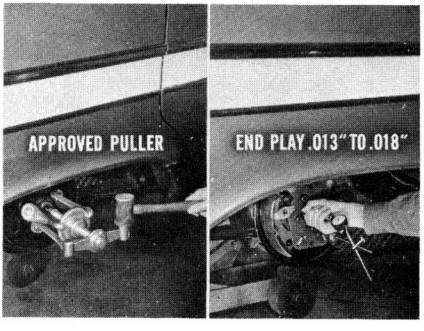


SURE-GRIP DIFFERENTIAL MAINTENANCE

Should you have occasion to check a Sure-Grip differential to determine the cause of a chatter, knock, growl, or failure to work as a Sure-Grip differential, there's a definite service sequence to follow.



First, remove the lubricant and refill with the right amount of Sure-Grip Hypoid lubricant. Road-test the car to see if proper lubrication corrects the reported condition. Frequently, this is all that's needed.

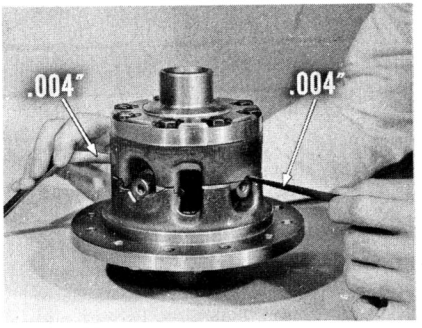


But if proper lubrication isn't the remedy, then use an *approved puller* (never a knockoff type, as it may cause damage) to pull the wheels. Check axle shaft end-play. It should be .013″ to .018″. Re-adjust end-play, if needed, and again road-test the car.

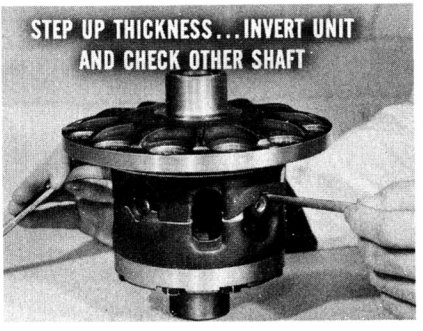
If the condition is still in the unit, your third step will be to use the approved puller to again pull the wheels. Remove the differential and clean off all the lubricant.

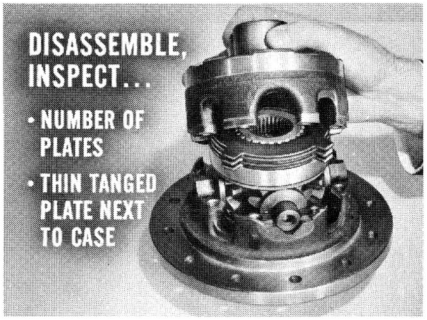
After cleaning off lubricant, your fourth step is to use two sets of feeler gauges to see that there's no more than .020″ total clutch plate clearance. This clearance check shows the amount of wear, or may point to improper plate assembly.

To make this check, use two .004″ feeler blades. Insert one at each end of the same pinion shaft, and on opposite sides of the V-shaped ramp.



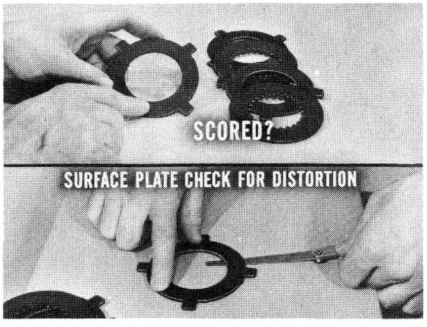
Then, increase the blade thickness until you get total clearance on one side. Invert the unit and check the clearance of the other pinion shaft ends in the same way. In addition to checking the total clearance, be sure there isn't more than .005″ variation in clearance from one pinion shaft to the other.





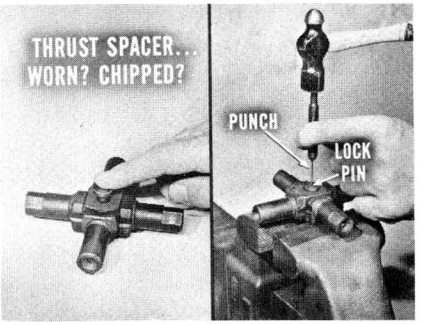
If you happen to find *more* than .020″ total clearance, remove the eight case bolts and disassemble the unit. Note the number of clutch plates. There should be five. See if the thin, $\frac{1}{16}$″, tanged plate was stacked next to the differential case.

