



Allied Systems
COMPANY
WINCH DIVISION

SERVICE MANUAL

FOR
POWER CONTROLLED
WINCH

W3.5B

OIL BRAKE

SCH

W3A

OIL BRAKE

SCH



SAFETY PRECAUTIONS

Observe the following PRECAUTIONS to prevent injury to personnel and damage to equipment.

- Do not operate winch unless tractor is equipped with a rear screen for operator protection against cable breakage.
- Authorized operators only!
- Report damage or erratic operation of winch or pressure gauge immediately.
- Do not stand while operating the tractor or the winch.
- Make sure that instruments and controls are operative before working the unit.
- Do not use control levers or handles as machine mounting assists.
- Do not use control levers or handles as hangers for clothes, water bags, grease guns, lunch pails, etc.
- Do not permit personnel in the control area when working or making checks on the machine.
- Do not allow riders on the machine or load.
- Use extreme care when operating close to other machines.
- Avoid operating near anyone working or standing.
- Do not stand or permit others to stand in the bight (loop) of a cable.
- Do not stand or permit others to stand near the winch or cable when it is under tension.
- Do not work a damaged cable (broken wire or strands, or a decrease in the diameter of the cable, are warning signs).
- Do not leave the tractor while the winch line is under tension.
- Avoid pulling the hook over the drum and through the throat of the winch.
- Do not anchor a double or two-part line to the winch.
- When not operating the winch, always leave it in neutral with the brake on.
- Never attempt to clean, oil or adjust a machine while it is in motion.
- Use extreme care when removing cable and ferrule from the drum. When the ferrule is released the cable may spring out with force.

Winch Serial Number _____

Date put in service _____

WARNING

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE SERIOUS INJURY OR DEATH

AUTHORIZED, TRAINED OPERATOR ONLY.

KNOW THE EQUIPMENT: Know the operating, inspection, and maintenance instructions in the **Operating Manual**. Do not operate the winch unless the vehicle is equipped with a screen to protect the operator if the cable breaks.

INSPECT THE WINCH BEFORE USE: Make sure that the controls and instruments operate correctly. Report the need for repairs immediately. Do not work with a damaged or worn cable. Do not use a winch that needs repairs. If the cable and ferrule must be removed from the drum, make sure the end of the cable and ferrule are controlled when the ferrule is released. The end of the cable can suddenly move from the drum like a compressed spring when the ferrule is released and cause an injury.

PROTECT YOURSELF: Do not use the control levers for hand holds when entering or leaving the vehicle. Do not permit other people near the control area when you inspect or repair a machine. Never inspect, repair, or do maintenance on a machine that is in motion. Stay in the operator's seat. Do not stand on the vehicle when operating the winch.

KEEP A CLEAR WORK AREA: Avoid winch operation near people or other machines. Never stand nor permit others to stand in the bight (loop) of a cable. Do not stand nor permit others to be near the winch or cable when there is tension on the cable. Observe jobsite rules. Be in complete control at all times.

USE COMMON SENSE: Do not use the control levers as hangers for clothes, water bags, grease guns, lunch pails, etc. Do not leave the vehicle when the winch cable is under tension. Do not permit riders on the vehicle or load. Do not use the winch as an anchor for a double or two-part line. Do not pull the hook through the throat or over the drum and cause damage. When the winch is not in use, make sure the control lever is in **BRAKE ON** position and the winch brake is applied.

WARNING

Indicates a condition that can cause personal injury!

CAUTION

Indicates a condition that can cause property damage!

NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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NOTES

DESCRIPTION

INTRODUCTION

This Service Manual is for the W3A and W3.5B Towing Winches. The following information is given in this manual:

- **Section 1, DESCRIPTION** of the operation and the assemblies are given as an aid for troubleshooting and repair.
- **Section 2, TROUBLESHOOTING** gives a list of some common problems and the possible causes.
- **Section 3, SERVICE** gives a guide for periodic maintenance, checks and adjustments.
- **Section 4, REPAIRS** describes the removal, disassembly, assembly, and installation of the winch.

DESCRIPTION

The W3A winch is the first model of the W3 series of winches and was manufactured from 1982 to 1988. The W3.5B winch is a later model of the same de-

sign manufactured after August 1988. The operation of both models of winches is the same.

The W3A and W3.5B winches have a power forward (LINE IN) function only and is used on skidders and tractors with a constant running power take-off (PTO). The **BRAKE OFF** and **FREESPOOL** functions permit the cable to be pulled from the drum. The **SCH** (Self Contained Hydraulics) indicates that the hydraulic system for winch operation is inside the winch case. A hydraulic pump is connected by a gear drive to the constant running pinion. Access covers on both sides of the winch case permit service repairs and adjustments. The design of the winch case permits different arrangements of PTO assemblies to fit the different skidders and tractors that use this winch.

The W3A winch has a maximum line pull capacity of 133 440 N (30 000 lbf) when there is one layer or less of cable on the drum.

The W3.5B winch has a maximum line pull capacity of 155 680 N (35 000 lbf) when there is one layer or less of cable on the drum. When there is more than one layer of cable on the drum, the maximum line pull capacity is reduced to 133 440 N (30 000 lbf).

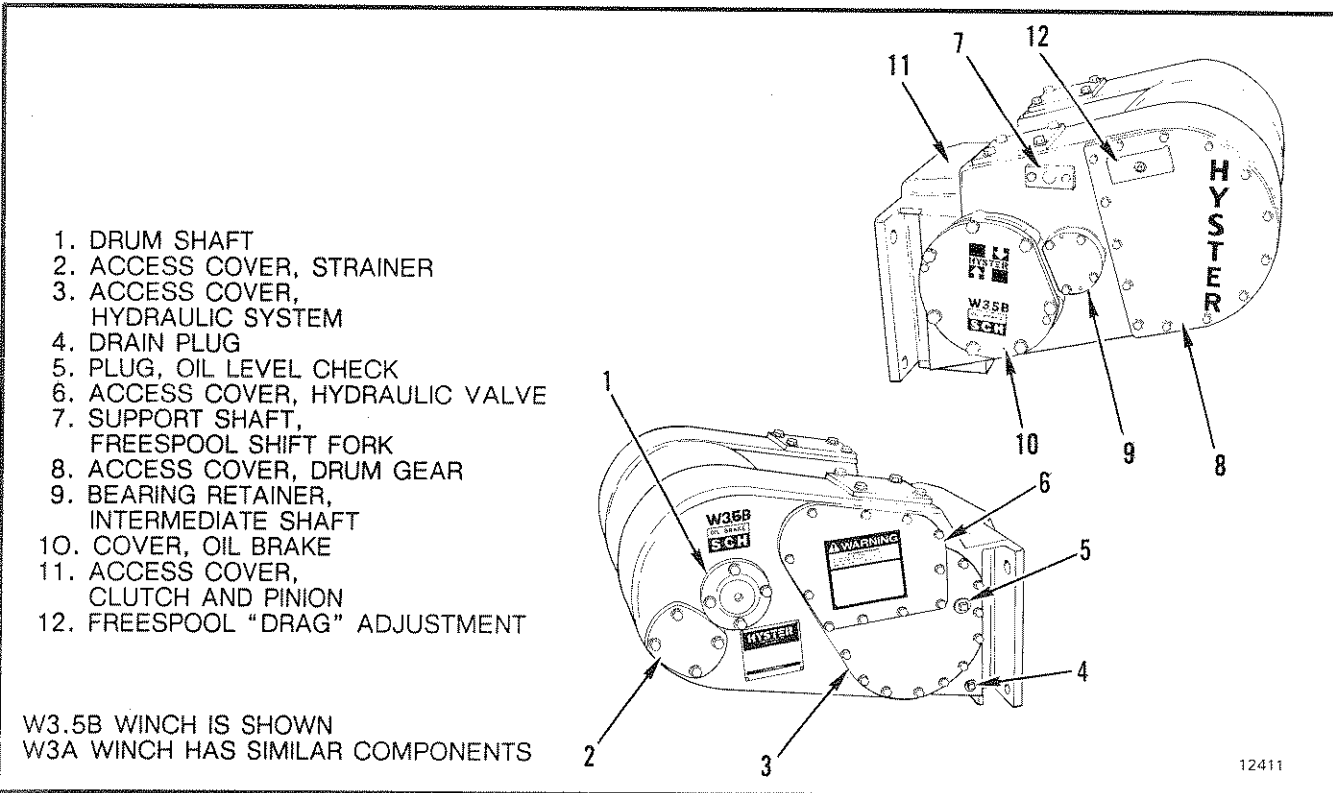


FIGURE 1-1. W3.5B TOWING WINCH



Optional Equipment

(All of the optional equipment is not available for each model of tractor or skidder.) The W3A and W3.5B winch can have the following optional equipment:

- integral arch
- fairlead assembly
- drawbar
- alternate gear ratio
- alternate drum size

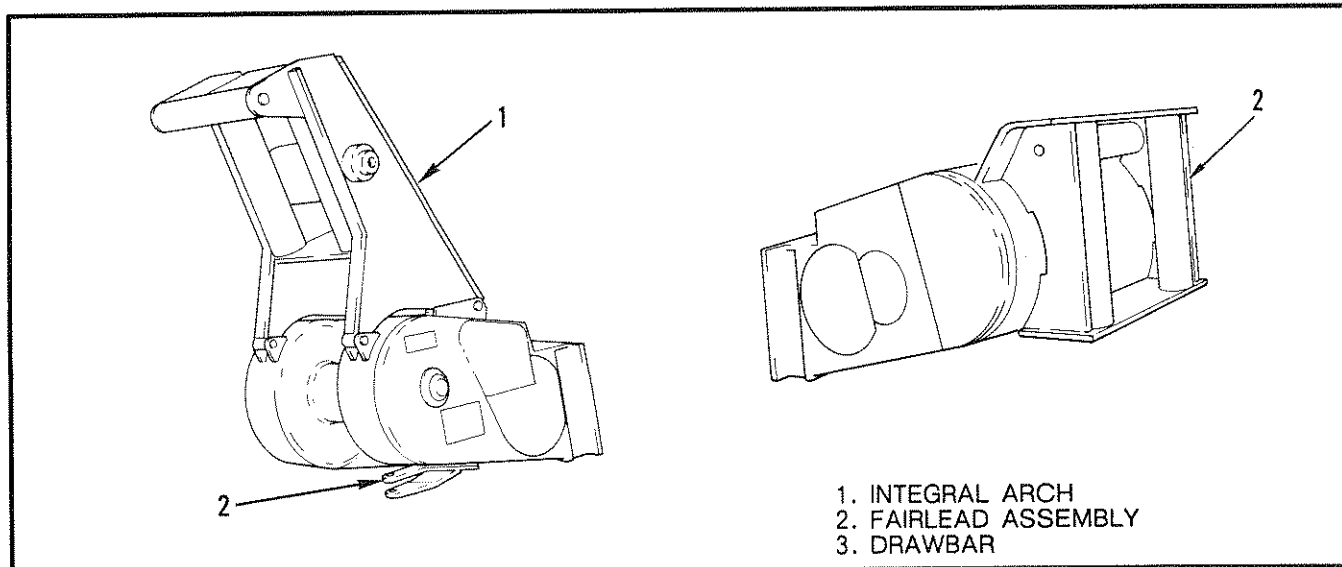


FIGURE 1-2. W3.5B TOWING WINCH, OPTIONAL EQUIPMENT

Serial Number Codes

The nameplate with the serial number code is found below the drum shaft on the right side of the winch case. The serial number code is also stamped on the top of the winch case near the cover for the control valve. A serial number indicates the following information:

W3.5B P 3 A 1565 C12
1 2 3 4 5 6

where:

- 1 = Winch Model
- 2 = Type of winch drive:
(P = Power Controlled Winch)
- 3 = Gear ratio code (see TABLE 1.)
- 4 = A = LINE IN Only with FREESPOOL
- 5 = Sequence number of manufacture
- 6 = Application code for the model of skidder or tractor (see TABLE 1.)

	FIATALLIS	CATERPILLAR	TIMBERJACK	JOHN DEERE	IHC/DRESSER	KOMATSU	CASE	
APPL. CODE	A	C	D	E	H	K	R	GEAR RATIO CODE
11	FD5, FL5 FL5, FL7 *2, #1	D3B *1, #2		450E, 550B 455E, 555B *5, #2	TD7E (Note 3) *1, #2	D31 D37 *2	450B *1, #2	1 = 29.7:1 2 = 49.8:1 3 = 19.8:1
12		518 (Note 1) *3	350/380/450 *4	450G/650G *5, #2	TD8E *1, #2		850B (Note 4) *1, #2	4 = 26.2:1 5 = 39.4:1
13		518 (Note 2) *3	(Note 1) CAT 518 S/N 50S3202 & 55U662 TO 94U1298 & 95U1185 (Note 2) CAT 518 S/N 94U1298 & 95U1185 & UP (Note 3) IHC TD7E beginning with S/N Prefix 4410019 (Note 4) IHC TD8E beginning with S/N Prefix 4420012					
	* Indicates standard gear ratio							
	# Indicates optional gear ratio							

TABLE 1. TRACTOR OR SKIDDER APPLICATION CODES



CABLE DIAMETER	DRUM CAPACITY	
	Drum Diameter = 178 mm (7 in)	Drum Diameter = 216 mm (8.5 in)
16 mm (5/8 in)	65 m (212 ft)	56 m (184 ft)
19 mm (3/4 in)	45 m (147 ft)	39 m (128 ft)

TABLE 2. DRUM LINE CAPACITIES

OPERATION AND CONTROL

Two control levers are used for winch control. See FIGURE 1-3. The power control lever is used to select one of the following operations:

- **LINE IN**
- **BRAKE ON**
- **BRAKE OFF** (brake release inching)
- **BRAKE OFF (DETENT)**

Except for the **BRAKE OFF (DETENT)** position, the power control lever will return to the **BRAKE ON** (neutral) position when the control lever is released. A spring arrangement on the spool of the control valve returns the spool and control lever to the **BRAKE ON** position. A ball and detent will hold the spool and control lever in the **BRAKE OFF (DETENT)** position. The operator must pull the

control lever from the **BRAKE OFF (DETENT)** position.

The **FREESPOOL** control lever has two positions: **POWER** and **FREESPOOL**. The **FREESPOOL** control lever disengages the gear train so that the cable can be pulled from the winch by hand.

Power Operation

The **BRAKE ON** position is a neutral position. The clutch is not applied. The conical washer springs (also called belleville springs) in the brake fully apply the brake. The winch drum will not turn.

The **LINE IN** position applies the **LINE IN** clutch and releases the brake. The winch will wind the cable at a speed controlled by the engine rpm or the output of the torque converter of the vehicle.

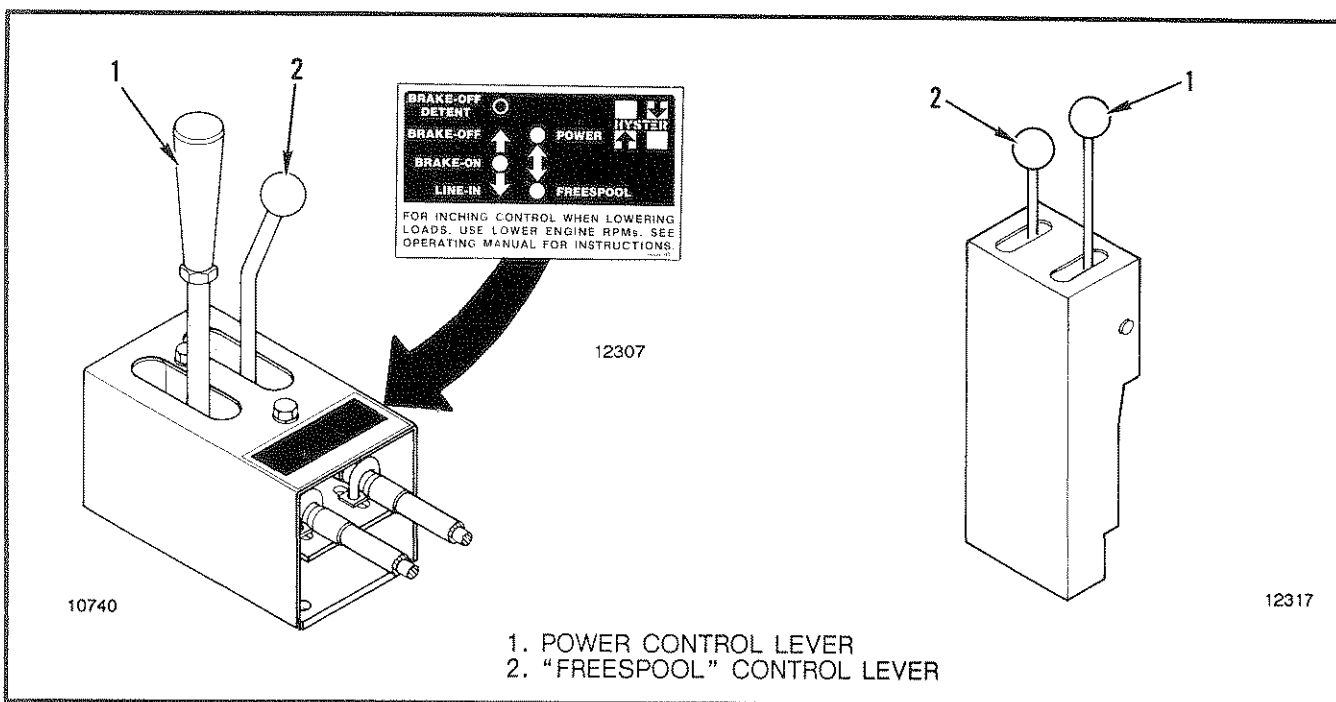


FIGURE 1-3. OPERATOR CONTROLS



BRAKE OFF (brake release inching) occurs when the operator moves the control lever towards the **BRAKE OFF** position. If there is a load on the cable, this action will slowly release the brake and permit the cable to unwind against the partial brake friction. The brake friction is controlled by the distance that the operator pushes the control lever toward the **BRAKE OFF** position.

NOTE: The PTO speed is important so that the hydraulic pump in the winch sends a minimum of 11 litres/min (3 gpm) to the control valve for best control of **BRAKE OFF** (brake release inching). The PTO speed of most skidders or tractors must be approximately 700 rpm. The best PTO speed is approximately 500 rpm for the Caterpillar® Model 518 (ONLY with serial numbers 50S3202 & 55U662 to 94U1298 & 95U1185) and the Case® Models 450 and 850.

The **BRAKE OFF (DETENT)** position completely releases the brake and does not apply hydraulic pressure to the clutch. If there is a load on the cable, this position will permit the cable to unwind from the drum against the friction of the clutch, brake, and gear train. The speed that the cable unwinds is not controlled by the operator, but by the movement of the load or the travel speed of the vehicle.

FREESPOOL Operations

WARNING

The control lever normally can not be moved to the **FREESPOOL** position if there is a load on the cable. If enough force were used to disengage the gear train for the **FREESPOOL** operation, an uncontrolled release of the load will occur. Loss of the load can result in injury and damage.

When the **FREESPOOL** control lever is moved to the **FREESPOOL** position, the winch drum is disengaged from the gear train. The **FREESPOOL** operation permits the cable to be pulled from the winch drum by hand.

GEAR TRAIN (See FIGURE 1-4.)

Part of the gear train is connected to the pinion and is constant running. The pinion turns a bevel ring gear and hub that is connected to the bevel gear shaft. A large spur gear at the hydraulics end of the bevel gear shaft turns the hydraulic pump. See FIGURE 1-6. and FIGURE 1-7. The splines of the bevel gear shaft engage splines in the clutch. The separator plates of the clutch are engaged in the splines of the clutch hub and turn with the bevel gear shaft.

The clutch carrier has an extension that engages the hub in the brake. See FIGURE 1-4. The clutch carrier, extension, and the intermediate pinion gear are a single machined part.

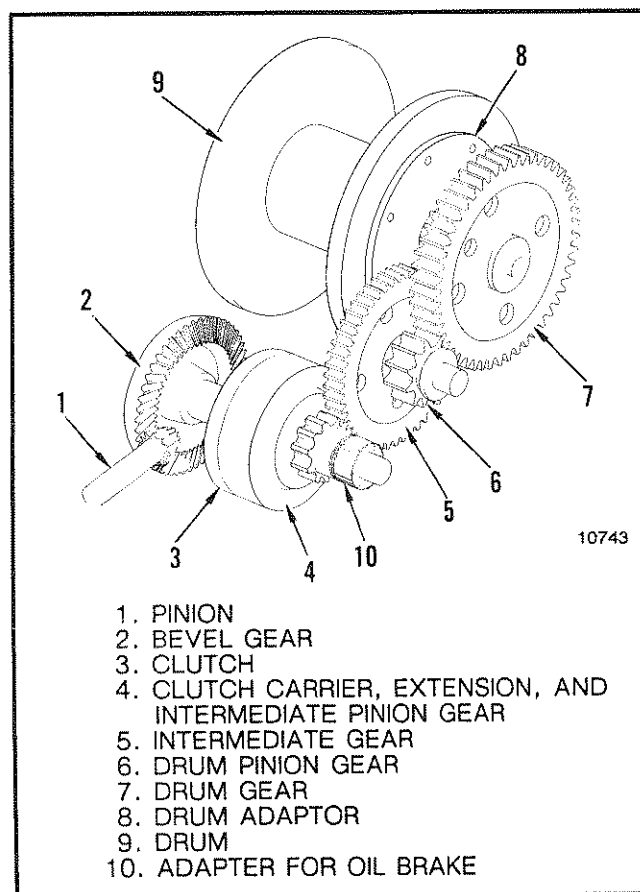


FIGURE 1-4. GEAR TRAIN

The oil brake holds the winch drum in a fixed position when no power operation occurs. When the clutch is applied, the brake is released by the same oil pressure that permits the clutch carrier to rotate.



The power is transferred from the PTO of the tractor through the clutch to the intermediate pinion gear and to the gear train. When the clutch is not applied, conical washer springs apply the brake.

Some tractors have a PTO that must connect to the at a lower position on the winch case than other tractors. A gear case is added to the front of the winch case for these models so that the PTO can be connected through a gear train to the pinion for the bevel gear. See FIGURE 4-3.

An intermediate gear assembly gives a gear reduction to increase the torque at the winch drum. A drum pinion gear engages and disengages from the intermediate gear to to give the **FREESPOOL** operation. (See FIGURE 1-5.) The operator can disengage or engage the drum pinion gear with the intermediate gear with the hand lever. The **FREESPOOL** operation disengages the gear train from the brake and clutch so that cable can be pulled from the drum by hand. Only the drum, drum gear, and drum pinion gear are rotated in the **FREESPOOL** operation.

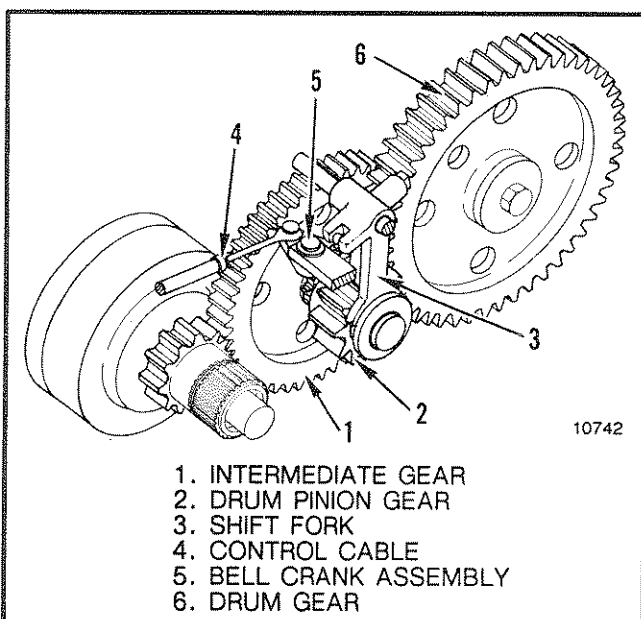


FIGURE 1-5. FREESPOOL SELECTOR

The drum gear engages the drum pinion gear and is connected to the drum through a drum adapter. The left side of the winch case has a bearing support for the tapered roller bearings that hold the drum

adapter. The right side of the drum runs on roller bearings held by a drum shaft. The drum shaft is connected to the winch case. When the clutch is applied, the power is sent through the gear train and causes the drum to rotate in the **LINE IN** direction. The rotating resistance of the drum in **FREESPOOL** is controlled by the preload on the bearings for the drum adapter and the "drag" adjustment installed on the cover of the drum gear.

