TOYOTA
REPAIR MANUAL

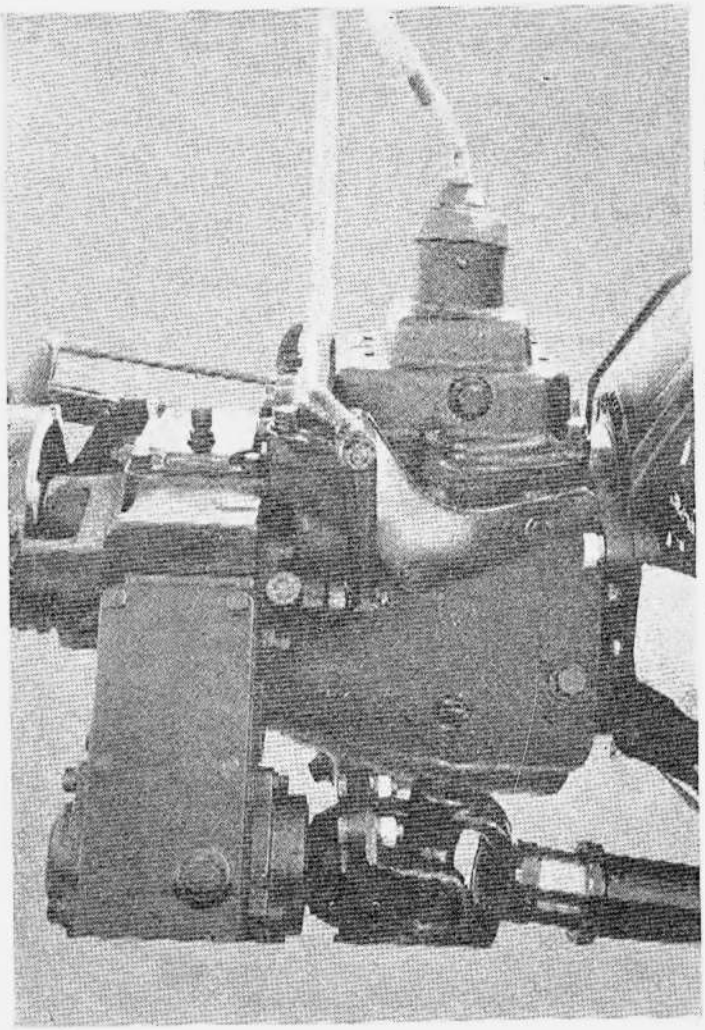
MODEL FJ

TRANSMISSION AND TRANSFER

TRANSMISSION AND TRANSFER

The transmission on the Toyota Land Cruiser is of the selective sliding gear type with 4 speeds forward and 1 reverse, the third and top gears being of the synchromesh type. In this type of transmission, 3 gears of different diameters slide on the main shaft to mesh with the gears on the countershaft placed parallel to the main shaft. The gears are selected to produce the required speed and tractive power to conform to the load and transfer the engine torque through the propeller shaft and differential to drive the rear axle. Since the engine is unable to rotate in the reverse direction, the reverse gear in the transmission is used to produce reverse rotation.

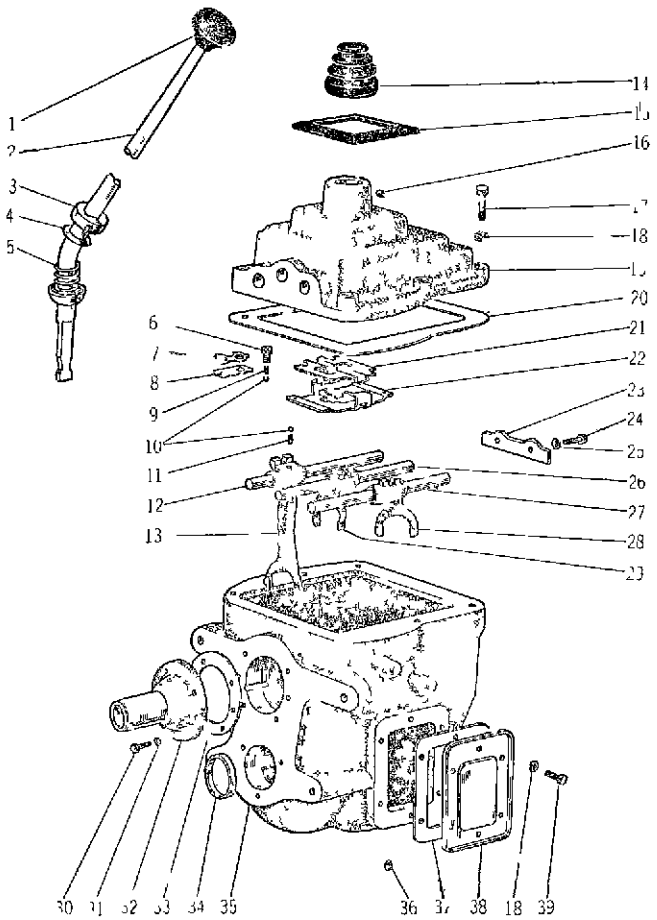
The gears are housed in a cast iron transmission case filled with oil to allow the gears to constantly rotate in the oil. The transmission specifications are as follows.



Transmission Specifications

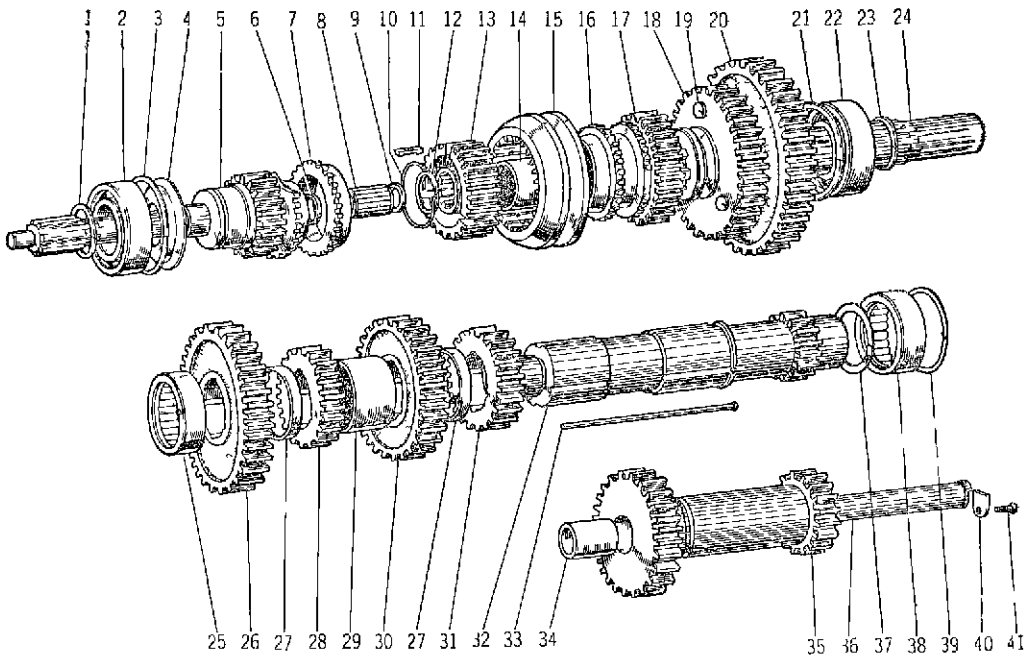
Case	Cast iron
Gears	Chrome-molybdenum case hardened steel
Speed Ratio:	
1st Speed	5.41 : 1
2nd Speed	3.12 : 1
3rd Speed	1.77 : 1
4th Speed	1 : 1
Reverse	5.44 : 1
Oil Capacity	3.3 liters