In addition, see if the tanged and internal-tooth plates were in alternate positions. Clean, dry, and inspect all parts.



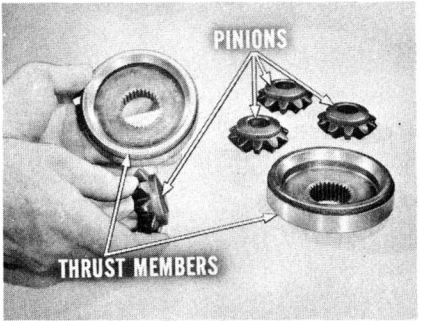
Scored or galled surfaces, of course, mean plates are damaged. A surface plate check will show up any distortion. Discard any damaged or distorted plates.

You should then check the thrust spacer securing the pinion shafts. If the spacer is worn, or chipped, use a small punch to drive out the lock pin, and replace the spacer.

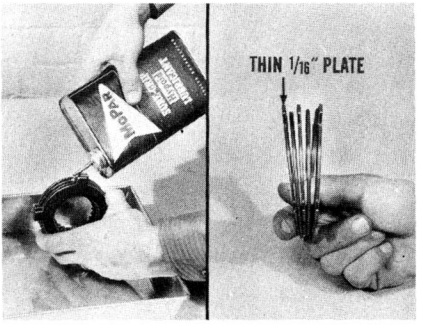


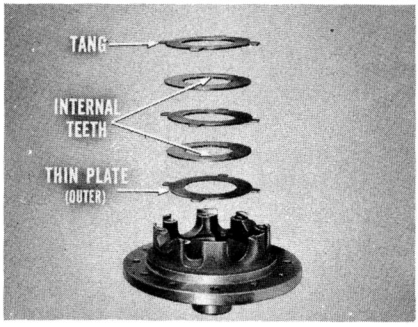
Carefully inspect the ramps in the differential case and on the pinion shafts. Replace both halves of the case if they are excessively worn. Replace the pinion shafts, too, if they appear to have bad surfaces where they contact the case ramps.

Check thrust surfaces on the differential pinions and on the pinion thrust members for excessive wear. Look for brinnelled or scored surfaces, and replace any parts worn or otherwise unsatisfactory.



Assembly Procedure. After replacing any part needing replacement, you're ready for reassembly. Oil the clutch plates with Sure-Grip Hypoid Lubricant. The thin, $\frac{1}{16}$" plate with external tang, remember, goes next to the case.

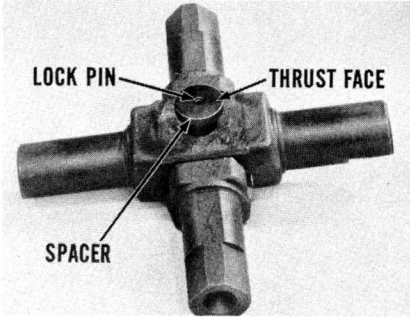




Follow the thin plate with an internal-tooth plate. Alternate for five plates in all—three with tangs, two with internal teeth—and be sure the thin plate remains as the outer plate to go next to the case.

Now, you can install the clutch pack on the pinion thrust member, the thick plate next to the thrust member. Pick up the pack and member, invert, and lower them carefully into the case so the tangs engage the slots in the case.

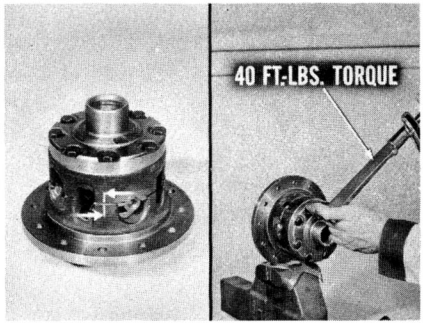
As an alternate method, you can place the thin, $\frac{1}{16}$" external tang plate in the case, then alternately place the internal tooth plate, tang plate, and so on, keeping the internal teeth lined up. Install the thrust member onto the pack so it engages the teeth of *both* clutch plates. Set one of the differential gears over the pinion thrust member.



Now, when you assemble the pinion shafts, drive in the lock pin until it shows at, but not beyond the thrust face. The thrust spacer should be a loose fit so it will let the shafts separate to actuate the clutches.

Install the four pinions on the shafts and place the pinion shaft assembly in position in the case, as indicated by index marks on the pinion shaft ends. Install the remaining differential gear, pinion thrust member, and clutch pack as you did the other side.