HYDRAULIC CONTROL

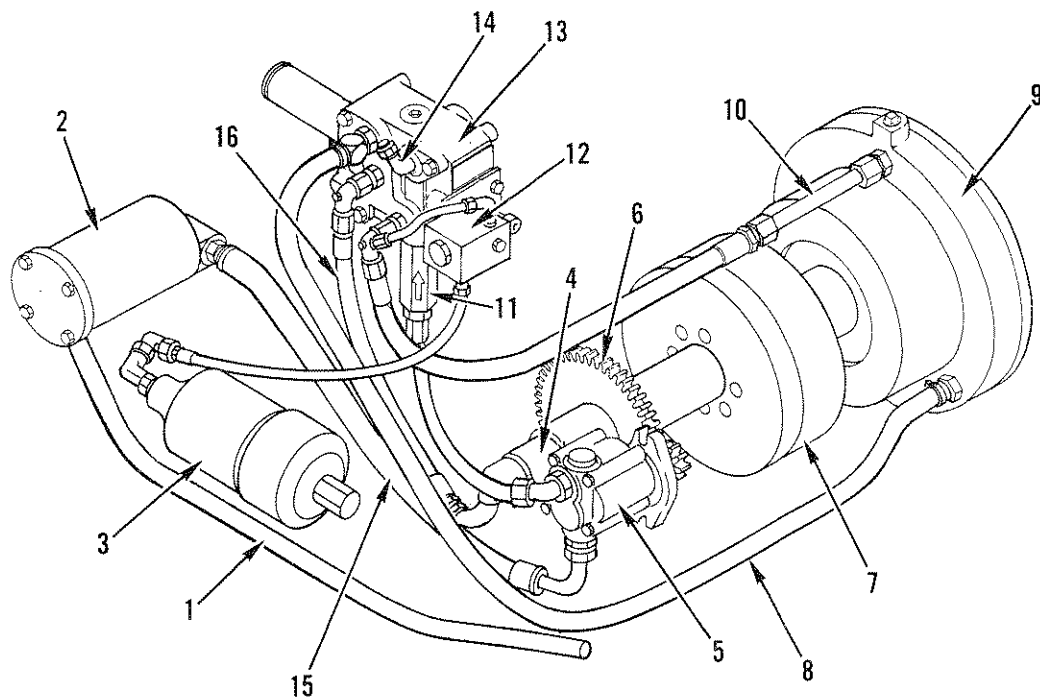
The operation of the winch is controlled by a hydraulic circuit. The design of the hydraulic circuit is different between the W3A and the W3.5B winches, but the operation is similar. See FIGURE 1-6, and FIGURE 1-7. A hydraulic gear pump is connected to the bevel gear shaft through a spur gear. The bottom of the winch case is the sump for the hydraulic oil. Oil flows through the suction line to the strainer before entering the pump and hydraulic system. The strainer keeps dirt and other particles out of the hydraulic system. The output of the hydraulic pump flows to the hydraulic control valve. A control lever near the operator's seat is connected to the control valve through a cable so that the operator can control the valve. The control valve controls the flow and pressure of the hydraulic oil to the clutch and the brake when the hand lever is moved.

An accumulator valve is fastened to the control valve. The purpose of the accumulator valve and accumulators is to quickly send pressurized oil to the clutch and reduce the application time of the clutch. The accumulator also permits the release of the winch brake if the tractor engine or the hydraulic pump is not operating. The accumulator valve is actuated by a cam on the control valve spool. The cam opens the accumulator valve when the control valve spool is moved from the **BRAKE ON** (neutral) position.

When the hydraulic pump is operating, a pressure of 1725 kPa (250 psi) can be in the hydraulic system. The accumulators are charged to the hydraulic system pressure when the hydraulic pump is operating. The accumulators discharge into the control valve when the control valve spool is moved to the **LINE**

IN, BRAKE OFF (brake release inching) and the BRAKE OFF (DETENT) positions. If the hydraulic pump is operating, the accumulators stay charged. If the hydraulic pump is not operating, this dis-

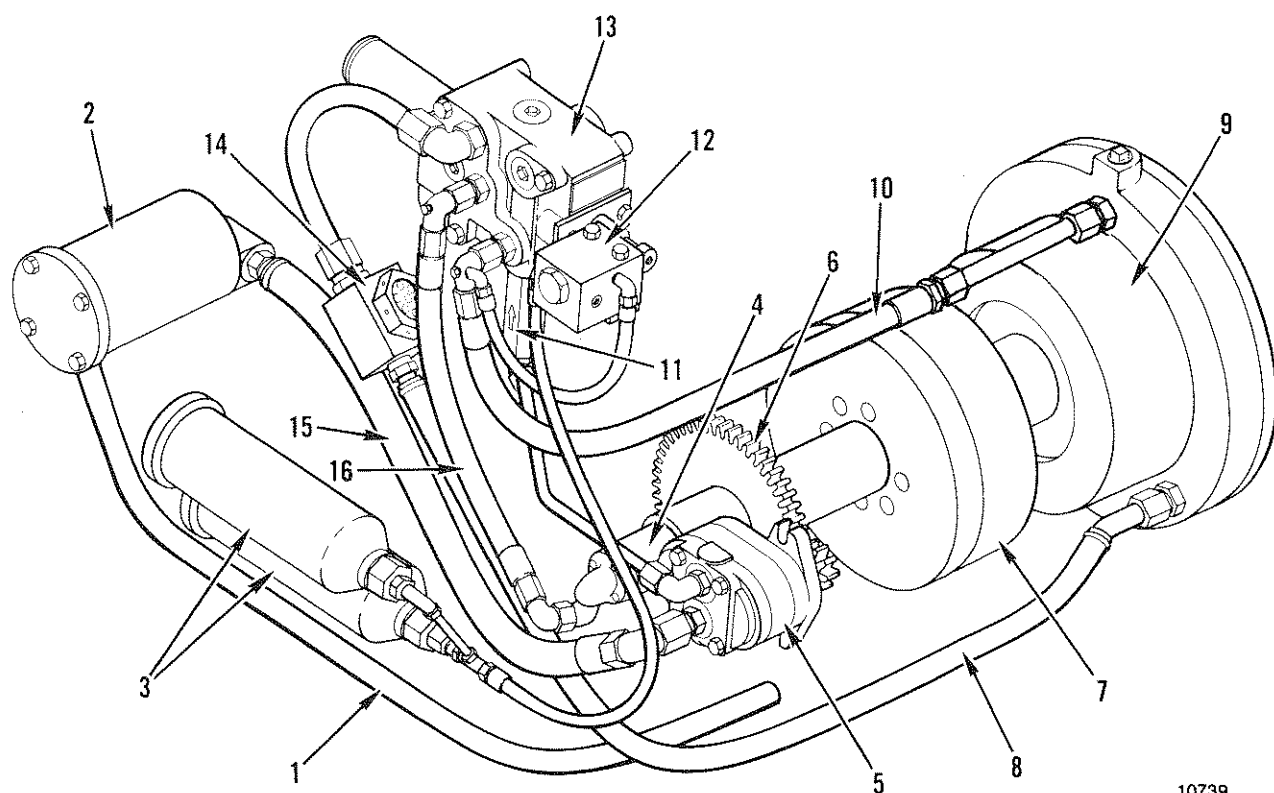
charge from the accumulators permits the release of the winch brake. A description of the hydraulic circuit is shown in FIGURE 1-16, through FIGURE 1-19.



10739

- | | |
|----------------------------------|-------------------------------------|
| 1. SUCTION (INLET) LINE | 9. OIL BRAKE |
| 2. STRAINER | 10. PRESSURE LINE FOR BRAKE RELEASE |
| 3. ACCUMULATOR | 11. CHECK VALVE |
| 4. ROTARY JOINT | 12. ACCUMULATOR VALVE |
| 5. HYDRAULIC PUMP | 13. CONTROL VALVE |
| 6. DRIVE GEAR FOR HYDRAULIC PUMP | 14. RELIEF VALVE FOR COOLING OIL |
| 7. CLUTCH | 15. INLET HOSE TO PUMP |
| 8. HOSE FOR COOLING OIL | 16. PRESSURE HOSE FOR CLUTCH |

FIGURE 1-6. HYDRAULIC SYSTEM, W3.5B WINCH



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- | | |
|----------------------------------|-------------------------------------|
| 1. SUCTION (INLET) LINE | 9. OIL BRAKE |
| 2. STRAINER | 10. PRESSURE LINE FOR BRAKE RELEASE |
| 3. ACCUMULATOR | 11. CHECK VALVE |
| 4. ROTARY JOINT | 12. ACCUMULATOR VALVE |
| 5. HYDRAULIC PUMP | 13. CONTROL VALVE |
| 6. DRIVE GEAR FOR HYDRAULIC PUMP | 14. RELIEF VALVE FOR COOLING OIL |
| 7. CLUTCH | 15. INLET HOSE TO PUMP |
| 8. HOSE FOR COOLING OIL | 16. PRESSURE HOSE FOR CLUTCH |

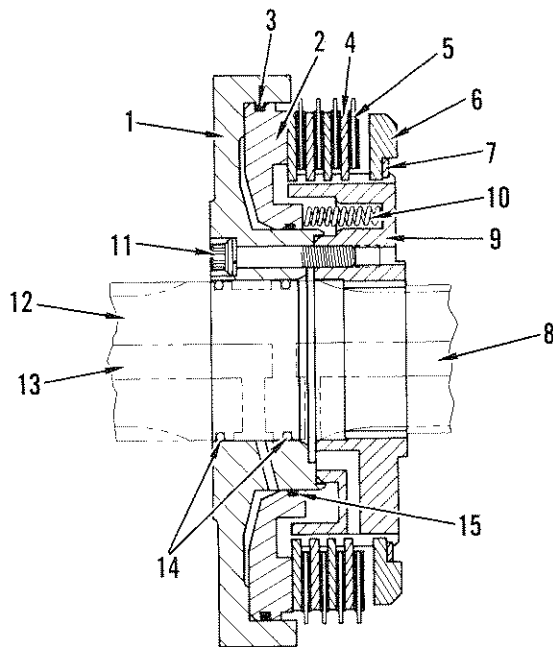
FIGURE 1-7. HYDRAULIC SYSTEM, W3A WINCH

Oil Clutch

The **LINE IN** clutch assembly has four friction discs, four separator plates, a piston housing, piston assembly and carrier. See FIGURE 1-8. The splines of the clutch hub are engaged in the splines of the bevel gear shaft. The separator plates of the clutch are engaged in the clutch hub and turn with the bevel gear shaft. The friction discs have large splines that fit the splines in the carrier. The friction discs rotate with the carrier. The piston and piston housing rotate on the bevel gear shaft next to the carrier. Oil passages in the bevel gear shaft supply the oil pressure from the control valve to the piston. When the oil pressure pushes the piston against the separator plates and friction discs, the clutch is ap-

plied. The torque from the pinion and bevel gear shaft is applied through the clutch and causes the winch to operate. An oil passage is drilled through the bevel gear shaft from the brake to the clutch. This oil passage supplies cooling oil to the clutch and lubrication to the shaft bearings.

Some tractors have a PTO that rotate in a clockwise direction and other tractors have a PTO that rotates counter-clockwise. Because of this difference in PTO rotation, the bevel gear and pinion arrangement must be changed on the bevel gear shaft. See FIGURE 1-9. This change in the bevel gear and pinion arrangement keeps the correct drum rotation for the **LINE IN** function.

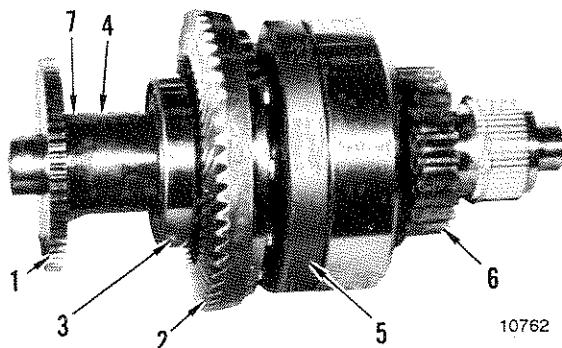


1. HOUSING
2. PISTON
3. PISTON SEAL
4. SEPARATOR PLATE (4)
5. FRICTION DISC (4)
6. END PLATE
7. SNAP RING
8. PASSAGE FOR COOLING OIL
9. HUB
10. RETURN SPRING (16)
11. 12-POINT CAPSCREW
12. BEVEL GEAR SHAFT
13. PASSAGE FOR PRESSURIZED OIL
14. O-RING
15. PISTON SEAL

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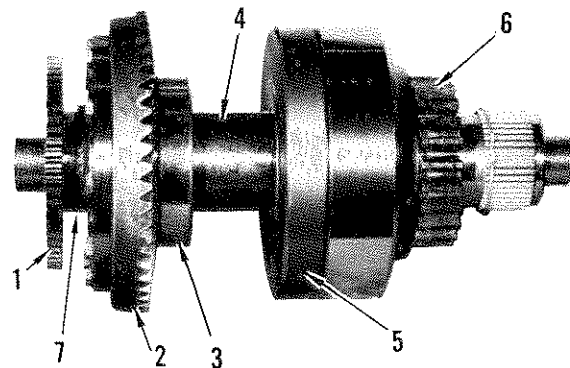
FIGURE 1-8. OIL CLUTCH ASSEMBLY

ARRANGEMENT WHEN TRACTOR PTO ROTATES COUNTER-CLOCKWISE (OR CLOCKWISE IF A GEAR CASE IS USED)



LOCATION OF THE BEVEL GEAR IS ON THE LEFT

ARRANGEMENT WHEN TRACTOR PTO ROTATES CLOCKWISE (OR COUNTER-CLOCKWISE IF A GEAR CASE IS USED)



LOCATION OF THE BEVEL GEAR IS ON THE RIGHT

1. DRIVE GEAR FOR HYDRAULIC PUMP
2. BEVEL GEAR
3. CENTER BALL BEARING
4. SPACER

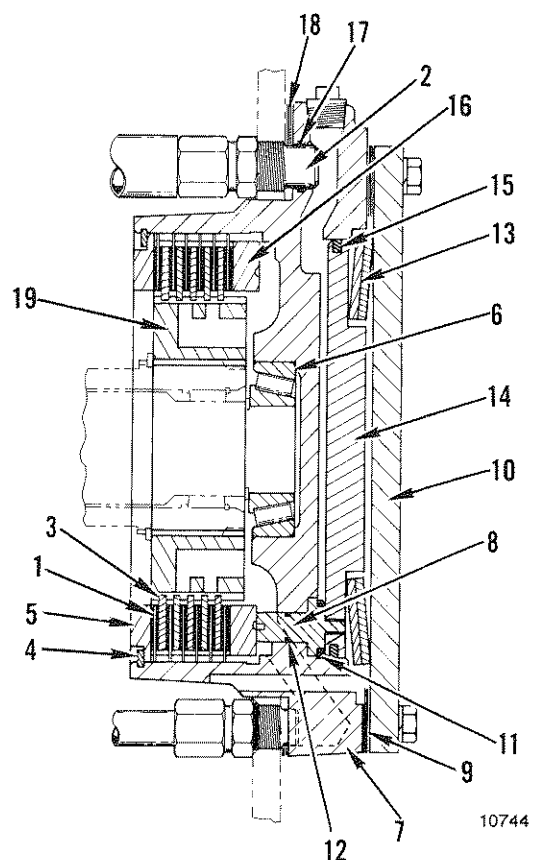
5. CLUTCH ASSEMBLY
6. INTERMEDIATE PINION GEAR
7. SPACER

NOTE: When a reference that is made to the LEFT or the RIGHT of the winch or the rotation of a part in the clockwise or counterclockwise direction, the point of view is from a person standing behind the winch and facing the vehicle.

FIGURE 1-9. BEVEL GEAR AND SHAFT ARRANGEMENTS



Oil Brake (See FIGURE 1-10.)



- | | |
|--------------------|--------------------|
| 1. FRICTION DISC | 13. CONICAL WASHER |
| 2. PRESSURE INLET | SPRING (2) |
| 3. SEPARATOR PLATE | (BELLEVILLE |
| 4. SNAP RING | SPRING) |
| 5. END PLATE | 14. PISTON |
| 6. BEARING | 15. PISTON SEAL |
| 7. HOUSING | 16. THRUST RING |
| 8. PLUNGER (4) | 17. O-RING |
| 9. SHIMS, FOR | 18. SHIMS, FOR |
| BRAKE ADJUSTMENT | SHAFT BEARING |
| 10. COVER PLATE | ADJUSTMENT |
| 11. O-RING | 19. HUB |
| 12. O-RING | |

FIGURE 1-10. OIL BRAKE

The oil brake is a disc brake that has six friction discs and five separator plates. The brake hub is connected to the clutch carrier so that the clutch carrier, intermediate pinion gear, and brake hub are a single rotating unit. The six friction discs have teeth that engage the splines inside the circumference of the brake housing and are held stationary. Teeth in the five separator plates engage the splines

in the hub and rotate with the hub. The brake is applied by spring pressure from two conical washer springs in the brake housing. The conical washer springs push against a piston and the pressure is sent through four plungers to the friction discs and the separator plates. When the brake is applied, the drum and gear train cannot rotate.

When the control valve sends hydraulic pressure to apply the clutch, the hydraulic pressure also releases the brake. The hydraulic pressure causes the piston to compress the conical washer springs and retract the plungers to release the brake. The brake is released in the **BRAKE OFF** position of the control lever. The **BRAKE OFF** function applies hydraulic pressure to release the brake, but no hydraulic pressure is sent to apply the clutch. The brake holding power and the brake release pressure is controlled by the number of shims under the brake cover on the brake housing. A separate oil supply gives a continuous flow of hydraulic oil for cooling the brake.

Control Valve (See FIGURE 1-13.)

The flow of hydraulic oil to and from the clutch and the brake is controlled by the control valve. The same control valve is used in both models of winches and is known as an open center hydraulic valve. The valve is open center because the hydraulic oil flows through the valve with minimum restriction when the spool is in the **BRAKE ON** position. Passages inside the valve body connect the oil flow and pressure with the functions that control the winch. The control valve spool opens and closes passages to apply and release the clutch and brake. All of the oil flow that is not used to apply the oil clutch and release the oil brake goes to the cooling oil circuit.

The **LINE IN** position of the control spool sends hydraulic oil to release the oil brake and apply the clutch. A pressure control valve is between the brake port and the clutch port in the control valve. This pressure control valve makes sure that the hydraulic pressure begins to be applied to the oil brake before the clutch. This arrangement prevents



the clutch from being applied before the oil brake begins to release.

When the control spool is in the **BRAKE ON** position, the clutch is not applied and conical washer springs apply the oil brake.

The control spool is connected through a cable to the hand lever for operator control. A return spring moves the spool to the **BRAKE ON** position when the control lever is released. A detent will hold the control spool in the **BRAKE OFF (DETENT)** position.

A system relief valve sets the limit for the maximum pressure within the hydraulic system. When the pressure reaches the setting of the relief valve, 1690–1760 kPa (245–255 psi), the pilot poppet moves from the seat. When oil flows past the pilot poppet, a decrease in pressure occurs across the relief valve poppet. The relief valve poppet then moves from its seat and compresses the return spring. This movement permits the oil flowing into the control valve to enter the drain circuit and keeps the hydraulic pressure within the limits. An adjustment increases or decreases the spring pressure on the pilot poppet.

The design of the hydraulic system permits a continuous flow of cooling oil through the clutch and brake. The hydraulic oil that is not used to apply the oil clutch and release the oil brake flows through a separate oil line to cool the clutch and brake. A relief valve for cooling oil is installed to make sure that the maximum pressure in the cooling oil never increases to greater than 82 kPa (12 psi). The normal pressure in the cooling oil circuit is 0–69 kPa (0–10 psi). (The oil pressure will be less than the relief pressure if the tractor PTO is operating at less than 1000 RPM.) A pressure greater than 12 psi will cause a malfunction of the oil clutch.

The relief valve for the cooling oil in the W3.5B winch is connected to the control valve. This relief

valve is set to open at approximately 69 kPa (10 psi) by the manufacturer and can not be adjusted. See Item 15 in FIGURE 1-6, and also FIGURE 1-11.

The relief valve for the cooling oil is installed in the oil line between the control valve and the brake in the W3A winch. See Item 15 in FIGURE 1-7, and also FIGURE 1-12. This relief valve has a poppet that opens at approximately 55 kPa (8 psi) and permits the oil to flow from the hydraulic circuit to the sump. The relief valve in the W3A winch can be adjusted if necessary.

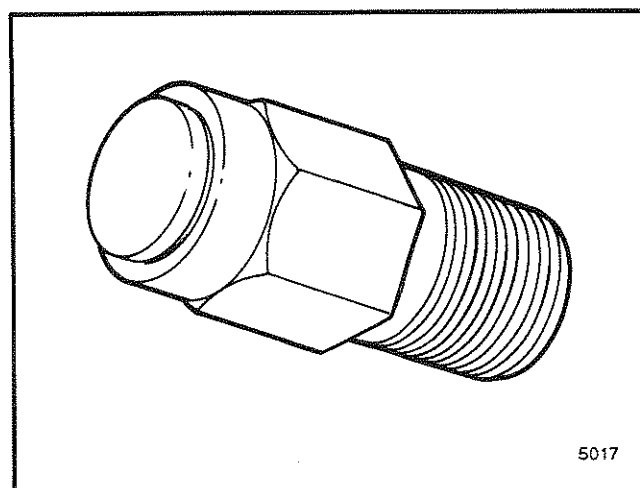


FIGURE 1-11. RELIEF VALVE FOR COOLING OIL, W3.5B

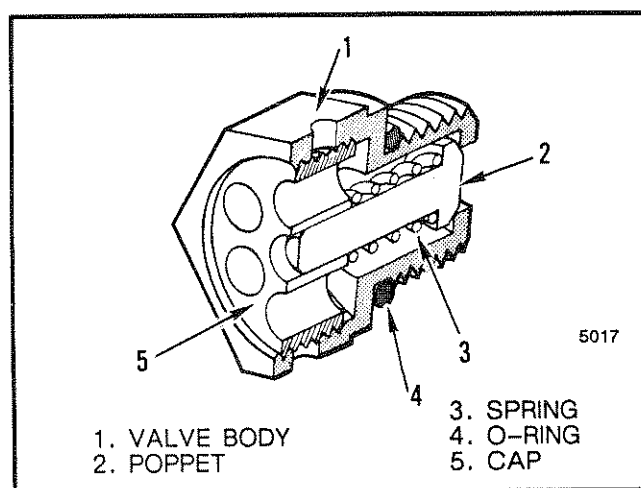
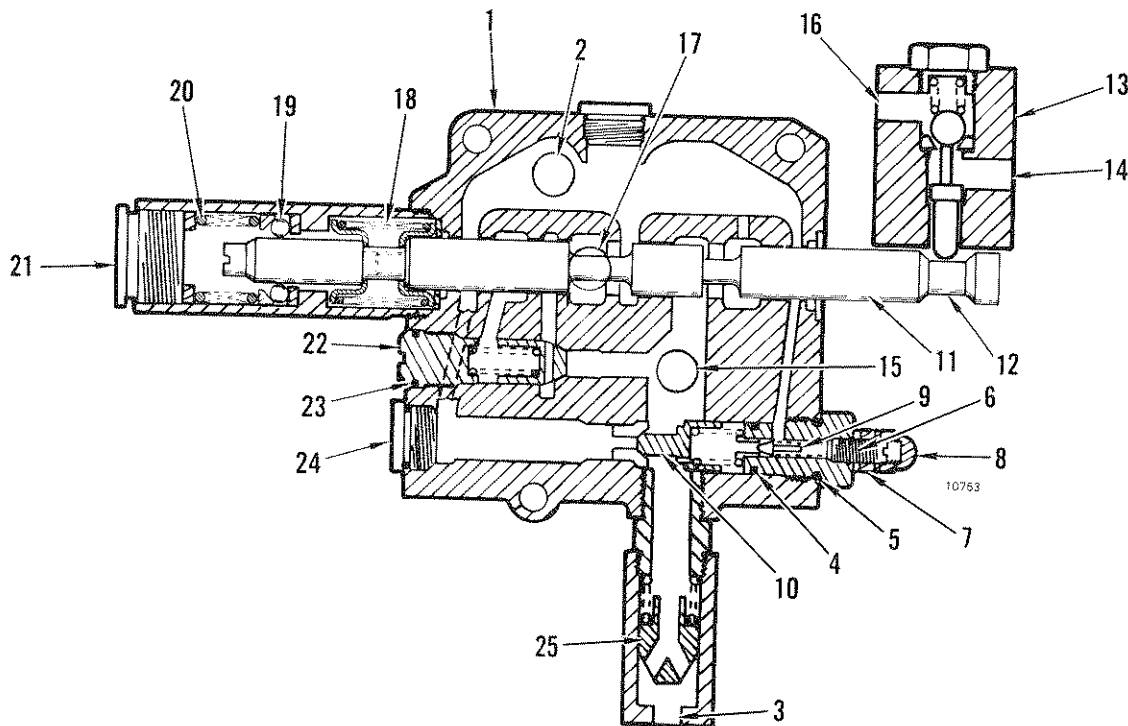


FIGURE 1-12. RELIEF VALVE FOR COOLING OIL, W3A



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- | | | |
|---------------------|---|---|
| 1. VALVE BODY | 11. CONTROL SPOOL | 19. DETENT BALLS |
| 2. COOLING OIL PORT | 12. CAM | 20. DETENT SPRING |
| 3. INLET FROM PUMP | 13. ACCUMULATOR VALVE | 21. PLUG |
| 4. O-RING | 14. OUTPUT PORT TO BRAKE
(CONNECTS TO ITEM 15) | 22. PRESSURE CONTROL
VALVE BETWEEN
BRAKE AND CLUTCH PORTS |
| 5. O-RING | 15. OUTPUT PORT TO BRAKE | 23. O-RING |
| 6. ADJUSTMENT SCREW | 16. OUTPUT PORT TO ACCUMULATORS | 24. PLUG |
| 7. LOCK NUT | 17. OUTPUT PORT TO CLUTCH | 25. INLET CHECK VALVE |
| 8. ACORN NUT | 18. CENTERING SPRING | |
| 9. PILOT POPPET | | |
| 10. RELIEF POPPET | | |

FIGURE 1-13. CONTROL VALVE

Accumulators

An accumulator is connected to the hydraulic system in the W3.5B winch. See FIGURE 1-14. There are two smaller accumulators joined by a tee fitting and connected to the hydraulic system in the W3A winch. See FIGURE 1-15. The volume of the accumulator in the W3.5B winch is approximately equal to the volume of the two accumulators in the W3A winch. The accumulator for the W3.5B winch can not be installed in a W3A winch. Each accumulator has an internal bladder made of rubber that holds nitrogen at a pressure of 690 kPa (100 psi).

