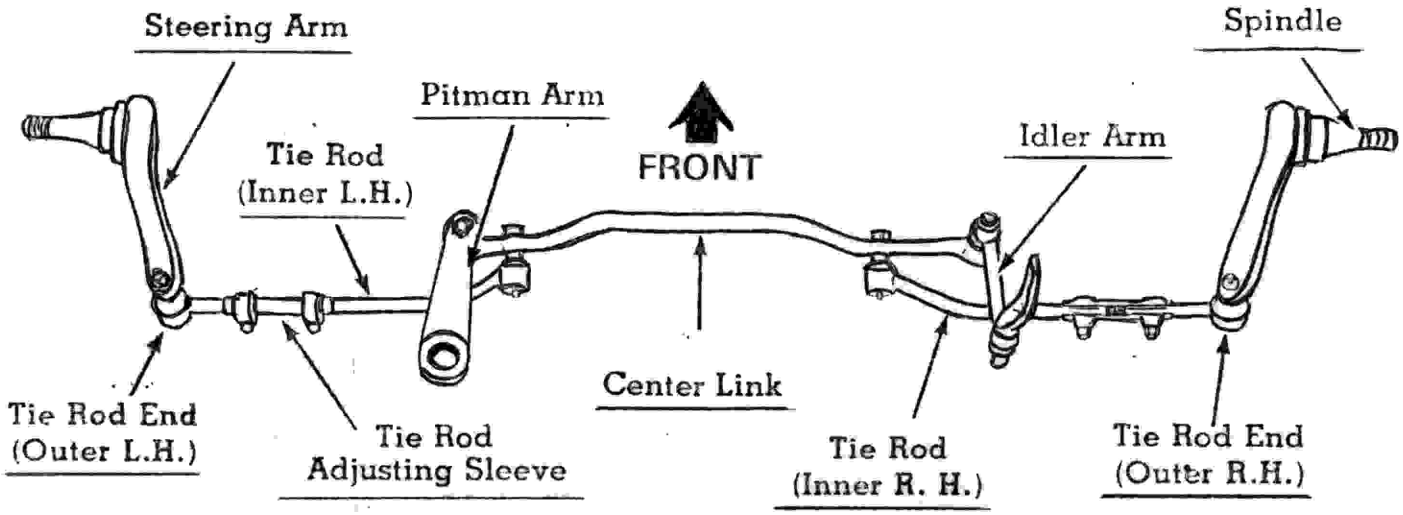
STEERING SYSTEMS

DEFINITION: A system of gears and linkages which enable the driver to control the direction of travel in a safe, controlled manner.

STEERING GEAR RATIOS: Manual (non-power) steering ratios vary from 15:1 to 24:1 depending upon the vehicle weight, type, and use. Power steering allows the use of smaller quicker ratios of 15:1 or less.

STEERING SYSTEMS:

a) PARALLELOGRAM: This system has been used on large american cars and pick-up trucks for many years. It is found on all heavy duty vehicle such as buses and large trucks. It is a complex arrangement of rods and levers which are all out in the open underneath the vehicle. Because they are in the open they are easy to inspect and service. Many of the parts are bent so as to allow them to clear other parts of the vehicle, the problem here is that how do you tell if they have been bent some more? The many joints in the system means more to wear and so the system can be sloppy. Some road-feel is lost, and the many parts are heavy.

