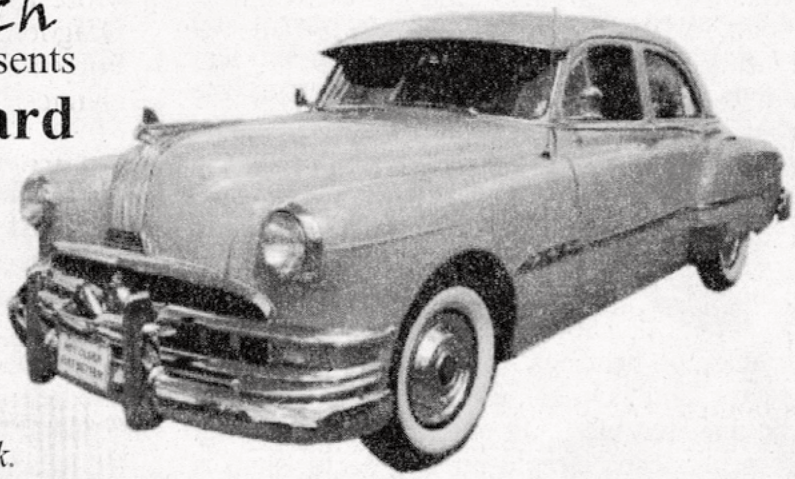
Orest Lazarowich
Presents

Looking Backward
but
Moving Forward

A Continuing Series focused on the Repair and Restoration of your old Car and Truck.



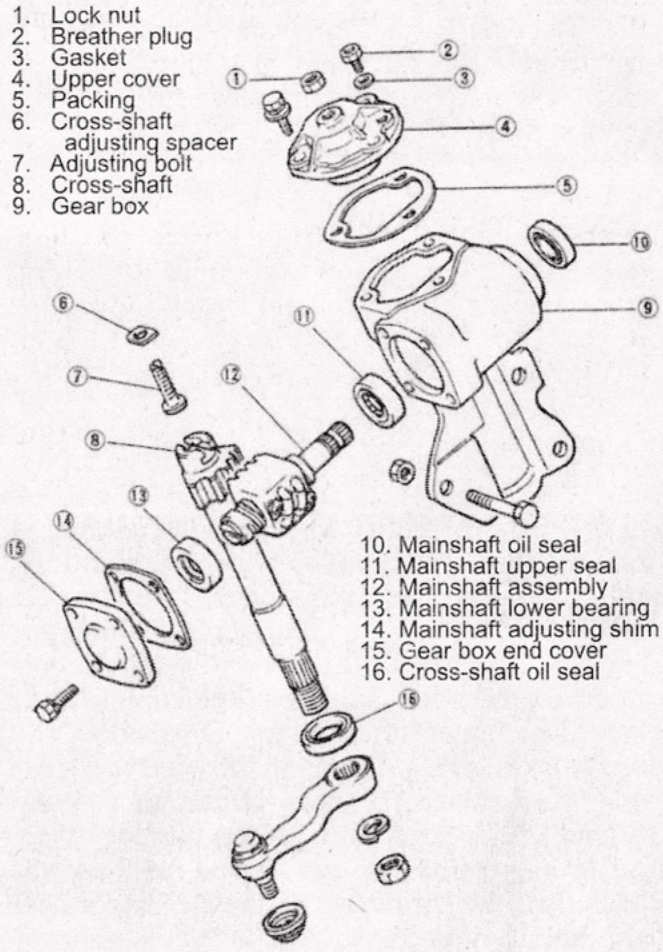
Rebuilding Manual Steering Gear Box

When you cannot keep your vehicle going straight on a roadway without making a lot of corrections at the steering wheel, and the rest of the steering gear is tight, the steering box needs adjustment or a rebuild. The cause of loose steering is gear wear and loose bearings (high mileage), lack of lubrication or neglecting mesh adjustments at the steering gear box. There are two adjustments: one adjusts the endplay in the wormshaft, the other adjusts excessive freeplay in the steering wheel. If you have made the necessary adjustments, and there is no change in road handling, the steering box has to be disassembled, and the parts checked for wear. Make sure the problem is not at a rag joint or universal joint on the steering shaft. The two most popular types of steering gear using a pitman arm are the worm and roller and recirculating ball nut.

