

GENERAL

The clutch used on the Satoh Beaver (Model S-370 & S-370D) tractor is single plate dry type using a diaphragm that provides not only the spring pressure required to hold the friction disc against the flywheel but also services as the release levers to take up the pressure when the clutch is disengaged.

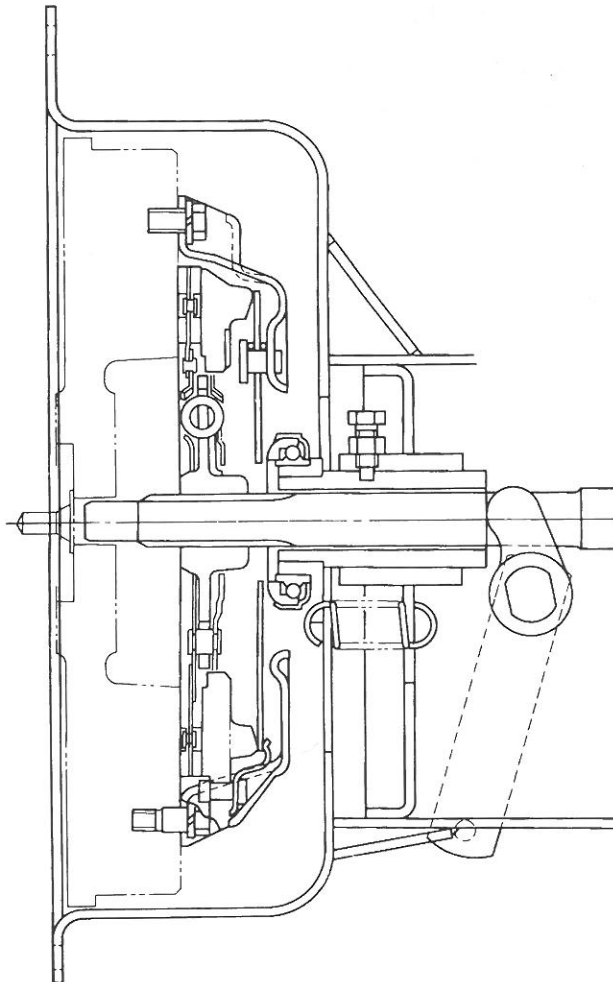
As compared with coil spring type clutches, the device is featuring: —

1. The tapering fingers require by far less pedal effort when taking up the spring pressure when the clutch is disengaged.
This reduces operator fatigue to a minimum and allows smoother shifting of the transmission gears.
2. The spring pressure increases as the clutch facings wear. In clutches using coil springs and

release levers, the spring pressure decreases as the clutch facings wear from the first time. Longer facing life is a feature of the system.

3. The disc-like construction resists distortion due to centrifugal force at higher speeds. The turning effort of the engine is delivered to the transmission without relative movement between the disc and plate when the clutch is engaged.
4. The tapering fingers assure even spring pressure over the entire surface of the pressure plate to hold the clutch disc against the flywheel. When the clutch is disengaged, the diaphragm is dished inward to lift the pressure plate away from the friction disc, there being no distortion in the plate. The clutch is built with ample margin of capacity to transmit the engine power to the transmission. Simple, rugged construction assures long, trouble-free life.

CONSTRUCTION



3-3 CLUTCH SYSTEM

Clutch Disc

1. The clutch disc is spline-fitted to the main shaft of the transmission so that it turns together as a unit when the disc is rotated.
2. The disc is normally held against the machined face of the flywheel by means of the pressure plate. It is light yet of sturdy construction.
3. The facings are rivetted through a cushion plate to the clutch plate and transmit the engine power to the splined hub through a total of 6 torsion springs.
4. They are of a special woven type with steel wires to increase friction.
5. The torsion springs absorb torsional vibration of the engine being transmitted through the clutch at starting and driving on rough surface.
6. Radial grooves in the facings prevent excessive rise in temperature during operation and assure longer life of the facings.

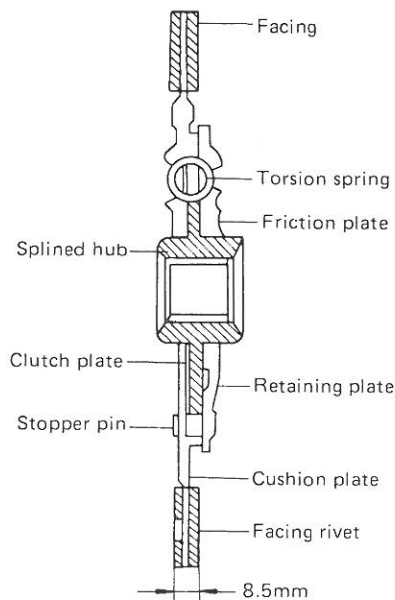


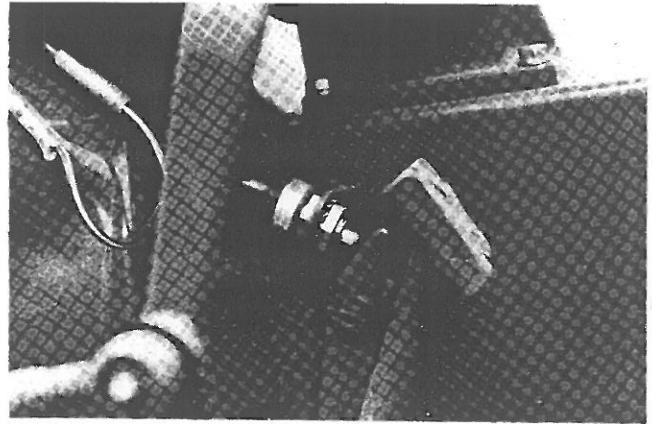
Fig. 3

SAFETY SWITCH

To prevent an accident or a runaway of the tractor when starting the engine, a safety starter switch is provided between the starter switch and starter motor. This switch is positioned on the left side of the clutch housing.

When the clutch pedal is completely depressed, the clutch is disengaged so the flow of engine power to

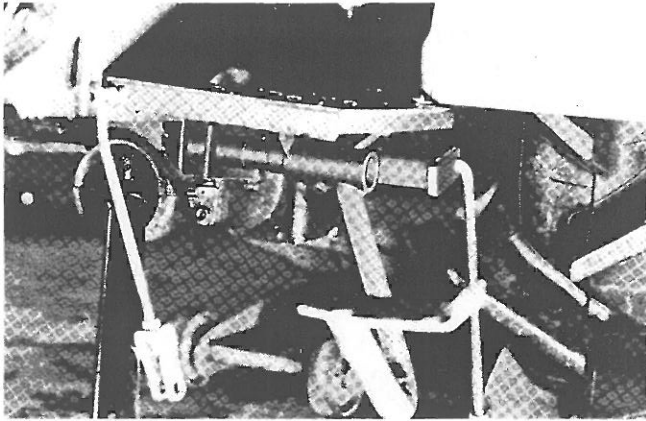
the transmission is interrupted. When the clutch is uncoupled, the safety starter switch is turned on, the starter motor circuit is closed to turn the starter motor.