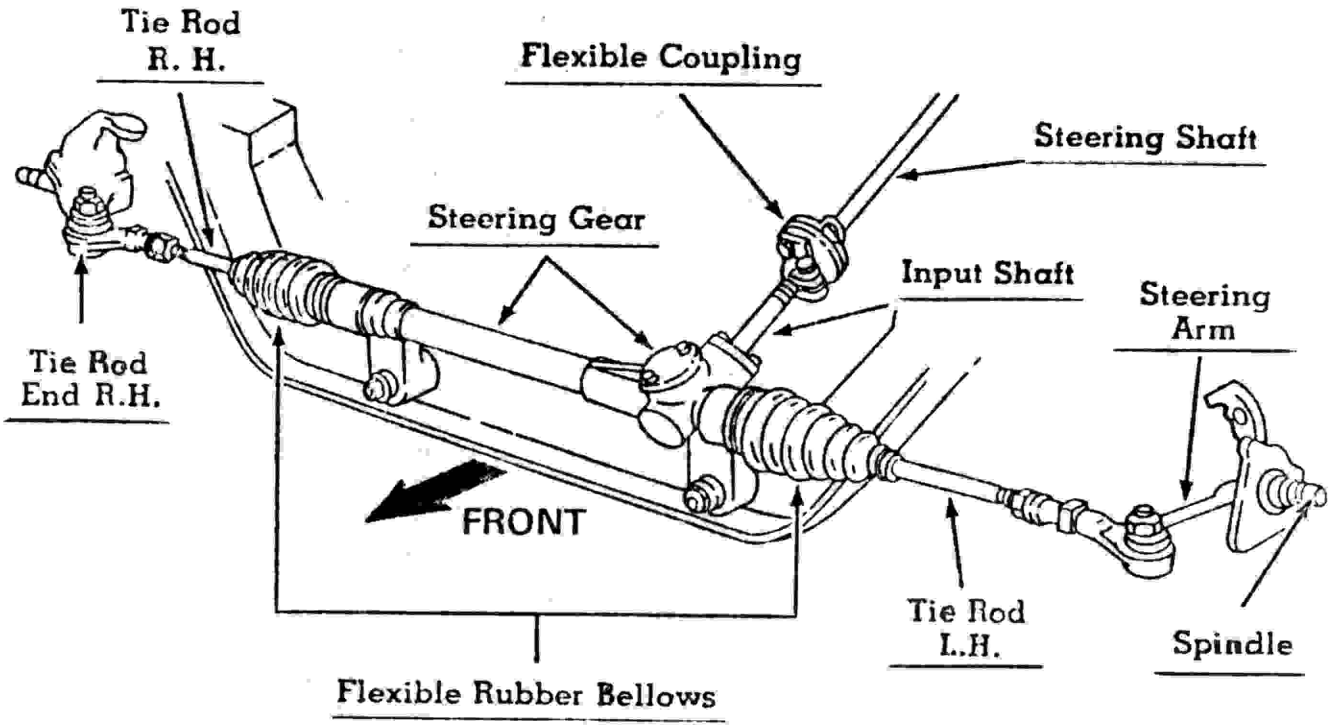


PARALLELOGRAM TYPE

b) RACK AND PINION: This system is lightweight, simple and direct-acting. These features make it well-suited to the modern automobile. The system has been around for a long time, but because the engineers weren't able to successfully power assist it it was only used on small light cars. The power assist problem has been overcome and now you will find that almost every new car comes equipped with it. Its fewer parts mean that it provides precise steering with better road - feel. Although some of the parts are enclosed and not easily visible the whole system can usually be taken off fairly easily for servicing. Special attention should be paid to the rubber boots at each end to see that they are not split or twisted, if they are they may allow the oil to run out and water to get in.