The purpose of the accumulator is to store a small volume of hydraulic oil at system pressure. If the op-

erator momentarily permits the rotation of the PTO to decrease to an rpm so that the hydraulic pressure decreases, the accumulator discharges pressure to keep the clutch applied. The accumulators also sends pressurized oil more quickly to release the oil brake and apply the clutch. If the PTO stops, the hydraulic pump stops. The pressure in the accumulator also permits the operator to release the winch brake (and release a load).

The pressure from the hydraulic pump compresses the nitrogen and the accumulator stores the pressure. The accumulator valve is a ball check valve that is mechanically operated. The accumulator valve permits the hydraulic pressure to charge the accumulator during operation. When the hydraulic

pump is stopped and the operator moves the control valve spool to **BRAKE OFF**, a cam on the valve spool opens the ball check valve. This action permits the accumulator pressure to enter the control valve and supply pressure to release the brake. A check valve between the control valve and the hydraulic pump prevents the flow of oil and pressure from the accumulators to the hydraulic pump.

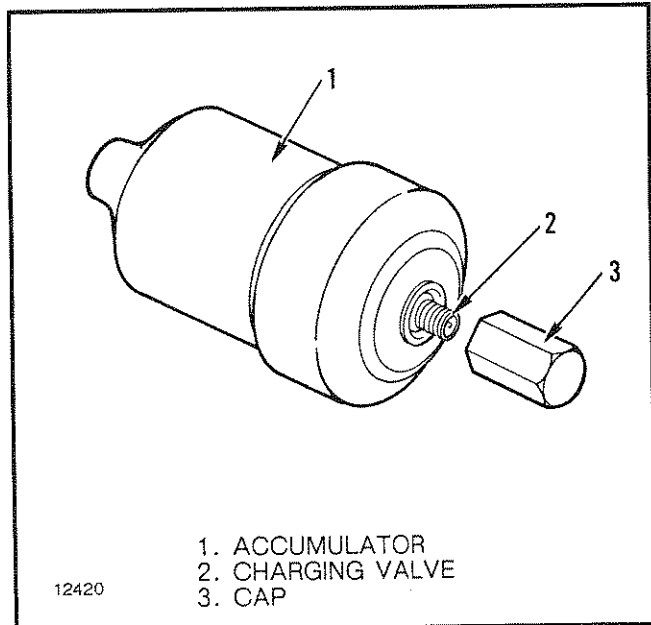


FIGURE 1-14. ACCUMULATOR, W3.5B

NOTE: There are two designs of accumulators used in the W3A winch. The shorter accumulator shown in FIGURE 1-15. uses an O-ring fitting and is used in W3A winches of later manufacture. The accumu-

lator used in W3A winches of earlier manufacture use an NPT fitting. Both designs of accumulators have the same operation.

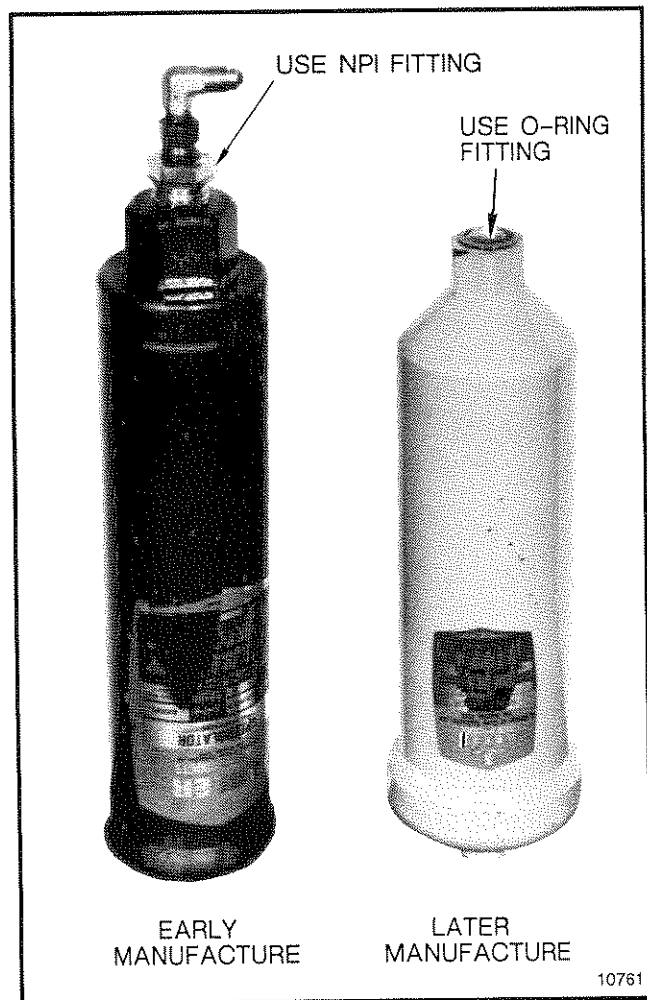
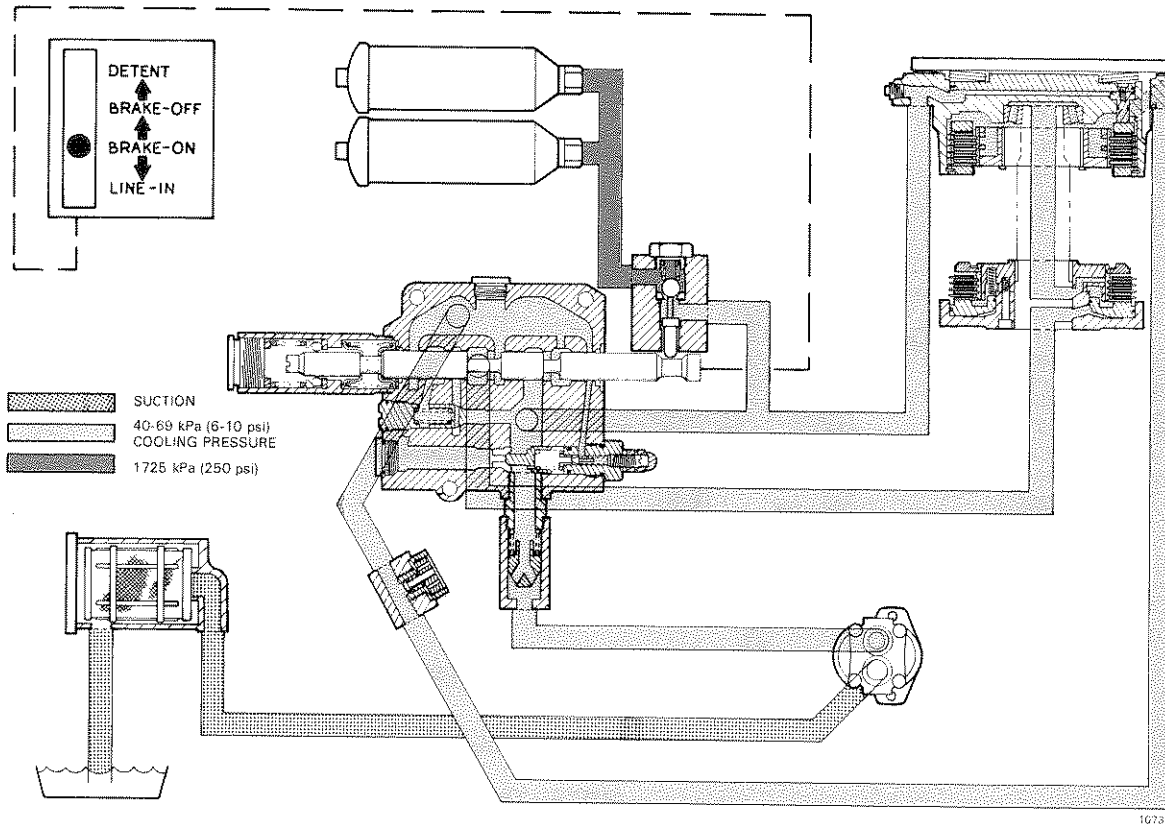


FIGURE 1-15. ACCUMULATORS, W3A



SEQUENCE OF OPERATION

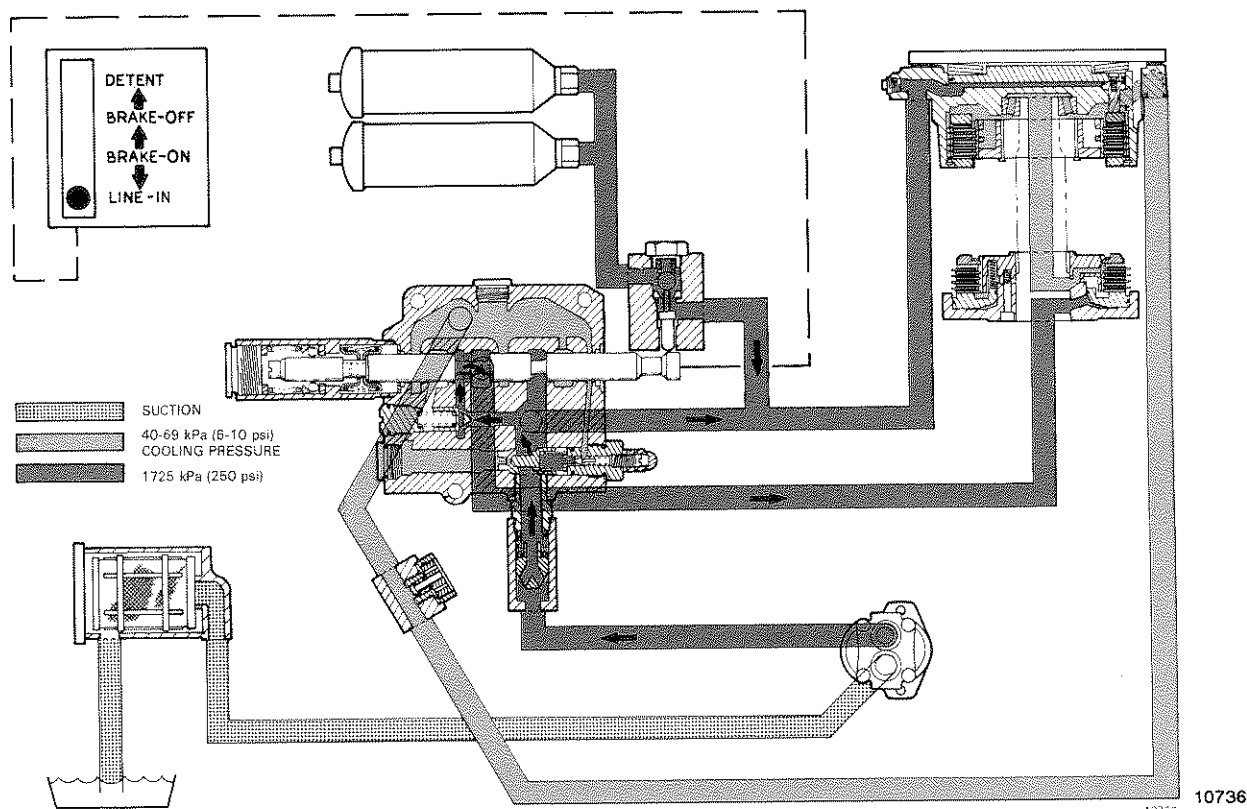


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NOTE: The W3.5B winch has only one accumulator.

- The hydraulic oil flows through the hydraulic circuit and back to the sump. A relief valve for the cooling oil makes sure that the pressure in the cooling oil circuit is never greater than 82 kPa (12 psi).
- If the winch has been operated, the accumulators will have a pressure of approximately 1720 kPa (250 psi).
- The conical washer springs have applied the brake.

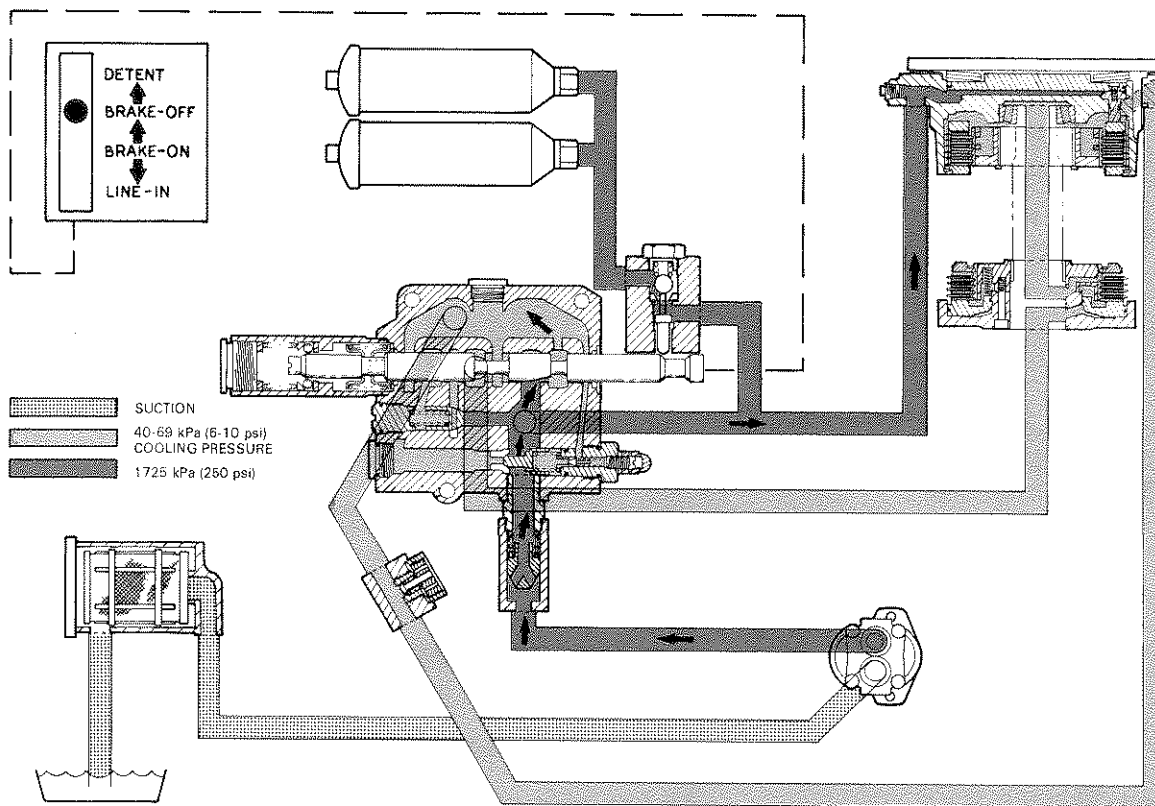
FIGURE 1-16. HYDRAULIC SYSTEM IN BRAKE ON



NOTE: The W3.5B winch has only one accumulator.

- When the control spool moves toward the LINE IN position, some of the oil flow goes to the LINE IN clutch.
- The oil flow increases oil pressure to apply the clutch.
- The oil flow also goes to the brake. The increased oil pressure applies the clutch and releases the brake at the same time.
- If the pressure increases to 1690–1760 kPa (245–255 psi), the pilot poppet opens. Some of hydraulic oil flows from the control valve to the cooling oil circuit. This pressure difference across the pilot poppet causes the relief valve poppet to open and keeps the system pressure within the specifications.

FIGURE 1-17. HYDRAULIC SYSTEM IN LINE IN

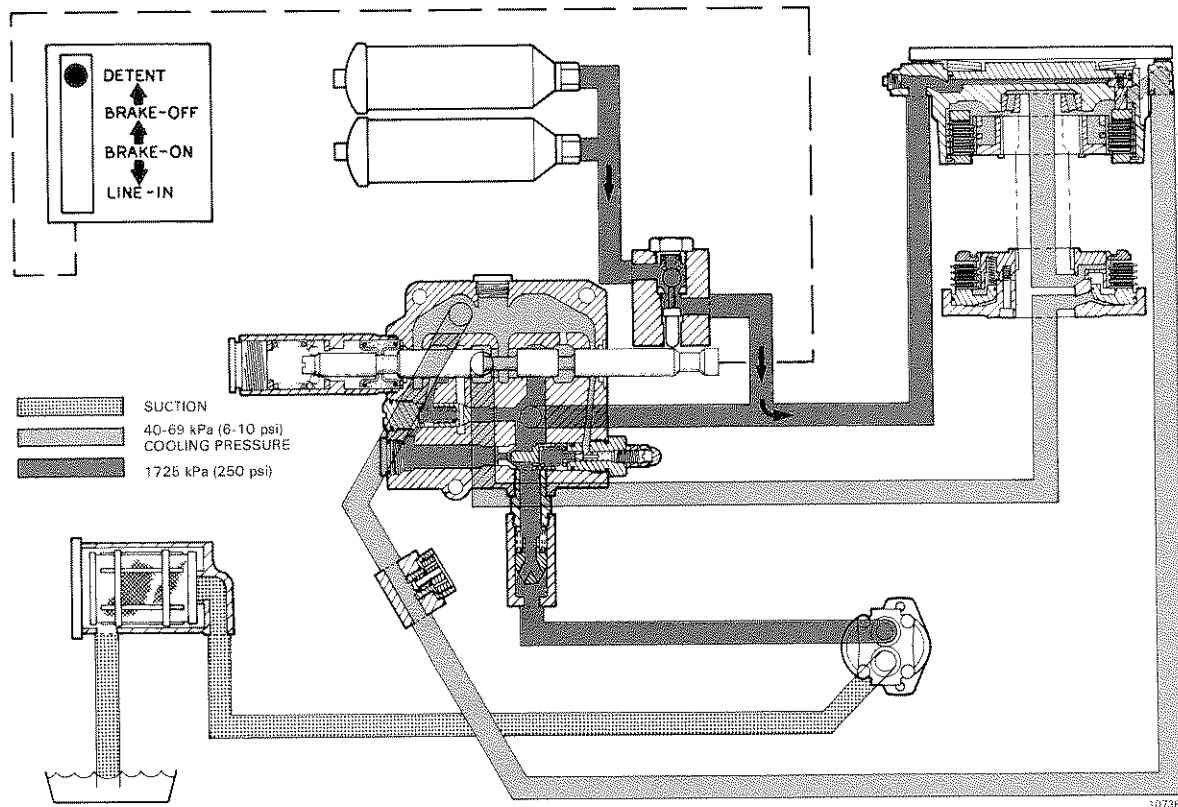


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NOTE: The W3.5B winch has only one accumulator.

- The control spool increases the oil pressure to release the oil brake.
- When the oil flows across the metering land on the control spool, the oil brake is released. The oil brake is released slowly at low engine rpm and is released quickly at high engine rpm.

FIGURE 1-18. HYDRAULIC SYSTEM IN BRAKE OFF (BRAKE RELEASE INCHING)



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NOTE: The W3.5B winch has only one accumulator.

- The cam opens accumulator valve to open and release the pressure in the accumulators to the inlet of the control valve.
- The control spool sends the oil flow directly to the oil brake to release it.
- The remainder of the oil flows from the control valve to the cooling oil system.

FIGURE 1-19. HYDRAULIC SYSTEM IN BRAKE OFF (DETENT)



TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Operation is not smooth nor regular	Low oil level.
	Wrong oil.
	Control cables need adjustment.
	Oil is too cold. Put the control lever in the BRAKE OFF position. Run the engine at 1000 RPM to warm the oil before operating the winch.
	Tractor engine is running too slow.
	Low oil pressure. See the Troubleshooting for low oil pressure.
Winch stops during shift when engine speed	Not enough PTO speed.
	Valve seat in the accumulator valve has a defect.
	Accumulator has a defect.
Low oil pressure	Loose connections in the winch hydraulic system.
	Suction screen is dirty.
	Main relief valve is defective.
	Oil brake has an internal leak (Indicated by low brake pressure and quick loss of pressure from the accumulators.)
	Worn hydraulic pump.
Brake does not hold	Worn friction discs in the brake.
	Spring pressure is too weak.
	Conical washer springs (belleville springs) have a defect.
	Shim thickness is too large.
Brake does not release	Low oil pressure.
	Accumulators have a defect.
	Piston seal leaks.
	Capscrews that fasten the plungers to the piston are too tight and will not permit the piston to move freely. (W3A only)
	Not enough shims to permit the brake to release correctly.
Winch drum begins to unwind before clutch is applied (brake begins to release before the clutch is applied).	Brake release pressure is too low.



TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Clutch slips or does not apply completely	Low oil pressure
	Worn friction discs in the clutch.
	Leak in the rotating joint.
	Worn clutch piston seals.
Hydraulic oil becomes too hot during operation.	Cooling oil pressure set too high and causes increases friction in the oil clutch.
	Winch is operated in the BRAKE OFF position for long periods. (When the BRAKE OFF position is used, the hydraulic oil continuously flows through the relief valve.
	Winch is frequently used for inching.
	Dirty suction strainer.
FREESPOOL lever is difficult to move.	If the FREESPOOL control lever can not be moved to engage the gear train for power operation, apply the clutch to move the gear train a small amount. This action will align the splines in the sliding sleeve so that the intermediate gear can be engaged.
	Control cable or linkage has dirt or corrosion.
	Detent pressure is wrong.
FREESPOOL will not stay engaged.	Control cable or linkage need adjustment.
	Worn shift fork.
	Detent pressure is wrong.

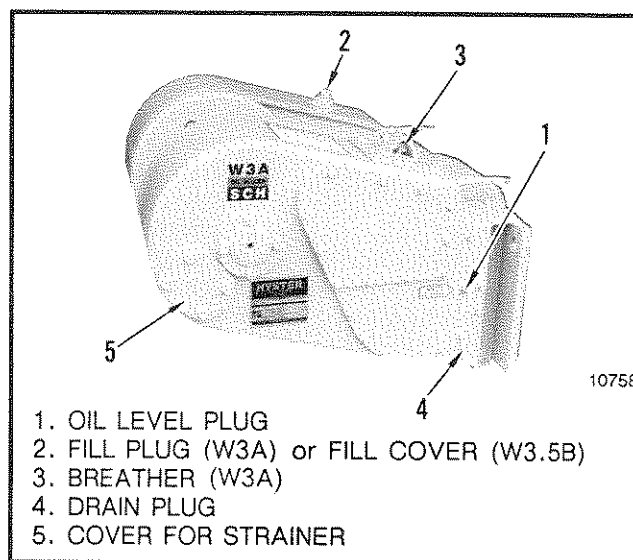
SERVICE

GENERAL

This section has the instructions for doing maintenance and making checks and adjustments. Standard shop tools are used in doing the work described in this section.