Transmission Case and Cover



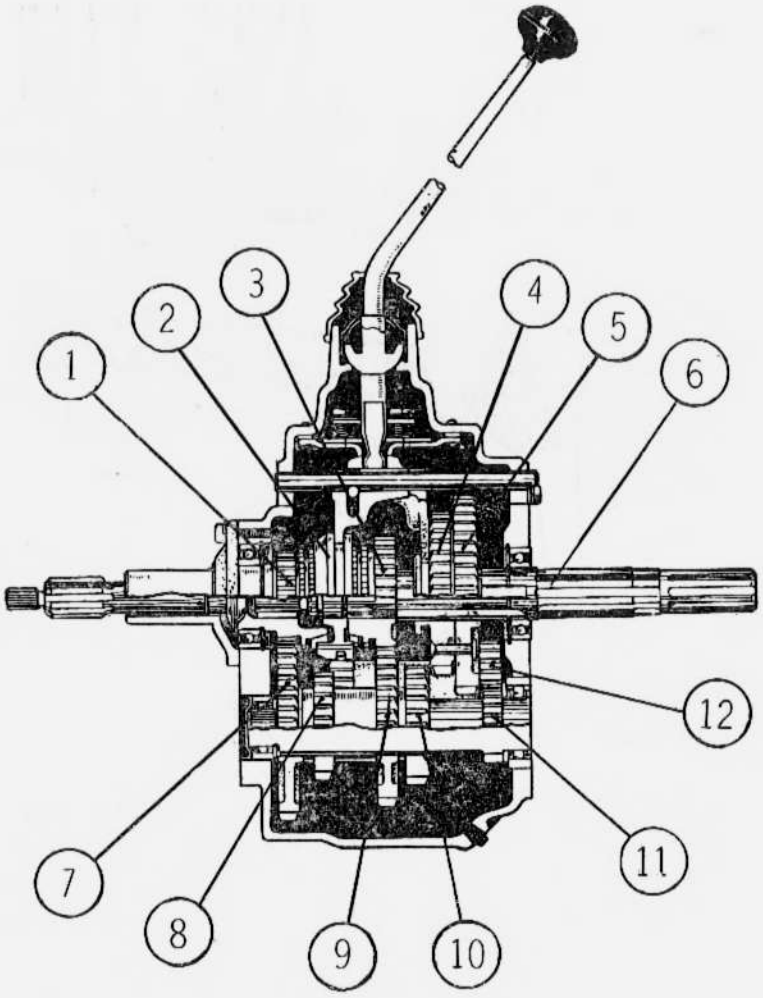
① *Lever Knob*
④ *Gear Shift Lever*
③ *Lever Cap*
④ *Lever Spring Seat*
⑤ *Lever Spring*
⑥ *Interlock Plate Ratch*
⑦ *Ratch Washer*
⑧ *Ratch Plate*
⑨ *Ratch Spring*
⑩ *Gear Shift Fork Lock Ball*
⑪ *Lock Ball Spring*
⑫ *Gearshifting Fork Lock Ball*
⑬ *Reverse Speed Fork*
⑭ *Gear Shift Lever Cap Cover*
⑮ *Cover Rubber*
⑯ *Lever Cap Lock*
⑰ *YBN 1010 Bolt*
⑱ *SWH 10 Spring Washer*
⑲ *Case Cover*
⑳ *Case Cover Packing*
㉑ *Interlock Plate*
㉒ *Interlock Plate Cover*
㉓ *Gearshifting Shaft Retainer*
㉔ *YBN 0820 Bolt*
㉕ *SWH 10 Spring Washer*
㉖ *Gearshifting Low Speed Shaft*
㉗ *Gearshifting High Speed Shaft*
㉘ *Top and Third Speed Fork*
㉙ *Low and Second Speed Fork*
㉚ *YBN 0820 Bolt*
㉛ *SWH 06 Spring Washer*
㉜ *Front Bearing Lock*
㉝ *Front Bearing Lock Packing*
㉞ *Countershift Bearing Lock*
㉟ *Case*
㊱ *Oil Plug*
㊲ *Power Take off Cover Packing*
㊳ *Power Take off Cover*
㊴ *YBN 1015 Bolt*

Transmission Gears



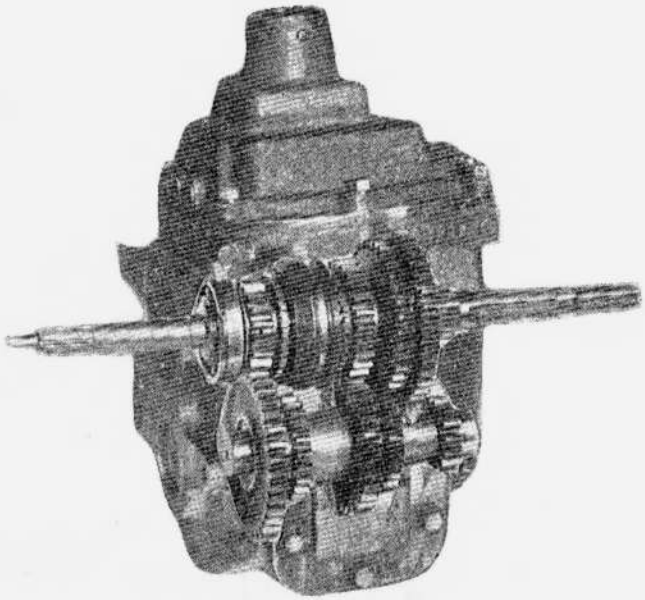
① *Bearing Lock*
② *Main Drive Gear Bearing*
③ *Snap Ring*
④ *Oil Deflector*
⑤ *Main Drive Gear*
⑥ *Service Ring*
⑦ *Top Synchronizer Ring*
⑧ *Needle Roller*
⑨ *Pilot Bearing Spacer*
⑩ *Key Spring*
⑪ *Key*
⑫ *Snap Ring*
⑬ *Clutch Hub*
⑭ *Bushing*
⑮ *Clutch Hub Sleeve*
⑯ *Third Synchronizer Ring*
⑰ *Third Speed Gear*
⑱ *Second Speed Gear*
⑲ *Rivet*
⑳ *Low and Reverse Sliding Gear*
㉑ *Snap Ring*
㉒ *Spline Shaft Rear Bearing*
㉓ *Snap Ring*
㉔ *Spline Shaft*
㉕ *Counter Shaft Front Bearing*
㉖ *Counter Drive Gear*
㉗ *Spacer*
㉘ *Counter Reverse Gear*
㉙ *Spacer*
㉚ *Counter Third Speed Gear*
㉛ *Counter Second Speed Gear*
㉜ *Counter Shaft and Low Speed Gear*
㉝ *Counter Gear Shaft Key*
㉞ *Bushing*
㉟ *Reverse Idler Gear*
㊱ *Reverse Idler Gear Shaft*
㊲ *Thrust Washer*
㊳ *Counter Shaft Rear Bearing*
㊴ *Bearing Shim*
㊵ *Lock Plate*
㊶ *SBN 0815 Bolt*