There is a lot of work involved in removing either type of steering box, and they are both expensive to repair. Plan the repair according to what you can afford at the time. You can repair the gear box yourself or exchange the old gear box for a rebuilt one. Compare the cost of parts and the downtime if this vehicle is your daily driver. Check on the cost of a rebuilt exchange unit. See if you can find a low mileage steering box at an automotive recycler. Consider a donor steering box, and build one good one out of two. Either way you have to remove the old gear box.

Worm and Roller Steering Box

Gemmer built this type of steering box for many automotive manufacturers including Chrysler, DeSoto, Dodge, Ford, Hudson and oth-



ers.. Ford and General Motors (Saginaw) also built variations of this design. The worm and roller steering gear uses rolling friction and less effort is required to turn the steering wheel. The worm has an hourglass shape, smaller in the center than at the ends. This shape allows the roller to stay in better contact with the worm teeth at the ends of the worm. The double or triple tooth roller is mounted on bearings in a saddle at one end of the sector shaft. On some models the roller can not be disassembled. On others the shaft, roller and bearings can be replaced. The sector shaft is supported on bearings or bushings. Over time, the worm gear tends to wear in the center because the vehicle is usually pointed straight down the road and the worm doesn't wear much on the ends. This wear causes the freeplay in the steering wheel. If you remove all this freeplay the steering will jam in a tight turn and an accident could be the result. Ford and Chrysler automobiles used the Gemmer type of steering up to 1955 and Ford pickups were still using it up to 1960. Ford Thunderbirds 55-57 and Corvettes 53-62 also used the Gemmer type of steering. Parts are readily available, if you decide to go the rebuild route.

Removing the Gear Box

Power wash the steering gear box area. Read the service manual, and follow the procedures for your particular make and model of vehicle. On some vehicles you can disconnect the steering column (mast jacket) from the steering box, and remove the steering box from under the vehicle. On others you have to remove the steering box with the column because the column is pressed into the steering box housing. Read the service manual. The following is general information for removing a Gemmer style steering gear box out through the firewall with the column attached: raise the hood, and support it in place. Disconnect the battery. Disconnect the horn wire at the bottom of the steering gear housing. Remove the horn button or ring by pressing down and rotating it counterclockwise. The air bag era has not yet arrived for these vehicles. Lift the spring out of the steering wheel hub. Pull the horn wire and contact assembly out of the steering shaft. Disconnect the signal light wires at the junction block, if so equipped.

Before you remove the steering wheel check the alignment of the front wheels to the center point of the steering gear. If the front wheels are straight ahead and the steering spokes in the steering wheel are not tilted left or right, the steering gear alignment is okay. If the steering wheel is keyed to the steering shaft and the steering wheel spokes are even across but the front wheels are not in straight ahead position, the tie rod adjustment sleeves have to be moved. Loosen the clamps, and rotate both sleeves an equal amount to move the front wheels. The toe-in will remain the same. If the steering wheel is not keyed and can be moved, reposition the steering wheel.

Remove the steering wheel to give you more room in the vehicle. Loosen the steering wheel nut, and bring it up level with the steering shaft end. This will protect the threads on the steering shaft depending on the type of steering wheel puller you will use. If the steering wheel nut has been removed previously using a chisel, replace the nut. Look for a master spline that locates the steering wheel to the steering shaft. If there isn't one, use a small chisel to mark the position of the steering wheel to the steering shaft to position the steering wheel during assembly. Use a steering wheel puller, and remove the steering wheel. Remove the floor mat, and locate the two floor plates around the steering column. Remove the floor plates, and push the rubber gasket up the steering column.