MAINTENANCE

The Maintenance Schedule is a program that includes periodic inspection and lubrication. Use the operating time on the hour meter of the tractor to find the maintenance time for the winch.



1. OIL LEVEL PLUG
2. FILL PLUG (W3A) or FILL COVER (W3.5B)
3. BREATHER (W3A)
4. DRAIN PLUG
5. COVER FOR STRAINER

FIGURE 3-1. MAINTENANCE POINTS

MAINTENANCE SCHEDULE

INTERVAL	PROCEDURE OR QUANTITY	SPECIFICATION
50 hours or weekly	<p>Check oil level at plug 1. Add oil as necessary at fill plug. (Do not operate the tractor when checking the oil level.)</p> <p>Lubricate the winch control lever and the FREESPOOL control lever.</p> <p>Clean the breather.</p> <p>Lubricate the rollers on the integral arch or the fairlead assembly if the winch is equipped with this optional equipment.</p>	<p>Use Transmission/Hydraulic oil Shell Oil Company DONAX TD or equivalent. See TABLE 3.</p> <p>Use SAE 30 oil on the linkage as needed. Check that the control cable and control housing are fastened correctly. Tighten the U-bolts as necessary.</p> <p>Clean the breather with solvent.</p> <p>Use multi-purpose grease with 2-4% molybdenum disulfide.</p>
500 hours or 3 months	Clean the oil strainer.* Use a new gasket between the cover and suction tube.	See parts manual for strainer element.
2000 hours or 12 months	Change the hydraulic oil. Drain oil from plug 4. Clean the strainer. Add approximately 24 litres (25 qt) through fill plug. Check the oil level at plug 1. Add oil as necessary so that the oil level is even with the fill plug 1.	Use Transmission/Hydraulic oil Shell Oil Company DONAX TD or equivalent. See TABLE 3.
*NOTE: Clean the oil strainer after the first 50 hours on new and rebuilt winches.		



The following list of tractor transmission oils have been successfully used in Hyster winches.

COMPANY	BRAND NAME	COMPANY	BRAND NAME
Amoco Oil Company	Amoco 1000 Fluid	Getty Refining Company	Tagoline 303
Atlantic Richfield	Arco Tractor Fluid	Getty Refining Company	Veedol Hydro Trans 303
Bessel Kok	Tractorelf ST.3	Gulf Canada Ltd	Duratran
Bessel Kok	Tractorelf BF 12	John Deere	Hy-Gard Transmission & Hydraulic Oil
British Petroleum	Tractran 9		Mobilfluid 423
Burmah Castrol Ltd.	Agricastrol MD Oil	Mobil Oil Company	Hydra Tranz & Wet Brake Lube
Burmah Castrol Ltd.	Agricastrol JD Oil	Pennzoil	Donax T4
Caltex	RPM Tractor Hydraulic Fluid		Sunfleet TH Universal Tractor Fluid
Chevron USA	Tractor Hydraulic Fluid	Shell Oil Company	1893 TDH Oil
Cities Service Company	Citgo Tractor Hydraulic Oil	Sun Oil Company	Union Hydraulic/Tractor Fluid
			Transmission MP Totalube
Duckhams Oils	Hydrolube 303	Texaco	Tractor H-T Fluid
Exxon Company	Torque Fluid 56	Union Oil Company	
Esso Company	Torque Fluid 56		
Fina Oil Company	Pontonic JDF	Total Oil Company	
		Wolf's Head Oil Co	

TABLE 3. OIL LIST

CHECKS AND ADJUSTMENTS

The checks and adjustments for the winch have the following descriptions:

- Control Cable Adjustments
- Hydraulic System
- Brake Adjustment
- FREESPOOL "drag" Adjustment

Control Cable Adjustments

There are two configurations of operator controls normally used with the W3A/W3.5B winches. Check the operation of the power control lever to make sure it moves smoothly and will return to the **BRAKE ON** position. The power control lever will stay in **BRAKE OFF** when pushed into the **DETENT** position. **Make sure the control lever**

does not hit the housing at the end of its travel. Adjustments for both configurations are described in the following paragraphs.

A. See FIGURE 3-2. Check that the positions of the power control lever are the same as the position indicators on the control housing. Remove the two capscrews and raise the cover. Loosen the U-bolt that holds the control cable in the housing to adjust the hand lever. Install the cover when the adjustments are complete.

Check that the positions of the **FREESPOOL** lever are the same as the position indicators on the control housing. See FIGURE 3-2. Loosen the U-bolt that holds the control cable in the housing to adjust the control lever. The linkage and cable must be adjusted so that the **FREESPOOL** shift mechanism will slide the drum pinion gear to both positions. Both positions have a detent.

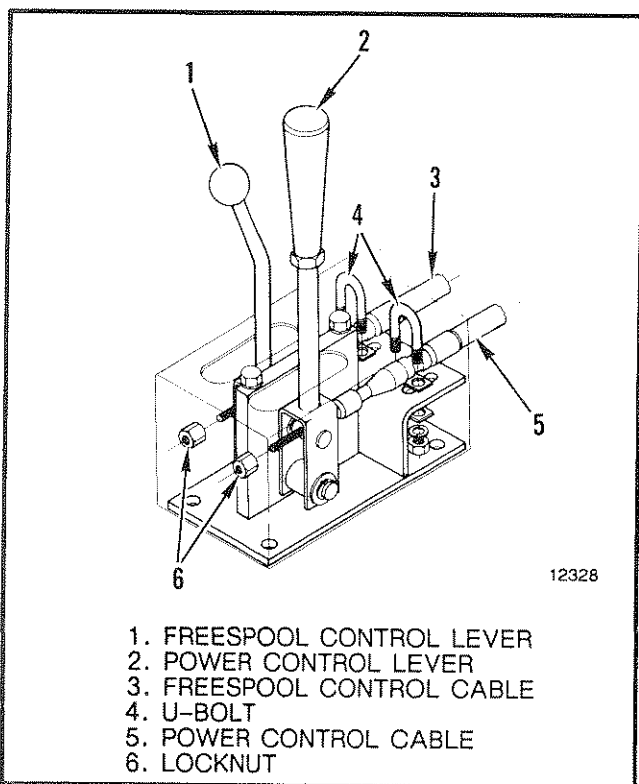


FIGURE 3-2. CONTROL CABLE ADJUSTMENTS

B. See FIGURE 3-3. Check that the positions of the power control lever are the same as the position indicators on the control housing. Remove the access cover on the housing to make adjustments. Loosen the jam nut that keeps the adjustment nut and clevis from turning. Remove the cotter pin and link pin from the clevis. Turn the adjustment nut and clevis to adjust the length of the the control cable. Use the link pin and cotter pin to connect the clevis to the control handle again and check the operation. When the adjustment is complete, install the access cover.

Check that the positions of the **FREESPOOL** lever are the same as the position indicators on the control housing. See FIGURE 3-3. Remove the access cover on the housing. Loosen the jam nut that keeps the adjustment nut and clevis from turning. Remove the cotter pin and link pin from the clevis. Turn the adjustment nut and clevis to adjust the length of the the control cable. Use the link pin and cotter pin to connect the clevis to the control handle again and check the operation. When the adjustment is complete, install the cover. The linkage and cable must be adjusted so that the **FREESPOOL**

shift mechanism will slide the drum pinion gear to both positions. Both positions have a detent.

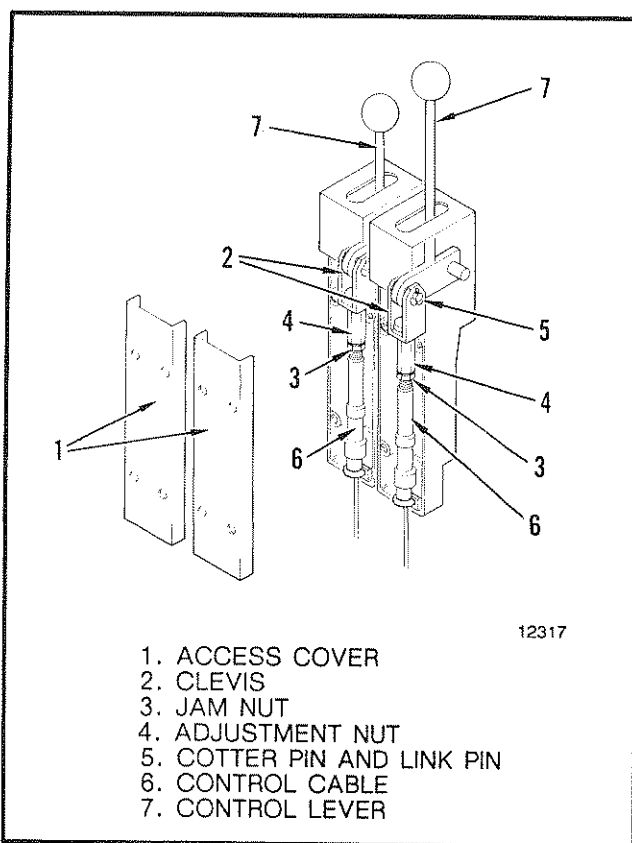


FIGURE 3-3. CONTROL CABLE ADJUSTMENTS

Hydraulic Pressure

PREPARATION

A. Put the **FREESPOOL** control lever in the **FREESPOOL** position so that the drum will not rotate while doing the pressure tests.

B. The oil in the winch must be at least 20°C (70°F). The oil can be heated by operating the winch in the **BRAKE OFF** position. When the oil is warm, stop the tractor engine.

C. Remove the dirt from the right side of the winch. Remove the access cover to the control valve. Install the pressure gauges as described in the following section. Put a piece of cardboard or cloth at the top of the opening for a spray guard. A spray guard will help keep the cooling oil from the relief valve in the winch case.



PRESSURE GAUGES

The pressure checks can be done with one 2000 kPa (300 psi) gauge and one 100 kPa (20 psi) gauge.

WARNING

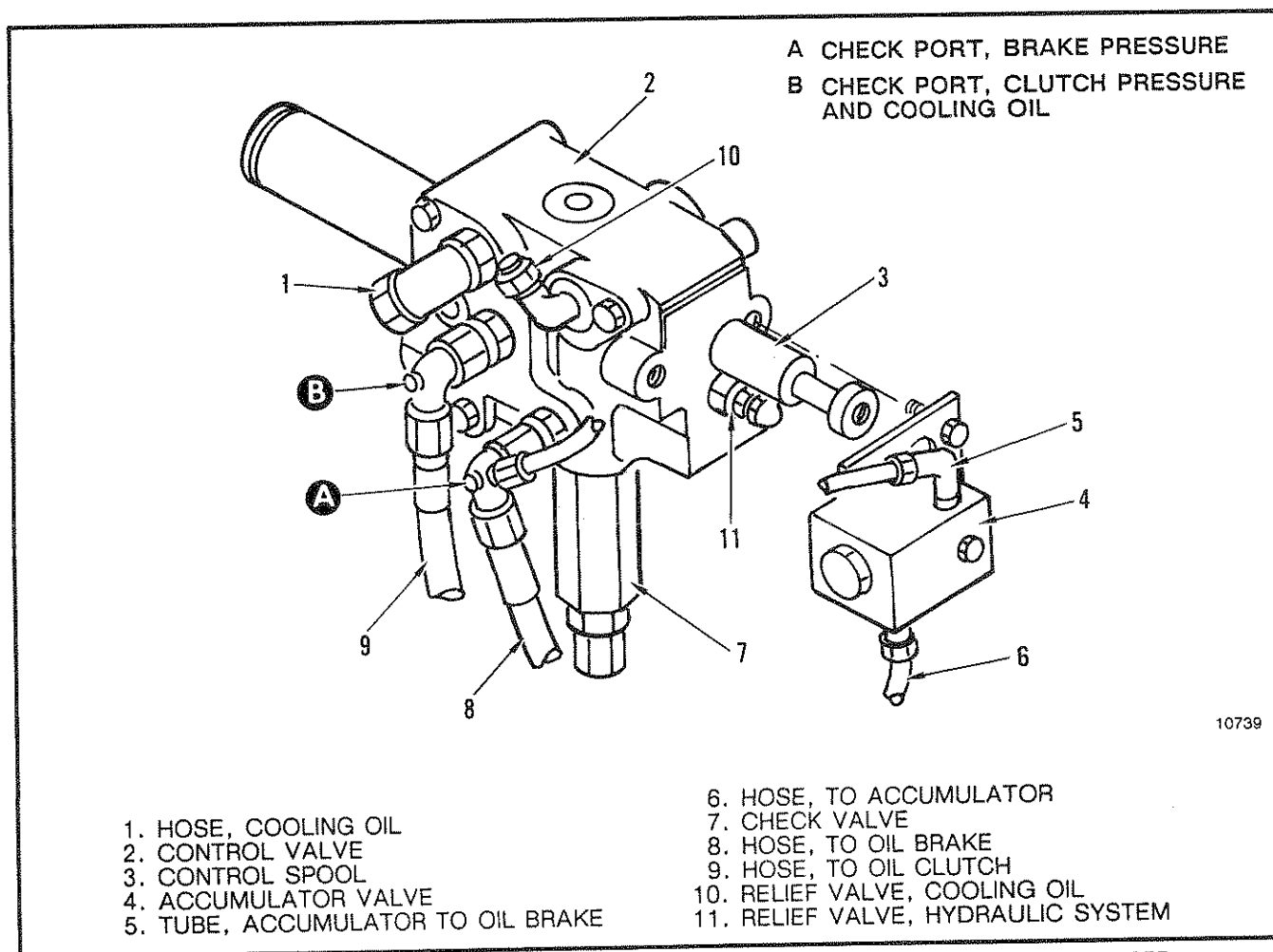
There is oil under pressure stored in the accumulator. Keep the power control lever in the BRAKE ON position when connecting or disconnecting the pressure gauges. Except when doing pressure checks, stop the tractor engine when working in the winch.

The test ports for doing the hydraulic pressure checks are shown for the W3.5B winch in FIGURE 3-4. The test ports for doing the hydraulic pressure checks are shown for the W3A winch in FIGURE 3-5.

The connection and pressure test for each port is shown in TABLE 4. The paragraphs following the table are notes and instructions that refer to TABLE 4.

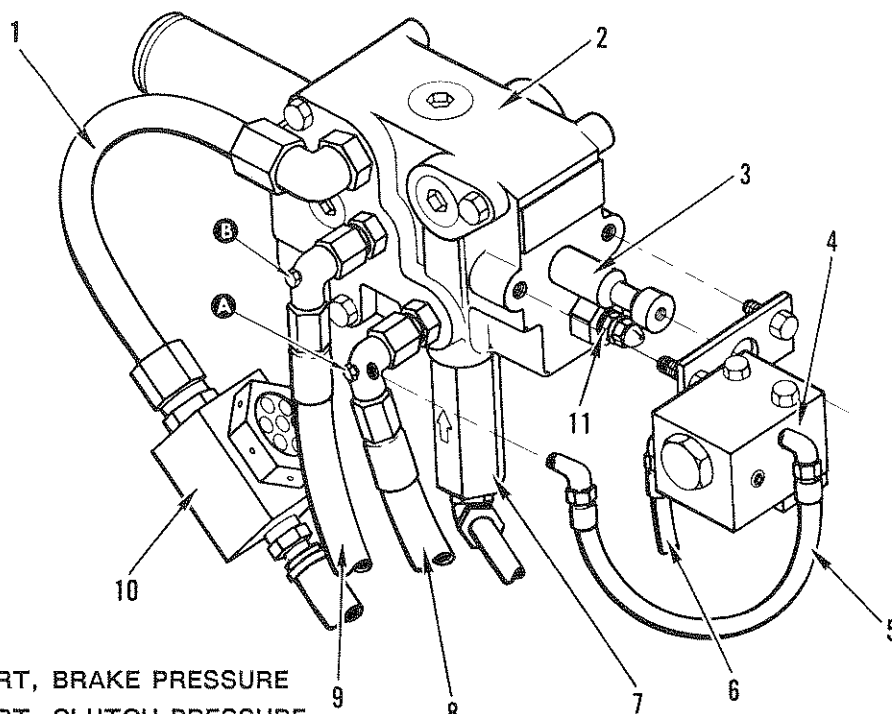
If the brake pressure at A is not correct, check for the following problems:

- relief valve is not set correctly
- screen on the relief valve poppet is plugged
- leak in a hydraulic line
- damaged seal on the brake piston
- damaged O-ring on any of the four brake plungers
- dirty strainer
- worn hydraulic pump



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FIGURE 3-4. CHECK PORTS FOR HYDRAULIC PRESSURE, W3.5B WINCH



- A** CHECK PORT, BRAKE PRESSURE
B CHECK PORT, CLUTCH PRESSURE
 AND COOLING OIL

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1. HOSE, COOLING OIL
 2. CONTROL VALVE
 3. CONTROL SPOOL
 4. ACCUMULATOR VALVE
 5. HOSE, ACCUMULATOR TO OIL BRAKE
 6. HOSE, TO ACCUMULATOR
 7. CHECK VALVE
 8. HOSE, TO OIL BRAKE
 9. HOSE, TO OIL CLUTCH
 10. RELIEF VALVE, COOLING OIL
 11. RELIEF VALVE, HYDRAULIC SYSTEM

FIGURE 3-5. CHECK PORTS FOR HYDRAULIC PRESSURE, W3A WINCH

SYSTEM CHECK	CHECK PORT	CONTROL POSITION	PRESSURE STANDARDS	ADJUSTMENT
BRAKE	A Use 2000 kPa (300 psi) gauge	BRAKE OFF Engine speed @ 1000 rpm	1690–1760 kPa (245–255 psi)	Adjust relief valve
ACCUMULATOR	A Use 2000 kPa (300 psi) gauge	BRAKE ON See instructions	690 kPa (100 psi minimum after 30 seconds)	See instructions for accumulator repair and charge.
COOLING OIL	B Use 100 kPa (15 psi) gauge	BRAKE ON Engine speed @ 1000 rpm	69 kPa maximum (10 psi maximum)	Adjust relief valve, cooling oil (W3A only).
LINE IN	B Use 2000 kPa (300 psi) gauge	LINE IN Engine speed @ 1000 rpm	1690–1760 kPa (245–255 psi)	If oil pressure is wrong, see Troubleshooting .

TABLE 4. HYDRAULIC PRESSURE TESTS



Adjustment of the Relief Valve (Check Port A)

A. Install the high pressure gauge in Check Port A. Remove the acorn nut on the relief valve. Loosen the lock nut.

B. Hold the lock nut and turn the adjuster screw into the control valve to increase the pressure and out of the valve to decrease the pressure. Pressure standard: 1690–1760 kPa (245–255 psi) at 1000 rpm of the tractor engine.

C. Tighten the lock nut after the adjustment is complete. Install the acorn nut.

Accumulator Pressure Test (Check Port A)

A. Install the high pressure gauge in Check Port A. Run the tractor engine at 1000 rpm.

B. Move the power control lever to the **BRAKE OFF** position for one minute. Move the power control lever to the **BRAKE ON** position and then stop the engine.

C. Move the power control lever to the **BRAKE OFF** position. The pressure on the gauge at Check Port A must immediately increase to greater than 1035 kPa (150 psi). The pressure must be greater than 690 kPa (100 psi) for more than 30 seconds.

D. If the pressure test is not correct, do the **Accumulator Volume Test** described in the next paragraphs.

Accumulator Volume Test

The purpose of this test is to measure the charge and operation of the accumulators.

WARNING

A charged accumulator has oil under pressure. Do not permit the oil to be released and cause an injury.

A. Run the tractor engine at 1000 rpm.

B. Move the power control lever to the **BRAKE OFF** position for one minute. Move the power control lever to the **BRAKE ON** position and then stop the engine.

WARNING

Do not disconnect the hose that goes between the accumulator valve and the accumulators.

C. See FIGURE 3–4. A tube (5) goes from the accumulator valve to the 90° elbow for the hose to the oil brake. Disconnect the tube from the 90° elbow.

D. Install a hose on the end of the tube that was disconnected in step C. Put the end of the hose into a one litre (one quart) container.

NOTE: See FIGURE 3–5. The W3A winch has a hose (5) instead of a tube that connects to the 90° elbow. Disconnect the hose and put the end of the hose into a one litre (one quart) container.

E. Move the power control lever to the **BRAKE OFF** position to discharge the accumulators. The flow of oil from the accumulators through the accumulator valve and hose is very rapid. Make sure that the oil does not flow out of the container because of the rapid discharge of the accumulators.

F. Measure the amount of oil that was discharged from the accumulators. If the accumulators are in good condition, there will be approximately 0.65 litres (22 fluid ounces) of oil.

G. If the amount of oil is wrong, check for the following causes:

- accumulators are not charged to 680 kPa (100 psi)
- rubber container in the accumulator is damaged
- valve stem on an accumulator has leaks
- valve seat in the accumulator valve leaks

The accumulators are charged with dry nitrogen to a pressure of 690 kPa (100 psi). Check the pressure. Charge the accumulators or install new accumulators.

The accumulator in the W3.5B winch can be checked without removing it from the winch. The



hydraulic oil must be drained for access to the charging valve on the accumulator.

The accumulators in the W3A winch must be removed from the winch case for checks.

Remove the cap or the plug from the valve in the bottom of the accumulator. See FIGURE 3-6, and FIGURE 3-7. Push on the pin of the valve. If the rubber bladder is damaged, oil will come out of the valve. Replace a damaged accumulator. If the accumulator is good, make sure that it is charged to the correct pressure when the test is complete. Make sure that the valve stem is tight. Replace the cap when the accumulator is charged correctly (W3.5B). Replace the valve for charging the accumulators with the plug when the accumulators are charged correctly (W3A).

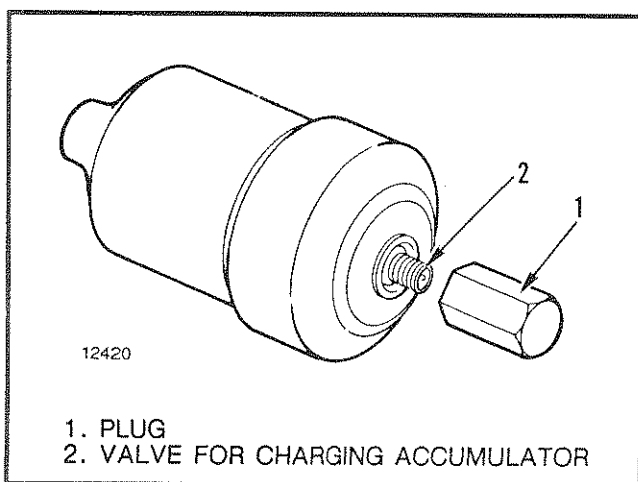


FIGURE 3-6. ACCUMULATOR, W3.5B

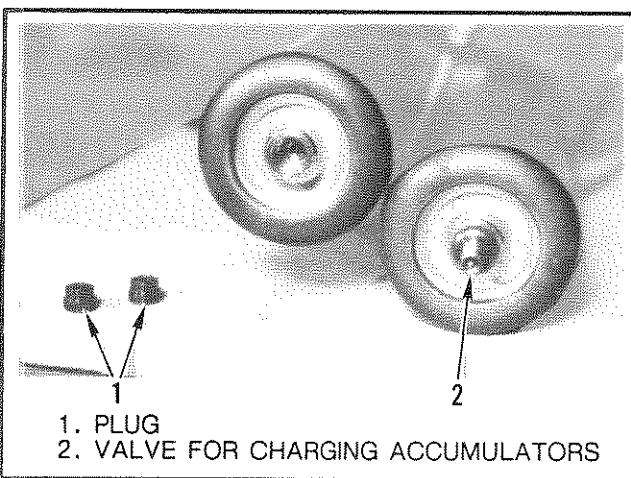


FIGURE 3-7. ACCUMULATORS, W3A

Relief Valve for the Cooling Oil (Check Port B)

NOTE: When the vehicle engine is at low idle, the cooling oil pressure can approach zero. The cooling oil pressure must never increase greater than 82 kPa (12 psi). The oil clutch will not completely release at the higher pressure. This test is to make sure that the cooling oil pressure does not increase to greater than the specification. The normal pressure is less than 69 kPa (10 psi) for all operations of the winch.

A. Install the low pressure gauge in Check Port B. Start and run the engine at 1000 rpm.

B. The power control lever must be in the **BRAKE ON** position. Check that the pressure is less than 69 kPa (10 psi).

C. If the pressure is not correct in the W3.5B winch, the relief valve for the cooling oil must be replaced. If the pressure is not correct in the W3A winch, adjust the cooling relief valve.

