Note. Major changes and/or additions are in boldface font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

************ GEARS *************

Revised April 30, 2009

******************** TRANSMISSION ********************

DIRECTIONS OF SHIFTING FORK SLOTS: During a rebuild of a '39 and newer transmission, the shifting fork's groove on the low/reverse sliding gear goes towards the rear of the transmission. The direction the second/high synchronizing drum goes is more difficult to explain. The shifting fork's slot for the synchronizer drum is located slightly off the drums mid-point. The longer side of the shifting drum goes towards the front of the transmission. The synchro drum on '38 and older transmissions had the shifting fork slot centered. See IDENTIFICATION OF GEARS further on in this section.

Fork direction: The forks in a floor shift are secured to their shift rail by expanded pins (like a long rivet). These forks can only be mixed-up if the top is dismantled. Record which direction they face before taking the top apart.

However, the shifting forks in a column shift trans simply drop into the shift cover's two selector cams and can easily be mixed-up. The second/high shifting forks pin is centered..... so it makes no difference which direction the fork faces. But the low/reverse (L/R) fork can be installed two different ways. The fork part of the shifting fork is offset from its pin. The side of the fork with the offset goes towards the rear of the trans (this positions the fork's shifting pin directly over the gear teeth on the L/R gear). An easy check to verify these are positioned correctly in column shift transmissions is to put the trans shifting cover in neutral (both balls in their rail's middle detent) and lay the trans on it's side with both the shifting drum and L/R slider gear in neutral. Drop the shift forks into the synchro drum and the L/R sliding gear. Lean both pins of the forks against the lower edge of the shift cover opening. Install the shift cover by directing the fork pins into the cover's selector cams receivers. If everything is correct the cover will slip on easily.

TRANSMISSION POPS OUT OF SECOND GEAR UNDER COMPRESSION: Several things can cause this. I'm assuming the case, top, and forks are not sprung, tweaked, or bent.

(#1) Add an additional rail detent in floor shift transmissions only: Two transmission tops are needed..... a '37-'38 and a '39. Remove the shift rails etc. from a '39 and also from a '37-'38 transmission top. The '38 trans top uses a spring and two short dowel pins with ball shaped ends for the two rails. The ball shaped ends are always engaged in one of the three detents machined in the inside of each shift rail. We need the spring and both dowel pins. The center spring has a stock length of 1.485".

The '39 floor shift top has two flat screw plugs located on opposite sides of the shift tower. Behind each of these plugs is a steel ball and a spring. These engage detents in the outside of the two shift rails. Each of the two steel balls are always engaged in a detent. There is a passageway in the trans top between the two rails that houses a roller type spacer to prevent shifting into two gears at one time. During tear down, remove the roller type spacer in this passageway.... we'll not be using it. The '39 top will use the center spring and two dowels from the '38 in addition to the '39 top's two steel balls and springs.

Stretch the ‘38 center spring to 1.540" length. On both shift rails from the ‘39 top, locate and grind new detents 180 degrees (to be on the inside of each rail) from the original detents located on the outside of the rails. These new detents are to be spaced *exactly* the same as the original ‘39 detents. Check the depth of the detents closely while grinding. CAUTION: Do not grind these detents deeper than the stock detents on the ‘39 rails. This will make the shifter hang up in gear. It’s better to grind them a little shallow to prevent this.

Assembly: The original ‘39 springs and steel balls go back in their original locations. The stretched ‘38 center spring and the dowel pins go in the top between the two ‘39 rails and into the newly ground detents. The remaining assembly is the opposite of tear down. When done, the top will have detents both on the inside and outside of each of the two ‘39 shift rails.

(#2) Excessive end-play: Check the end-play between the mainshaft’s thrust washer type spacer and second gear. This tolerance is 0.004" to 0.008". Add or make a washer type shim spacer to correct.

(#3) Shifting drum: The shape and condition of the engaging teeth on the inside of the synchronizing shifting drum must be wedge shaped in order to engage both the MDG and second gear smoothly and completely. Often the sharp ends of the teeth are worn flat or worn back over half way which prevents engaging second gear correctly. If the sharp ends of the teeth are worn, they need replacing.

GRINDS WHEN SHIFTING INTO SECOND OR HIGH: I’m assuming the clutch is good and adjusted correctly with about 1” free play in the pedal.

Grinding is usually caused by worn brass synchronizer rings rather than the gears. Checking brass synchronizing rings to determine if they’re good. The purpose of these rings is to grip the taper on the selected gear (the gear you’re shifting into) tight enough to assist the synchro drum meshing with the engaging teeth on the MDG and second gear. There are multiple tiny grooves machined around the inside of these synchro rings. When new, these feel sharp to your fingers. They become worn and dull from use. Lack of sharpness doesn’t necessarily mean they’re junk, but it does mean they’re nearly worn out. Another check is done by measuring the distance between the brass synchro and the gear teeth on a MDG or second gear using a feeler gauge. If this gap is less than 0.020", the synchro is worn out. But the best test I think is to place them on the MDG or second gear and push them against the gear while trying to rotate the brass ring. They should friction-lock tightly on the tapered shoulder of the gear. If they don’t lock tight, the synchro ring is shot and needs replacing.

Grinding can be caused by worn teeth in the synchro drum, which engages the second and high gears. These have wedge shaped ends and are on both inside ends of the synchro drum. Also verify the teeth on the MDG and second gears are not worn excessively. [See preceding #3 for more information and possible corrective grinding.]