OPERATION

1. When the clutch is in the engaged condition, the spring pressure between the clutch cover and the pressure plate exerted by the diaphragm spring holds the disc tightly against the machined face of the flywheel.
2. The friction between these surfaces causes the disc to rotate with the flywheel and in this manner transmits the engine power to the transmission.
3. The friction disc uses both a cushioning and a dampening device. The power delivered from the engine passes through the clutch facings, cushion plate, clutch plate and stop pins, retaining plate, clutch plate and retaining plate, torsion springs, splined hub and drive shaft to the transmission gears.
4. The cushion plate provides a cushion effect between the facings whereas the torsion springs absorb torsional vibrations of the engine.
5. When the clutch pedal is depressed to uncouple the clutch, the release collar is moved toward the flywheel, causing the diaphragm to dish inward round the inner pivot rings (wirings).
6. This lifts the pressure plate away from the friction disc through a series of the clips. That is, the clutch is disengaged.

3-5 CLUTCH SYSTEM



3. Remove the clutch pedal return spring and clutch pedal shaft circlip, and remove the clutch pedal.

Note: _____
 On the tractors shipped to Southeast Asian countries in the early stage of shipment, part of the clutch pedals are of shaft type.

INSPECTION, MAINTENANCE, AND WEAR LIMITS

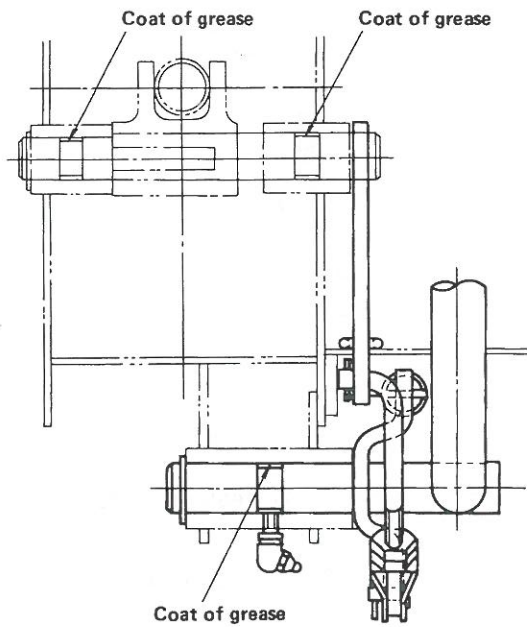
Inspection	Maintenance	Wear Limit
Contact of clutch disc with matching parts, seizure, and cracks	Smooth out if within the wear limit. If exceed wear limit, replace.	If the distance between rivet head and lining is 0.012 in. (0.3 mm) or more, replace.
Oily or greasy clutch disc	Eliminate the cause. If oil or grease is little, wipe it off with cloth damped with gasoline and allow it to dry.	If oil or grease is too much, replace.
Hardened surface of clutch disc	Smooth out hardened surface.	If the distance between rivet top and lining is 0.012 in. (0.3 mm) or more, replace.
Wear on clutch disc	Measure gap between rivet top and lining.	If the distance between rivet top and lining is 0.012 in. (0.3 mm) or more, replace.
Deflection of clutch disc	Rotate the clutch disc, and measure deflection at its outer edge.	If deflects 0.03 in. (1 mm) or more, replace.
Loose rivet		Replace, even if lining thickness is within the allowable limit.
Scratches or burning on pressure plate	Smooth out. Readjust clutch pedal free play properly.	0.0078 in. (0.2 mm) or less
Flatness of pressure plate	If impossible to correct by smoothing out the surface, replace.	0.0078 in. (0.2 mm) or less
Release bearing	Washing is not allowed.	Rotate by hand. If abnormal noise is heard, or it turns irregularly, replace.

3-7 CLUTCH SYSTEM

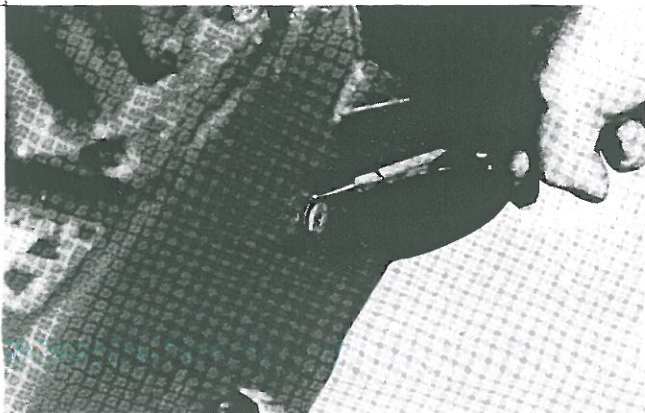
2. Assembling the Release Bearing

1. When reinstalling the release bearing to the bushing, make sure that the release bearing is directed correctly.
2. Apply grease to the slot in the boss, and align the stopper bolt with the slot, and install.
When the stopper bolt is removed:
Slowly screw in the stopper bolts. When the bolt end comes to contact with the slot, back it out 1/3 to 1/2 turn from this position, and lock it with the lock nut.
3. Install the return spring.

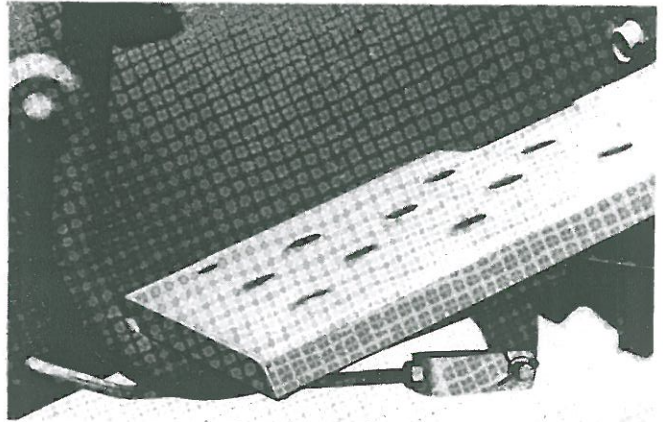
3. Assembling the Clutch Shifter and Clutch Pedal