Adjustment of the cooling relief valve (W3A) is made by turning the cap. Turn the cap into the valve to increase the pressure. Turn the cap out of the valve to decrease the pressure. Normal position of the cap is approximately even with the top of the valve body. (See FIGURE 1-12.) There are small holes in the sides of the cap so that a punch can be used to lock the cap in the correct position.

Pressure Check for the LINE IN Clutch (Check Port A)

A. Put the winch control in **FREESPOOL** so that the drum will not turn when the clutch is applied. Install the high pressure gauge in Check Port B. Start and run the tractor engine at 1000 rpm.

B. Hold the power control lever in the **LINE IN** position. Check that the pressure is 1690-1760 kPa (245-255 psi).

C. If the pressure is wrong, check for the following problems:

- valve spool does not travel full stroke
- leak in a hydraulic fitting or hose
- rotating joint at the bevel gear shaft has a defect
- damaged O-rings in the clutch or on the bevel gear shaft

Make repairs as needed to have the correct oil pressure.

Adjustment of the Brake

Shims are added or removed from under the brake cover so that the brake will hold a load correctly and release at the correct hydraulic pressure. Adjust the number of shims so that the brake releases at 930–1035 kPa (135–150 psi). Do the check and adjustment described in the following procedure:

1. Install a 2000 kPa (300 psi) pressure gauge in Check Port A. Run the tractor engine at low idle.
2. Hold a torque wrench on one of the drum bolts so that the torque wrench is perpendicular to the axis of the drum. See FIGURE 3–8. Put a 30 N.m (20 lbf ft) torque on the drum in the same direction that the cable will unwind from the drum.

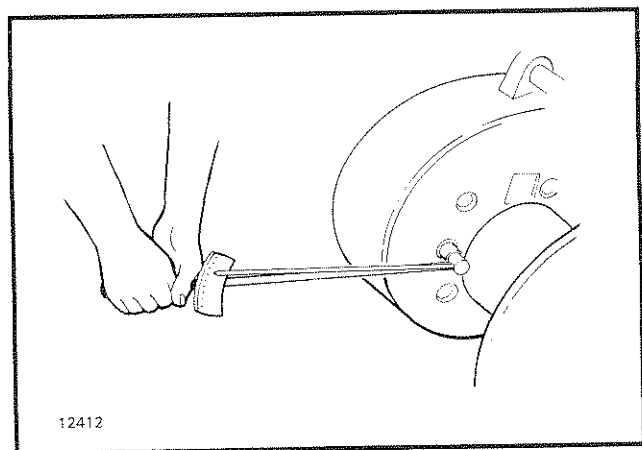


FIGURE 3–8. PUT A TORQUE ON THE DRUM

3. Look at the pressure gauge and slowly move the power control lever toward **BRAKE OFF**.
4. When the drum begins to move, the brake is released. The correct brake release pressures are shown in TABLE 5. Add or remove shims until the brake release pressure is correct.

Brake release pressure with new brake discs:
1140 to 1200 kPa (165 to 175 psi)

Brake release pressure with used brake discs:
930 to 1035 kPa (135 to 150 psi)

TABLE 5. BRAKE RELEASE PRESSURES

Freespool Adjustment

There are two adjustments for the preload that controls the resistance to rotation of the drum during the **FREESPOOL** operation. The resistance to rotation (drag) is correct when the drum can be rotated by hand, but will not rotate more than one-half revolution after the hand is removed.

A. Bearing Preload. The addition or removal of shims for the preload on the bearings for the drum adaptor requires the removal of the drum gear and disassembly of the bearing assembly. This adjustment is normally only necessary if the “drag” shoe adjustment is not effective. See step 18 of FIGURE 4–6. if this adjustment is required. This adjustment must be done by a trained service person.

NOTE: Early production W3A winches do not have a “drag” shoe adjustment and the bearing preload is the only adjustment available.

B. Drag Shoe Adjustment. See FIGURE 3–9. Loosen the lock nut (1) on the setscrew (2). Use an Allen wrench to turn the setscrew 1/4 turn. Turn the setscrew to the right (clockwise) to increase the “drag” or turn the setscrew 1/4 turn to the left (counterclockwise) to decrease the “drag”. Tighten the lock nut. Test the “drag” on the drum. Make additional adjustments as necessary.

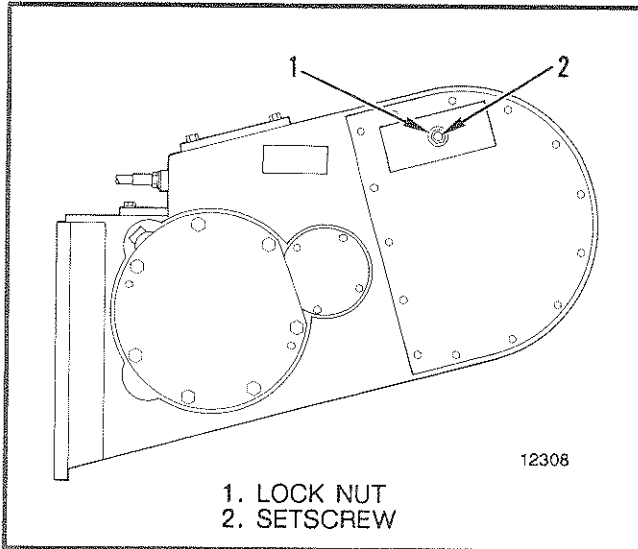


FIGURE 3-9. "DRAG" SHOE
ADJUSTMENT

ADJUSTMENT OF THE FREESPOOL LEVER

The linkage and cable must be adjusted so that the **FREESPOOL** shift mechanism will slide the drum pinion gear to both positions. Both positions have a detent.

CLEAN THE OIL SCREEN

Remove the access cover to the strainer. Remove the strainer from the strainer housing. Clean the strainer in solvent. Make sure any metal particles are removed from the magnets. When the strainer is installed in the winch, use a new gasket on the access cover.

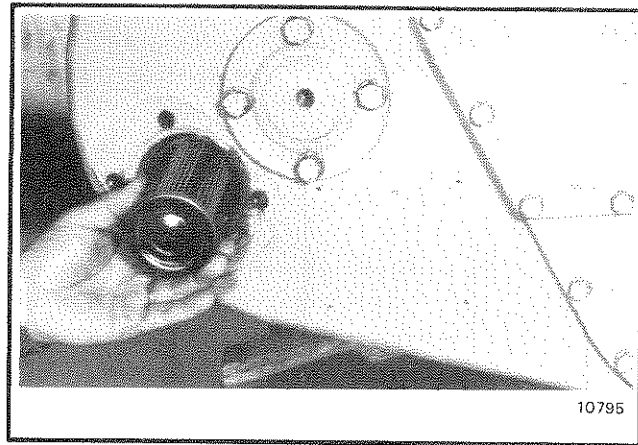


FIGURE 3-10. CLEAN THE OIL SCREEN

INSTALLATION OF THE CONTROL CABLE IN THE WINCH

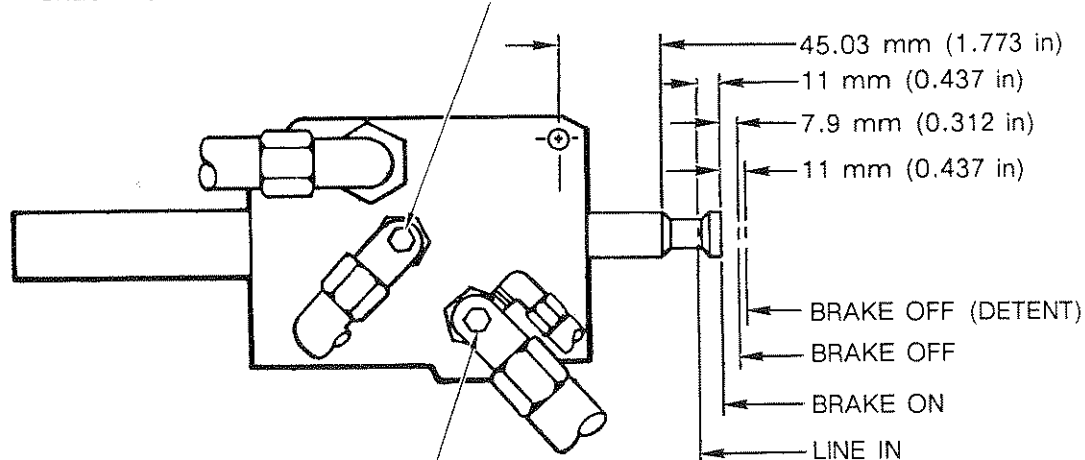
NOTE: These instructions are for the replacement of a control cable and are not instructions for a new installation of a winch on a tractor or skidder.

Install a new gasket on the control cable where the mounting block is fastened winch case. Install the 1/2 UNC x 1-1/4 inch capscrew that holds the control cable to the winch case.

The 1/4-28 UNF threads on the end of the control cable fit the threaded hole in the end of the control valve spool. Install a nut and jam nut on the end of the control cable that connects to the hand lever. Use a wrench to turn the nut and turn the control cable into the control valve spool. The cable is turned into the control valve spool until the control cable is tight at the bottom of the threaded hole. Remove the jam nut and nut from the control cable.

Install the control cable into the cable anchor of the hand lever. Install the tall nut on the end of the cable and tighten the tall nut against the cable anchor. See the Checks and Adjustments in this section to make the necessary adjustments.

CHECK PORT FOR PRESSURE CHECK OF FORWARD CLUTCH AND COOLING OIL



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CHECK PORT FOR BRAKE AND RELIEF VALVE.

The movement of the control valve spool is adjustable only at the control lever housing. The dimensions shown in this Figure are for reference. The control cable adjustments are described in **Checks and Adjustments** in this section.

FIGURE 3-11. MOVEMENT OF THE CONTROL VALVE SPOOL



REPAIRS

GENERAL

This section has the instructions for disassembly and assembly of the winch for repairs. The winch must be removed from the vehicle for disassembly. The instructions for the removal and installation of the winch on the vehicle are included in this section.

WINCH REMOVAL

WARNING

Be careful when you remove the cable from the drum. The end of the cable can move like a compressed spring and cause an injury when the ferule is loosened on the drum.

WARNING

The slings and crane used to lift the winch must have a minimum capacity of 1000 kg (2000 lb).

A. Remove the cable from the drum. Clean the outside of the winch and the joint where the winch is connected to the vehicle.

B. Drain the oil from the winch.

C. Move the power control lever to the **BRAKE OFF** position at least five times to discharge the pressure in the accumulators

D. Disconnect the control cables from the control levers.

E. Connect slings and a crane or lifting mechanism to the winch. Put the slings around the drum and the front of the winch to lift the winch. Use the crane to hold the weight of the winch while the winch is disconnected from the vehicle.

F. Remove the nuts and washers that hold the winch to the vehicle. Use the crane to move the winch away from the vehicle. Put the winch in a work area so that you can make repairs.

WINCH INSTALLATION

WARNING

The slings and crane used to lift the winch must have a minimum capacity of 1000 kg (2000 lb).

A. Connect the crane or lift mechanism to the winch and move the winch to the mount surface of the tractor. Put the slings around the drum and the front of the winch to lift the winch.

B. Align the splines of the coupling with the PTO. Install the control cables along the route to the control levers on the vehicle as the winch is installed. Align the winch with the bolt holes and install the bolts, lock washers, and nuts that hold the winch on the tractor. Tighten the bolts to the correct torque. Remove the slings and crane.

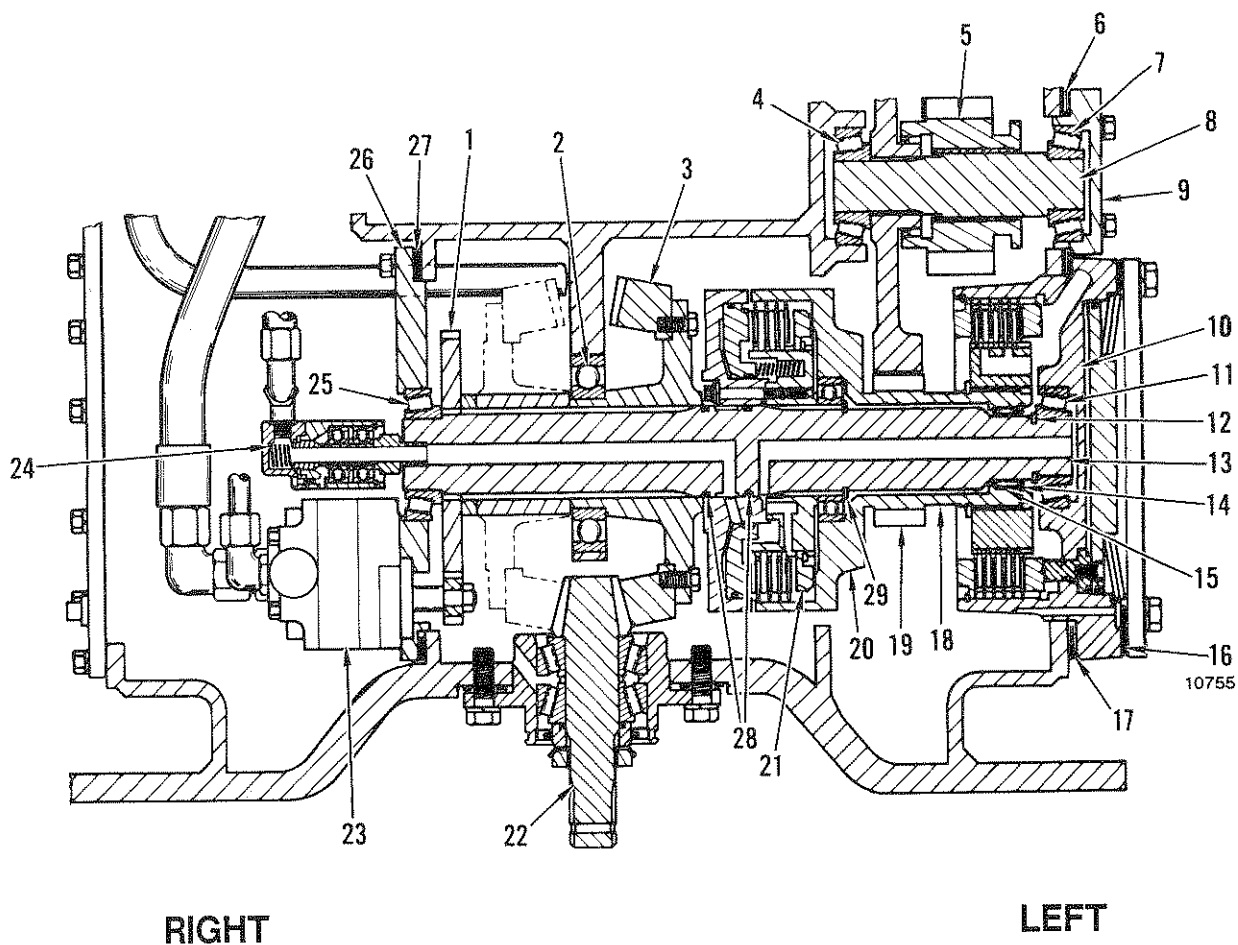
C. Connect the control cables to the control levers.

D. Leave the access to the hydraulics open if you need to make checks and adjustments. See the **Checks And Adjustments**. Add the correct hydraulic oil until the oil level is at the plug for checking the oil level.

When the checks and adjustments are complete, install the access cover for the hydraulics. Check that the oil level is correct.

DISASSEMBLY OF THE WINCH

This winch is normally removed from the tractor or skidder for repairs. This winch can be disassembled except for the PTO assembly while mounted on the tractor or skidder. This procedure describes the complete disassembly of the winch when it is removed from the tractor or skidder. Disassemble the winch as necessary to make repairs. Repair of the pinion, brake, clutch, and hydraulic parts are described in sections following the assembly instructions.

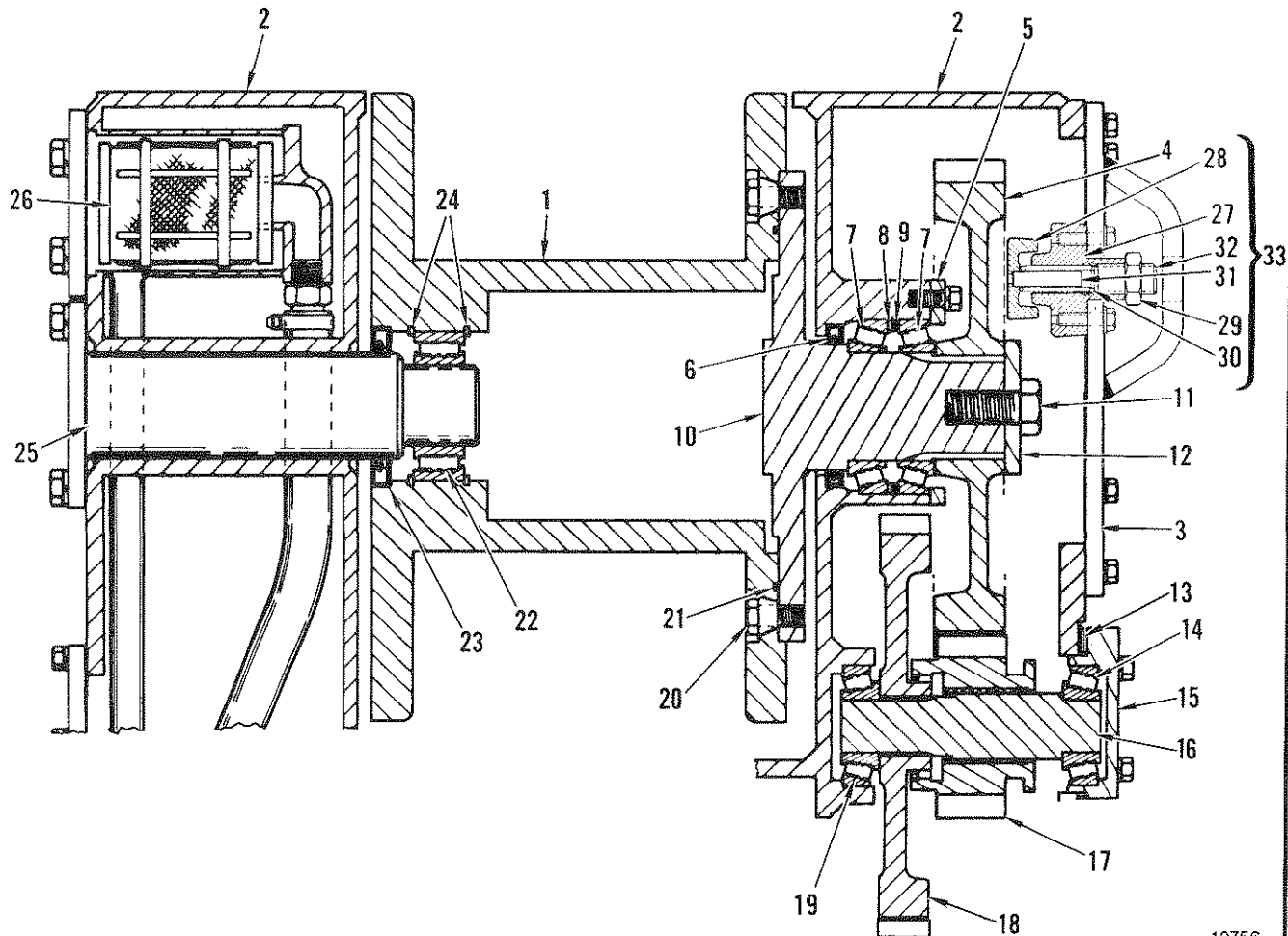


1. DRIVE GEAR FOR HYDRAULIC PUMP
2. BALL BEARING
3. BEVEL GEAR
4. TAPERED ROLLER BEARING, INNER
5. DRUM PINION GEAR
6. SHIMS
7. TAPERED ROLLER BEARING, OUTER
8. INTERMEDIATE SHAFT
9. COVER, INTERMEDIATE SHAFT
10. BRAKE ASSEMBLY
11. SHAFT BEARING
12. SNAP RING
13. BEVEL GEAR SHAFT
14. SNAP RING

15. NEEDLE BEARINGS
16. SHIMS FOR COVER OF OIL BRAKE
17. SHIMS FOR AHAFT BEARING ADJUSTMENT
18. EXTENSION OF CLUTCH CARRIER
19. INTERMEDIATE PINION GEAR
20. CLUTCH CARRIER
21. CLUTCH ASSEMBLY
22. PINION ASSEMBLY
23. HYDRAULIC PUMP
24. ROTATING JOINT
25. SHAFT BEARING
26. BEARING CARRIER
27. SHIMS FOR SHAFT BEARING ADJUSTMENT
28. O-RING
29. SNAP RING

NOTE: When a reference that is made to the LEFT or the RIGHT of the winch or the rotation of a part in the clockwise or counterclockwise direction, the point of view is from a person standing behind the winch and facing the vehicle.

FIGURE 4-1. BRAKE, CLUTCH, AND SHAFT ASSEMBLY



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RIGHT

LEFT

1. DRUM
2. WINCH CASE
3. ACCESS COVER FOR DRUM GEAR
4. DRUM GEAR
5. BEARING RETAINER
6. OIL SEAL
7. TAPERED ROLLER BEARING
8. SPACER
9. SHIMS
10. DRUM ADAPTER
11. CAPSCREW
12. RETAINER
13. SHIMS FOR INTERMEDIATE SHAFT
14. OUTER BEARING, INTERMEDIATE SHAFT
15. CARRIER, INTERMEDIATE BEARING
16. INTERMEDIATE SHAFT

17. DRUM PINION GEAR
18. INTERMEDIATE GEAR
19. INNER BEARING, INTERMEDIATE SHAFT
20. CAPSCREW AND THIMBLE
21. O-RING
22. ROLLER BEARING
23. OIL SEAL
24. SNAP RING
25. DRUM SHAFT
26. STRAINER
27. BLOCK
28. SHOE
29. LOCK NUT
30. SPRING
31. PIN
32. SET SCREW (USE SEALANT ON THREADS)
33. DRAG ADJUSTMENT

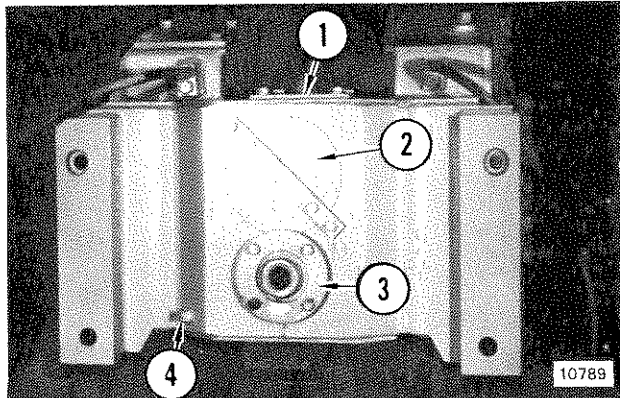
NOTE: When a reference that is made to the LEFT or the RIGHT of the winch or the rotation of a part in the clockwise or counterclockwise direction, the point of view is from a person standing behind the winch and facing the vehicle.

FIGURE 4-2. DRUM ASSEMBLY

PTO Assembly

There are two general arrangements of the PTO assemblies for the W3.5B and W3A winch. Some tractors and skidders have a PTO arrangement that enters the winch case towards the top. Other tractors

have a PTO arrangement that enters the winch case at the bottom. An additional gear case (sometimes called a "drop box") is welded on the winch case for the additional gears required for the bottom entry PTO. These two arrangements are shown in FIGURE 4-3. and FIGURE 4-4.