As you assemble the case half-sections, be sure to line up the index marks. Insert and tighten the case bolts to an even 40 foot-pounds torque.



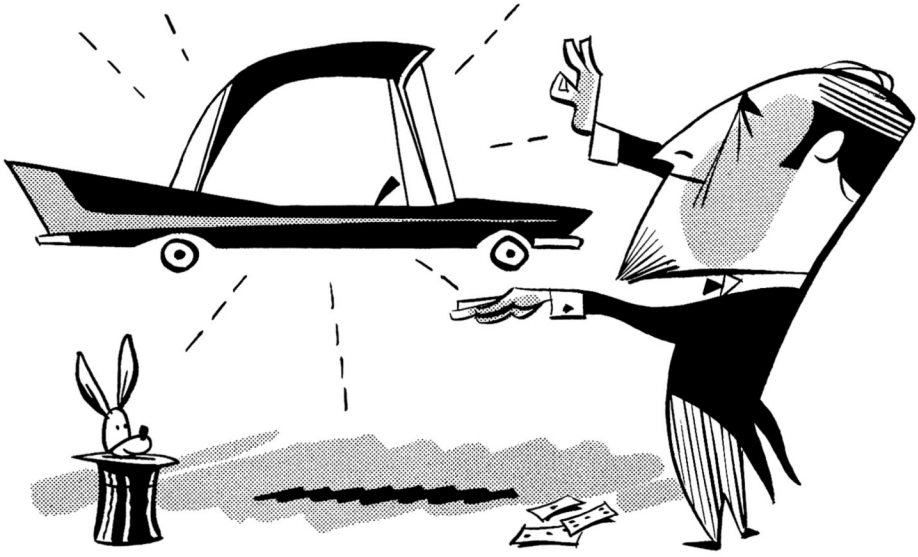
Before you reinstall the differential in the carrier, recheck total clutch plate clearance. This is always a good practice whenever the differential's been disassembled. If clearance is under .020", install the assembly in the axle housing. Fill the unit with Sure-Grip Hypoid Lubricant. Then, finally, road-test the car to be sure the condition has been satisfactorily corrected.

PRECAUTIONS WHEN BALANCING REAR WHEELS

When one rear wheel is up on a jack, spinning it may transmit torque to the other wheel on the ground. If that happens, the car may jump off the jack. *So, don't spin one rear wheel when the other wheel is being held stationary!*

If it is necessary to jack up one rear wheel, place blocks ahead and behind the front wheel diagonally opposite, before raising the car. Naturally, it's safer to raise both rear wheels.

NOTE: A warning sticker, attached to the base of the jack on cars equipped with Sure-Grip differential, points out this danger. Call this sticker to the attention of the owner whenever possible.