1. Pack the machined area of release shaft with grease, and install the shift fork.



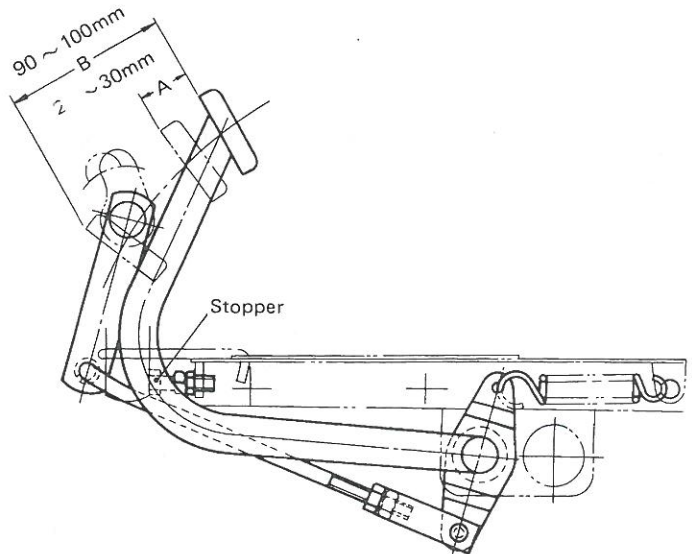
2. Install the circlip to the release shaft.
3. Install the clutch pedal to the clutch housing shaft, and set with the circlip.



4. Install the clutch pedal spring, and set the rod with the pin.

4. Adjusting the Clutch Pedal Free-play

1. The clutch pedal free-play should be adjusted from time to time to compensate for natural wear on the facings. If there is excessive pedal play, even full movement of the pedal to the floor board will not force the clutch release



TROUBLESHOOTING

6-1. Clutch Slips While Engaged

Slipping of the clutch while it is engaged is very hard on the clutch facings. The relative movement between the clutch disc, pressure plate and flywheel causes heat to develop as well as loss of power developed by the engine. It also increases fuel consumption.

Possible cause	Remedy
Too little a pedal play	Adjust to 0.98 ~ 1.18 in. (25 ~ 30mm)
Oil or grease getting on facings	Replace.
Worn clutch disc	If disc is worn too badly so that rivet head recession from top face of facings is 0.0078 in. (0.2 mm), replace a new one.
Too little a pedal play due to wear on facings	Discard old disc and install a new one when rivet head recession is 0.0078 in. (0.2 mm). Adjust pedal free play to 0.98 ~ 1.18 in. (25 ~ 30mm)
Excessive wobbling of disc	Replace if woddling exceeds 0.03 in. (1mm).
Corroded disc splines due to neglected lubricaiton	Remove rust and coat with grease.

6-2. Shudder When Starting

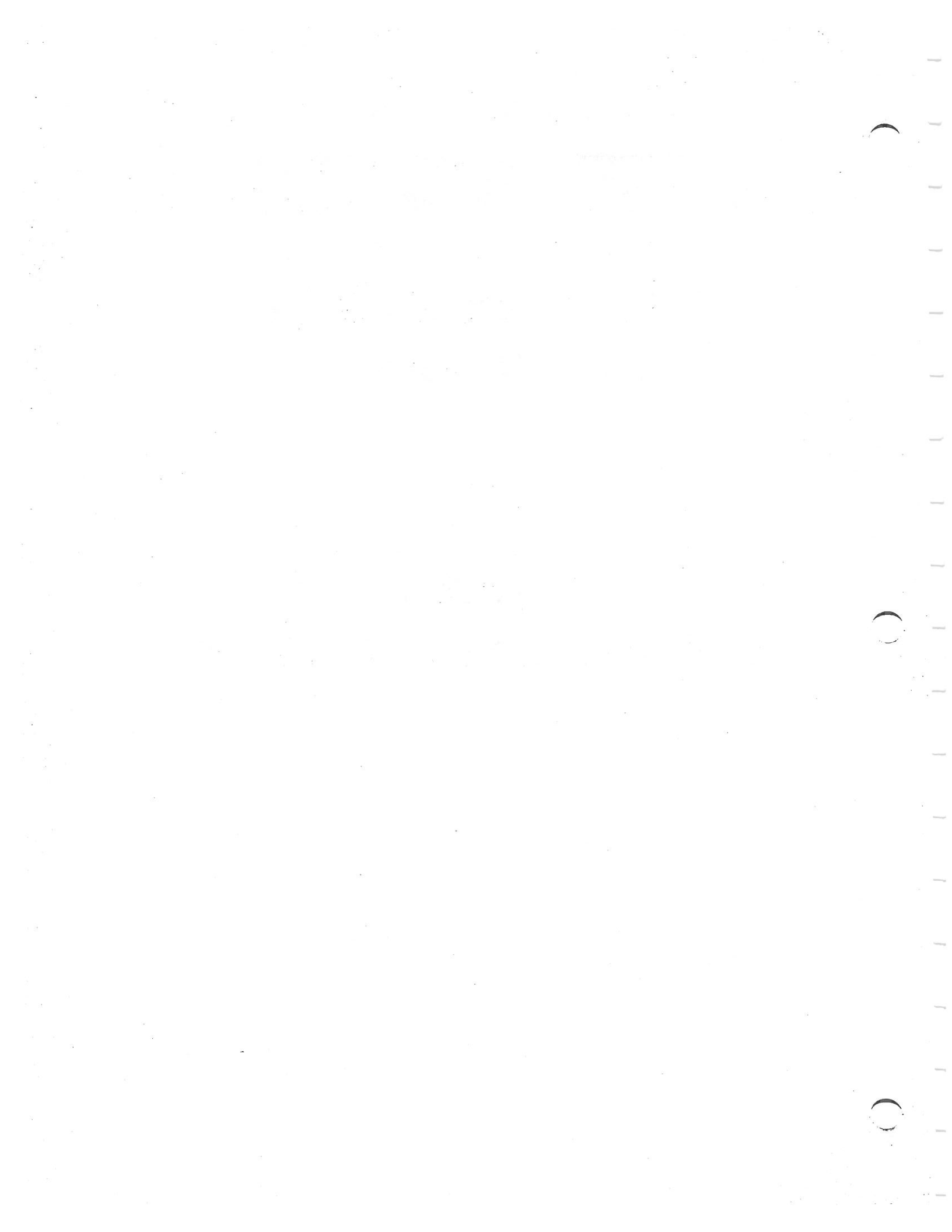
Possible cause	Remedy
Hardened disc surface	Grind it with sandpaper or replace.
Exceeding disc shudder	Replace.
Rust in disc spline groove	Correct and apply grease.
Looseped or damaged tension spring	Replace.