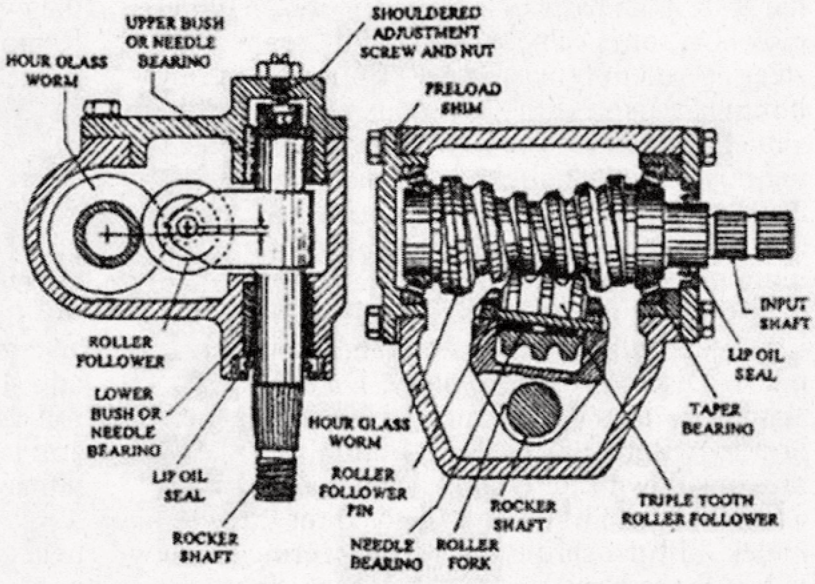
Raise the front of the vehicle on safety stands, and remove the left front wheel. Disconnect the drag link. The pitman arm nut is usually pretty tight. Clean any threads that are showing beyond the nut with a wire brush. Spray some rust buster on the threads. Use a breaker bar or an air wrench, if you have one. Hold the pitman arm shaft in place; do not force the pitman shaft roller against the worm gear. Remove the pitman arm nut and washer, and mark the position of the pitman arm to the pitman arm shaft with a chisel. The pitman arm fits on a tapered spline and is held solidly in place. Do not try to hammer the pitman arm off the shaft.

Rent a top quality pitman arm puller. A cheapie will not do the job. Install the puller and tighten it down as hard as you can. Use a BFH and hit the head of the puller bolt. This should crack it free. Tighten the puller and use the hammer again, if necessary. If the pitman arm is stuck, tight the use of a torch will help to remove it. Disconnect the transmission selection rods. Remove the bolts holding the steering box to the frame. Note the length of the bolts and where they fit. There may be alignment wedges between the steering box and the frame; mark their location with a scratch awl. Disconnect the bracket that holds the steering column to the dash. Note the number of shims on either side, if any. Move the steering gear box pitman arm shaft out of the frame. Rotate the gear box as you pull it up through the floor. Pay attention to the top of the steering shaft. Do not run it into the headliner.

Worm and Roller Steering Gear

Clean the outside of the steering box, if it is still dirty. Get in the habit of working on clean sub assemblies and learn to stay somewhat clean yourself. What about those mechanic's gloves? Clamp the steering box in a vise. Remove the steering column and then the felt washer on the steering shaft. Clean up the end of the pitman arm shaft that sticks out of the gear box with emery cloth. Remove the 4 bolts on the housing cover and pull out the pitman arm shaft and roller assembly. Remove the 4 bolts on the housing endplate and the wormshaft adjusting shims if any are left. Make sure the horn tube is tight to the endplate. If it is loose it will leak oil, Solder or braze it in place. Tap the upper end of the steering shaft with a plastic hammer to push out the bearing cup and race. Pull out the steering shaft and worm assembly. Wash all the parts. Do not waste your time examining the parts for wear. If you couldn't adjust the freeplay, the worm and roller are worn and have to be replaced. Clean the pitman arm shaft splines. The pitman arm shaft should have very little wear in the bushing/bearing area to prevent any leak past the bushings and seal. If wear is excessive, the seal will not keep the oil back. Replace the shaft. If you can't find a good used steering gear box, you have to consider a rebuilt one or rebuild your old one. Compare the price of the rebuilt against the price of parts before you start. Deal with a reliable parts source for a kit or a rebuilt unit.