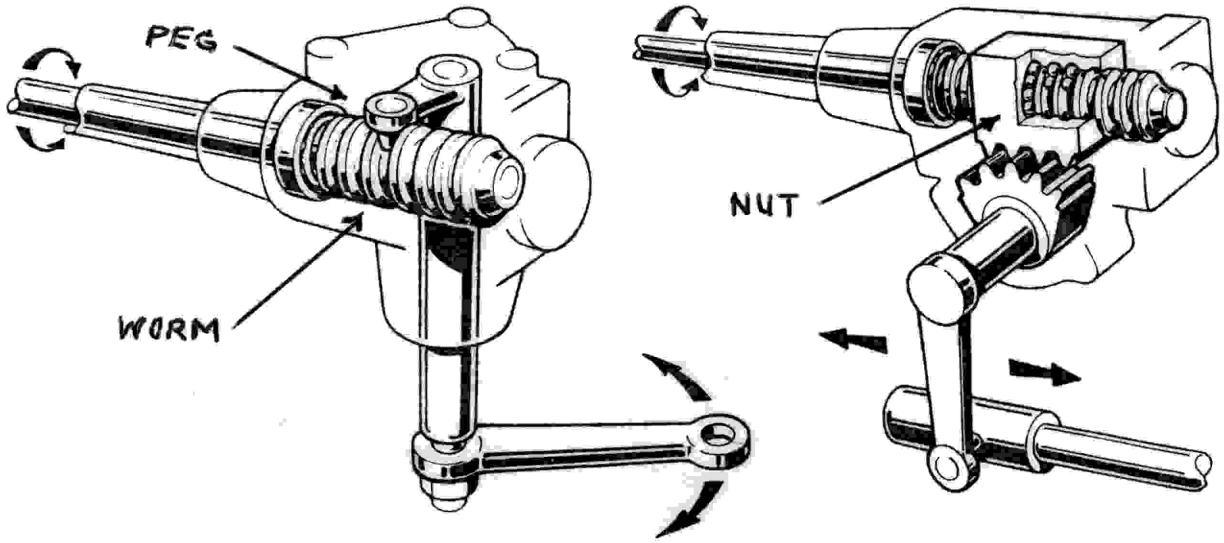
Some of the newer R&P systems have variable power assist, that is that they give little assist at first but increase the help as the driver turns the wheel more and more.

The next thing to happen to R&P steering is that the assist will be done by a built-in electric motor (see diagram). The motor will be controlled by a mini computer which will sense how fast the car is going before making a decision as to how much assist to give (more when parking, less at highway speeds).



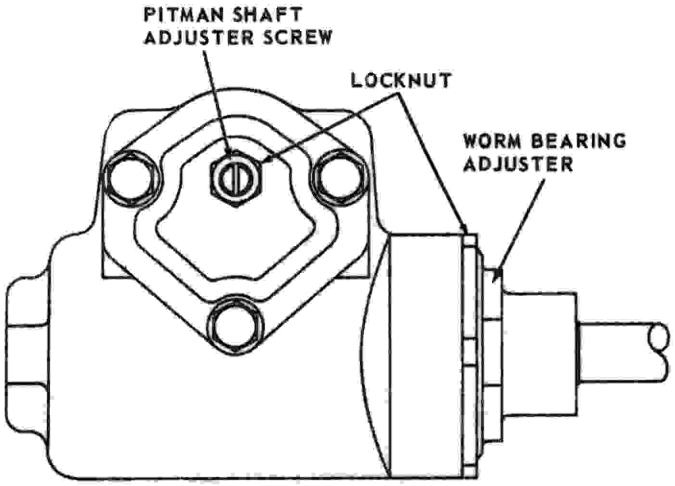
RACK AND PINION TYPE

MANUAL STEERING BOXES: These have developed from the early "worm and peg" which were heavy to turn, wore quickly needing frequent adjustment to the modern " recirculating ball and nut". The latter is easy to turn and is very strong due to the many ball bearings in the nut... ....little friction means little wear and adjustment.