6-3. Clutch Overheats

Possible cause	Remedy
Burnt release bearing	Replace.
Too little play in release bearing	Adjust

7. SPECIFICATIONS

Type	Dry single disc plate diaphragm spring type
Lining material	Wire-reinforced special woven fabric
Dimension of clutch disc (outer x inner x thickness)	7.24 x 5 x 0.307 inch (184 x 127 x 7.8mm)
Static transmission torque	58.61 ft-lb (8.1 kg-m)
Release bearing	Non-lubrication system
Operation	Foot operating system
Clutch disc depressing pressure	429.51 lb (195 kg)
Diaphragm max. operating length	0.27 inch (7mm)
Release lever height	1.22 inch (31mm)



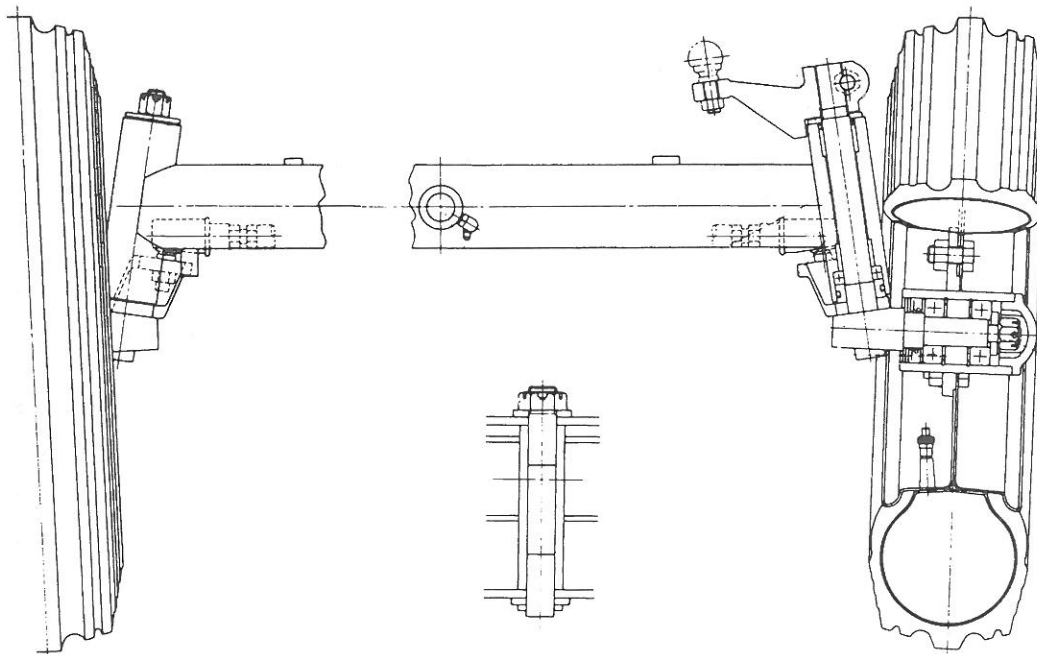
2-WHEEL DRIVE

GENERAL

The Satoh Beaver (Model S-370 & S-370D) steering system is the type that is most widely used for the farm tractors.

The front axle is a center pivot type and provided with a full swinging angle, permitting full-face contact even with a rough ground. King pin is the Lumoan type which allows greater ground clearance and stable steering.

The steering gear is a worm and sector type which offers simple construction and accurate steering.



CONSTRUCTION

The Ackerman Jant steering linkage is employed so that the front wheels can be swung concentrically.

The steering gear has simple construction consisting of a worm and sector gear. The optimum gear ratio permits the most comfortable steering.

The torque applied to the steering wheel is carried to the worm shaft integrated with the worm gear and then to the worm gear integrated with the sector shaft, thus causing the front wheels to turn to right or left.

The pitman arm is connected to the end of the sector shaft, and as the sector shaft turns, the end of the pitman arm moves describing an arc.

The drag link attached to the end of the pitman arm moves back and forth with the movements of the pitman arm, and the steering lever pivots on the king pin. This causes the front wheels to swing, thus steering the tractor.

The steering system consists of the steering gear box incorporating a worm gear and a sector gear, drag links, steering levers, tie rods, front axle, king pins and front wheels.

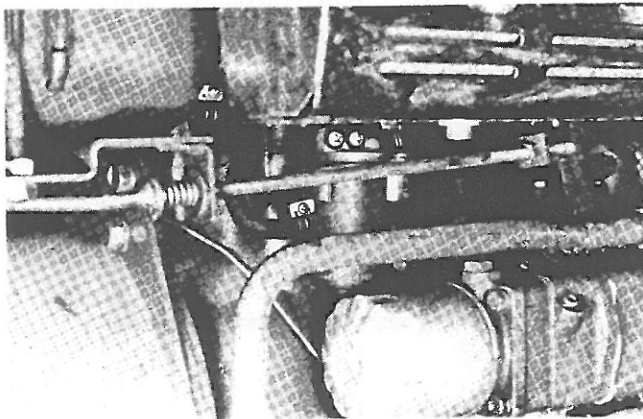
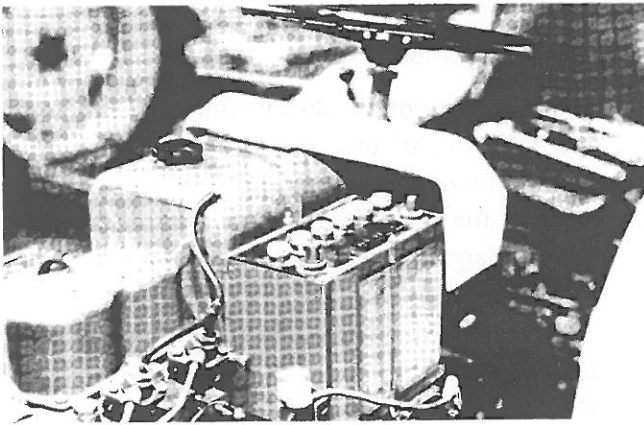
4-3 STEERING LINKAGE SYSTEM

2. Support the front axle, pull out the center pin, and remove the front axle.

DISASSEMBLING THE STEERING GEAR BOX

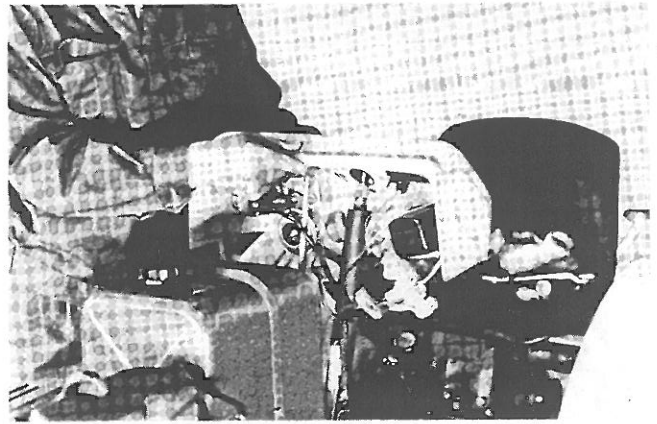
Steering Gear Box Removal

1. Release the hook on the right side of the bonnet, and open the bonnet.
2. Remove the battery cables from the terminals, and remove the battery.
3. Disconnect the fuel pipe from the fuel filter, and take the necessary step so that fuel does not leak out. Disconnect the fuel return pipe from the fuel pipe.