IDENTIFICATION OF TRANSMISSION GEARS: The ‘32 thru mid-‘35 had spur (straight) cut teeth on low/reverse gears. The cluster gear had both straight and helical cut gears depending on what type of teeth they mesh with. These transmissions used straight cut splines on the mainshaft (the low/reverse gear slid back and forth on these splines on the mainshaft) and is the main difference between a ‘34 and ‘36 transmission. The synchronizing drum had a lip at only one end. This lip is to be installed towards the rear. The synchro drum was 1.406" wide. The synchronizers were minimal and pause shifting (pausing momentarily in neutral) was the rule of the day when shifting into a higher gear.

From mid-‘35 thru ‘38 there were only a couple of main changes as far as I can recall. All of trans gears were helical cut which made low and reverse gears stronger as well as being a lot quieter in low and reverse. The mainshaft was changed to spiral cut splines for the newer low/reverse gear to slide back and forth on which improved low gear shifting. The synchronizing drum had the shifting slot in the center of the drum. There is a slight lip on one end of the earlier synchro hubs.... it’s to be installed towards the rear. The width of this drum was changed to 1.345". Pause shifting still ruled.

Beginning in ‘39, second gear and the MDG were changed to work with a new and improved synchronizer assembly. The second/high synchronizer clutch hub, brass synchronizers, and shifting drum were improved considerably and are different than pre-’39. The synchro drum is bigger and is now directional during assembly. The brass synchros are larger. The synchro clutch hub is different, but retains the same miserable ball/springs design the earlier transmissions used. The complete synchronizer drum assembly interchanges from ‘39 through ‘53 (column and floor shifters <u>will</u> interchange)..... just be sure to match the width of the slots in the brass synchro rings with the width of the slots in the synchro clutch hub. About ‘46 they replaced the miserable springs and balls in the synchronizing assembly with flat steel plates.... a HUGE improvement in my book.

CLUSTER GEAR AND MAIN DRIVE GEAR BEARINGS: Needle bearings. The ‘49 and newer Fords, as well as Mercs beginning in ’51, came with loose needle bearings (not caged bearings) in both the Main Drive Gear (MDG) and cluster gear. Some heavy wheel bearing grease will help hold the loose MDG needle bearings inside the MDG during assembly. Keeping loose needles in place in a cluster gear requires a different strategy because it gets rattled around during assembly which causes the small needles to fall out of place. Installing a cluster with needles is a lot easier if a dummy shaft is used in conjunction with heavy grease. Fabricate a dummy cluster shaft by shortening an old cluster gear shaft to 6¼". Then grind down the outside diameter to about 0.740" or so. It doesn’t have to be smooth.... rough grinding will work. It has to be small enough to <u>be pushed easily</u> through the cluster gear shaft’s hole in the front of the case. Coat the inside of the cluster gear with a big glob of heavy grease. Insert the dummy shaft and install the metal spacer. Then a needle bearing retaining washer on each side of the metal spacer. Install the needle bearings around the dummy shaft (use a small electrician’s screwdriver to help line them up and spread them apart). When the needles are all installed around both ends of the dummy cluster shaft, put a needle bearing retaining washer at each end to help keep the bearings in place. Smear some more grease to hold things together. Grease the cluster gear’s two bronze washers and stick them on the cluster gear. Leave the dummy shaft in the cluster and lay the cluster in the bottom of the case. Add the steel thrust washer between the rear bronze washer and the case. Leave the cluster gear laying in the bottom of the case while you finish assembling the other gears. After all the rest of the gears and shafts are in the case, lift up the cluster gear and line up the washers and the cluster gears hole in the case. When everything is aligned, install the cluster gear’s shaft from the rear towards the front. Then push the dummy shaft out towards the front.

Caged bearings: All Ford/Merc/Lincoln cluster gears and MDG through ‘48 used caged needle bearings. The ‘49-’50 Mercs also had caged bearings in both the MDG and the cluster. There are two different lengths of caged bearings (two short and one long). The longer one goes at the rear of the cluster, a short one goes in the front of the cluster gear, and the remaining short one goes inside the MDG.

(From rodnut 1/30/03. Do not use new caged bearings sold by Ford repro parts dealers. The end plates holding the needles come apart eventually. Use only NOS or excellent used ones.)

REAR TRANSMISSION BEARINGS FOR ’48 AND OLDER: Using a bearing with a seal on one side will help prevent lubricants from leaking in or out of the transmission. The rear main shaft bearing which features a seal on one side is part #6306-ZZ/C3.

INTERCHANGING CLUSTER AND MAIN DRIVE GEARS ‘39 THROUGH ‘50: Both ‘49-’50 Ford and Merc cluster gears and MDG interchange with ‘39 through ‘48 parts. Keep in mind the different diameters of MDG clutch splines when using different years. Use the correct cluster gear bearings, spacers, and bronze washers. Be sure to match the number of teeth on the MDG with the correct number of teeth on the cluster gear as noted below. These combinations HAVE to be as shown. Mixing the gears causes either too much or not enough play between the meshing teeth and will cause the gears to fail quickly. There isn’t any interchange with the ‘51 and newer gears.

Early transmission gears and ratios prior to 1951 Ford/Merc:

25 tooth Lincoln-Zephyr has 19t MDG, 24t second, 29t LR slider, cluster has 25t-22t-18t-14t. Gear ratios are 2.12:1 first gear and 1.44:1 second gear.

26 tooth Lincoln-Zephyr has 18t MDG, 24t second, 29t LR slider, cluster has 26t-22t-18t-14t. Gear ratios are 2.33:1 first gear and 1.58:1 second gear.

28 tooth Ford & Mercury has 16t MDG, 22t second, 29t LR slider, cluster has 28t-24t-18t-14t. Gear ratios are 2.82:1 first gear and 1.60 second gear.

29 tooth Ford & Mercury has 15t MDG, 22t second, 29t LR slider, cluster has 29t-24t-18t-14t. Gear ratios are 3.11:1 first gear and 1.77:1 second gear.