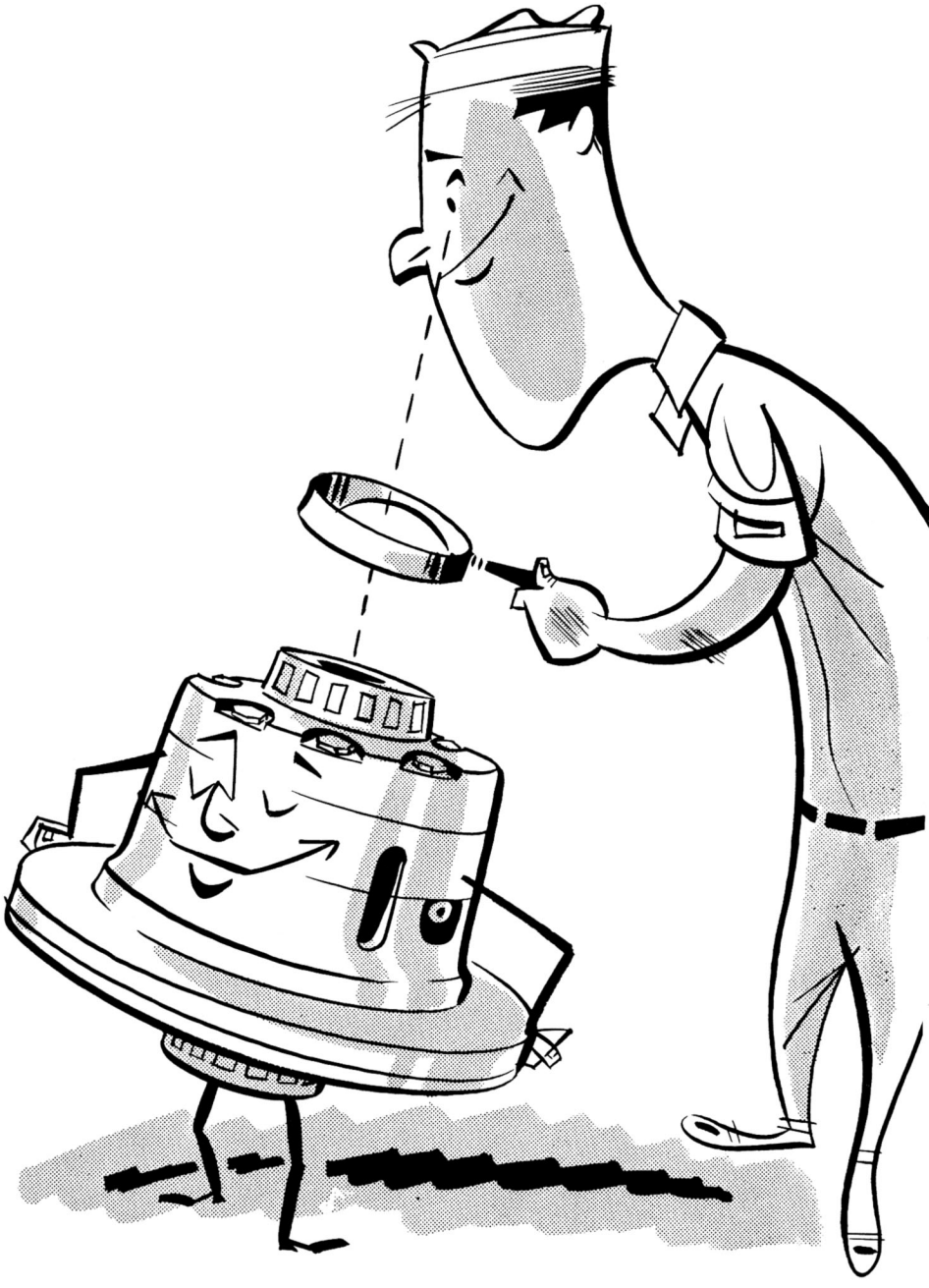


By now you can see why the latest type, on-the-car wheel balancing equipment shouldn't be used to spin rear wheels of cars equipped with the Sure-Grip differential. Besides moving the car off the jack at an untimely moment, high-speed spinning can damage differential parts. Instead, remove the rear wheels. Mount and balance them on front wheel spindles, or on a wheel balancer, and then remount them on the rear axles.

CONCLUSION

Nobody needs to tell you that the Sure-Grip differential is going places. It provides benefits needed on passenger cars for some time. You can look for a steady rise in popularity of this desirable feature, and you can expect an increase in service opportunities.

So study over the valuable tips on maintenance outlined in this reference book. They're designed to help make your work on Sure-Grip easier, more dependable, and satisfying to our customers.



RECORD YOUR ANSWERS TO THESE QUESTIONS ON QUESTIONNAIRE NO. 122

A conventional differential lets the rear wheels turn at different speeds, while it divides the torque equally between the two wheels.	RIGHT	1	WRONG
Each pinion, like a balance pivoted about its center, has to apply the same force to both differential side gears.	RIGHT	2	WRONG
Differential pinions still continue to divide torque equally even when one wheel spins on ice while the other wheel is standing still.	RIGHT	3	WRONG
A rear wheel standing on dry pavement can't get any more torque than a rear wheel spinning due to poor traction, because of the equal torque division provided by the differential.	RIGHT	4	WRONG
With Sure-Grip, when rear wheels turn at different speeds, instead of dividing torque equally, the greater share of torque is sent to the slower moving wheel.	RIGHT	5	WRONG
In the Sure-Grip unit, clutches are engaged to some degree any time torque is applied.	RIGHT	6	WRONG
Both clutches in the Sure-Grip unit engage at the same time.	RIGHT	7	WRONG
On a turn, there's a slight amount of clutch slippage in the Sure-Grip differential which permits differential action to occur.	RIGHT	8	WRONG
Any Hypoid Lubricant can be used in the Sure-Grip differentials.	RIGHT	9	WRONG
Always use an approved wheel puller to pull wheels; never the knock-off type.	RIGHT	10	WRONG

Litho in U.S.A.