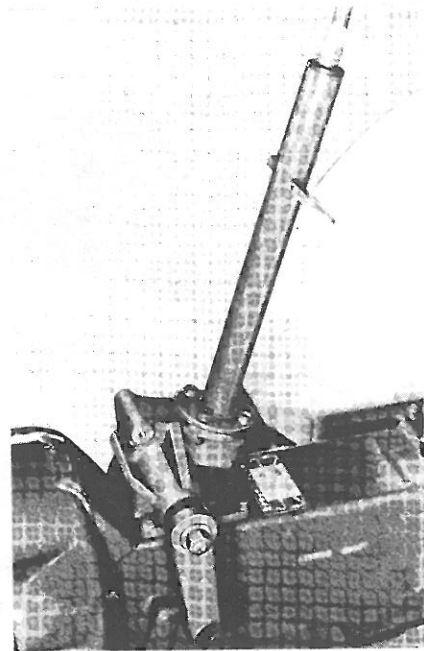


Throttle Lever Removal

1. Remove the steering wheel cap, loosen the steering wheel nut, and remove the steering wheel.
2. Disconnect the lead wires at connectors and terminals.
3. Loosen the three bolts securing the instrument panel, and remove the instrument panel.



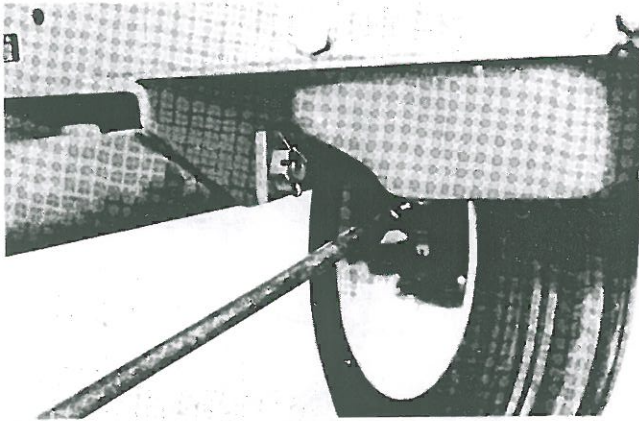
4. Remove the fuel tank, and remove the fuel tank base.
5. Loosen the steering gear box bolts, and remove the steering gear box from the clutch housing.



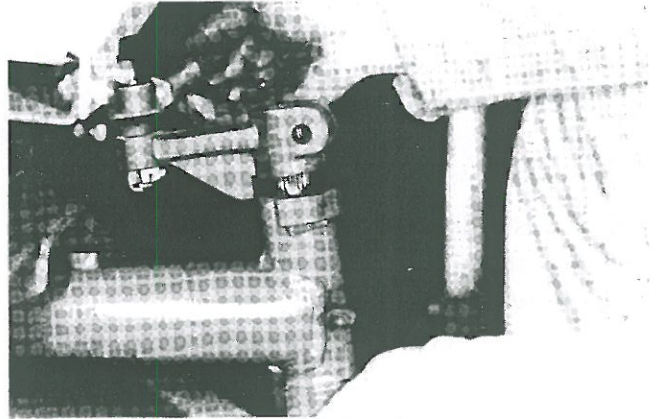
4-5 STEERING LINKAGE SYSTEM

Push the greased center pin to the rear, and tighten the castle nut to specification. Then back it off 1/4 ~ 1/3 turn so that the cotter pin holes can be aligned.

Tightening torque: 108 – 123 ft-lb
(15.0 – 17kg.m)



2. Lock with the cotter pin.
3. Make sure the front axle swings smoothly without end play.
4. Insert the greased oil seal into the king pin, while taking care so that the king pin does not slip off.
5. Install the washer, and align the knuckle arm bold hole with the cut on the king pin, and tighten the bolt.

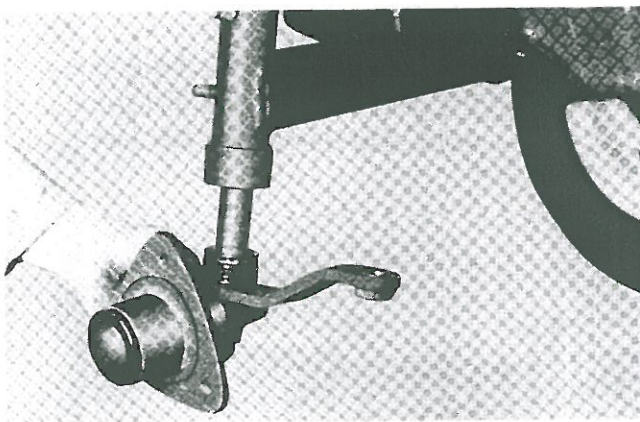


3. Assembling the King Pin

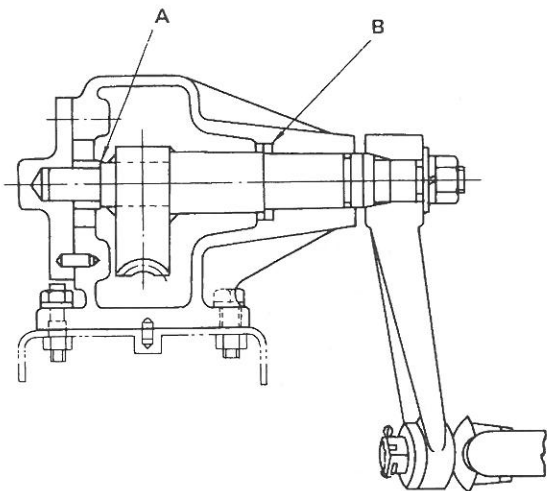
Before installing the front axle to the chassis, insert the bushing into the king pin.

1. Oil the king pin sparingly, and push the bushing into the king pin. Install the grease-coated O-ring.
2. Install the thrust bearing, and apply a liberal amount of grease to it, and install the king pin to the front axle.

Tightening torque: 15.2 – 21.7 ft-lb
(2.1 – 3.0 kg-m)



4-7 STEERING LINKAGE SYSTEM



Note:

Because of improved accuracy of the worm at part B, the liner is not in use as from tractor serial numbers ST1300-700851 (2-wheel drive) and ST1300D-700641 (4-wheel drive).

5. Incorporate the sector shaft in the steering gear box, install the collar and cover, and adjust the play of sector shaft end to 0.004 inch (0.1mm) by inserting shims into the A and B portions.