Transmission Sectional View



① *Main drive gear*
② *Clutch hub spring*
③ *Third speed gear*
④ *Second speed gear*
⑤ *Low and reverse sliding gear*
⑥ *Spline shaft*
⑦ *Counter drive gear*
⑧ *Counter reverse gear*
⑨ *Counter third speed gear*
⑩ *Counter second speed gear*
⑪ *Countershaft and low speed gear*
⑫ *Reverse idler gear*

CONSTRUCTION



The main drive gear is supported on the transmission case with ball bearings and is in constant mesh with the countershaft drive gear. Thus, when the clutch is engaged, the engine power is always being transmitted to the countershaft.

In addition to the counter-drive gear, the countershaft is provided with the reverse gear, third speed gear, second speed gear and low speed gear. The low speed gear is made integral with the countershaft while the other four gears are keyed on to the countershaft so that all these gears rotate together with the countershaft. The low speed gear is in constant mesh with the reverse idler gear.

The front end of the spline shaft is supported by the pilot bearing (needle roller bearing) on the inner side of the main drive gear and its rear end is supported by ball bearings on the transmission case and transfer case. The rear end of the spline shaft extends into the transfer case and on this part are attached the speedometer drive gear, universal joint of the propeller shaft, and center brake drum. The speedometer driven gear is attached to the universal joint front retainer.

The low and reverse sliding gear, and the second speed gear which is riveted on to this gear fits over the spline shaft but is made free to slide on this shaft. The third speed gear does not slide and is in constant mesh with the counter gear. This third speed gear fits over the spline shaft through a bronze bushing and rotates independently of the shaft.

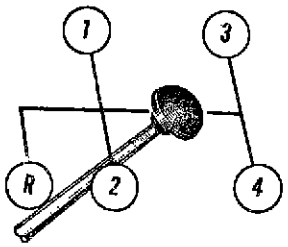
The clutch hub and sleeve together with the synchronizer ring and shifting key connects on to the spline shaft through the clutch hub, this hub being fixed on to the shaft with snap ring.

In order to adjust clutch hub so that there is no play in the axial direction, snap rings with thicknesses of 2.5 mm and 2.3 mm are provided.

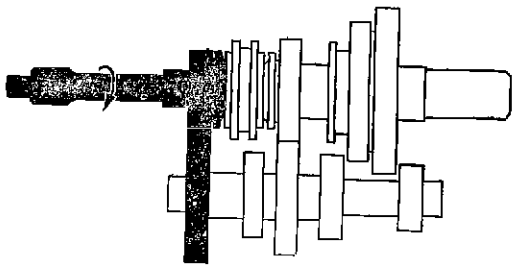
The reverse idler gear fits over the reverse idler gear shaft through a bushing, being free to rotate on the shaft. The shaft is force fitted into the transmission case and is prevented from turning by the lock plate bolted on to the case. Collars are provided on the clutch hub, and second speed and reverse idler gear on the spline shaft. The lower end of the fork on the gear shifting shaft fits into these collars for the purpose of sliding these gears.

The operating positions of the transmission gear shift lever are as shown in

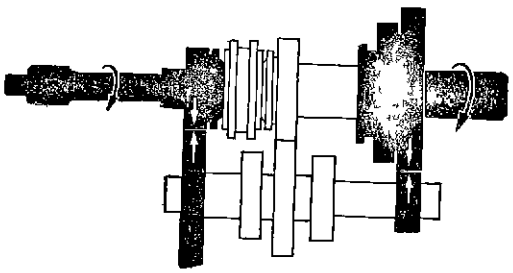
the illustration. The gear mesh positions and its power transmission routes for the various positions of the gear shift lever are shown in the following illustrations