To rebuild the steering box, remove the pitman arm bushings/bearings and the upper bearing cup. Wash out the steering box. Check for cracks. Run a flat file over the machined surfaces to remove any burrs that might cause a gasket leak. Use a bushing driver or the correct size socket to press in the new bushings. The pitman arm shaft should slide (0.001" clearance) in and not press in. Use a brake cylinder hone to enlarge the bushings, if the pitman arm shaft does not slide in. Wash out any grit. If you do not have the use of a hone, visit a machine shop that has a piston pin hone, and let them hone the bushings. Install the upper bearing cup. You need a grinder to remove the welds that hold the sector roller pin in the sector housing. After installing the new pin and roller, the new pin has to be spot welded in place. If you do not have the necessary equipment, have the pin removed/installed at the machine shop. To install the new worm gear, you have to press the old worm gear off and press the new gear on. Attempt this in your own shop only if you have a hydraulic press. The steering shaft is not hardened, and if you try to hammer the worm gear on, you can bend the shaft, which of course you can then straighten. Let the machine shop remove/replace the worm gear.



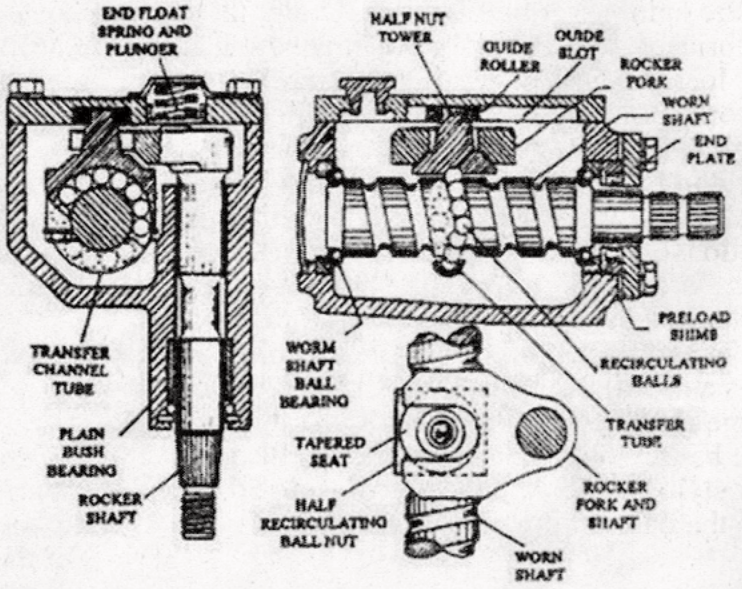
Bring the parts home. Clamp the steering box in the vise. Lubricate all the moving parts with 90W gear oil during assembly. Slide the upper bearing over the steering shaft. Fit the steering shaft into the gear box. Fit the lower bearing and cup to the worm gear. Install all the shims that come with the rebuild kit to the housing endplate, and test for bearing endplay by turning the steering shaft. The worm shaft should be free to turn with no drag, and there should not be any endplay. Add/subtract shims as necessary. Turn the worm gear so you can insert the sector shaft with adjuster screw and plate into the steering box. Install the housing cover and gasket. Thread the adjuster screw through the housing cover. Tighten the cover bolts. Adjust the screw until there is a slight amount of play at the end of the pitman arm shaft. Do not tighten it too much. Snap a vise grip on the steering shaft, and count the number of turns from lock to lock. Count back half way. This is center position, and there should be a light drag so that the steering wheel stays straight as you drive on the straight away. Readjust, if necessary. Install the star washer and lock nut. Use a proper sized pipe, and install the pitman arm shaft seal. Coat the outside of the seal with sealer. Install the felt washer on the steering shaft, and slide the steering column in place. Tighten the pinch bolt. Paint the steering box gloss black. Fill with 90W gear oil.

Reinstalling Gear Box

If you are installing an exchange gear box, check it for oil. Do NOT assume it has oil in it. Slide the gear box through the firewall. Turn the steering assembly to align the pitman arm shaft with the hole in the frame. Fit the bolts in place, and locate any wedges between the gear box and the frame. Snug the bolts down, but do not tighten them. Attach the bracket and any shims at the steering column to the dash. The steering gear box must align with the column and the dash bracket. Move the steering gear box until the column is aligned. Tighten the bolts. Align the steering wheel hub to the steering shaft. Torque the steering wheel nut 40-45 foot pounds. Install the spring and the horn contact assembly. Slide the horn wire into the steering shaft. Position the horn button or ring on the steering wheel. Connect the signal light wires. Connect the horn wire. Align the pitman arm to the pitman shaft. Install the washer and the nut. Hold the pitman arm from moving, and tighten the nut as tight as you can. Torque on this nut is 150 ft/lbs. Connect and adjust the drag link. Connect the transmission rods. Bolt the wheel in place. Lower the vehicle. Road test. Happy motoring.