OVERDRIVE TRANSMISSION PARTS: There are no differences between the transmission gears used in an overdrive transmission and a standard transmission (providing they’re the same year). The one exception is the main shaft the L/R slides on. This is obvious since the standard trans is considerably longer than the overdrive (it only extends to the front of the overdrive while the standard extends to the front U-joint yoke). Just stick with the same year and you’ll be OK.

TRANSMISSION PARTS DIFFERENCES: Shift forks: The ‘39-’48 second/high shift fork is wider and has a different offset than a ‘37-‘38. These must match with the width of the second/high synchronizer drum assemblies and won’t interchange. Grinding the sides of a ‘38 shift fork to fit a ‘39 or newer synchro assembly won’t work due to the ‘38 having a slightly offset fork which moves the shifting drum too far forward against the main drive gear and not far enough towards the rear into second gear. This causes grinding noises and the trans will fly out of second gear under <u>both</u> power and compression.

Synchro assemblies: The ‘39 changed synchronizing assemblies and are superior to the earlier ones. The ‘39 synchro assemblies won’t interchange with the ‘38 and older units. Just be sure the second/high shifting fork matches the synchronizer drum assembly (‘38 and older or ‘39 and newer) and you’ll be okay.

MDG & second gears: The MDG and second gears were changed beginning in ‘39 and will not interchange with ‘38 and older. The ‘38 and older MDG and second gear can be identified by their narrow synchronizer band. It’s about half as wide as a ‘39. This narrower band does not extend to the gear teeth like the ‘39 and newer do.

The L/R slider gears are all the same (22t) for ‘39-‘48 transmissions. The exception is the Lincoln L/R gears (24t). The reverse/idler gear is the same for all ‘39-’48 Ford/Mercs/Lincolns.

The L/R slider gear for ‘51-’53 (28t) are different and will not interchange with the earlier L/R gears. The reverse/idler gear (17t) is different for ‘51-’53 and will not interchange with the ‘39-’48 units.

1951 THROUGH 1953 CAR AND PICKUP TRANSMISSIONS: Beginning with the ‘51 Ford/Merc all of the transmission gears were changed and have a tooth configuration of “diamond” or “chisel” shape. This was done to increase their strength. The car trans cases were all 4 bolt square front. None of the gears will interchange with pre-’51 gears. The ‘51 mainshaft’s spiral gear teeth (the low/reverse gear slides back and forth on the spiral gear) has a slightly different twist than ‘50 and older transmissions. This prevents interchanging low/reverse sliding gears with early ones. These ‘51 up transmissions can easily be identified by their diamond (or chisel) shaped teeth. The ’51 and newer MDG can be easily identified by the machined groove just in front of the MDG bearing. Most ‘51 and newer pickup 3 speed transmissions came with the MDG having the early type large diameter clutch spline.

Transmission gears and ratios for ‘51 thru ‘53 Ford and Mercs: 27 tooth Ford/Merc has 16t MDG, 22t second, 28t LR slider, cluster has 27t-23t-17t-14t. Gear ratios are 2.78:1 first gear and 1.61:1 second gear.

UNIQUE CLUTCH BELL HOUSING AND THROW-OUT BEARING FOR EARLY ‘51 MERCS. These are different than any other Merc or Ford clutch/throwout bearing arrangements. The front of the trans cases are the same for all ‘51 -’53 Ford/Merc transmissions (square bolt pattern). No problem there.

In ‘49, Ford changed to a stamped steel fork to operate the throw-out bearing. This stamped steel fork extended through the stamped bell housing. One end of the plate is the fork which engages the throw-out bearing collar. The other end of this steel plate is outside the bell housing and is moved rearward by the clutch pedal mechanism to disengage the clutch. The pivot for the stamped plate is inside the bell housing. It changes plate direction for clutch pedal operation. They also changed to a smaller size throw-out bearing and collar because of their new smaller diameter MDG clutch spline.

But the Mercs didn’t change in ‘49. Instead they elected to stick with the same mechanism as was used so successfully on the ‘48 and earlier Ford/Merc cars. A round shaft extends through the cast transmission case’s bell housing to the throw-out bearing fork. The throw-out bearing fork is pinned on the round shaft. The other end of the round shaft is outside the trans case and has a pinned lever which is pushed forward by the clutch pedal mechanism to disengage the clutch. They also stayed with the larger MDG clutch spline and earlier throw-out bearing.

In 1951 when Ford decided to change the Merc's to the same transmission arrangement the Ford line had been using beginning in '49, the engineers blew it big time. They forgot the difference in the clutch actuating mechanisms. I think they figured they'd just use a Ford stamped steel bell housing to mate the engine and trans together. Then they'd use the Ford stamped steel throwout bearing actuating plate. No problem... or so they thought.

The clutch operating mechanism problem became evident when production of '51 Mercs came up the assembly line. An immediate design change had to be made in the Merc's clutch actuating system in the car (not in the bell housing). But design and setting up automated machining would take time and delay production for some time. Solution? It was relatively easy to cast some bell housings using the early Merc's clutch shaft system but with the newer square transmission bolt pattern. Oh yeah... they had to come up with a different throw-out bearing and collar design too. These changes came only in the very early '51 Mercs and are very rare today. The throw-out bearings are probably still available since they're a bearing, but I'm sure the collars aren't available from any source... new or used. You might want to keep these differences in mind if you're building an early '51 Merc for competition. Of course you always have the option of going to an early '49-'50 Merc...... unless you'll be entering your Merc for concourse judging.