ARRANGEMENT FOR JOHN DEERE 450E AND 550B SHOWN

- | | |
|-----------------------|------------|
| 1. TOP ACCESS COVER | 3. CARRIER |
| 2. FRONT ACCESS COVER | 4. DRAIN |

ARRANGEMENT TYPICAL FOR THE FOLLOWING UNITS:

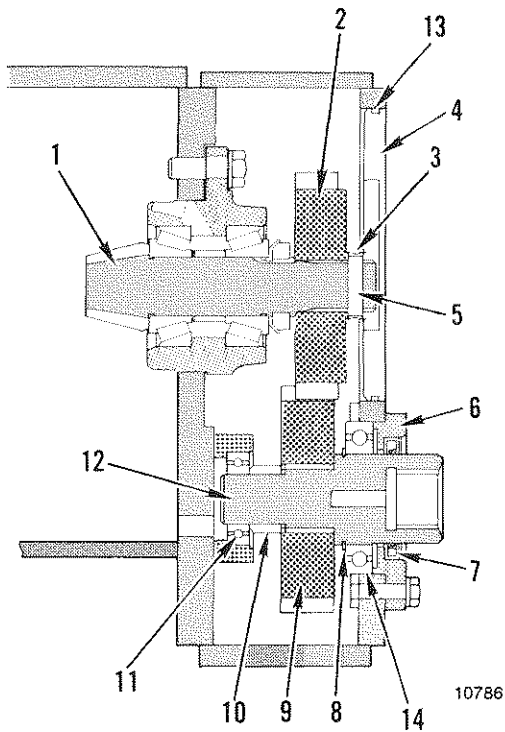
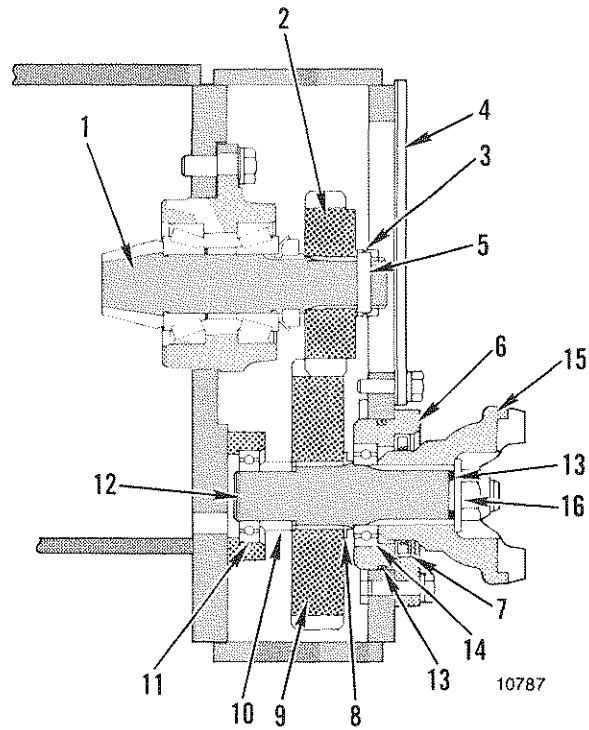
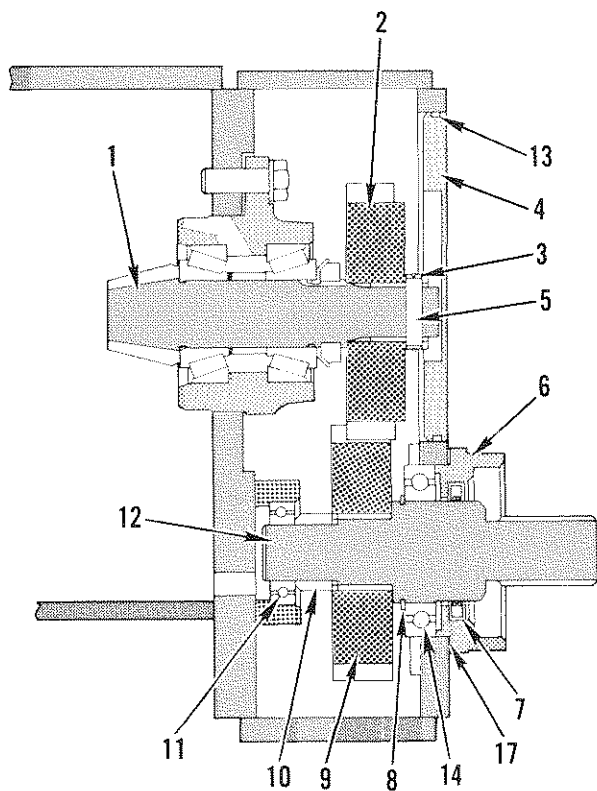
- CATERPILLAR® 518
- FIATALLIS® FD5 and FD7
- JOHN DEERE® 450E and 550B
- TIMBERJACK® 350, 380, and 450

Removal

[See FIGURE 4-4 (2 of 2)]

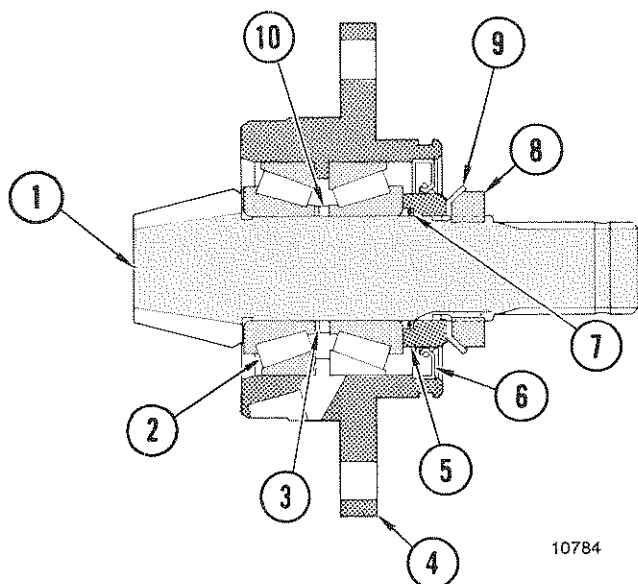
1. A winch with a gear case has additional hydraulic oil in the bottom of the gear case. Use the drain shown in the Figure to remove the hydraulic oil. Remove the top access cover to the pinion. Remove the front access cover to the pinion.
2. Remove the four capscrews that hold the carrier to the winch case. Pull the input shaft (12) and carrier (6) from the winch case. The drive gear (9) and the spacer (10) will slide from the input shaft as it is pulled from the winch.
3. Remove the snap ring and pin from the end of the pinion. Remove the pinion gear.
4. If the pinion must be disassembled, use a prybar to hold the pinion from turning. Use a spanner to loosen the lock nut [this lock nut is tightened to 200 N.m (150 lbf ft)].
5. Remove the six capscrews and remove the pinion assembly. Make a note of the shim arrangement. Unless the pinion is being replaced, this shim arrangement will be used when the pinion is installed.
6. Remove the drive gear and spacer from the winch case. Remove the rear bearing for the input shaft from the winch case.

FIGURE 4-3. PTO ARRANGEMENT WITH GEAR CASE (1 of 2)


JOHN DEERE 450E AND 550B

**CATERPILLAR 518
TIMBERJACK**

FIATALLIS

1. PINION ASSEMBLY
2. PINION GEAR
3. SNAP RING
4. COVER
5. PIN
6. CARRIER
7. OIL SEAL
8. SNAP RING
9. DRIVE GEAR
10. SPACER
11. REAR BEARING
12. INPUT SHAFT
13. O-RINGS
14. FRONT BEARING
15. YOKE
16. NUT AND WASHER
17. GASKET

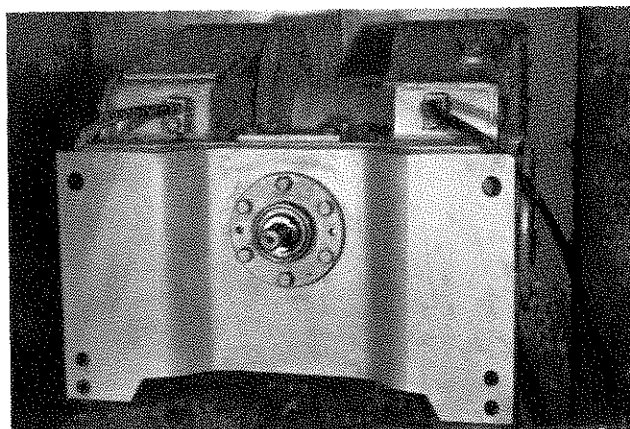
FIGURE 4-3. PTO ARRANGEMENT WITH GEAR CASE (2 of 2)



PINION ASSEMBLY

- | | |
|------------|----------------|
| 1. PINION | 6. OIL SEAL |
| 2. BEARING | 7. O-RING |
| 3. SHIMS | 8. LOCK NUT |
| 4. CARRIER | 9. LOCK WASHER |
| 5. SPACER | 10. SPACER |

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ARRANGEMENT TYPICAL FOR THE FOLLOWING UNITS:

CASE 450B and 850B

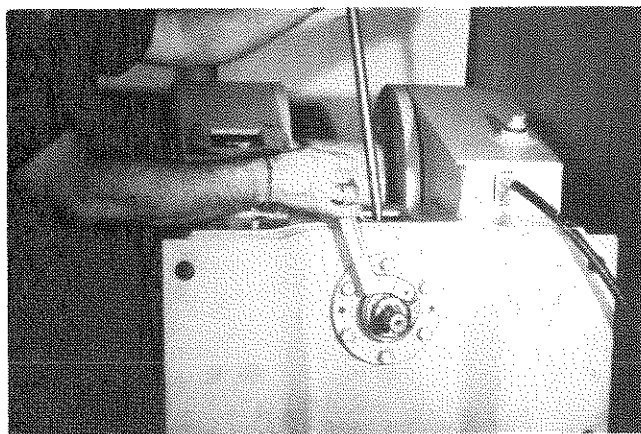
CATERPILLAR D3

FIATALLIS FD5 (low mount)

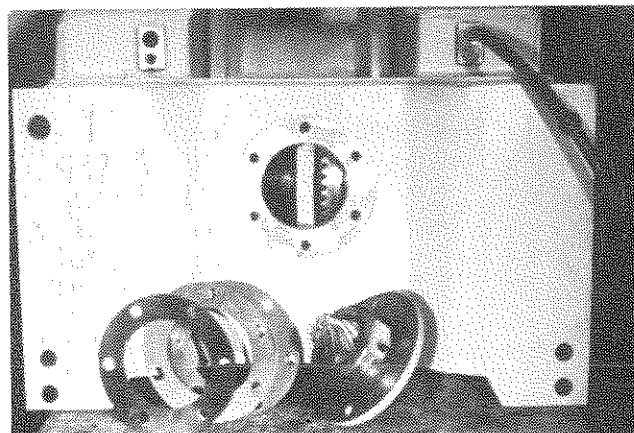
IHC/DRESSER TD7E & G and TD8E & G

KOMATSU D31 and D37

JOHN DEERE 450G-650G



10783

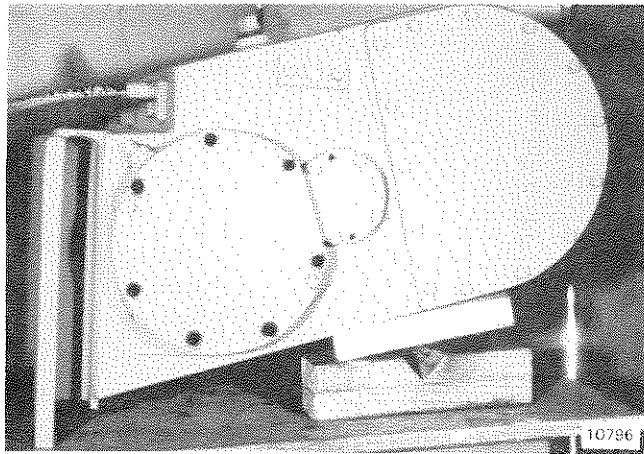


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Removal

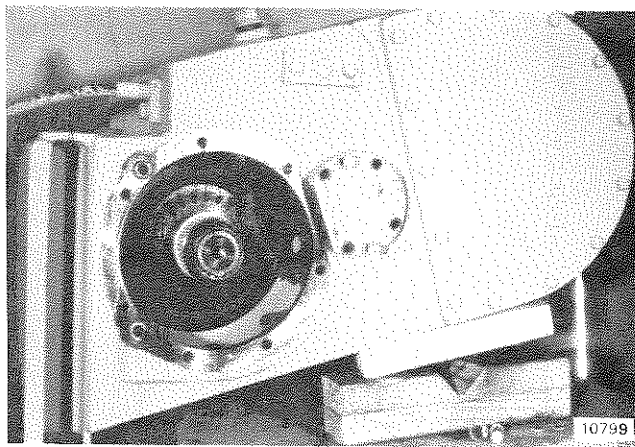
1. Remove the top access cover. If the pinion must be disassembled, use a piece of wood or a brass drift to hold the pinion from turning. Loosen the lock washer. Use a spanner to loosen the lock nut [this lock nut is tightened to 200 N.m (150 lbf ft)].
2. Remove the six capscrews and remove the pinion assembly. Make a note of the shim arrangement. Unless the pinion is being replaced, this shim arrangement will be used when the pinion is installed.

FIGURE 4-4. PTO ARRANGEMENT WITHOUT GEAR CASE



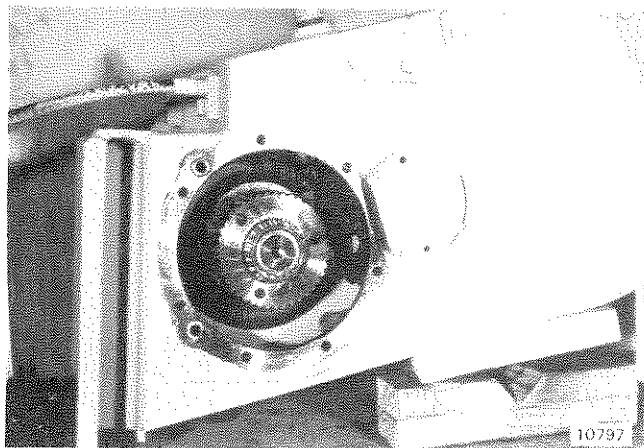
1. If the brake must be disassembled for repairs, loosen, but do not remove the two 3/8 UNC x 1-1/4 inch capscrews that hold the cover.

Remove the seven 1/2 UNC capscrews that hold the brake to the winch case.

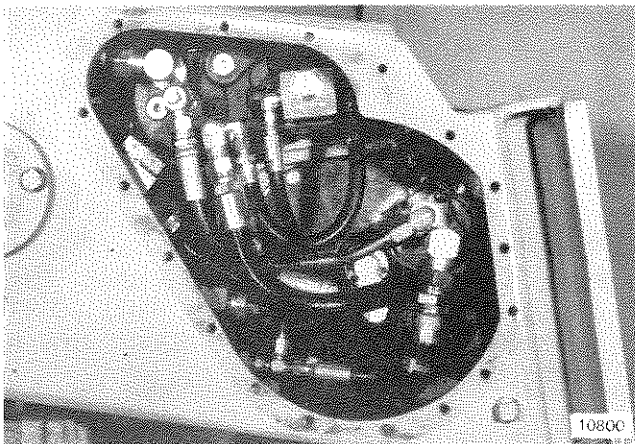


4. If the clutch must be disassembled, put a puller on the bearing and remove it from the shaft.

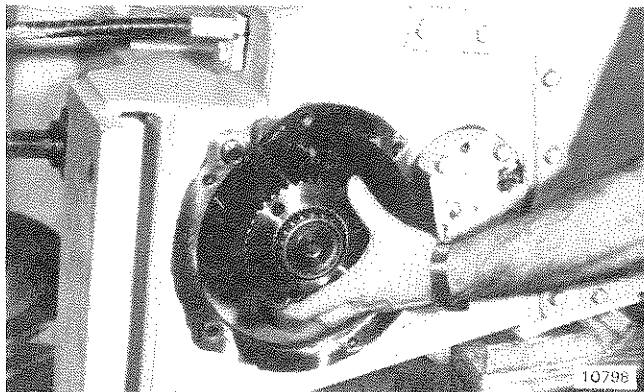
NOTE: This bearing is difficult to remove without causing damage to the bearing cage.



2. Remove the brake from the winch. The hub normally stays on the shaft.



5. Remove the access covers to the hydraulic system.

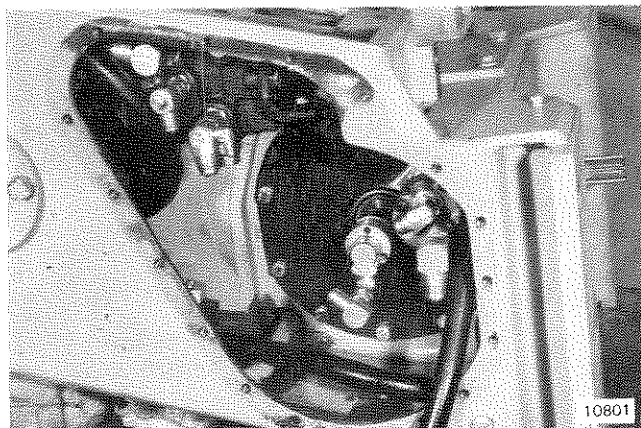


3. Remove the hub.

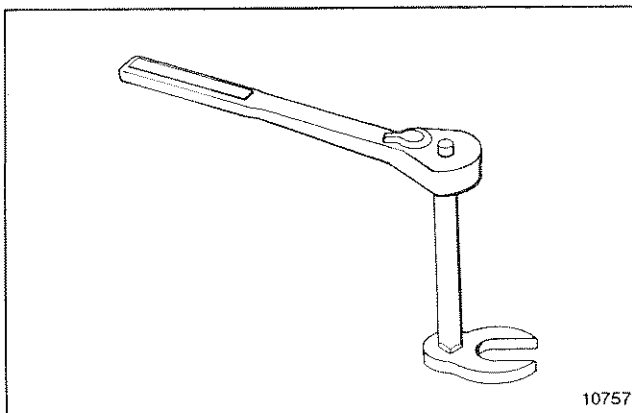
WARNING

Make sure the accumulators are discharged before any work is done on the hydraulic system. If the control lever is connected, move the control lever to the BRAKE OFF position until the accumulators are discharged. If the hand lever is disconnected, use a screwdriver to lift the accumulator valve pin until the accumulators are discharged.

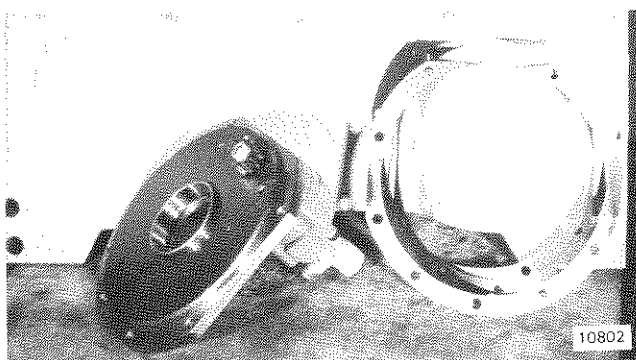
FIGURE 4-5. DISASSEMBLY OF THE WINCH (1 of 5)



6. Remove the hoses and tubes to the hydraulic control valve.

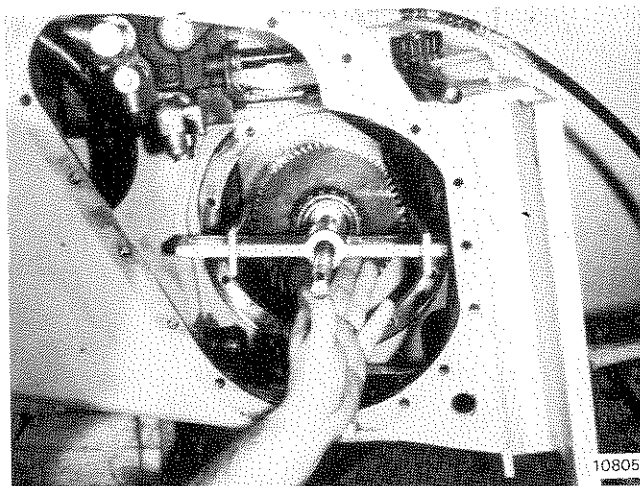


NOTE: A 7/8 inch special wrench called a "crow-foot wrench" is necessary to loosen the rotating joint from the shaft on the W3A winch. The wrench must be turned clockwise because the threaded section on all winches have a **LEFT HAND THREAD**.

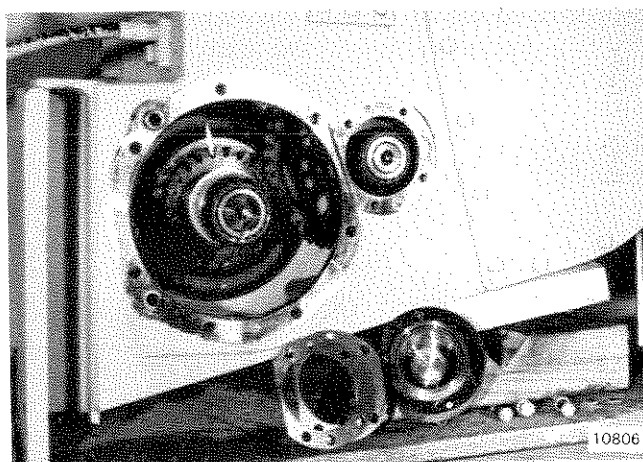


7. Remove the rotating joint from the shaft. **THE THREADED PART OF THE ROTATING JOINT THAT IS CONNECTED TO THE SHAFT HAS A LEFT HAND THREAD.**

Remove the eight 3/8 UNC x 1 inch capscrews and remove the carrier and hydraulic pump. Make a note of the shim arrangement. This shim arrangement will be used when the winch is assembled.

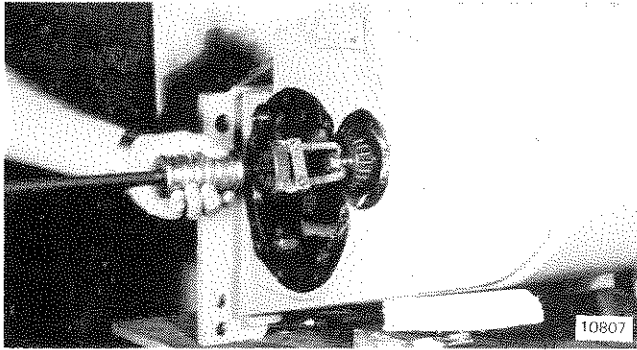


9. Use a puller to remove the drive gear for the hydraulic pump and the shaft bearing.

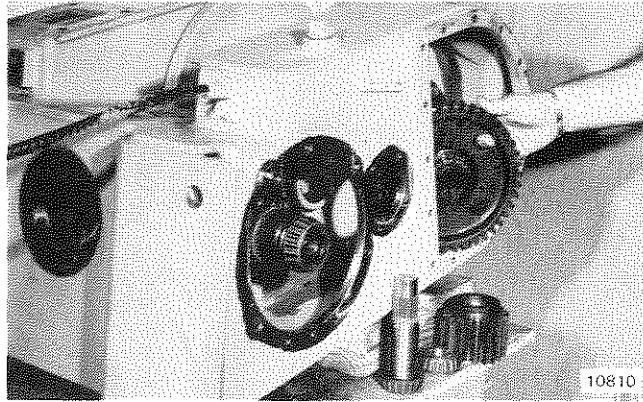


10. Remove the carrier and the shims for the intermediate shaft. Make a note of the shim arrangement.

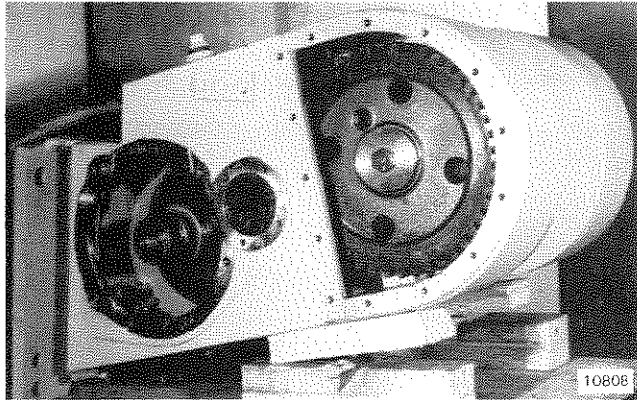
FIGURE 4-5. DISASSEMBLY OF THE WINCH (2 of 5)



11. Use a puller to remove the intermediate shaft.

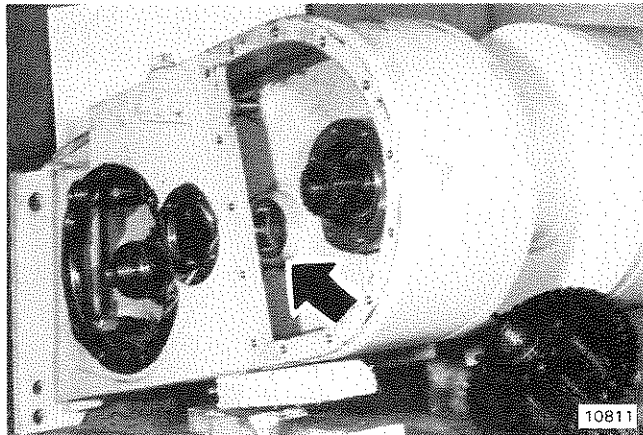


14. Remove the intermediate gear, drum pinion gear, and inner bearing cone from the winch case.

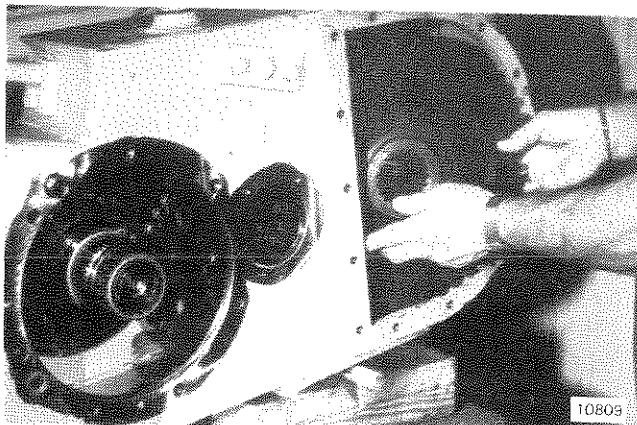


12. Remove the access cover to the drum gear. Loosen the eight special 1/2 UNF x 1 inch drum capscrews. Oil will begin to drain from the drum.