Adjusting shim

- * 1135-2109-000: 0.004 inch (0.1mm)
- 1135-2112-200: 0.004 inch (0.1mm)
- * 1135-2110-000: 0.008 inch (0.2mm)
- 1135-2111-000: 0.008 inch (0.2mm)
- * 1135-2112-100: 0.012 inch (0.3mm)
- 1135-2112-000: 0.016 inch (0.2mm)

The shim marked * should be used at the B portion.

Select the proper shims for end play of the worm shaft and sector shaft, and proceed as follows:

6. Install the greased O-ring to the sector shaft, install the adjustment shims and collar, and install the cover with the gasket.
7. Place the worm wheel in the case so it faces upward, push the worm shaft (to which the bearing is already installed), and engage the worm wheel with the worm gear.
8. Install the collar, shim, and install the steering column, together with the gasket, in the gear box.

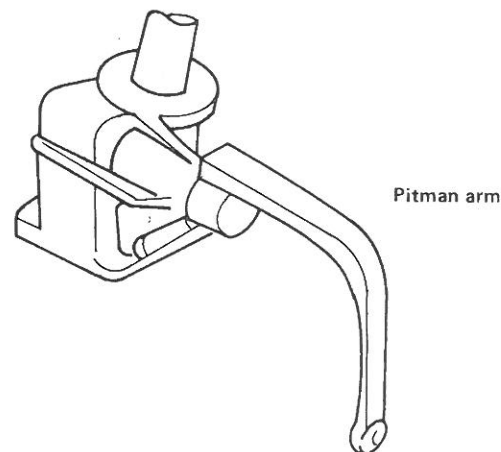
Tightening torque: 8.67 – 12.3 ft-lb
(1.2 – 1.7 kg.m)

9. Align the punch mark on the sector shaft with the punch mark on the pitman arm, and install the pitman arm.

Tightening torque: 86.7 – 101 ft-lb
(12 ~ 14 kg.m)

Note:

The pitman arm used in some models is shaped as illustrated, but it can be installed in the similar way.



10. Install the steering gear box assembly to the clutch housing, while watching the dowel pin position.
11. The fuel tank base, fuel tank, battery, instrument panel, steering wheel, etc. should be installed in the reverse order to the removal.

Tightening torque: 14.4 – 18.1 ft-lb
(2 ~ 2.5 kg.m)

4-WHEEL DRIVE

GENERAL

A 4-wheel drive tractor is capable of easily operating and moving around in places such as marshy land, slippery fields, hilly areas, etc., where an ordinary 2-wheel drive tractor would have difficulty. In the case of a 4-wheel drive tractor, the force applied to the treads of the wheels is more widely distributed than with a 2-wheel drive tractor since all the tires of the tractor work as traction wheels. Consequently the traction of the tractor is considerably increased due to less slippage. The efficiency of the

4-9 STEERING LINKAGE SYSTEM

The knuckle unit has two functions: one is to drive the front tires and the other is to steer them. The spherical portion of the king pin case is hard chrome plated to protect the knuckle from being damaged by protecting the seal from damage due

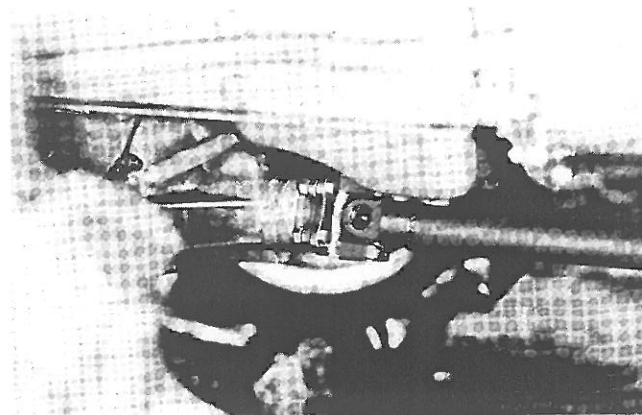
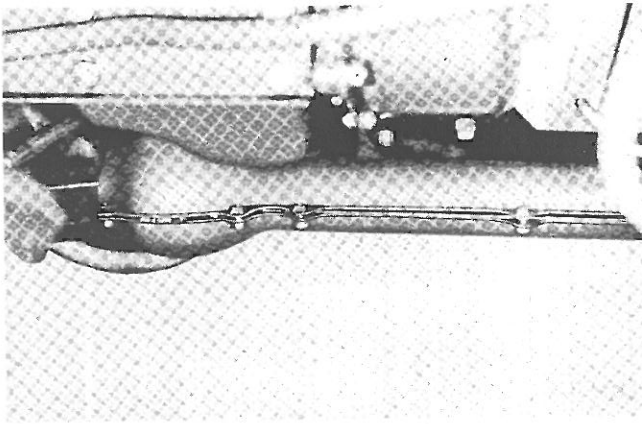
DISASSEMBLING THE 4-WHEEL DRIVE STEERING SYSTEM

Front Axle

1. When disassembling the knuckle assembly only, it is unnecessary to remove the universal joint and differential.
2. This manual describes the general procedure for disassembly and assembly of the 4-wheel drive system. Take the proper disassembling procedure depending on the trouble.

Removing the Universal Joint

1. Loosen the universal joint cover, tightening bolts, and remove the universal joint cover.



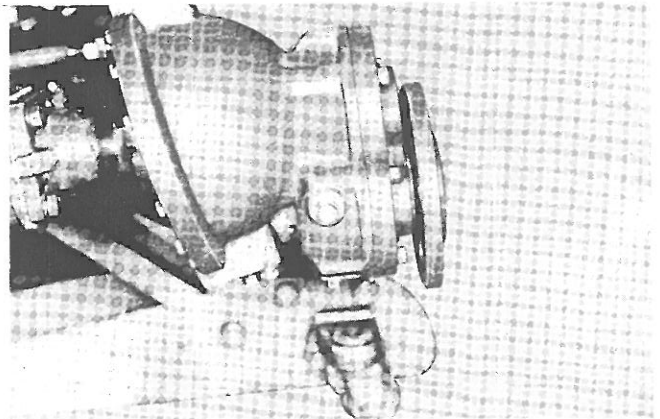
to rust on the spherical portion and muddy water from entering due to a damaged seal, etc.

The steering operation is made easy by reducing the frictional resistance between the spherical portion and seal by this chrome plating.

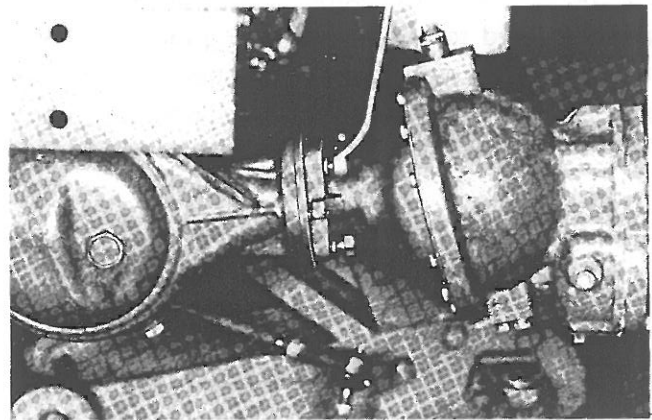
2. Remove the universal joint flange yolk and flange assembly bolt, and remove the universal joint.
3. Remove the cotter pins from the castle nuts on the drag link and tie rod, loosen the castle nut, and remove the drag link and tie rod.