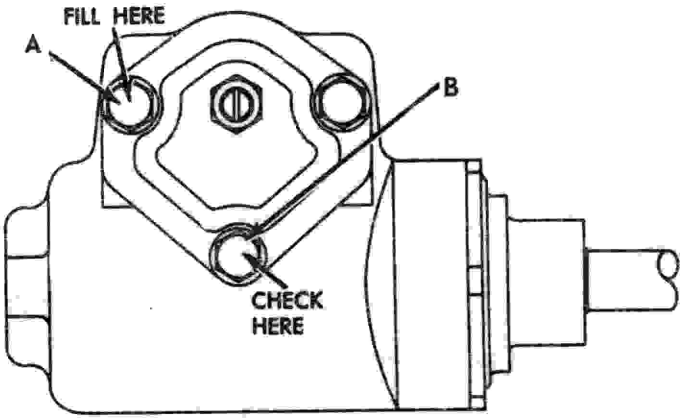


STEERING BOX ADJUSTMENT(General):

1. Raise front wheels off the ground (SAFETY STANDS!)
2. Turn front wheels to the straight ahead position.
3. Loosen steering box adjustment lock-nut, tighten the adjustment screw while helper moves the steering back and forth through the centre position. Tighten until helper feels a slight drag at the centre position.
4. Hold adjustment screw still and tighten lock-nut.
5. Check that the steering doesn't bind in centre and check the oil level in the box, add oil as necessary.



Loosen locknut and unscrew pitman shaft adjuster screw. (Chevrolet)



Remove gear cover fasteners to check and adjust lubricant level. (Chevrolet)

POWER STEERING: Originally only used on large, heavy vehicles to help the driver turn the steering. It is now found on most cars, especially those having rack and pinion steering and radial tires (think about it - why these two?) Power assist allows quicker steering ratios to used.

TYPES OF POWER ASSIST.

1. LINKAGE BOOSTER: Used with parallelogram steering, a hydraulic ram is attached to a bracket on the frame and the other end is attached to the centre link. The amount and direction of push is determined by the action of the Pitman arm end inside a control valve on the centre link. The steering box is an ordinary manual type full of heavy oil. The oil pressure is supplied by an engine-mounted pump and reservoir.
2. SEMI-INTEGRAL: The booster works as above, the difference is the location of the control valve. It is now located inside the steering box. The oil from the engine-mounted pump now lubricates the steering box as well as giving the power assist.
3. INTEGRAL (FULL POWER): The control valve and the ram are contained inside the steering box. Only the pump is external. The steering box is a very large version of the recirculating ball and nut type, the nut has a piston on either side. Oil pressure pushes the nut from side to side giving assist as needed, the oil lubricates the steering box.

NOTE: all the above steering systems have a fail-proof backup system in case of power failure, you can still steer but it will be very stiff/heavy.

LUBRICATION: As stated some use a heavy EP type of oil in the box and others rely upon the pump oil to lube the box. Older power steering systems used either type "F" or type "A" ATF oil, some of the newer cars now require a special power steering fluid, check the manual, be sure Watch some of the dipsticks - some have seperate marks for Hot and Cold readings.

POWER STEERING PUMPS: Most are vane type driven by Vee belt. For now consider them as non-serviceable units, go for rebuilt or new if any problems. An internal pressure-relief valve makes a loud "hiss" on full turns, this is normal, the pressure can go as high as 1000 psi !!!!

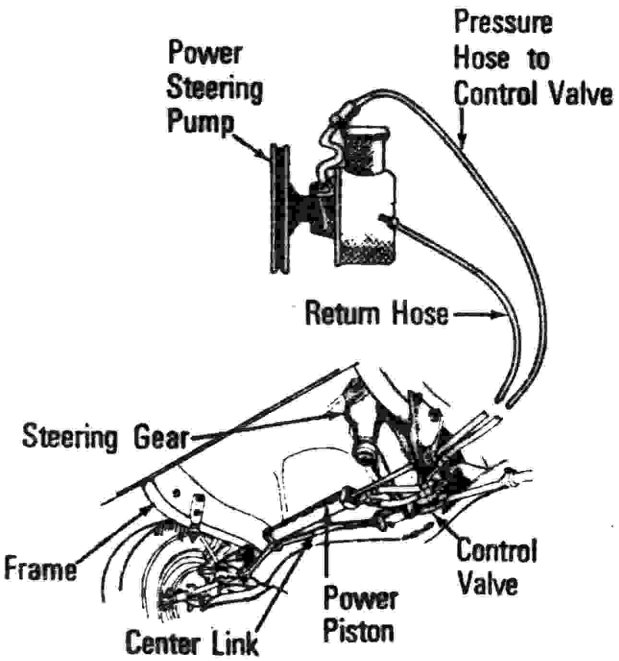
PROBLEMS:

"Squeal" on any turn -- Check for loose/worn belt.
"Squeal/Hiss" full turns -- Can be normal, check belt.
"Growling", heavy turns -- Check for low fluid level.
Steering wheel jerks -- Loose belt grabbing/slips.
Loss of oil -- Check hoses,seals,clamps.

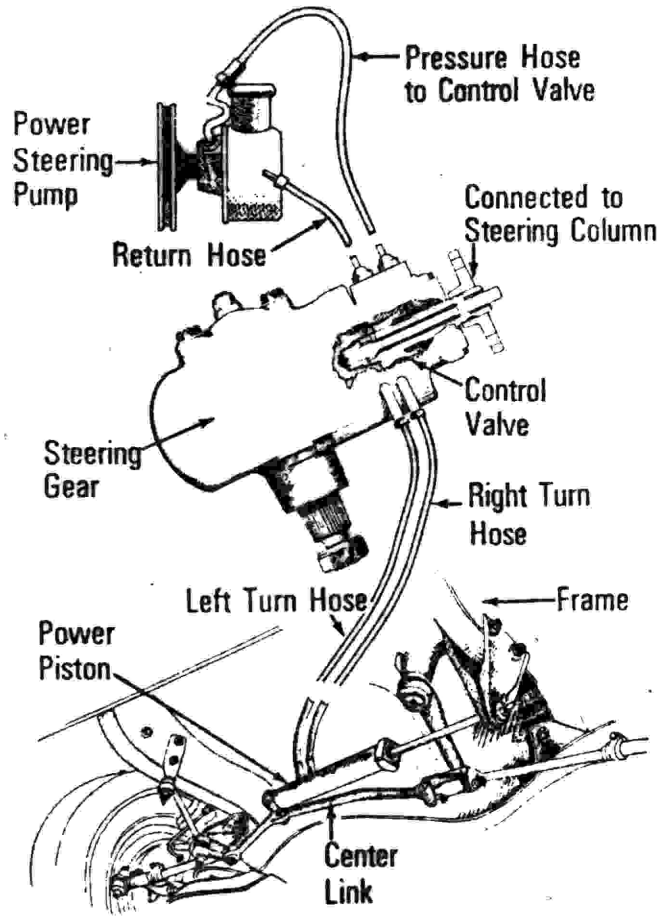
HYDRAULIC POWER STEERING

(ON PARALLELOGRAM STEERING)