Remove the 3/4 UNC x 1-1/4 capscrew and the retainer that holds the drum gear to the drum adaptor.

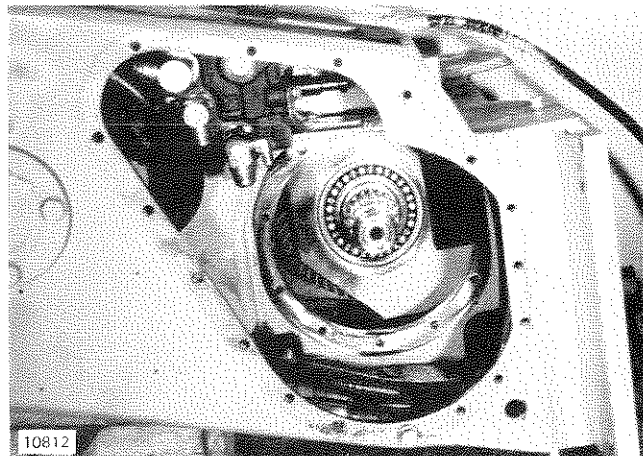


15. Use a puller to remove the inner bearing cup from the winch case.



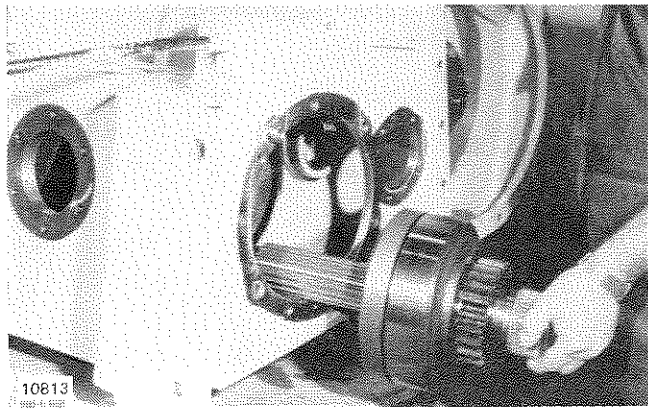
13. Pull the drum gear from the drum adaptor. Slide the drum gear out of the winch case.

NOTE: The clearance between the gear and the winch case is small. It can be necessary to install a wedge between the winch case and drum to gain additional clearance. If there is still not enough clearance, the drum adaptor must be removed.

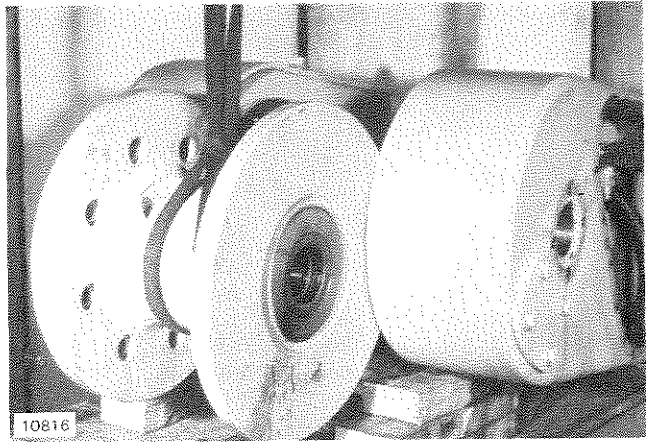


16. Use a wood driver to push the clutch and shaft out of the brake side of the winch.

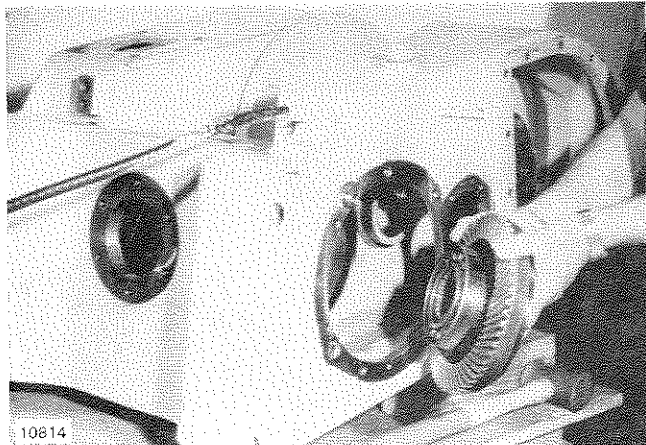
FIGURE 4-5. DISASSEMBLY OF THE WINCH (3 of 5)



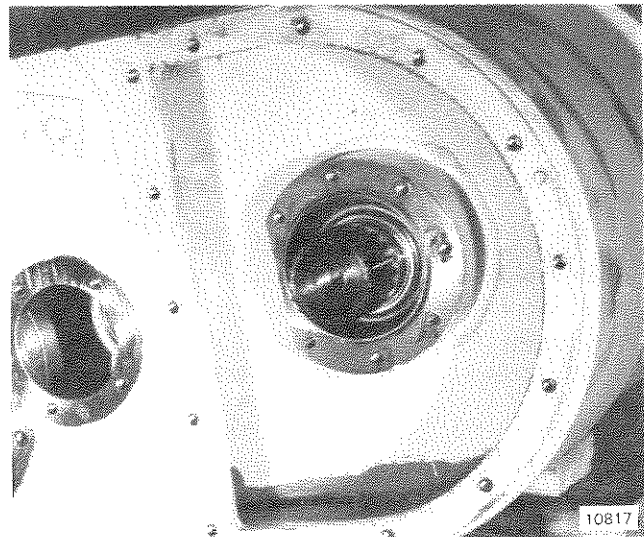
17. Remove the clutch and shaft. Disassembly of the clutch and shaft is described in FIGURE 4-12.



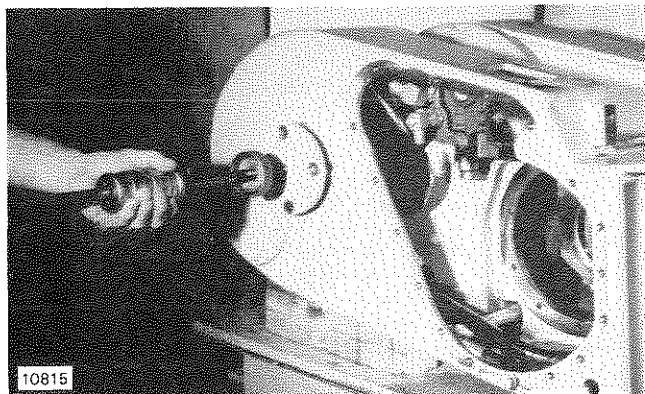
20. Remove the eight drum capscrews and lift the drum away from the winch.



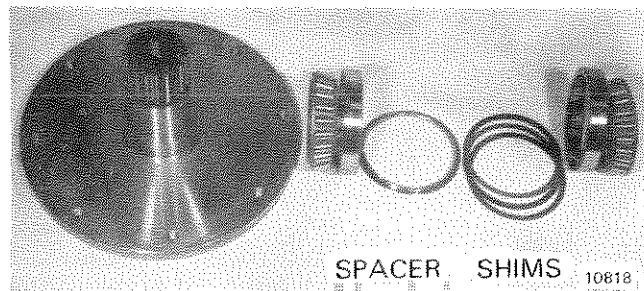
18. Remove the bevel gear from the center support. Remove the bearing from the bevel gear hub.



21. Remove the seven $\frac{3}{8}$ UNC x 1 inch capscrews from the retainer. Use a prybar to remove the drum adapter from the winch case.

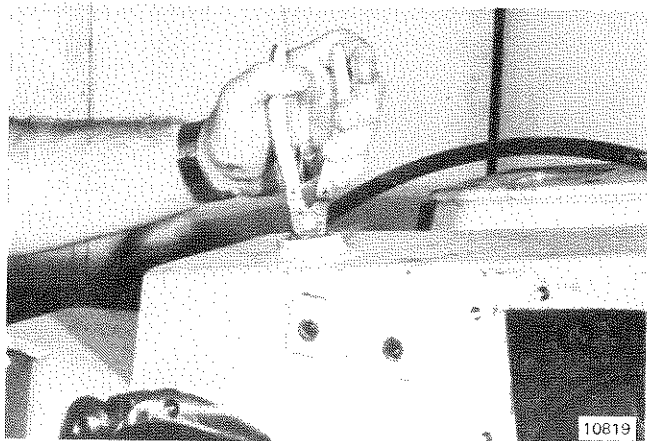


19. Connect a sling to the drum and hold the weight of the drum with a crane or lifting device. Remove the four capscrews from the drum shaft. Use a puller to remove the drum shaft.



22. Remove the bearing assembly from the winch case. Make a note of the shim arrangement in the bearing assembly. This shim arrangement controls the preload on the bearings for the drum adapter. This preload controls the resistance to the rotation of the drum during FREESPOOL operations.

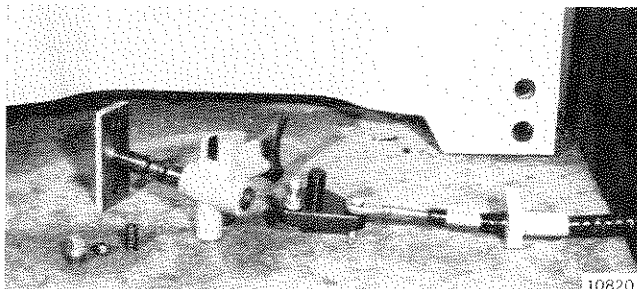
FIGURE 4-5. DISASSEMBLY OF THE WINCH (4 of 5)



23. Remove the cotter pin and pin that holds the control cable to the bellcrank. Remove the 1/2 UNC x 1-1/2 inch cap screw that holds the control cable to the winch case. Remove the control cable. Remove the two cap screws that hold the **FREESPOOL** shaft.

W3A: Reach through the fill hole and remove the snap ring that holds the bellcrank to the bracket in the winch case.

W3.5B: The photograph shows the W3A winch. There is an access plate in this position on the W3.5B winch case that gives easier access to the snap ring that holds the bellcrank to the bracket.



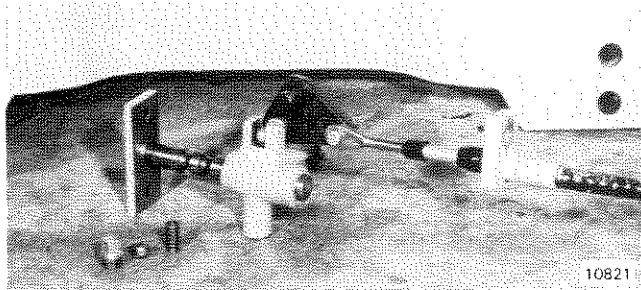
24. Remove the **FREESPOOL** shaft. Be careful that the detent ball and detent spring are not lost. Remove the **FREESPOOL** shift assembly.

NOTE: See the **Hydraulic System** for additional information on the disassembly and assembly of the hydraulic control system.

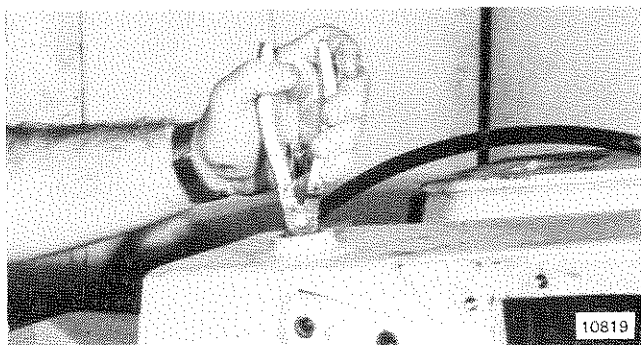
FIGURE 4-5. DISASSEMBLY OF THE WINCH (5 of 5)



ASSEMBLY OF THE WINCH



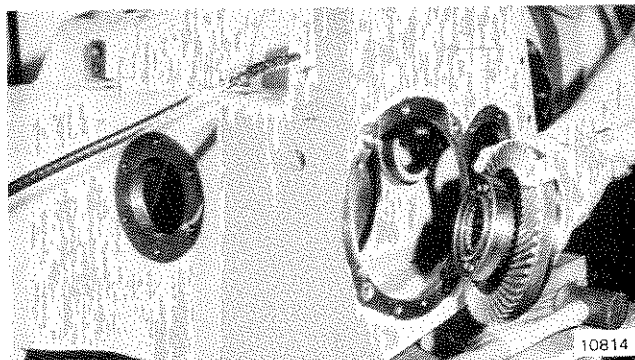
1. Install the **FREESPOOL** shift assembly. Install the shift fork and the **FREESPOOL** shaft. Install the detent ball, detent spring, and plug in the shift fork. Tighten the plug enough so that it will stay in the shift fork. Final adjustments will be made to the detent pressure later in this procedure.



2. Install the bellcrank in the winch case. Install the two 1/2 UNC x 1-1/2 inch capscrews that hold the **FREESPOOL** shaft. Use a new gasket on the mounting block for the control cable. Install the control cable in the winch and connect the cable to the bellcrank. A cotter pin holds the pin for the control cable and the bellcrank in the bellcrank. Install the capscrew that holds the mounting block to the winch case.

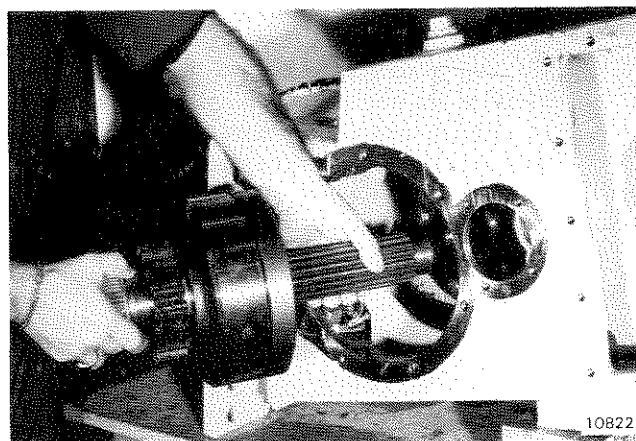
W3A: Reach through the fill hole in the winch case with snap ring pliers to install the snap ring.

W3.5B: The photograph shows the W3A winch. There is an access plate in this position on the W3.5B winch case that gives easier access to the snap ring that holds the bellcrank to the bracket.

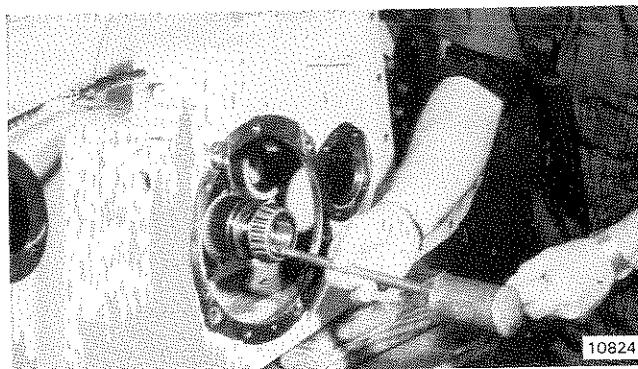


3. Assembly of the clutch and shaft is described in FIGURE 4-13. Install the ball bearing on the bevel gear hub. Install the bevel gear in the center support of the winch case. (Installation on the left side of the winch case is shown.)

NOTE: See FIGURE 1-9. for the arrangement of the clutch and bevel gear shaft. The bevel gear must be installed on the correct side of the pinion for the winch to operate correctly with your tractor or skidder.

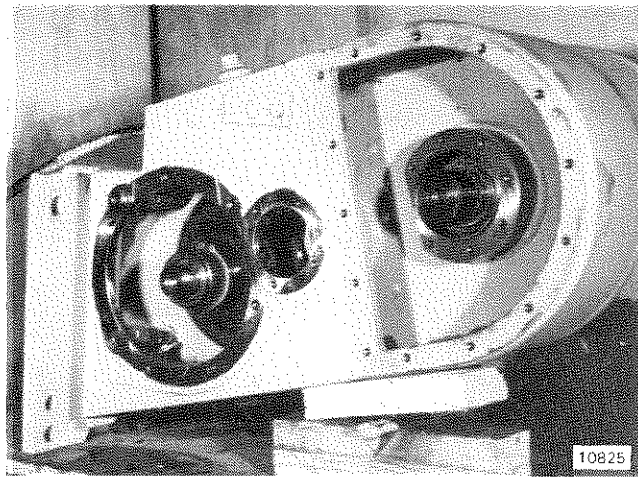


4. Install the clutch and bevel gear shaft in the winch.

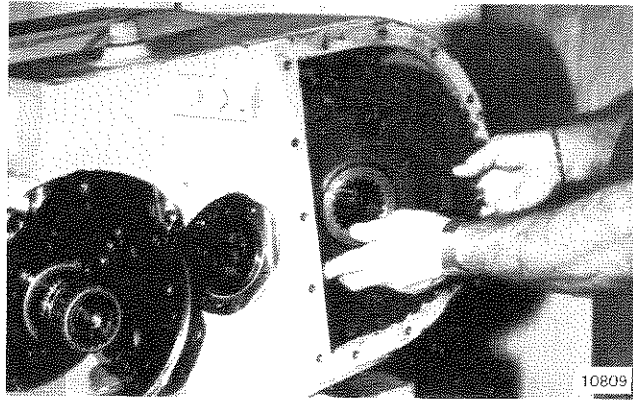


5. If the bearing on the brake side of the shaft was removed, install the bearing.

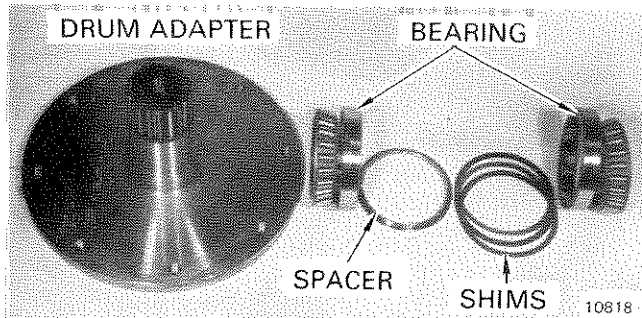
FIGURE 4-6. ASSEMBLY OF THE WINCH (1 of 7)



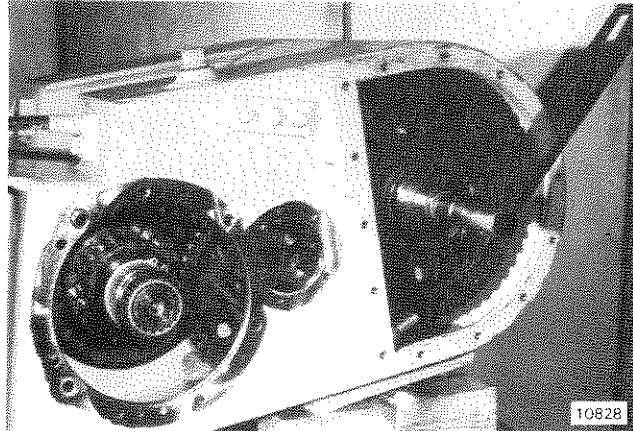
6. Install a new oil seal for the drum adapter. Install the drum adapter in the winch.



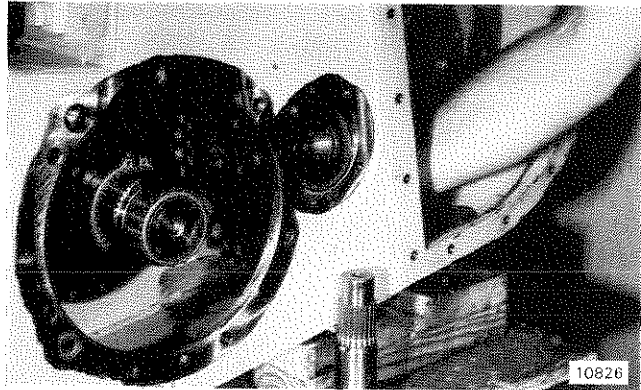
9. Install the drum gear on the drum adapter. Install the retainer.



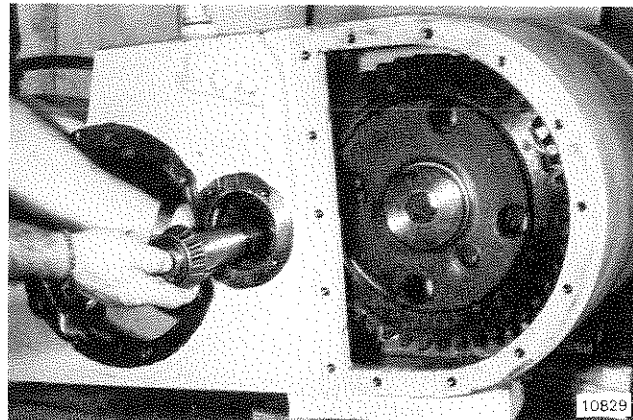
7. Install the bearing assembly in the winch. Install the retainer.



10. Tighten the 3/4 UNC x 1-1/4 inch cap screw to 270 N.m (200 lbf ft).

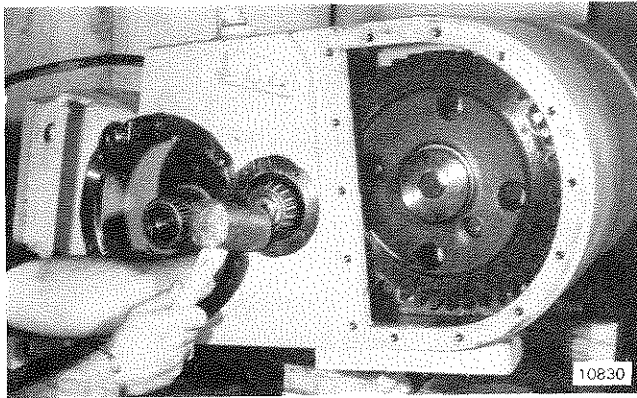


8. If the inner bearing cup for the intermediate shaft was removed, install the bearing cup. Put some grease in the bearing cup to hold the bearing cone when it is installed. Put the intermediate gear and the drum pinion gear in position in the winch case. Hold the intermediate gear assembly towards the outside of the winch case. Reach behind the intermediate gear assembly and install the bearing cone in the bearing cup.

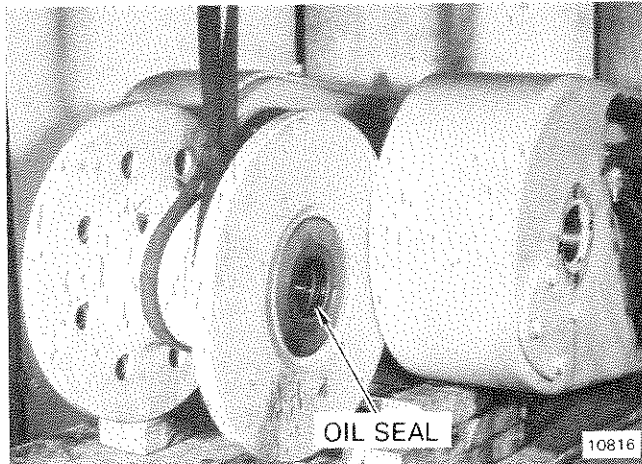


11. Align the intermediate gear assembly and install the intermediate shaft. Make sure the **FREESPOOL** shift fork is engaged correctly in the drum pinion gear.