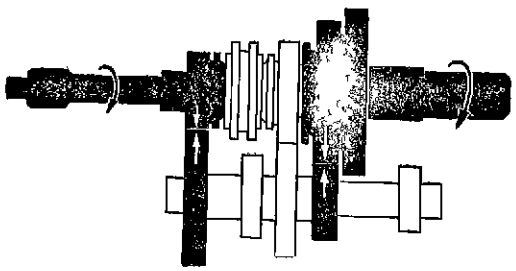
Shift Lever Positions



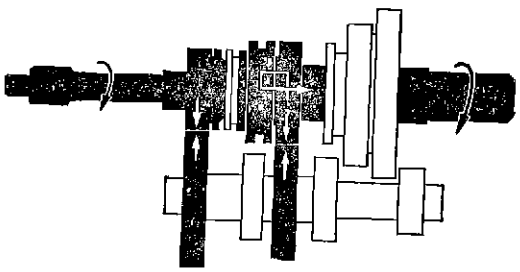
Neutral



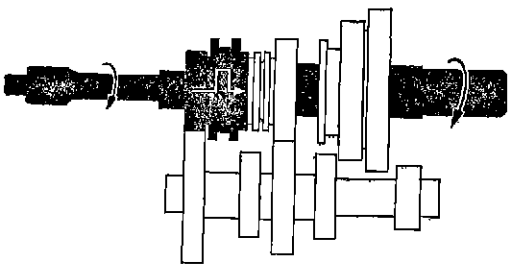
First Speed



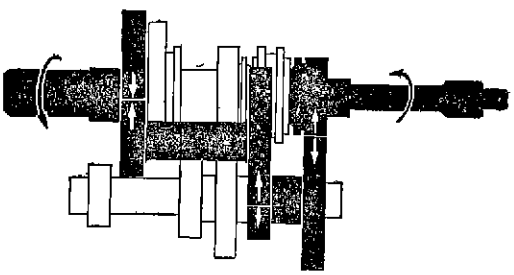
Second Speed



Third Speed

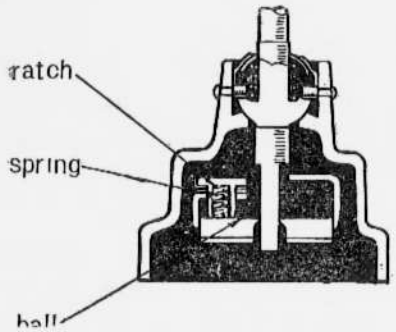


Top Speed



Reverse Speed

The gear shift lever assembly is attached to the transmission case cover with the lever spring and to provide smooth operation of the lever, its contacting part with the cover is made spherical The shift fork shafts for the various gears are also fitted in the case cover and their back and forth stop positions are fixed by



Transmission Cover Reversing Ratch

the gear shift fork lock ball and lock ball spring.

The shift lever reverse shifting is of the spring type as shown in the illustration. The interlock plate is provided with the lock plate ratch and inside this ratch are the ratch spring and lock ball. When shifting to reverse, this ball is pushed by the shift lever to compress the spring.

CONSTRUCTION OF SYNCHROMESH MECHANISM

The blocking ring type synchromesh is used for third and top speeds. Its construction and operation are as follows.

1. Construction

A : Main drive gear

B : Spline shaft

C : Third speed gear -Rotates freely on B but is in constant mesh with counter third gear.

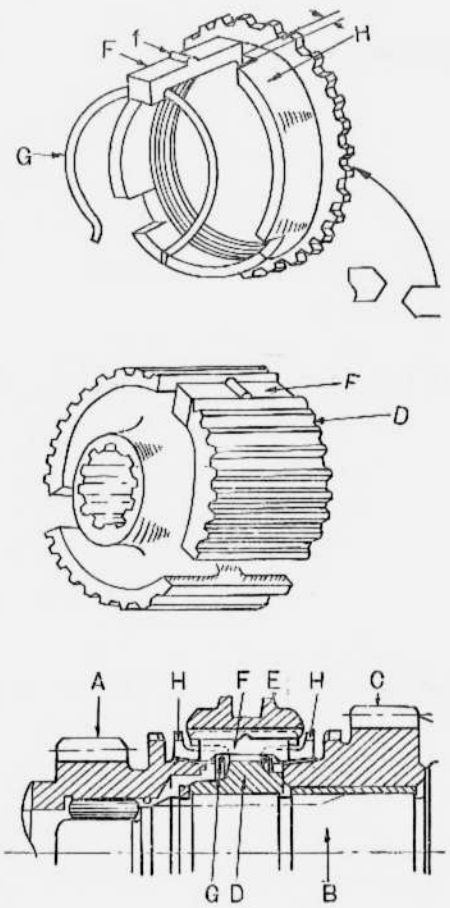
D : Third and top clutch hub—rotates together with B.

E : Clutch hub sleeve—fits over D with splines, slides in axial direction.

F : Synchromesh shifting key—fits inside 3 grooves cut in D, is pressed outward against inside face of E with ring shaped spring G, shoulder f fits into slot in E when in neutral.

G : Synchromesh shifting key spring

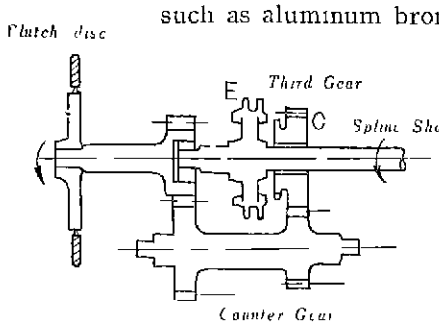
H : Synchronizer ring (blocking ring) ring side cones which fit into cones on A and C are provided with fine grooves to facilitate oil drainage, splines fit into spline on E and parts facing E are chamfered.



Synchromesh Mechanism

This part is the heart of the synchromesh mechanism. The inner side is provided with 3 slots for the ends of the keys F to fit in. The

width of the slot is made slightly larger than the width of the keys so that H can turn at slight angle with reference to E. A copper alloy such as aluminum bronze with high hardness factor is used for this part.

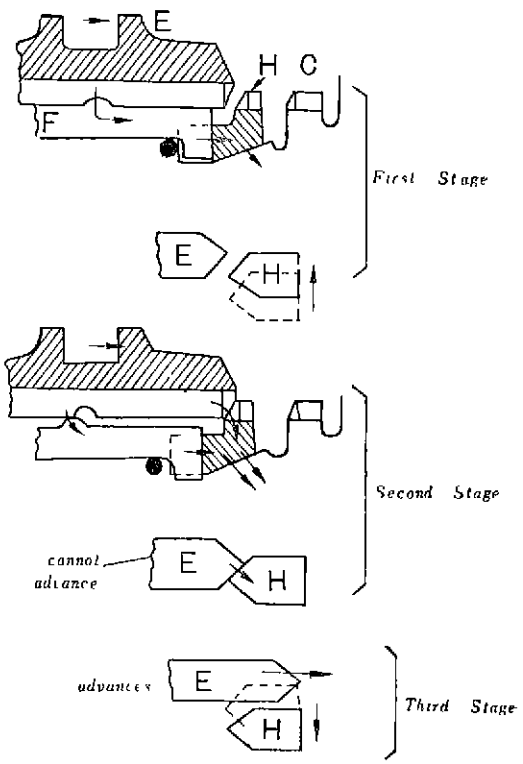


2. Principle

If we take a case of shifting down from top to third speed while running, the clutch will be disengaged to shift from top to neutral and the moving parts from the clutch disc, counter gear to the third gear will be at the former top speed rotation

The speed of C which was slower than that of E will decrease rapidly due to frictional resistance but the part connected to spline shaft and E conforming to vehicle speed will not lose speed so quickly Consequently, there will be a large difference in speed between C and E and trying to push E into C at this condition will be exceedingly difficult besides producing noise Ordinarily when driving, the clutch is reengaged and the engine speeded up to make the speed of C approximately same as E before meshing E to C, performing what is known as double clutching to engage the gears smoothly

In the synchromesh mechanism, instead of increasing the speed of C with the engine, a frictional force is placed between C and E to first raise the speed of C and when it is equal to that of E, the splines are engaged. This method of making the speeds equal to mesh is called synchromesh.