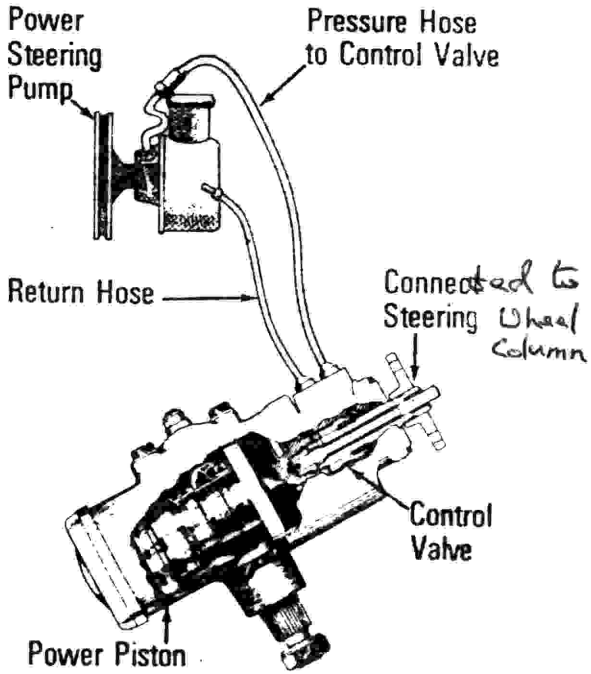
Linkage-Booster Power Steering System



Semi-Integral Power Steering System

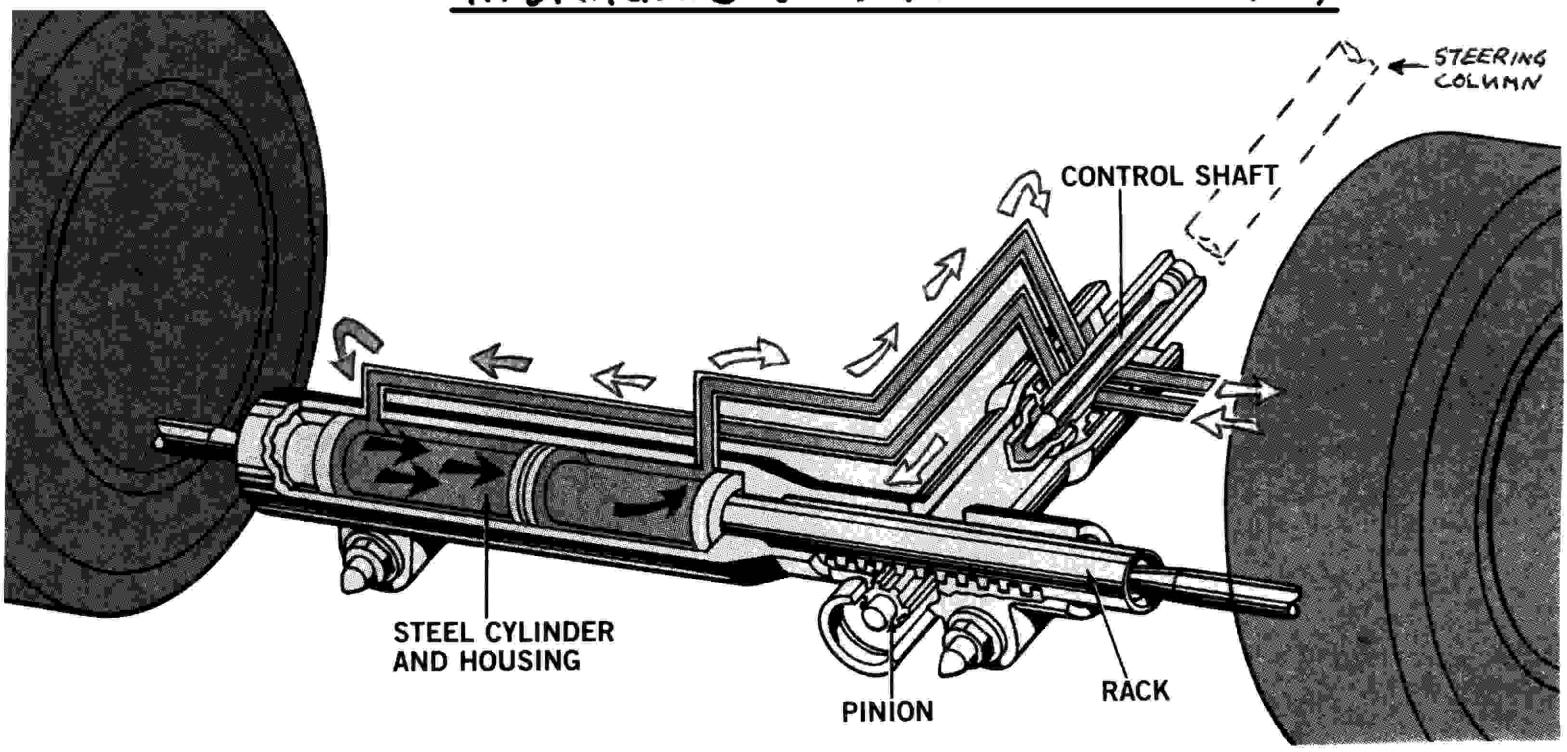


Integral Power Steering System



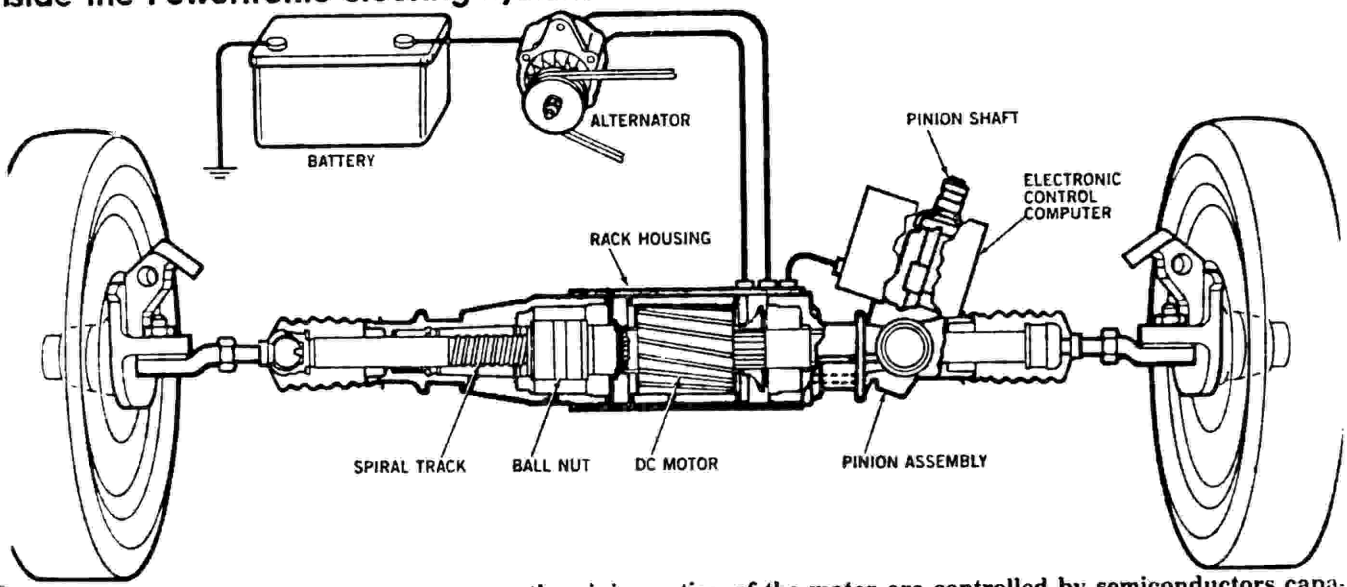
RACK AND PINION

HYDRAULIC (OIL) POWER STEERING



ELECTRONIC

Inside the Powertronic steering system



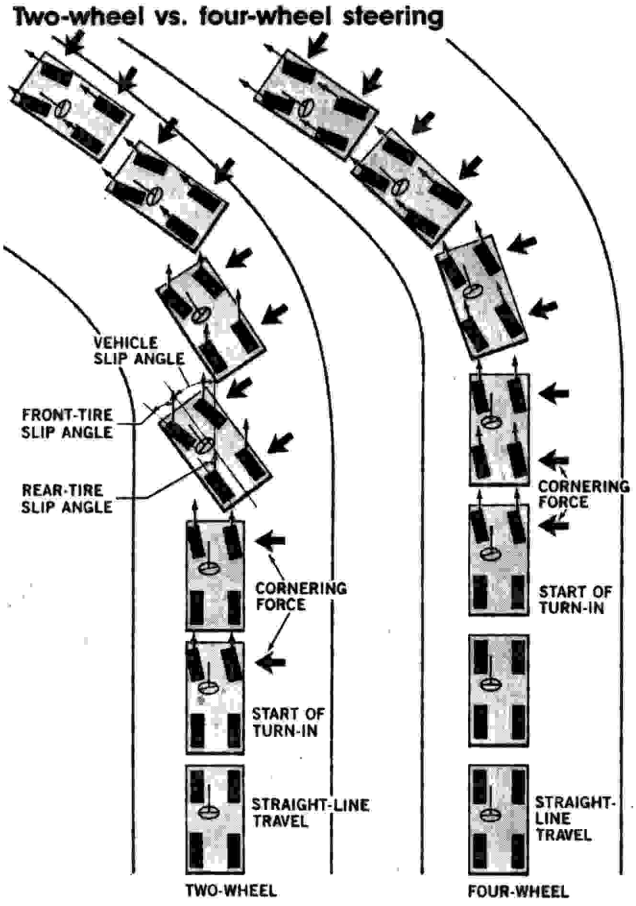
The TRW Powertronic system uses sensors on the pinion shaft to provide a computer with information on the steering wheel's movement. Assist is then supplied by a DC motor in the rack housing. The rack passes through the hollow armature of the motor; the armature's rotation moves the rack back and forth via a ball nut, a ball-bearing-filled gear that rides in a spiral track on the rack. Speed and direction of the motor are controlled by semiconductors capable of switching up to 75 amps. The rest