TRANSMISSION ALIGNMENT STUDS: Stabbing a trans into a '49 and newer Ford is tough since there is no center X-member to take the weight while we rest our arms. Consequently, the transmission's weight ends up prying on the clutch disc and often times damaging it. Use two headless cap screws on the two bottom bolt locations in the bell housing. These will support the trans weight and save your arms and your new clutch disc. Just cut the heads off two 3/8" cap screws with NC threads (16 threads per inch) that are 3-3/4" long. They really help. (Tip. I made two smaller ones for my '39 flathead trans. Sure helps this weak old man!)

TRANSMISSION ADAPTERS FOR T-5 OR CHEV S-10 5 SPEED TO AN 8BA: For an adaptor and other specific information contact;

Cornhusker Rod and Custom, Inc.
Dept. RC11
RR1, Box 47
Alexandria, NE 68303 (402)-749-1932

CAD/LA SALLE TRANSMISSION TO A 59AB ENGINE: Use the Cad/LaSalle gear box, a Cad/LaSalle clutch disc, a 59AB Ford pressure plate, a Cad/LaSalle pilot bushing, a Ford throwout bearing, and a Ford flywheel. Flame cut an adaptor from 1/2" steel to adapt the two different bolt hole patterns. Strength of these old LaSalle boxes is the same as the newer Borg-Warner T-10.

************************* GEAR OIL & LEAKS **********************

GEAR OIL/GREASE: Borg-Warner (B-W) manufactured the '49-'53 transmission overdrives. They recommend 30 wt <u>engine oil</u> for lubrication!! Not in my transmission! This may be best for their overdrive, but will surely eat transmissions in hot weather and under hard use. I've used EP-90 gear lube year round in my '66 Ranchero for the past 470,000 miles with not one overdrive gear related problem. In all flathead transmissions with no overdrive, I stick with

EP-90 year round. In rear ends, I follow Henry's recommendations and run straight weight EP-140 in the summer if I'm taking a long trip. Other than that, I just use EP-90 gear lube.

Oil leak areas are where the different cases of a transmission bolt together. This is especially true in an overdrive trans due mostly to Victor brand rebuild gaskets being very thin. Next time try making gaskets out of a grocery paper sack. The sack paper is about twice as thick as the stock gasket and helps seal things up. (From rodnut on 1/30/03. "Go to NAPA and get proper gasket material.")

(Tip. Use some 3M brand #77 General All-Purpose Adhesive on the gasket surfaces.)

One last thing on lube. I know a lot of people are using synthetic gear lube and swear by it. I just end up swearing at it! I've tried it in various years of transmissions and rear ends and found it leaks where non-synthetic gear lube doesn't. Probably leaks because I don't know what I'm doing. I'm tired of having oil spots all over the driveway and garage floor. I don't use it in any trans or rear end I garbage together. (From rodnut on 1/30/03. He uses 75-90 Synthetic Amzoil year round in the trans and axle. He states "There have been no leakages in properly sealed units.".)

GEAR OIL LEAK AROUND CLUSTER SHAFT: Most of our transmissions have been apart many times, and/or have been brutalized during tear down and assembly. The cluster gear shaft's front hole in the transmission case is often wallowed out of round. It may not drip much gear lube, but most will seep heat-thinned gear lube. This may not show up as a drip, but can turn to a mist which gets on the clutch pressure plate and disc and creates clutch chatter. When the trans is pulled, the inside of the bell housing and clutch have an oil film. I used to think the MDG bearing retainer seal was bad, but discovered the cluster gear shaft's hole was worn. Cure? Super simple if you're running a '49 through '53 Ford or late '51 through '53 Merc with a 4 bolt square case. Pick up some gasket paper about 0.025" thick. Make a gasket that is exactly the same as the front of your square shaped trans case. Cut it so it's snug around the MDG bearing retainer. Before you install the trans, use some 3M weather striping adhesive (you may want to re-use this gasket at a later date so don't use anything that turns to concrete) to hold this to the front of the trans. When it's bolted against the bell housing, this gasket will be squeezed between the trans and bell housing and seal the cluster shaft hole.

Large front early transmission cases: These don't have a simple cure like the later transmissions.... least I can't find one. I've tried machining "O" ring grooves on the shaft and in the case. But installing the "O" ring has defeated me..... they simple role out of their groove when the cluster shaft is being pushed or driven through. However, there are two different methods I've used with good results.

(1)This is the best one, but is more work than the second method. Remove the clutch cross shaft to get to the cluster shaft hole. Grind off the end of the front of the cluster gear shaft 0.120". Enlarge the cluster gear shaft's hole in the front of the trans case to 1.000" diameter, but only go 0.100" deep (this will provide a ledge for a 1" expansion plug to rest on). Trans cases are case hardened which makes enlarging the hole tough unless you've got the machinery. I recommend taking it to a machine shop. Pick up a 1" diameter expansion plug. After the trans is assembled, use some oil proof sealer (like #2 Permatex) on the expansion plug and drop it into the cluster shaft hole with the raised side of the plug outward. Now flatten the raised side with a hammer and drift punch or bolt. This causes it to expand and wedge itself tightly against the sides of the hole. Reassemble the cross shaft. Next time you pull the cluster shaft, just use a large drift punch from the rear and drive the shaft forward to pop the plug out. I did this type of seal to mine and the inside of the bell housing is now dusty instead of oily.

(2)The second method. Before stuffing gears into a case, peen around the cluster shaft hole to tighten it up. Invert the case and, using a long drift punch, peen around the cluster shaft hole on the inside of the case. Careful, it doesn't take much to over-peen (this is a word?) it. Too much and the cluster shaft won't go into the smaller hole and you'll end up filing or grinding the hole to remove excess peening. During assembly, I coat the inside of the hole with #2 Perma-Tex. This usually works, but I've had a couple of them seep some... which caused me to go the expansion plug cure.