Operation of Synchromesh

3. Operation

a First stage Sliding E to the right transfers its force to F since E and F are meshed at the center by the shoulder and groove The end of F pushes against H to push cone H against C to operate clutch and increase speed of C due to rotation of E At this time H is pulled in by C and turns by the amount equal to the clearance between F and H, this condition being as shown in the illustration.

b. Second stage As E continues to slide to the right, the mesh between shoulder

and groove is released to free E from F. Since the splines are crossed as shown in the illustration, H prevents E from advancing. This causes the chamfered parts of the splines to press against each other strongly and also allows the force to be transferred at this part. The speed of C continues to increase and in short time E and C are in synchronism.

c. Third stage: When E and C are in synchronism, H is no longer pulled in by C so that it becomes free to rotate and does not prevent the progress of E. E then continues to advance smoothly to fit into the splines in C and complete the engagement between E and C.

In the blocking ring type, E is prevented from advancing until complete synchronization is obtained. Thus, between the second and third stages, a little time is required so that this point should be kept in mind when operating the shift lever. The lever should be pushed lightly and held during this period until synchronization is completed. Hard and quick shifting will impose considerable strain on this mechanism.

The time required for synchronization increases as the difference in speeds between E and C becomes greater. This time will become smaller as more force is applied during operation but it is preferable to take more time and use less force. With the adoption of the synchromesh mechanism, the troublesome double clutching has been eliminated and the gear shifting has been made much easier being especially effective when changing gears while climbing hills.

REMOVING TRANSMISSION AND TRANSFER CASE

Removal should be made in the following order.

1. Remove driver's seat and assistant's seat. (The assistant's seat need not be removed but can be tilted down)
2. Remove transmission gear shift lever.
3. Remove transmission cover on toeboard and undercover bolted to frame.
4. Remove universal joint yoke bolts on transfer side and lower front and rear propeller shafts.
5. Disconnect speedometer cable at the transfer case.
6. Remove undercover on clutch housing, remove 4 bolts mounting transmission and pull out transmission to the rear and lower to the ground.
7. Jack up vehicle and pull out transmission and transfer case as one unit from under the vehicle.

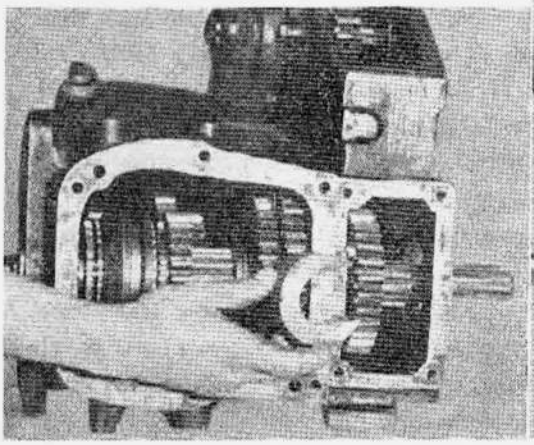
DISASSEMBLING TRANSMISSION FROM TRANSFER CASE

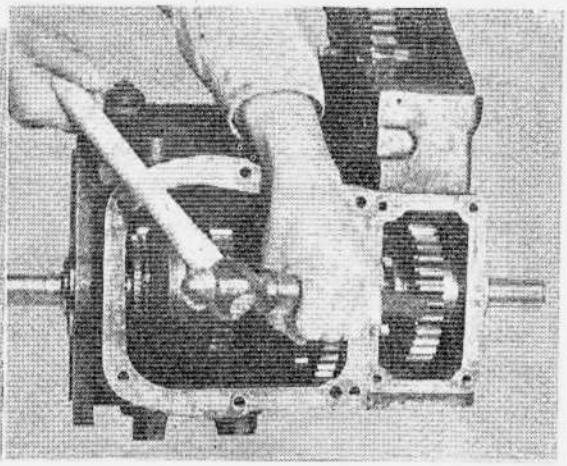
1. Drain out oil in transmission and transfer case from drain plugs.
2. Pull out universal joint front yoke retainer from spline shaft. If tight, use main drive gear puller (BXSST–1081) to facilitate operation.

3. Unscrew bolt on lever sector and remove hand brake lever from transmission case. Remove universal joint front retainer from transmission case and remove speedometer drive gear and spacer from spline shaft.

4. Remove transfer shift lever and transfer shaft guide from transmission and transfer, remove transfer case upper and side covers, and remove transfer gearshaft fork by unloosening pin on forkshaft.

5. Move transfer shift gear forward, and insert spacer between gear and spline rear bearing as shown in the illustration. Using brass bar, lightly knock gear to drive out rear bearing to the rear.





6. Remove bolts attaching transmission to transfer case (5 on inner side and 1 on outer side) to dismantle transmission from transfer case leaving only the spline shaft.

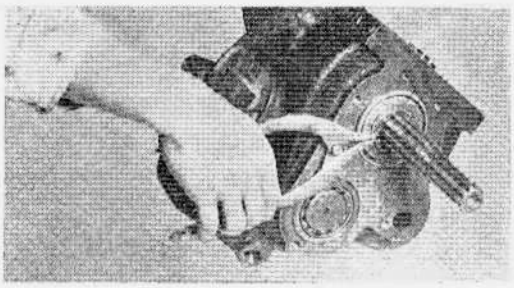
DISASSEMBLING TRANSMISSION

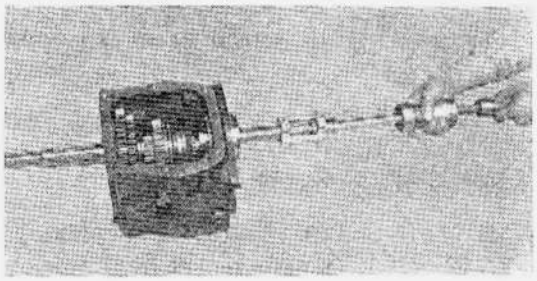
1. Remove transmission case cover.