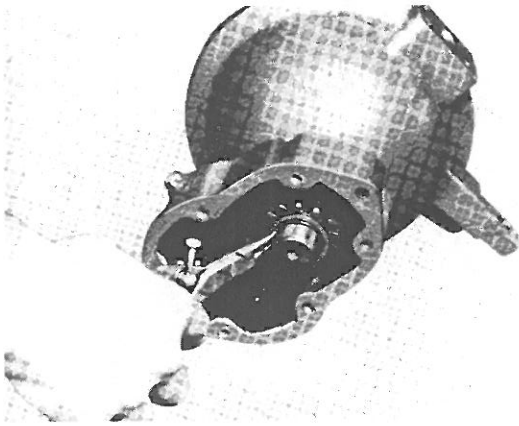
Removing the Knuckle Assembly

1. Jack up the front axle, and remove the front wheel.



2. Loosen the bolt securing the axle housing and knuckle assembly, and remove the knuckle assembly.





2. Remove the ball bearing from the final gear case, and remove the circlip. Remove the gear, and by tapping the shaft, remove the yoke assembly from the final gear case.

Note: _____

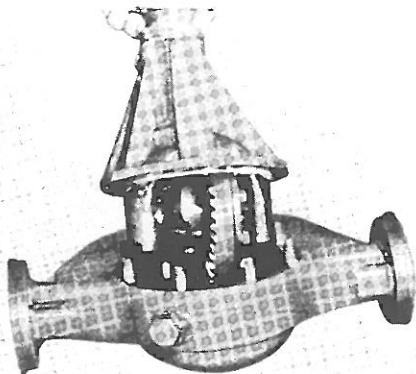
The yoke must be replaced as an assembly.

3. Remove the circlip from the wheel shaft, and by tapping the shaft, remove it from the final gear case (B).
Remove the ball bearing and oil seal.

Disassembling the Axle Housing and Differential Gear Assembly

Normally it is unnecessary to disassemble the axle housing and differential gear assembly. In principle, replacement of a single component is impossible. In case that disassembly is required, proceed as follows:

1. Loosen the differential gear assembly mounting nut, and remove the differential gear assembly from the axle housing.



2. Loosen the bearing holder bolt, and remove the differential gear.
3. Remove the ball bearing from the differential case assembly, loosen the ring gear bolt, and remove the ring gear.
4. Pull out the pin locking the center pin, and pull out the center pin, and remove the pinion gear and side gear as well as thrust washer.

Disassembling the Pinion Gear

1. Loosen the self-lock nut, and pull out the pinion shaft while taking care so that the shim or spacer does not drop.
2. Remove the flange assembly, and remove the oil seal from the flange assembly.

INSPECTION

1. Check the spherical part of the king pin case for scratches or rust.
2. Check the oil seal retainer plate, and if excessively deformed, replace.
3. Check the oil seal felt, and if deformed or damaged, replace.
4. Check the oil seal, and if deformed or damaged, replace.
5. If the king pin O-ring is damaged, replace.
6. Check the smooth rotation of each bearing, and if not, replace.
7. Check the oil seals, and if any one is damaged, though slightly, replace with a new one.
8. Check shafts, gear and joints for damage or wear, and correct or replace as required.

ASSEMBLY

1. Always use new O-rings and oil seals.
2. Thoroughly wash all parts, and apply oil or grease to moving parts. Assemble them in the correct manner.
3. Using special tools, measure the pinion shaft cone center and pre-load correctly.

Assembling the Differential Gear

1. Install the thrust washer and side gear in the differential case, and set the pinion gear and thrust washer with the center pin, and measure the backlash between the side gear and pinion gear.

Backlash: 0.001 – 0.006 inch (0.05 – 0.15mm)

4-13 STEERING LINKAGE SYSTEM

Install the bearing metal, and tighten the bolts evenly. Make sure that the differential gear turns smoothly.

Tightening torque: 10.8 – 14.4 ft-lb
(1.5 – 2 kg-m)

5. Apply a sealing compound to the axle housing, and install the pinion gear case.

Tightening torque: 8.67 – 12.3 ft-lb _____
(1.2 – 1.7 kg-m)

6. Install the axle housing to the chassis, and

adjust the clearance between the chassis and axle housing to $0 - 0.0077$ inch ($0 - 0.2$ mm) using a shim, and lock with the center pin.

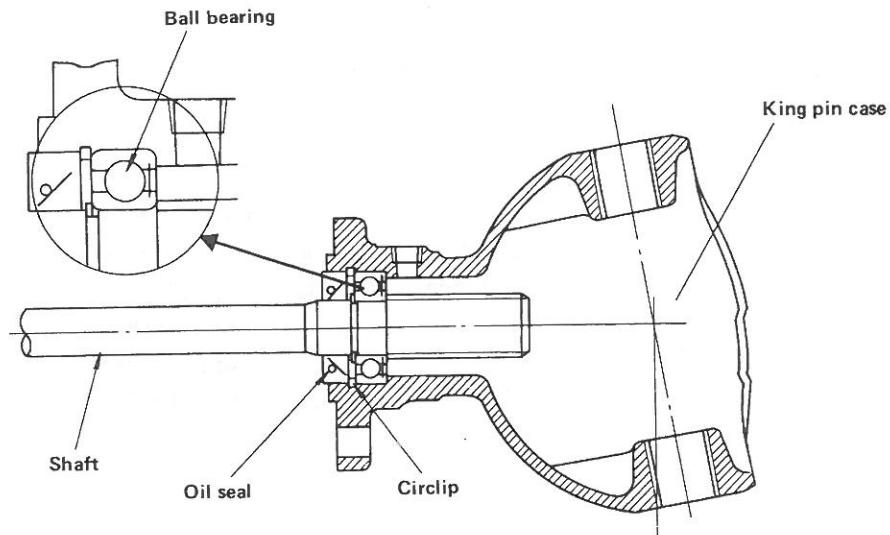
Tightening torque: 43.3 – 50.6 ft-lb
(6.0 – 7.0 kg-m)

Install the grease nipple to the center pin.