TEMPORARY REPAIR FOR A REAR END AXLE HOUSING LEAK: A trick I've used several times to cure a leaking axle housing gasket when I didn't have the time or ambition to tear the rear end apart (I'm just plain lazy) is to loosen the axle housing bolts several turns. Then use a chisel or screwdriver to pry the housing slightly away from the rear end housing. It doesn't take much prying since you only need it far enough away to wrap a few turns of string. Use some ordinary cotton string and wrap it around the outside of the axle housing bolts a few times. Re-tighten the bolts. Only takes about 20 minutes. This has never failed to stop an oil leak. And it's a lot easier than pulling the housing clear off to replace the gasket... especially on the road. Even though the axle housing gasket is also a shim used to adjust the ring gear engagement depth, it has never hurt any rear ends I've done this to.

***************** OVERDRIVES *******************

OVERDRIVE SHIFT SHAFT TAPERED PIN REMOVAL: These are tough to find due to caked mud and grease. They have to be removed or the overdrive housing will only move ¼. The housing has to be removed to work on the inside of an overdrive. I have no idea how many drift punches I have broken, bent, and destroyed removing these tapered pins, but it's got to be close to 50! I've resorted to drilling a few out..... which usually ruins the case. My solution is to use a single loose needle bearing for a '49 and up Ford cluster gear. Clean off the area to find the location of the elusive tapered pin. They are usually installed either vertically from the top....or horizontally from the front. Hold the needle bearing with pliers and position it on the correct end to remove the tapered pin. Then beat on the bearing with a large ball peen hammer. Sometimes it takes two or three bearings before it comes out. Just another dumb way I do things.

OVERDRIVE GEAR REDUCTIONS: There are currently several different manufacturers of overdrives for our Fords. I only have knowledge of two and will discuss them.

Borg-Warner made the transmission overdrive for '49-'53 Ford/Mercs and Lincolns. Columbia made a rear end overdrive for '48 and older flatheads. Both have the same reduction ratio (70%). Technically, they're 72.2%, but everyone uses 70% since it's a lot easier on us that ain't so good with arithmetic! Simply multiply the rear end ratio by 70% (0.70) and you have the ratio in overdrive (O'D).

Example. Suppose you're thinking about running 4.11 : 1 rear end gears. And you want to know what ratio it would be in O'D. (4.11)(70%) = (4.11)(0.70) =

2.877 : 1. Simple isn't it? No wonder everyone wants an O'D. The 4.11 gears are a tiger at stop lights and the 2.87 permits running 80 mph for days without injuring your flathead mill. Also the overdrive decreases engine noise, wear, increases gas mileage, and helps our hopped up mills run cooler.

In case you're wondering what rpm you'd be turning at 60 mph in and out of O'D....... With 28" diameter tires and 4.11:1 gears: Out of O'D you'd be turning 3000 rpm at 60 mph and in O'D, you'd be turning 2000 rpm. Just for fun, let's look at 90 mph with the same gears and tires. Out of O'D it'd be turning 4500 rpm and in O'D, it'd be turning 3000 rpm. I've included a formula for calculating rpm and speed in the FORMULA SECTION if you're interested in toying with what gears to run.

BORG-WARNER ELECTRIC OVERDRIVE TRANSMISSIONS. These are the more common of the two types of overdrives I've listed. They were manufactured by Borg-Warner (B-W) and used regular Ford transmission gears with B-W overdrives. They're electrically controlled whereas the Columbia's are vacuum operated. Internally, the balk ring, sun gear, planetary gear (pinion cage), ring gear, and free wheel unit are identical for all early B-W overdrives. This means parts are identical in Ford, Merc, Lincoln, Kaiser, Frazer, Hudson, tri-year Chevies, Studebaker, Nash, and Rambler overdrives (provided they're not a heavy duty 3 speed overdrive). Many of these B-W overdrives, which are left, are 12V. Almost all of the O'D relays (same voltage rating) and most kick down switches work when used in a different breed of car. The governors are the same except for the governor's driving shaft. But these shafts interchange so you can often times use your shaft in another governor when yours goes bad.... which is *really* rare. Just remember there are several parts that <u>will NOT</u> interchange because they were designed to fit a particular make and year of car. An instance of a special piece is the overdrive rail switch on '49 Ford overdrives. This switch is actuated by a shaft that is in a hole in the overdrive adapter housing. This pin is shoved rearward by the L/R sliding gear when the trans is shifted into reverse..... which operates the rail switch.... which opens the governor's ground.... which prevents the overdrive from shifting into overdrive when backing up. '50 overdrives did away with this switch.

Gasket sets for these transmission overdrives are being repo'd, but are scarce. A paper grocery store sack makes better gaskets than NOS ever were. Victor brand rebuild gasket sets are too thin to effectively seal the cases. The sack paper is a tad thicker and seals better. I use 3M #77 All Purpose Adhesive on gasket surfaces to help prevent leaks and to hold the gaskets during assembly.

Solenoids have many different sizes, shafts, and shapes as well as voltage ratings. Often you can combine two different solenoids to make one with little trouble. A stumbling block is the mounting surfaces. On Fords you'll find there are two types of mounting surfaces. One is flat across the mounting surface and the other has a 1/8" step to the mounting bolt surface. They must match the mounting surface of the adapter housing they are bolting to.

Many relays are thrown in the trash when the only problem is a broken wire internally or the points have become pitted. Remove the cover and examine the very fine wire coming out of one of the windings. They are frequently burned in two. Apply a drop of solder to reconnect the two ends and they'll work fine for years. Re-surface pitted points with a point file. Gap is not critical.