2. Remove transmission front bearing lock.

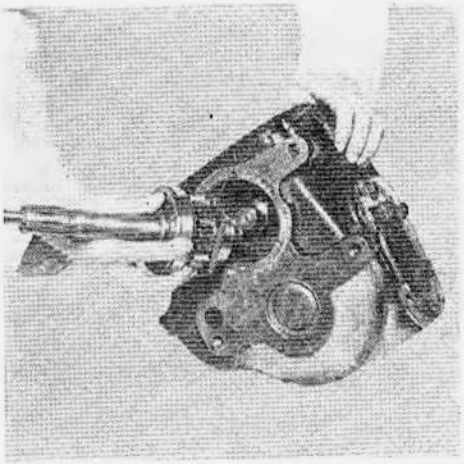
3. Remove rear bearing lock on main drive gear by using special tool (RS SST-2003) Snap Ring Expander. (See figure)

4. Using special tool (BX SST-1081) Main Drive Gear Puller, drive out main drive gear. (See figure)





drive gear bearing to the position shown in the figure.
(Main drive gear cannot be pulled out forward)

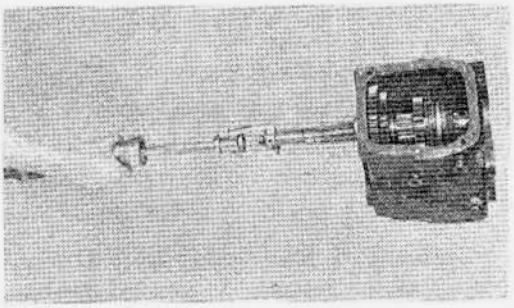


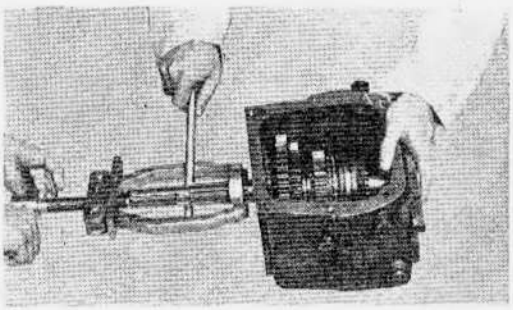
As shown in the figure, the top gear on the main drive gear is provided with a cut part. In the above operation, this cut part must be facing the countershaft side. Failure to observe this will result in the top gear being caught on the counterdrive gear and making it impossible to pull out.

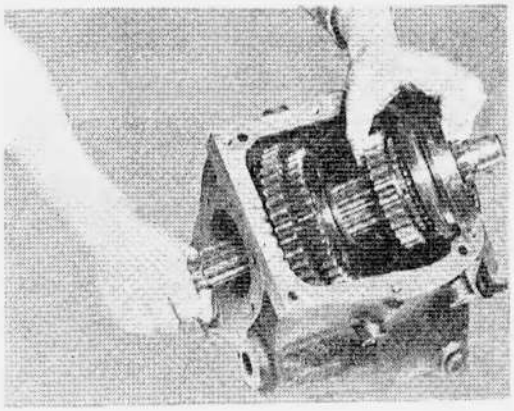
5. Remove spline shaft snap ring in the same manner as Article 3 using special tool (RS SST 2003) Snap Ring Expander.

6. Knock out spline shaft rear bearing in the same manner as Article 4, using special tool BXSST—1081. See figure.

7. Pull out rear bearing knocked out above by using special tool BX SST 2034 Universal Puller. See figure.





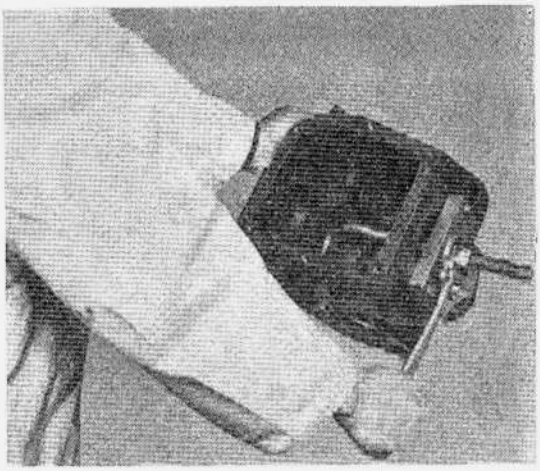


8. Remove gears on spline shaft from transmission case as shown in the figure. In this case, remove low and reverse sliding gear, and second gear by leaving inside case.

9. Pull out main drive gear bearing knocked out in Article 4 in the same manner as Article 7 using special tool BS SST—2034 Universal Puller and take out main drive gear from inside the case.

10. To pull out counter gear, use special tool BX SST 1084 Counter Gear Puller.

Hook on puller fork to third speed gear and bolt on plate to bolt holes used for attaching transfer to transmission case. Then turn tightening nut with wrench and the counter gear assembly together with the rear bearing will be pulled out of the case.



11. The reverse idler gear can be easily removed by removing lock plate and knocking shaft to the rear.

12. To replace second, third, and reverse gears on the counter gear assembly, this operation can be performed easily on a press.

DISASSEMBLING TRANSMISSION COVER ASSEMBLY

1. Turn cover upside down and place in a vise. Place all three fork shafts in neutral positions.

2. Remove retainer locking shift fork shafts.

First remove low and second speed fork shaft by placing bar and knocking out from front side with a hammer.

Then remove third and top, and reverse shafts in same manner.

Since the gear shift fork lock balls are held down by springs, care should be taken during the above operations not to lose these balls as they will fly out.

3. The interlock plate cover is riveted on to the case cover so that if defective, replace by removing 4 rivets.

This completes the disassembly of the transmission. All parts should then be carefully inspected on the following points and necessary repairs and replacements made.

1. Condition of wear in all bearings
2. Chipped tooth on all gear
3. Wear in idle gear bushing and shaft
4. Weakened spring on gear shift fork lock ball
5. Bending in all speed fork shaft
6. Wear in third speed gear bushing
7. Wear in synchronizer ring

ASSEMBLING TRANSMISSION

1. Clean transmission case and all gears thoroughly, and coat with new transmission oil. Then assemble using special care.

2. All gaskets used on the transmission must be new.

3. First place reverse idler gear into the case and insert shaft from rear side. Position shaft lock plate to match groove and pound in after which bolt lock plate securely.

If the reverse idler gear bushing has too much play due to wear, replace with new bushing and adjust so that it will have a minimum clearance of 0.002 inch (0.05 mm).

4. Install countershaft front bearing, and insert countershaft with counter gears into front bearing. Then fit thrust washer and rear bearing to shaft and install.

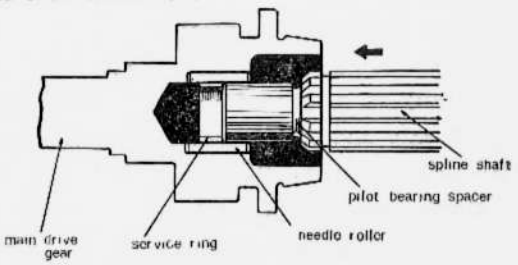
There should be a clearance of 0.1 to 0.45 mm between the counter shaft and thrust washer. Adjust this clearance with rear bearing shim.

5. Assemble on the spline shaft; third speed gear, third synchronizer ring, clutch hub, clutch hub sleeve, shifting keys, and key spring. Then fit snap ring on to shaft.