of the system is similar to the hydraulic rack-and-pinion steering TRW also makes. The pinion gear rides in teeth on the sliding rack, allowing the driver to steer the car if the electrical system fails. Because it doesn't rely on a belt-driven pump, Powertronic will provide assist even with a stalled engine.

FOUR WHEEL STEERING:

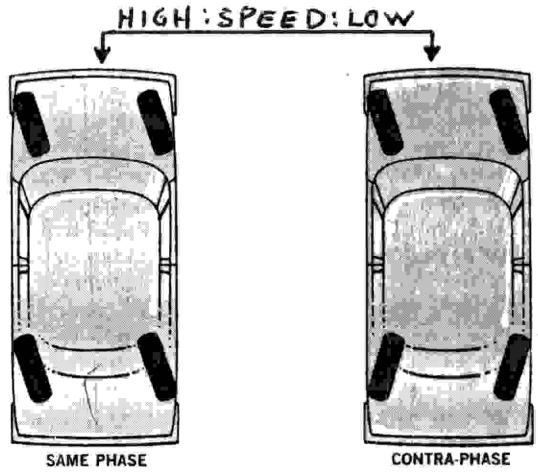
The latest technology in steering. The rear wheels can now be steered, not by the driver, but by a computer. When the car is moving very slowly the computer will turn the rear wheels in the opposite direction to the front wheels. This "Contra-phase" move makes the car turn very tightly - just the job for parking!

This would be dangerous at high speeds, so the computer is linked to the car's speedometer, and at high speeds the rear wheels turn in the same direction as the front wheels. This has the effect of improving the car's high speed cornering ability. You win all ways!

Should anything go wrong with the system the rear wheels will automatically return to the straight ahead position and the car will steer just like any other car.



The contribution of four-wheel steering to smooth cornering is demonstrated in these drawings. Note how much more tightly the maneuver is accomplished in the four-wheel-steering car. With only front-wheel steering (drawing at left), the rear end of the car swings to the right and the nose swings to the left. With four-wheel steering, the vehicle tracks straighter and feels more controllable.



Active four-wheel-steering system allows the rear wheels to steer in the same direction as the front wheels (same phase) for speed stability. For low-speed maneuvers, the rear wheels steer in the opposite direction of the front (contra-phase).