OVERDRIVE SOLENOID VOLTAGE CONVERSION ON '49 AND NEWER: Converting from 6V to 12V. Most 6V solenoids have a different engagement shaft (length and/or twist) than a 12V solenoid. This, with the exception of a possible different type of mounting and voltage, is the only difference between a 6V and 12V solenoid. The easiest voltage conversion is to use a 12V solenoid with the same mounting characteristics as the 6V. Exchange the 12V shaft with the 6V. Be sure to mark the shell of the 6V solenoid the location of the flat sides on the shaft. This saves a lot of trial and error during re-assembly. Position the flat sides of the shaft in exactly the same position as they were on the 6V solenoid.

OVERDRIVE SOLENOIDS FOR ‘49 thru ‘51 CONVERTIBLES AND STATION WAGONS: These are different than ones used on the passenger cars due to the design of the frame’s center section. The beefed up frame doesn’t have enough room for the sedan’s solenoid. So B-W used a 90 degree type bracket with an internal cable and located a unique solenoid several inches away. These cable extension pieces are a real pain to remove and/or install in the car (you have to remove the floor carpeting and a plate to get to the bolts). Both of these pieces are VERY rare and VERY expensive if you can find one. However, some “tomahawk engineering” using your basic hot speed-wrench on the center member will make enough room for a standard sedan solenoid. I’ve been told a complete ‘51 overdrive transmission will fit in ‘49-’50 convertibles and station wagons since the ‘51 solenoid mounts slightly different than the ‘49-’50 does, but I’ve not actually done one. It looks as if it will fit but will be an awfully tight fit.

OVERDRIVE TRANSMISSION FREE WHEELING ROLLERS: To assemble these: Use a 1/8" wide rubber band and stretch it around the overdrive’s free wheeling unit a couple of times. This will hold the large steel roller bearings in the sprag clutch as well as provide needed tension to pre-load the sprag clutch. Lift the rubber band and install, one at a time, the individual rollers in their slots in the sprag clutch. When all rollers are installed, rotate the sprag clutch to its loaded position. The tight rubber band will hold the sprag clutch in the loaded position. This reduces its outside diameter so the overdrive’s ring gear will fit down over the rollers. Don’t sweat leaving the rubber band inside the overdrive..... it’ll grind up and mix with the gear oil.

COLUMBIA OVERDRIVES: These are really a two-speed rear end like the ones used in big trucks for years. They’re just not as massive. Since they are rear end overdrives, they actually change the rear end ratio. Because the speedometer drive comes off before the overdrive, the speedometer must change at the same time the rear end shifts in or out of overdrive. This requires a speedometer gear changer that’s controlled by the operation of the rear end. All Columbia overdrives for our flatheads are primarily vacuum operated. The vacuum is controlled either mechanically through ‘41 or electrically from ‘46-’48 (I don’t know about ‘42). The mechanical controls, some of the electrical components, and internal parts are now being repop’d. But they do shrink a credit card quickly. Before you lay out your cash for a Columbia at a swap meet, tear it down and verify the condition of the 15 tooth sun gear as well as other parts. The sun gear is normally cracked or broken. Expect to pay about $175 and up for a used sun gear with no cracks.... if you can find one. They are being reproduced for about $350-$450. If there are pieces which are cracked or broken, lower your bid accordingly. There are several internal pieces that need to be strengthened (welding, machining a tool steel collar, etc.). Sending the pieces to a specialist is well worth the money. Cost to beef these up and get new gaskets and misc needed assembly parts is in the $500 range. These modifications make a Columbia a lot stronger than when they were new.

REAR END CENTER SECTION REQUIREMENTS WHEN ADDING A COLUMBIA OVERDRIVE. The width of the rear end from backing plate to backing plate varies according to the year of the rear end. Nothing new here. The newer they are, the wider they are. Usually it's the axles and housings where all the added width is. But late '32 through '34 rear ends have narrower center sections. And these narrower center sections will not accept a Columbia made for '35 and newer cars (only late '32 through '34 Columbias fit in these older center sections). However, axle housings all have the same bolt pattern and bolt up to any center section. If you're adding a Columbia from a '35 and newer to your '34, you'll have to change to a '35 through '48 center section (they're all the same). Understand center section includes the spider gears, the ring, and the pinion gears for this discussion. But when you go to the later center section, the '34 and older axles will each be too short by about 3/8". Solution is to cut off the ends of two longer axles to the correct length. Machine threads, axle key slot, and taper in each axle. None of this makes much difference if it's going in a high-boy and you don't mind the tires being some distance from the body. One other thing, keep in mind the mounting and angle of the rear radius rods since they vary according to the year of car. I found it's easier to graft a section of the inner overdrive housing to an outer section of the '34 right side housing. This retains the original radius rod mounting, angles, shocks, and brakes. Just shorten the stock right housing so the right housing with the overdrive housing is *exactly* the same length as the original housing was. Be sure to carefully line the two housings up so the radius rods etc. are all located and indexed properly. Cost to do this is usually about $100 and can be done by any competent machine shop.

ALTERNATIVE FOR SHIFTING TRANSMISSION OVERDRIVES. The Borg-Warner transmission overdrive can be shifted out of overdrive <u>without</u> flooring the accelerator to activate the kick down switch. This is neat if you come up on a slick road or downhill and you want to shift it out of overdrive without using full throttle. Just apply a slight amount of power and, <u>very quickly</u>, turn the ignition key off and then back on (as fast as possible). This breaks the overdrive electric circuit and kicks out the solenoid. This puts you in direct drive without the throttle being wide open (a sudden full throttle sure makes for excitement on sheet ice!). Once you're in direct drive (out of O'D) retain the same amount of power and pull the overdrive handle out. *REMEMBER*, anytime you want to move the overdrive handle (in or out), you must be in direct drive (out of overdrive) with some power being applied...... or completely stopped.