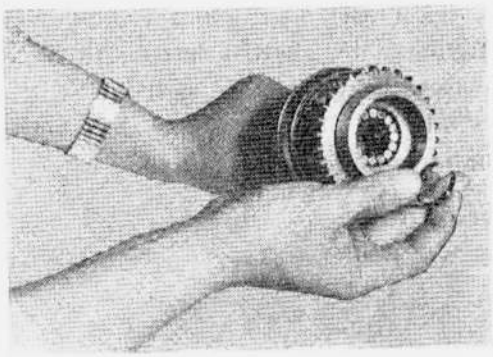
—*NOTE*—The key spring should be installed so that it is tightly pressing the shifting keys outwards. The clutch hub should be installed with the boss facing towards the front side. In installing the third gear bushing, it is necessary that both surfaces be greased in order to prevent it from burning. To eliminate axial play in the clutch hub, the proper size snap ring should be selected to make the adjustment. Snap rings are provided in two size of 2.5 mm thickness and 2.3 mm thickness. Any presence of play in the clutch hub will result in faulty operation of the synchromesh.

6. Assemble top synchronizer ring and pilot bearing spacer. The top and third synchronizer rings are provided with key slots so that the assembly should be made to have the keys in the clutch side fit into these slots.

—*NOTE*—Worn synchronizer rings should be replaced with new parts. When these rings are badly worn, the synchromesh operation becomes faulty and makes speed changing difficult.



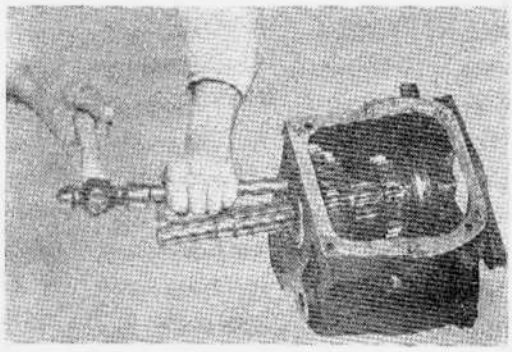
7. Assemble oil deflector on main drive gear and install 16 needle rollers. The

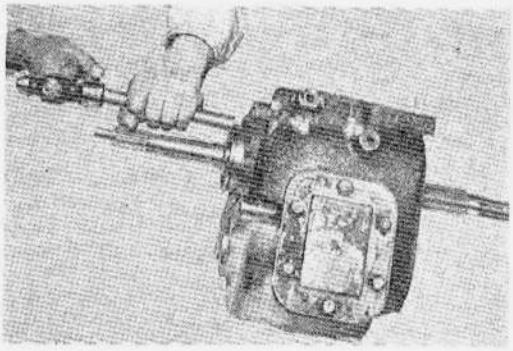


needle rollers are greased and inserted into the main drive gear, and preven ted from falling out with needle roller service ring.

8. The main drive gear is inserted from the inner side of the case in the same manner as when disassembling. Next place low and reverse gear, and second gear inside the case. Then install spline shaft, previously assembled in Articles 5 and 6, into the case in the same manner as when disassembling.

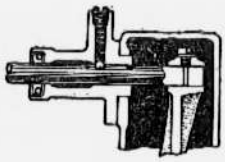
9. Fit on and drive in main drive gear bearing with brass bar, and install bearing lock.





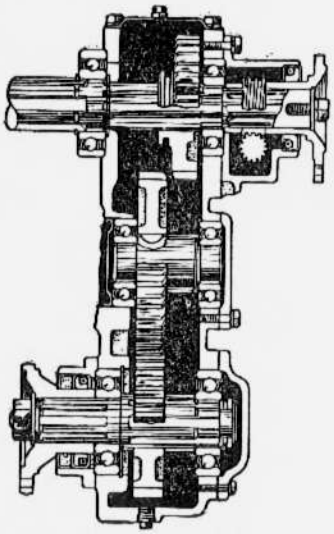
10. Install transmission front bearing lock. Finally pound in spline shaft rear bearing to complete the assembly of the transmission.

TRANSFER CASE



The transfer case is an auxiliary gear mechanism located behind the transmisssion and serves as a transmission for the front drive. The transfer case transmits any gear speed from the transmission to drive the front axle and this together with the power transmitted directly from the transmission to the rear axle makes it possible to obtain a powerful driving action.

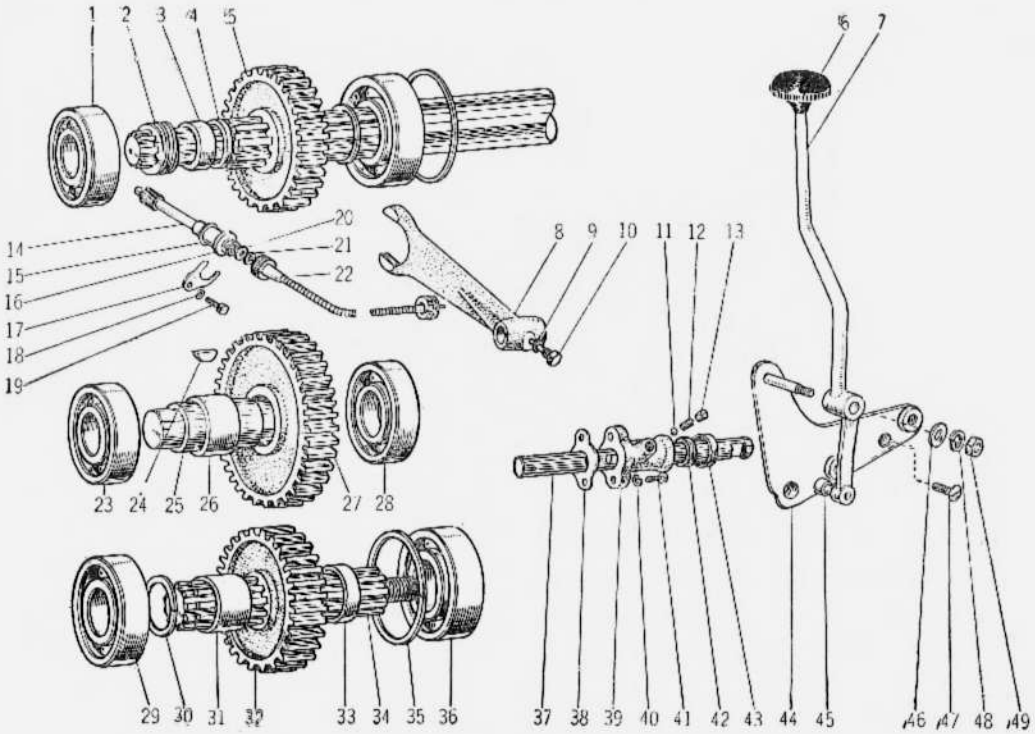
The sliding mechanism is shown in the illustration. Pulling the transfer lever back slides the transfer shift gear on the transmission spline shaft to mesh with the idle gear. This drives the front drive gear which is constantly in mesh with the idle gear. Thus, the front propeller shaft rotates to drive the front axle.