Recirculating-ball Nut Steering

In this type of steering the ball nut is mounted on the wormshaft and moves by means of ball bearings which circulate in helical grooves in both the wormshaft and ball nut. Ball return guides attached to the nut recirculate two sets of ball bearings in the grooves. As the steering wheel is turned to the right, the ball nut moves upward. When the wheel is turned to the left, the ball nut moves downward. The sector teeth on the pitman shaft and the ball nut are designed so that they fit the tightest when the steering wheel is straight ahead. This mesh action is adjusted by an adjusting screw which moves the pitman shaft endwise until the teeth mesh properly. The worm bearing adjuster sets the preload and endplay of the upper and lower wormshaft bearings. If the pitman shaft adjustment does not correct steering wheel freeplay, the steering gear



box must be removed and the inner parts checked for wear and/or damage. This would also be the best time to correct any lubricant leakage at the seals or gaskets.

Power wash the steering gear box work area at the car wash before you remove it. This procedure is for a Saginaw steering gear used by General Motors and other manufacturers during the '60s and '70s. The steering gear box is connected to the steering gear shaft by a rag joint. The steering gear box is removed from under the hood. Raise the hood and prop it up. Disconnect the rag joint from the steering shaft. Raise the front of the vehicle on safety stands. Remove the left wheel. Remove the pitman arm retaining nut. You need a breaker bar or an impact wrench. Remove the pitman arm. Remove the bolts that hold the steering gear box to the frame.

Remove the gear box to your work bench. Clean the outside of the gear box. Work in a clean work bench space. Remove the rag joint pinch bolt and remove the coupling from the end of the wormshaft. Remove the three bolts that hold the side cover. Remove the lock nut from the lash adjusting screw. Turn the lash adjusting stud to back off the side cover. Use emery cloth, and clean the exposed end of the pitman shaft. You may have to turn the wormshaft to line up the pitman shaft gear with the opening in the gear box so you can remove it. Drive the pitman shaft out of the box using a plastic hammer or brass punch. Drain out the old lubricant. Loosen bottom worm bearing adjuster locknut. Screw out the adjuster. Pull out the wormshaft and ball nut. Keep the ball nut in the center of the wormshaft to prevent damage to the ball guides. If the ball nut is free to rotate on the worm with no binding or tightness, do NOT take it apart. However, if there is binding or tightness, the unit should be disassembled, cleaned and inspected. Work over a flat pan and remove the ball guide clamp, ball guides and ball bearings. Check ball guides for damage at the ends where they deflect or pick up the balls. Count the number of ball bearings. Older style has 54, and the newer style 50. Remove the ball nut off the wormshaft.

Remove the wormshaft and pitman shaft seals using a seal puller or large screwdriver. Drive out the upper worm bearing race. If this steering has not been worked on before, there is a bearing retainer on the lower worm bearing. Remove the retainer and the bearing. There is no retainer on the new bearing because the bearing is between the wormshaft and the worm bearing adjuster. Use a slide hammer to remove the old bearing cup. Wash all the parts in solvent and then rinse in clean solvent. Blow dry with an air hose or wipe with a clean cloth. Inspect the wormshaft and pitman shaft gear for pitting, chipping and wear. Check the fit of the pitman shaft in the housing bushings. About 0.001" is allowed. Replace the pitman shaft bushing(s) if they are worn. There is a bushing in the side cover that supports the pitman shaft. This bushing has to be ordered separately. Use a magnifying glass and inspect the ball bearings, bearing cups, worm and nut grooves. Inspect the separate ball bearings for any signs of surface breakdown. Check the clearance of the lash adjuster shim in the pitman shaft. It should not be greater than 0.002". Shim packs with different thicknesses of shims are available to set this clearance. Check the steering gear box for cracks.