SHIFTING THE COLUMBIA OVERDRIVE. We've all heard the two-speed axles shift on large trucks. It sounds like they're grinding themselves to pieces. The Columbia sounds the same and scares me! One way to decrease this grinding is to shift it up into overdrive about 40-45 mph. Makes shifts a lot quieter. It also makes for a lot less wear on the sun gear during engagement.
Also, when you're slowing down for a stop, don't shift out of overdrive until about 25 mph or less. You'll just hear a click instead of gears grinding. This has to be easier on the overdrive unit. I usually just kick the trans into neutral and shift it out of overdrive when I slow to about 20 mph.

****************** REAR ENDS & DRIVE SHAFTS ****************

REAR END GEARS: Many members of the Early Ford V8 Club are super sharp. But I have to disagree with them when it comes to rear end ratios in early Fords. Many say '48 and older Fords came with only 3.54:1, 3.78:1, 4.11:1, 4.44:1, and 4.55:1(?) ratios in 85 and 100 hp V8's. And they back this up with their Ford manuals. While scrounging wrecking yards in south Texas in the early fifties, I came across about a dozen or so early Ford rear ends with 3.27:1 gears! I also found quite a few 4.33:1 ratios as well. All had gennie Ford lettering. It was our belief these came as special orders for large customers. The 3.27's were mostly found in Texas Ranger's Border Patrol '46-'48 cars (must have needed more top end). The 4.33 gears were in factory stripped down Fords made especially for cross country patrolling the huge King Ranch (low end grunt was needed for traversing washes and ravines). These were always in '34, '36, '38 and '39 Ford Phaetons with truck 4 speed transmissions, butterfly fenders, no running boards, with gun scabbards, and super wide (for the time) rims running fairly tall tires. I've never seen, nor heard of anyone who has seen 4.55:1 Ford gears for an early Ford car.

A word of caution, the 3.78:1 (9/34) and 4.11:1 (9/37) both use 9 tooth pinion gears. The pinions are not interchangeable due to different width of gear teeth and pitch. Keep them together with their original ring gear.

9" SPECIFICATIONS: I ran across this table several years ago in a Super Ford Magazine. I neglected to get the name of the contributor, so am unable to give him an "atta-boy".

Measurements are between the mounting faces of the backing plates. Note many of these are performance cars and not you're typical grocery-getter. They came in either leaf or coil springs.

'64-'77 Bronco = 46"
'58-'60 T-Bird = 50"
'57-'59 Ford & Edsel, '63-'69 Falcon, '63-'65 Comet, '67-70 Mustang & Cougar,
'66-'69 Fairlane and Cyclone. These are all 52"
'63-'65 Fairlane & '65-'66 Mustang. These came with either 52" or 54"
'71-'73 Torrino & Cyclone, '60-'64 Ford & Merc (full size), '61-'67 T-Bird. All are 56"
'58-'72 F-100 pickup = 57" ***
'73-'90 F-100 pickup = 58¾" ***
***NOTE: F-100 pickups came with various gear ratios of 3.25:1, 3.40:1, 3.70:1, 3.90:1, 4.10:1, 4.30:1, 4.56:1, and 4.67:1

OPEN TYPE DRIVE SHAFT U-JOINTS: Many early flatheaders have changed to open type driveshafts. Over tightening the U-joint's small "U" bolts can cause destruction of the u-joint's cross shaft and bearings in short order. Tighten the nuts just tight enough to compress their lock washers. Any tighter and it distorts the cup which quickly ruins the needle bearings and wears notches in the cross shaft. This will cause a drive line rumble in the 50 to 55 mph range. I'm nervous the nuts might come loose so I use some green locktite on the bolts after they're tightened.

U-JOINTS FOR ENCLOSED DRIVESHAFTS: These were used in cars through '48. They came with bushings. However, Lincoln used U-joints with needle bearings beginning in '39. As to be expected, they are considered to be better than the bushing type.

Incidentally, grease for the U-joint is a regular question on the early Ford sites. Ford calls for "filling with engine oil and soda soap grease at 1000 mile intervals"...... whatever soda soap grease is and how you fill it since there isn't any hole to pour it in. This mixture must be pumped through the zerk???? (I wonder if a grease gun will pump liquid.) It also states to "never use chassis grease"! I have no idea what to substitute for "soda soap grease". I've always

put 3-4 pumps of chassis grease in whenever I'm greasing a car and haven't had any U-joint problems.

AXLE NUT TIGHTENING. **Tighten axle nuts to 200-220ft/lbs. Then tighten it to the align the next cotter pin hole/slot and install a cotter pin. Caution: Never exceed 275 ft/lbs to align to the next cotter pin hole. After a few hundred miles, I re-check the torque. I think retorquing helps decrease shearing axle keys.**

AXLES FOR '32 THROUGH '48 REAR ENDS: There were different axles used on our flatheads.
(1)Axles for Model "A" thru '32 are the same. These have 24 teeth and use 12 tooth spider gears. In late '32, Ford changed to the '33 style straddle mount pinion. This prevented installing the ring gear on the wrong side of the pinion and having 3 gears in reverse and one gear forward! Ask me how I learned this while still in high school! Sure tore up the front of a '32 coupe!

(2)Axle length of '33-'34 Fords are 1/2" shorter than the '35 thru '41 axles. These have 18 teeth and use 12 tooth spider gears.

(3)Axle length of '35 thru '41 are 1" shorter than the '42 thru '48 axles. These have two different numbers of axle gear teeth:

The '35 thru '38 have 18 teeth and use 12 tooth spider gears.