Specifications

Model	Spur gear type
Gear Ratio	1 : 1
Oil Capacity	1 liter

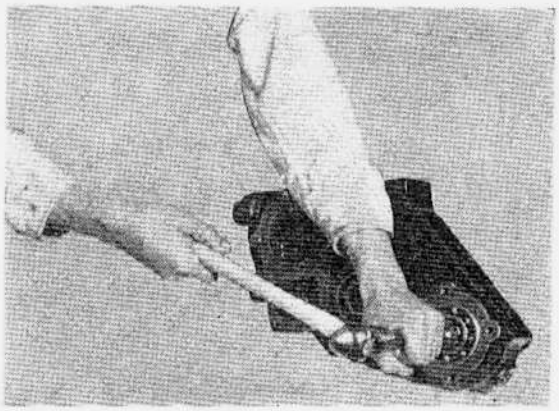
Transfer Gears and Lever



① *Spline Shaft Bearing*
② *Speedometer Drive Gear*
③ *Spacer*
④ *Ring*
⑤ *Transfer Shift Gear*
⑥ *Knob*
⑦ *Shift Lever*
⑧ *Shift Fork*
⑨ *Spring Washer SWII 08*
⑩ *Pin*
⑪ *Lock Ball*
⑫ *Spring*
⑬ *Plug*
⑭ *Speedometer Driven Gear*
⑮ *Packing*
⑯ *Sleeve*
⑰ *Stopper*
⑱ *Spring Washer SWII 08*
⑲ *Bolt TBN 0815*
⑳ *Collar*
㉑ *Packing*
㉒ *Speedometer Cable*
㉓ *Bearing, Same as* ①
㉔ *Key*
㉕ *Idler Gear Shaft*
㉖ *Spacer*
㉗ *Idler Gear*
㉘ *Bearing, Same as* ①
㉙ *Bearing*
㉚ *Snap Ring*
㉛ *Spacer, Same as* ㉖
㉜ *Front Drive Gear*
㉝ *Spacer*
㉞ *Front Drive Shaft*
㉟ *Snap Ring*
㊱ *Bearing*
㊲ *Fork Shaft*
㊳ *Packing*
㊴ *Guide*
㊵ *Spring Washer SWH 08*
㊶ *Bolt TBN 0820*
㊷ *Packing*
㊸ *Lock*
㊹ *Lever Set Plate*
㊺ *Lever Pin*
㊻ *Plate Washer DWL 0010*
㊼ *Set Bolt*
㊽ *Spring Washer SWH 10*
㊾ *Nut TNN 1008*

DISASSEMBLING TRANSFER CASE

1. When the transfer case was removed from the transmission, the transfer shift gear and spline shaft rear bearing were removed.



2. Remove transfer front drive rear bearing cap and snap ring. Knock out drive shaft by hitting with brass bar from the back side as shown in figure. This can also be removed by using Main Drive Gear Puller and pulling out to the front.

Remove drive shaft rear bearing by hitting lightly with brass bar.

3. In the same manner as Paragraph 2, remove bearing lock on the rear side of idle gear shaft and knock out idle gear shaft from the back side together with front bearing lock.

ASSEMBLING TRANSFER CASE

The assembly is made in the reverse order from disassembly as outlined above.

1. Drive in idle gear shaft rear bearing and install bearing lock. Place spacer and idle gear inside case, insert key into shaft and after fitting into key slot in gear, drive in shaft.

2. The drive gear shaft is installed in the same manner except that the thinner gear spacer goes on the front side.

The rest of the assembly is made in the reverse order of disassembly.

TROUBLES IN TRANSMISSION AND TRANSFER CASE

1. Noise Developing

When noise develops, it is usually caused by worn or damaged gears, worn bearings, or lack of lubrication. Noise can also develop from the gears not lining up properly due to twisted spline shaft and similar causes.

A little noise or groaning in the transmission or in any gear mechanism should never be thought of lightly as it frequently is a warning for major trouble to

follow. The mistaken idea of "what about a little noise" should absolutely be forgotten.

When noise develops in the transmission or transfer case, first check lubricating oil. If found satisfactory, remove case cover and check interior carefully. From the type of noises, lack of lubrication and worn gears and bearings will produce a high groaning sound while running. Damaged gears will also produce a groaning sound but this will change to a knocking sound at low speed.

2. Gears Hard to Mesh

When gears are being shifted, a clashing unpleasant sound is produced and gears are exceedingly difficult to shift. This is usually caused by lack of oil inside the case or by the clutch not disengaging properly. In this case, first try adjusting the clutch. If after the clutch is operating properly and the trouble still continues, remove case cover and inspect the interior carefully.

3. Gear Shift Lever Is Heavy.

This is caused in the winter when the oil inside the case hardens and makes it difficult for the sliding gears to shift. In this case, do not force the gears in since this may cause the shift lever to bend or break but engage the clutch and run the engine quietly until the gear oil softens up. To prevent this condition, use the lighter type winter oil or else, if the summer type oil is to be used, mix it with 20% mobiloil.

4. Gears Jumping Out While Running.

The following are the causes for the vibration to make the gears jump out of mesh while running.

a. The gear shift fork is bent so that the sliding gears do not shift fully and result in shallow meshing.

b. Splines worn so that there is looseness between the sliding gear and spline shaft.

c. Gear shift fork lock ball spring weakened.

d. Fork shaft retainer deformed so that the shaft is loose.

e. Bearings badly worn so that spine shaft has excessive clearance in axial direction.

The above parts should be carefully checked and any defective part should be repaired or replaced.

MAINTENANCE INSTRUCTIONS

The transmission is an important unit in the power transmission system. It is subjected to hard usage while the vehicle is in operation and since its construction is composed mainly of gears, its performance will be immediately reflected in the performance of the vehicle and will greatly affect the operation of the vehicle. Thus, in its maintenance, the following instructions should be observed.

1 The low gear should be used only when necessary.

2. Gears should not be shifted roughly but should be shifted carefully and positively

3. Any small noise or abnormal conditions detected should be immediately checked for cause and repairs effected.

4 The case should always be maintained level up to the filler neck with recommended gear oil

a. Oil should be replenished every 5,000 kms.

b. Oil should be changed every 15,000 kms

c However when vehicle is new, change every 5,00 kms

The gear oil recommended for use in Toyota Land Cruiser are as follows.

Below 10°C	SAE No 90
Above 10°C	SAE No 140

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