7. Make sure that the axle housing swings lightly.

Assembling the Knuckle Assembly

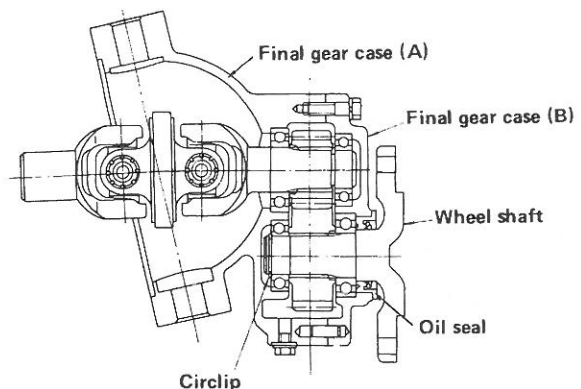
1. Push the ball bearing into the differential shaft so that the sealed surface faces inward, set with the circlip, and install the king pin case.
2. Apply grease to the oil seal, and install the king pin case.



Assembling the Final Gear Case

1. Install the oil seal to the final gear case (B), and apply grease.
2. Install the wheel axle, and install the ball bearing, gear, and ball bearing, in that order. Set with circlips.

Note: The chamfered side must face the oil seal.



4-15 STEERING LINKAGE SYSTEM

5. Set the yoke assembly to the splined portion of the differential shaft in the king pin case, and pack the yoke with 0.44 lbs (200 g) of grease.
6. Install the greased O-ring to the king pin. Install the shim (selected previously) into the hole on top of the final gear case. Install the king pin case and final gear case (A) while keeping the shim in its position with the king pin. Insert the ends of the yoke into the gear case (A) correctly.
7. Insert the key plate into each king pin, and

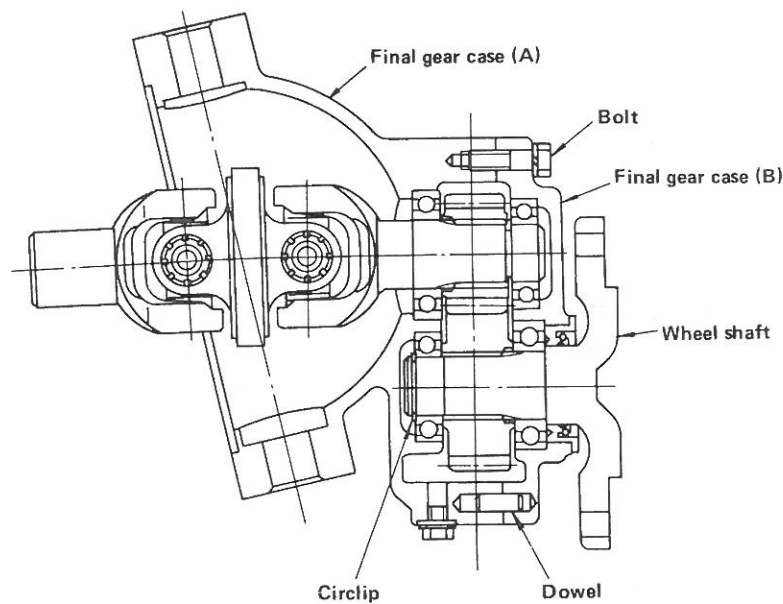
lock with the bolt.

Tightening torque: 18.1 – 21.7 ft-lb
(2.5 ~ 3 kg-m)

Note:

The king pin on the top of the left side final case is longer than the three other king pins since the steering lever is attached to it.

8. Push the ball bearing into the final gear case so that oil seal is on the inner side, and install the gear with the chamfered side on the inner side, and set with the circlip.



9. Apply a sealing compound to the matching surfaces of the final gear cases (A) and (B), install the gasket, and install the final gear case (B) together with the dowel pin.

Tightening torque: 8.67 – 12.3 ft-lb
(1.2 – 1.7 kg-m)

10. Install the oil seal and oil seal felt (which is oiled) to the spherical part, hold them down with the oil seal retainer, and tighten the bolt.

Tightening torque: 3.61 – 5.06 ft-lb
(0.5 – 0.7 kg-m)

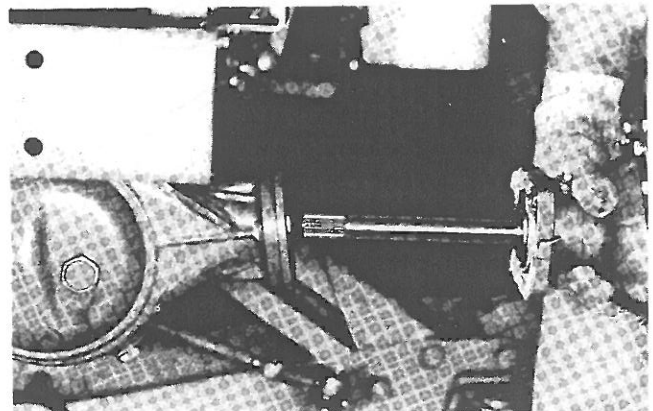
11. Install the steering lever to top of the left side final gear case, and install the key plate, then tighten the bolt.

Tightening torque: 18.1 – 21.7 ft-lb
(2.5 – 3.0 kg-m)

Make sure that the king pin case lightly moves and also the differential shaft turns lightly.

12. Install both right and left knuckle assemblies to the axle housing assembly.

Tightening torque: 36.1 ~ 43.3 ft-lb
(5 ~ 6 kg-m)



4-17 STEERING LINKAGE SYSTEM

SPECIFICATIONS

Steering (2-wheel)	
Steering system	Ackerman Jant Method
Axle center	Center pivot type
King pin type Lumoan	
Steering gear box	Worm sector type
Tread adjustment	With set in adverse
Axle center swing angle	8°
King pin angle	8°
Chamber	2.5°
Caster	3°
Toe-in	0.24 in. (6mm)
Steering angle	
2-wheel	Inside 55°, outside 42.5°
4-wheel	44° ^{-0°} _{-2°}
Gear ratio	1/15
Steering wheel size	14.96 in. (380mm)
Turning radius	
2-wheel (with brake)	66.93 in. (1700mm)
(without brake)	78.74 in. (2000mm)
4-wheel (with brake)	78.74 in. (2000mm)
(without brake)	98.42 in. (2500mm)
Front tire (2-wheel)	
Tire size and ply rating	400-9, 2PR
Tire pattern	Fam service rib
Tire pressure	22.8 lb/in ² (1.6 kg/cm ²)
Outside diameter	17.99 in. (457mm)
Tire width	4.49 in. (113mm)
Loaded radius	286.3 lb (130 kg)
Type of valve	TR-13
Rim	3.00D x 9
Front tire (4-wheel)	
Tire size and ply rating	5-12, 2PR
Tire pattern	AG
Tire pressure	17.1 lb/in ² (1.2 kg/cm ²)
Outside diameter	21.57 in. (548mm)
Tire width	4.92 in. (125mm)
Loaded radius	330.4 lb (150 kg)
Type of valve	TR-13
Rim	4-JA x 12