The '39 thru '41 have 16 teeth and use 11 tooth spider gears.

(4)Axle length of the '42 thru '48 were the longest of the early axles. These had 16 teeth and use 11 tooth spider gears.

Thanks to Bill Bentley (BILLB) of the flathead V8 web site for this information.

ENCLOSED TYPE DRIVESHAFTS FOR '35 THROUGH '48: There were two different driveshaft lengths used from '35 thru '48. The shorter driveshaft was used from '35 thru '40. The longer driveshaft was used from '41 thru '48. In addition there were two types of driveshafts.
A tube type was used on '35 through '38 and uses a 10 spline pinion shaft coupler sleeve.
A solid type was used on '39 through '48 and uses a 6 spline pinion shaft coupler sleeve.
Ford made a 10 spline to 6 spline coupler for mixing pinions and driveshafts. I understand these are still available from early Ford parts dealers under Ford PN 48-4684.
Oddity: Some early Merc's used a one piece driveshaft/pinion that did away with the need for a driveshaft to pinion gear sleeve. Trouble is, you have to replace the entire driveshaft whenever you change or break rear end pinions or driveshafts. Not one of Henry's better ideas in my book. I've only seen these in '39 Mercs but I've been told they also were in some '40 Mercs. All of the ones I've seen were 3.54:1 gears.

REAR END SPECIFICATIONS: Pinion bearing adjustment for all '33-'48 rear ends is 12 to 17 inch/lbs (torque required to turn the pinion with engine oil in the bearings).

A method I picked up stock car racing some 50 years ago is to set the pinion bearing the same way as I set a front wheel bearing. Tighten the adjusting nut and then back it off one flat and secure the jam nut and locking washer. The pinion should turn with no bind and have no slop in the bearings. I still use this method today. The ring gear backlash is 0.006" to 0.010". (From rodnut 1/30/03. Gear backlash tolerances are 0.003" to 0.008". He also advises new bearings are tighter than used ones and setting by hand doesn't work.) Adjust the depth the ring gear engages the pinion gear by adding or subtracting axle housing gaskets (shims). The axles should turn easily with no binds, but not have any appreciably end play.

Pinion adjustment for Model A through '32 non-straddle mount rear ends is 35 to 47 inch/lbs. I adjust these the same as a front wheel bearing. Ring gear backlash is 0.006" to 0.010". Adjust the depth the ring gear engages the pinion by adding or subtracting axle housing shims (gaskets).

Increasing gasket thickness between the Left axle housing and the banjo housing will increase back-lash. Decreasing gasket thickness between the Left axle housing and the banjo housing will decrease back-lash. There are four different thicknesses made by Best brand gaskets and are color coded for ease of use.

White is 0.003" thick.
Ivory is 0.005" thick.
Green is 0.007" thick.
Blue is 0.009" thick.

*************************** SPEEDOMETERS ************************

QUIVERING SPEEDOMETER NEEDLE. I'm assuming the speedo cable is not too long and being jammed into the back of the speedometer. Quivering is usually caused by the bushing at the back of the speedometer head (where the cable enters the speedometer) becoming dry. Remove the head and drip several drops of light machine oil into this bushing. Rotate it a few times with your fingers and add a couple of more drops. Leave it turned face down for about 15 minutes so it'll soak in. Test it with a drill and a short section of junk speedometer cable. It should no longer shake.

However, if you're lazy like me and don't have the energy to pull the speedometer, disconnect the cable from the speedometer head. Then spray some penetrating oil into and onto the bushing a few times. Test with the aforementioned drill and speedometer cable. It usually works, but I have been known to get oil on the carpet..... oh well... it's just an old Ford! At least that's what my spouse says.

SPEEDOMETER DRIVE GEARS: Note the following is for 28" diameter tires (6.00 X 16). Remember different diameter of tires will probably require a different number of teeth on the driven gear to be accurate.

17t for 3.27:1
18t for 3.54:1
19t for 3.78:1
21t for 4.11:1
22t for 4.33:1
23t for 4.44:1

CORRECTING SPEEDOMETER READINGS: Using the mile markers alongside the interstate works fairly well (they're not real accurate). We need to know how many seconds it takes to cover the mile between two markers. Drive the mile at a constant speed. Do this 10 times using the same mile markers and the same speed. Record each time. Now disregard both the slowest and fastest times. Add the remaining 8 times up and divide by 8. This gives you an average time. This average time to travel the mile is used in the following table:

seconds =	56	58	60	62	64	66	68	70	72	74
mph =	63	62	61	58	56	55	53	51	50	49

(these numbers are rounded off in accordance with standard engineering practices)
Example: Suppose your speedometer shows 55 and you average 58 seconds traversing the mile. Using the preceding table 58 seconds is 62 mph. Now all we need to do is figure the speedometer error.....

(62 actual mph)-(55 indicated mph) = 7 mph error. So you’re actually going 7mph faster than the speedometer indicates. Correction methods are discussed in the next paragraph.

The number of teeth on the speedometer drive gear (at the transmission) controls the rpm of the speedometer drive cable... which operates the mechanism in the speedometer head. Nothing new here. To change the speedometer reading we can increase or decrease the number of driven teeth at the transmission quite easily (the drive gear is on the driveshaft). To increase the speedometer reading, decrease the number of teeth on the driven gear at the transmission. To decrease the speedometer reading, increase the number of teeth on the driven gear at the transmission. One tooth change makes a 4 to 5 mph change.

If you can’t get it accurate enough to suit you, you can always take it to a speedometer shop where they will test it and correct it. They have small housings with interchangeable gears which fit between the speedometer drive gear and the cable. Cost is usually about $95-$120, but are certified accurate by the shop should you have to go to court for some reason or other?????

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