Many types of rebuild kits are available. If the surfaces of the ball bearings, sector teeth on the pitman shaft, the helical grooves in the wormshaft and ball nut are slightly worn but not damaged, order a minor rebuild kit. Quote the housing casting number and order a kit that contains the worm bearings, pitman shaft bushings, seals and gasket. If the wormshaft, ball nut or pitman shaft are pitted or severely worn, they have to be replaced. Check the cost of a rebuilt exchange unit. Seek out a similar steering box on a low mileage vehicle at an auto parts recycler. It might be cheaper. Deal with a reputable company.

Repairs

Press out the sector shaft bushing. Check the length of the old bushing against the bushing supplied in the kit. The kit bushing maybe long because the kit fits may different steering gears. Cut the bushing to the proper length with a hack-

saw and clean up the cut edges with emery cloth. Press the new bushing into position using a bushing driver or a proper size socket. Check the fit of the pitman shaft in the bushing. Service bushings are bored to size. Press in the pitman shaft and wormshaft seal. Press new bearing cups into the steering gear box and the worm bearing adjuster. Place the ball nut on the wormshaft with the ball guide holes up and the shallow end of the rack teeth to the left from the steering wheel position. If you put the ball nut in wrong, the pitman shaft will not seat fully. Feed the balls into the openings. Lift one end of the wormshaft so that the balls can travel all the way down the threads. Pour a bit of 90W gear oil into each of the openings. Reposition the guides before placing the last few balls in each thread. Secure the guides with the retainer and screws. Check the assembly by rotating the nut on the worm to see that it moves freely.

On reassembly use an oil resistant sealer such as Permatex 2 to prevent leakage of lubricant. Coat the threads of the adjuster, side cover bolts, lash adjuster and gasket with the sealer. Grease the upper worm bearing and slide it over the wormshaft. Insert the wormshaft and ball-nut assembly into the steering gear housing. Locate the worm bearing adjuster lock nut on the worm bearing adjuster. Grease the lower bearing and place it in the adjuster cup. Center the ball nut and tighten the worm bearing adjuster until there is no endplay. Slip an 11/16" 12 point socket over the end of the wormshaft. Use an adapter to fit an inch-pound torque wrench to the socket. Turn the wormshaft back and forth as you tighten the worm adjuster. When the torque wrench registers 5 to 8 inch-pounds, tighten the locking nut. Do not move the worm adjuster. Recheck torque. Center the ball-nut in the steering gear housing opening.

Before you install the pitman shaft in the housing, check the gap between the end of the lash adjuster and the channel on the top of the shaft. It should be 0.002" or less. Adjust with thicker shims. Grease the pitman shaft sector gear and insert the pitman shaft into the steering gear housing. Apply sealer to the side cover gasket and threads of the adjuster. Thread the adjuster through the side cover, and when it is seated, tighten the 3 bolts to 35 ft/lbs. Install the lash-adjuster nut but do not tighten it in place. The worm and sector gears are designed so the interface is the tightest when the vehicle is traveling straight down the road. You must center the pitman shaft before adjusting the steering wheel free play. Turn the lash adjuster screw until there is a reading between 10-14 inch-pounds as you rotate the wormshaft through the center position. When the setting is correct, tighten the lash adjuster locknut while holding the adjuster in place with a screwdriver. Install the rag joint coupling on the wormshaft. Reinstall the steering box.

Place the steering gear in position and guide the rag joint into the steering shaft flange. Install the pinch bolt, torque 24 ft./lbs. Line up the steering gear to the frame and torque the bolts 70 ft./lbs. Line up the alignment marks and install the pitman arm onto the pitman shaft. Torque the pitman shaft nut to 185 ft./lbs. Connect the drag link. Locate and remove the 'check lube' bolt on the side housing cover. Add 90W gear lube through the bolt hole until it just starts to leak out. Attach the wheel and lower the vehicle. Check the fluid level and the lash adjustment after the vehicle has been driven a few hundred miles. Remember the lash adjustment must be checked with the front wheels in the straight ahead position. Happy motoring.

S.K.

NEXT MONTH
Rear Suspension