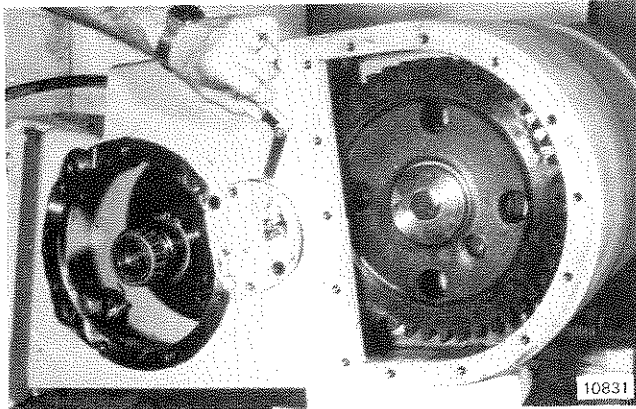
FIGURE 4-6. ASSEMBLY OF THE WINCH (2 of 7)



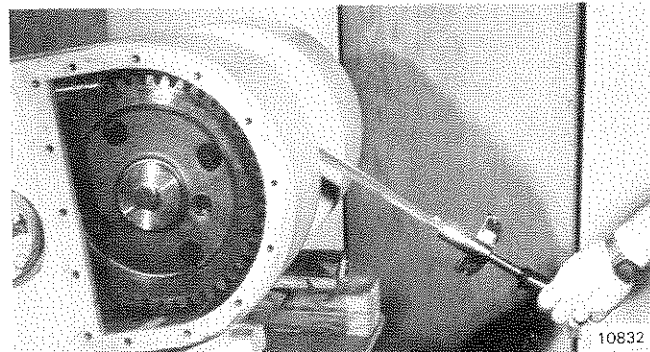
12. Use a soft hammer to push the intermediate shaft fully into the inner bearing.



15. Install a new oil seal in the drum. Install a new O-ring on the drum where it joins the drum adapter. Install the drum in position in the winch.

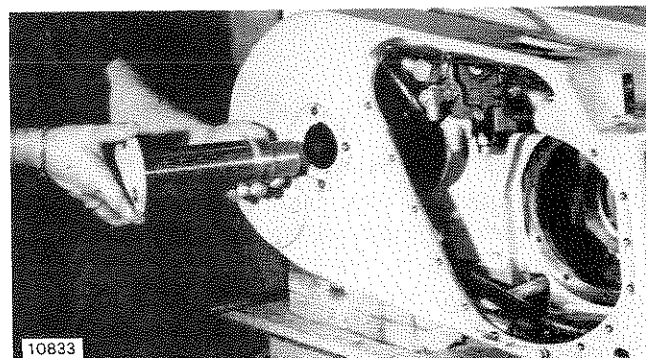


13. Install the outer bearing carrier without the shims. Measure the distance between the bearing carrier and the winch case. Install shims so that there is a preload of -0.07 to $+0.05$ mm (-0.003 to $+0.002$ in) on the bearings of the intermediate shaft. (If there are no parts changes on the intermediate shaft, the original shim arrangement will be approximately the correct value.) Put liquid sealer on the surface of each shim and the bearing carrier when the final assembly is made.



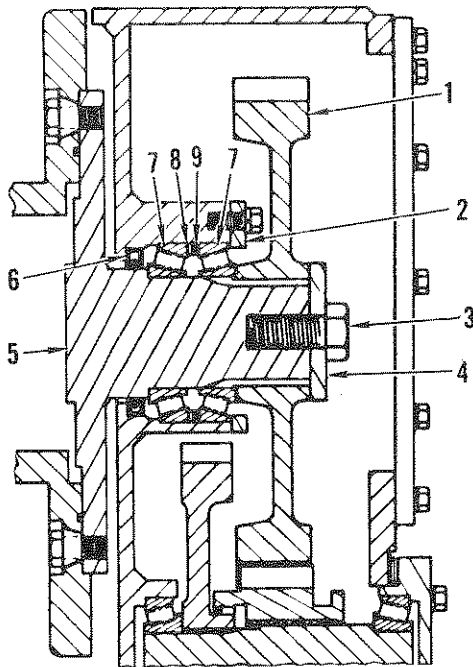
16. Install the eight special $1/2$ UNF x 1 inch capscrews with the tapered thimbles. Tighten the capscrews evenly to 160 N.m (120 lbf ft).

14. Adjust the detent plug to set the pressure on the detent ball. The pressure on the detent ball must be enough to make sure that the **FREESPOOL** shift fork will stay in each detent position. The force to move the **FREESPOOL** shift fork from the detent can be adjusted to the needs of the operator. When the adjustment is complete, install a safety wire through the hole in the adjustment plug and around the **FREESPOOL** shift fork.



17. Turn the drum so that the ferrule pocket is up. **ADD ONE LITRE (QUART) OF HYDRAULIC OIL INSIDE THE DRUM.** Lubricate the drum shaft with grease. Install the drum shaft.

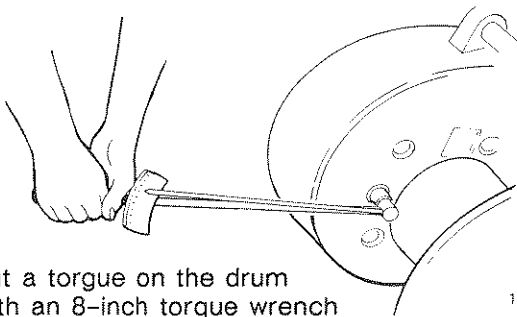
FIGURE 4-6. ASSEMBLY OF THE WINCH (3 of 7)



10754

- | | |
|--------------------------------------|-------------------|
| 1. DRUM GEAR | 5. DRUM ADAPTER |
| 2. BEARING RETAINER | 6. OIL SEAL |
| 3. CAPSCREW,
3/4 UNC x 1-3/4 inch | 7. ROLLER BEARING |
| 4. RETAINER | 8. SPACER |
| | 9. SHIMS |

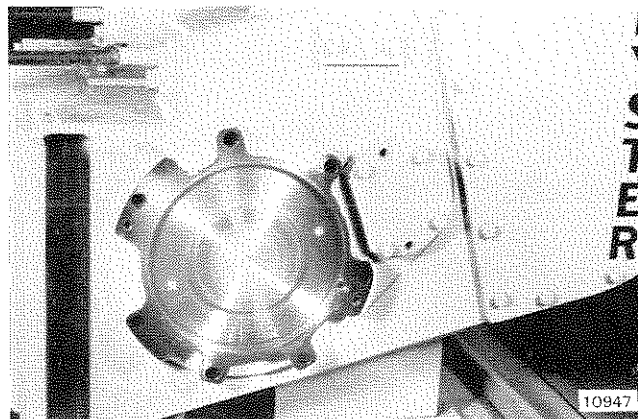
18. Measure the preload on the drum. Move the drum pinion gear to the **FREESPOOL** position. Put a torque wrench on one of the special capscrews that hold the drum to the drum adapter. Use an 8-inch torque wrench to measure the torque required to rotate the drum. The correct torque is 6-11 N.m (55-95 lbf in). If the torque is not correct, the drum gear must be removed. Remove the retainer and the outer bearing for the drum adapter. Add or subtract shims to measure the correct preload. The shims are available in the following thicknesses: 0.13 mm (0.005 in) 0.18 mm (0.007 in)



Put a torque on the drum
with an 8-inch torque wrench

12412

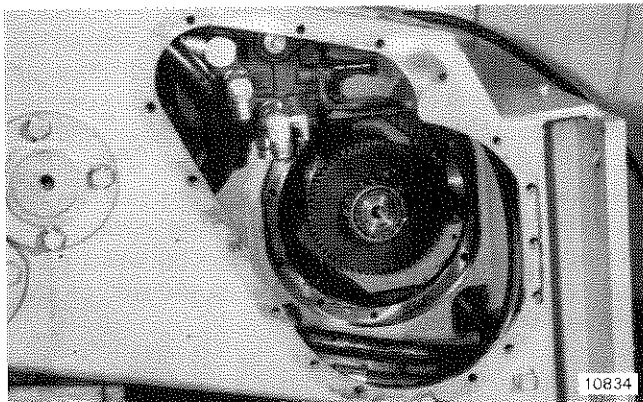
NOTE: The small clearance between the winch case and the drum gear can make the drum gear difficult to install and remove. Some service people make a tool that has the same dimensions as the hub of the drum gear to measure and adjust the preload on the drum before the drum gear is installed. A piece of pipe made to the dimensions shown in the following drawing can be used as a tool to be used during the measurement of the preload on the drum.



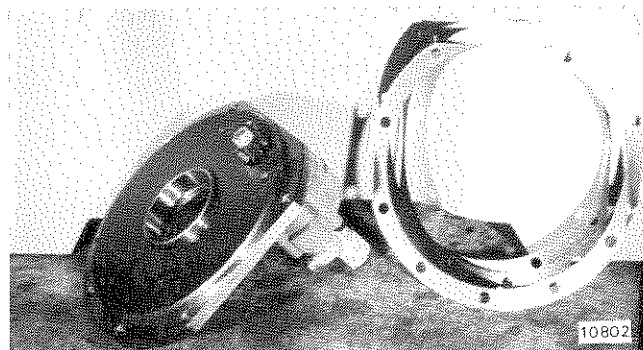
10947

19. Install the brake assembly on the winch. Use the same shim arrangement that was removed. Make sure the surfaces of the shims are clean. Do not apply liquid sealer to the shims and the brake housing until the adjustment is complete. See the **Pinion And Bevel Gear Adjustment** at the end of this section.

FIGURE 4-6. ASSEMBLY OF THE WINCH (4 of 7)



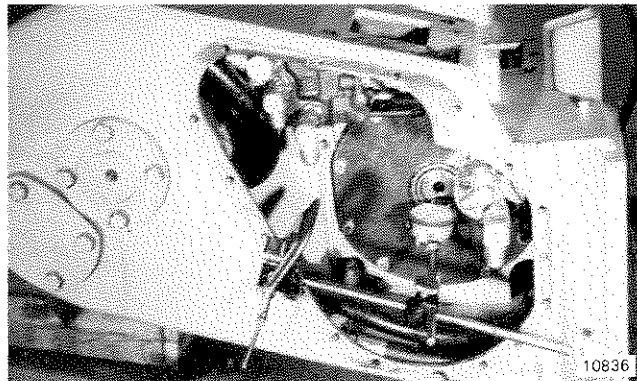
20. Install the drive gear for the hydraulic pump and the bearing cone.



21. Install the shims, carrier, and hydraulic pump. Use the same shim arrangement that was removed.



22. Install the pinion assembly if it was removed. Use the same shim arrangement that was removed. Use a spanner to tighten the lock nut to 200 N.m (150 lbf ft). Do not bend the lock washer to lock the nut until the preload and gear clearance checks are complete.



23. Install a dial indicator and measure the shaft clearance. Adjust the shaft clearance to the specifications described in the following NOTE. Use a prybar to move the clutch from side to side. The movement of the shaft indicated on the dial indicator is the thickness of the shims that must be removed. No movement can indicate that shims must be added. Add or remove shims so that the preload is within the specifications.

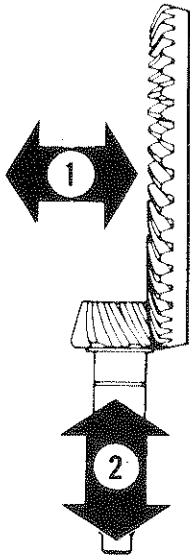
NOTE: The shims at each end of the clutch and brake shaft control the preload on the shaft and also control the clearance of the bevel gear with the pinion. The following specifications are for the preload on the clutch and brake shaft: 0.00 to +0.10 mm (0.000 to +0.004 in).

The clearance specification between the bevel gear and the pinion is 0.20 ± 0.07 mm (0.008 ± 0.003 in). Rotate the bevel gear and make measurements at a minimum of three points to make sure that the gear clearance is within the specification.

The depth of engagement of the pinion with the bevel gear is controlled by the shims on the pinion assembly. The pinion and the bevel gear are a matched set. If one of the gears must be replaced, both gears must be replaced.

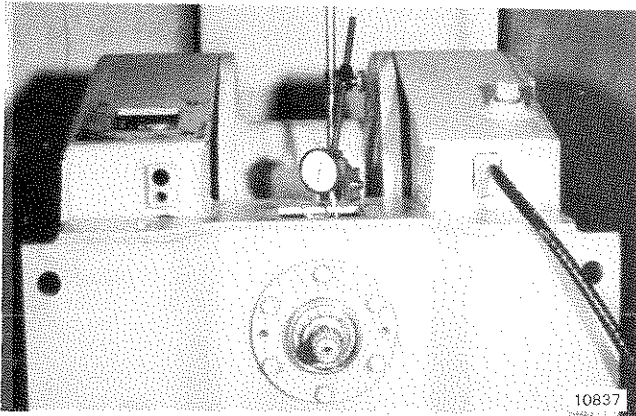
If the clearance of the bevel gear and pinion must be changed because new parts were installed, see the **Pinion And Bevel Gear Adjustment** at the end of this section.

FIGURE 4-6. ASSEMBLY OF THE WINCH (5 of 7)



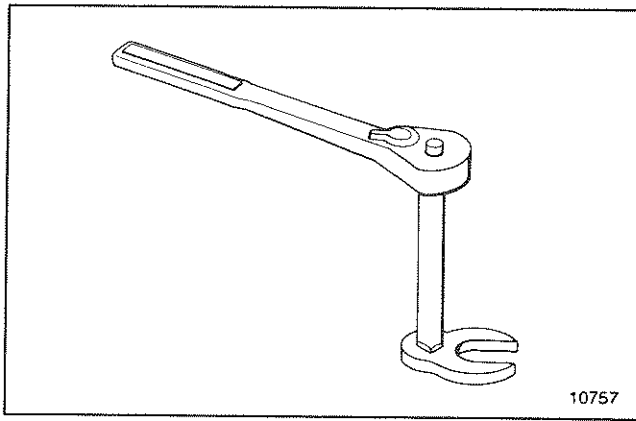
5840

1. The position of the bevel gear is controlled by the shims at each end of the clutch and brake shaft.
2. The position of the pinion is controlled by the shims on the pinion shaft.



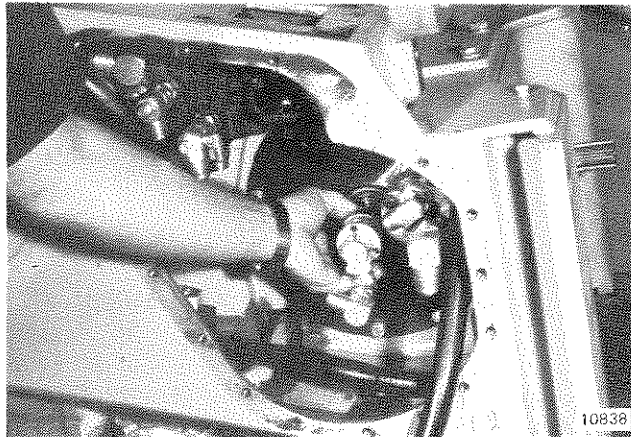
10837

24. The clearance specification between the bevel gear and the pinion is 0.20 ± 0.07 mm (0.008 ± 0.003 in). Rotate the bevel gear and make measurements at a minimum of three points to make sure that the gear clearance is within the specification. Change shims at the end of the clutch and brake shaft as necessary. See the section **Pinion And Bevel Gear Adjustment**. The bearing clearance permits a small amount of movement of the pinion.



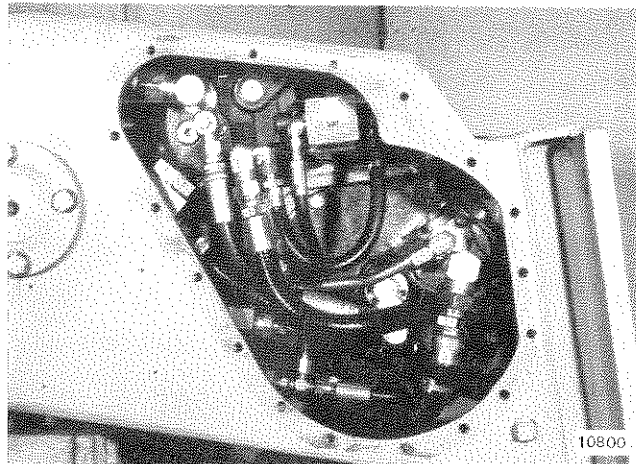
10757

NOTE: A 7/8 inch special wrench is necessary to tighten the threaded part of the rotating joint that is connected to the shaft on the W3A winch. The threaded part has a **LEFT HAND THREAD** on all winches.



10838

25. Install the rotating joint for the hydraulic system.

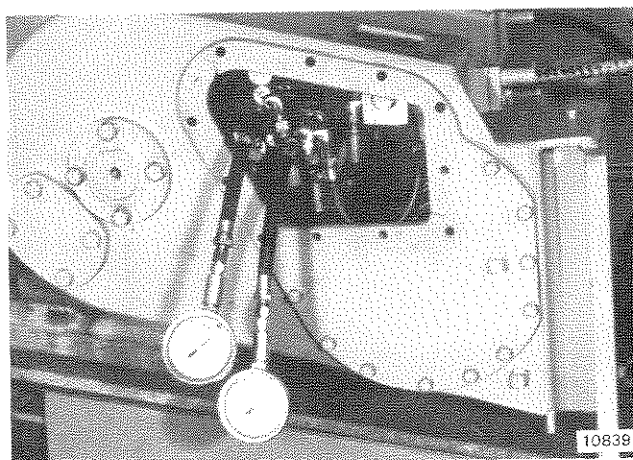


10800

26. Install the hoses and tubes for the hydraulic control system.

FIGURE 4-6. ASSEMBLY OF THE WINCH (6 of 7)

27. If the winch has a PTO gear case assembly, install the pinion gear, snap ring, and pin on the end of the pinion. See FIGURE 4-3. Install rear bearing for the input shaft. Align the drive gear and spacer inside of the winch and install the input shaft and bearing carrier. Tighten the four capscrews for the bearing carrier to 30 N.m (25 lbf ft).



28. Install the gasket and large access cover for the hydraulic system. When the winch is installed on the tractor or skidder, add hydraulic oil to the winch. Install pressure gauges so that the checks and adjustments can be completed as described in Section 3.

FIGURE 4-6. ASSEMBLY OF THE WINCH (7 of 7)

PINION AND BEVEL GEAR ADJUSTMENT (See FIGURE 4-8.)

If the pinion or bevel gear is worn or damaged, they must be replaced as a set. When the pinion bearings are replaced, or the pinion and bevel gear are replaced, the shim arrangement must be adjusted for the new parts. Service persons must often make more than one adjustment before the clearances are correct. This procedure describes the following steps:

1. Check and adjust the the preload on the clutch shaft.
2. Find the amount of shims necessary to correctly install the pinion.
3. Measure and the adjust the clearance between the bevel gear and the pinion.

NOTE: The pinion and bevel gear are made in sets. Both the pinion and ring gear must be marked with the same serial number. The clearance between the pinion and bevel gear at the closest point is also

marked on the bevel gear. The “checking distance” is marked on the end of the pinion. If the original pinion is not available and its “checking distance” is not known, use the test dimension of 77.85 mm (3.065 inches) to begin the adjustment of the “checking distance”. Use shims between the bearing carrier and the mount surface on the winch case to adjust the “checking distance”.

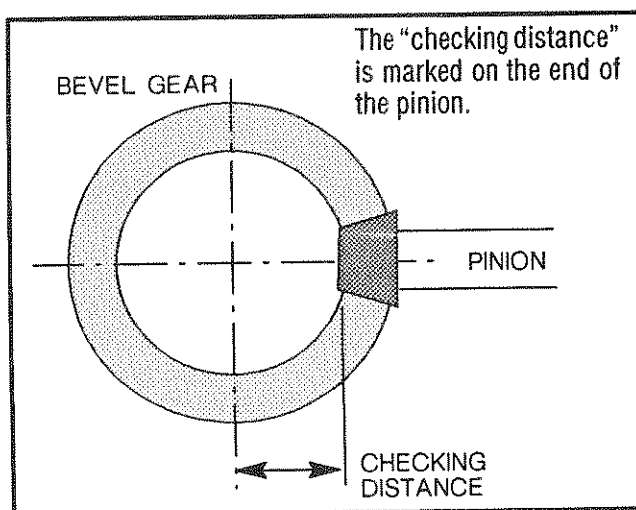
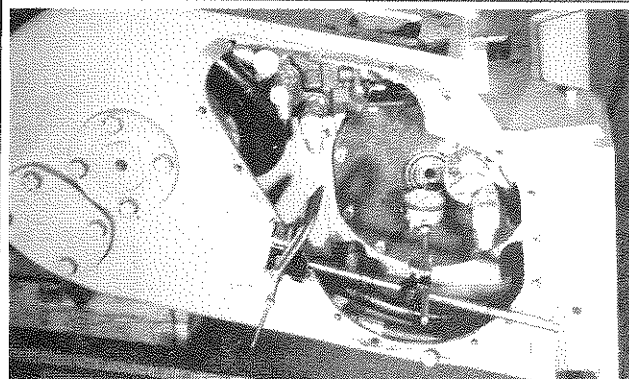


FIGURE 4-7. “CHECKING DISTANCE”



10836

1. Check And Adjust The Preload On The Clutch Shaft.

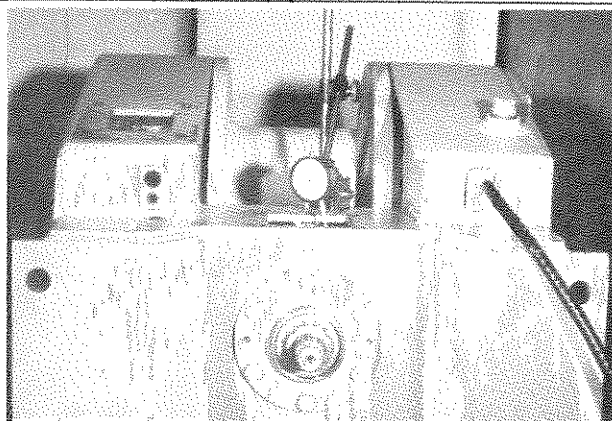
Install a dial indicator and measure the clearance of the clutch and brake shaft. Adjust the clearance to the specifications described in the following NOTE. Use a prybar to move the clutch from side to side. The movement of the shaft indicated on the dial indicator is the thickness of the shims that must be removed. No movement can indicate that shims must be added. Add or remove shims so that the preload is within the specifications.

NOTE: The shims at each end of the clutch and brake shaft control the preload on the shaft and also control the clearance of the bevel gear with the pinion. The following specifications must be used for the preload on the clutch and brake shaft: 0.00 to +0.10 mm (0.000 to +0.004 in).

2. Find the amount of shims necessary to correctly install the pinion.

Look at the number on the pinion that was removed. Subtract the number that is on the new pinion. The remainder is the amount of shim thickness that must be added or removed from the shim set on the pinion that was removed. The shim adjustment must be within ± 0.001 inch.

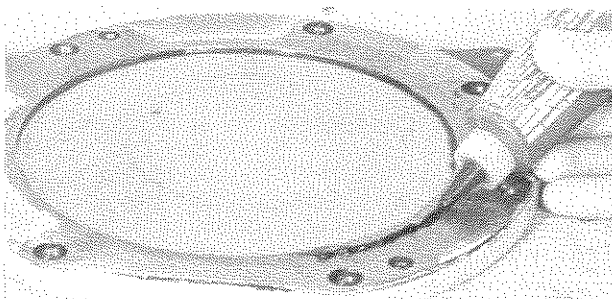
EXAMPLES	1	2
Number on OLD PINION – Number on NEW PINION	3.172 – 3.183	3.172 – 3.160
SHIMS TO BE REMOVED OR ADDED TO THE OLD SET	– 0.011 in REMOVE SHIMS	+ 0.012 in ADD SHIMS



10837

3. Check The Clearance Between The Bevel Gear And The Pinion

Measure the clearance in a minimum of three places on the bevel gear. The clearance between the pinion is 0.10 to 0.15 mm (0.004 to 0.006 in) at the closest measurement. Add or remove shims from the bearing carrier at one end of the clutch and brake shaft and add or remove the same value of shims under the brake housing to adjust the clearance of the bevel gear.



10950

When the pinion and bevel gear clearances are within the specifications, bend the lock washer to lock the pinion nut. Remove the oil brake housing and apply liquid sealant around the housing and the inner diameter of the shims. Install the oil brake on the winch case. Also see **Assembly Of The Oil Brake**, FIGURE 4-11.

FIGURE 4-8. PINION AND BEVEL GEAR ADJUSTMENT



OIL BRAKE

This procedure describes the repair of the oil brake.
The disassembly of the brake is described in

FIGURE 4-10. The assembly of the oil brake is described in FIGURE 4-11.

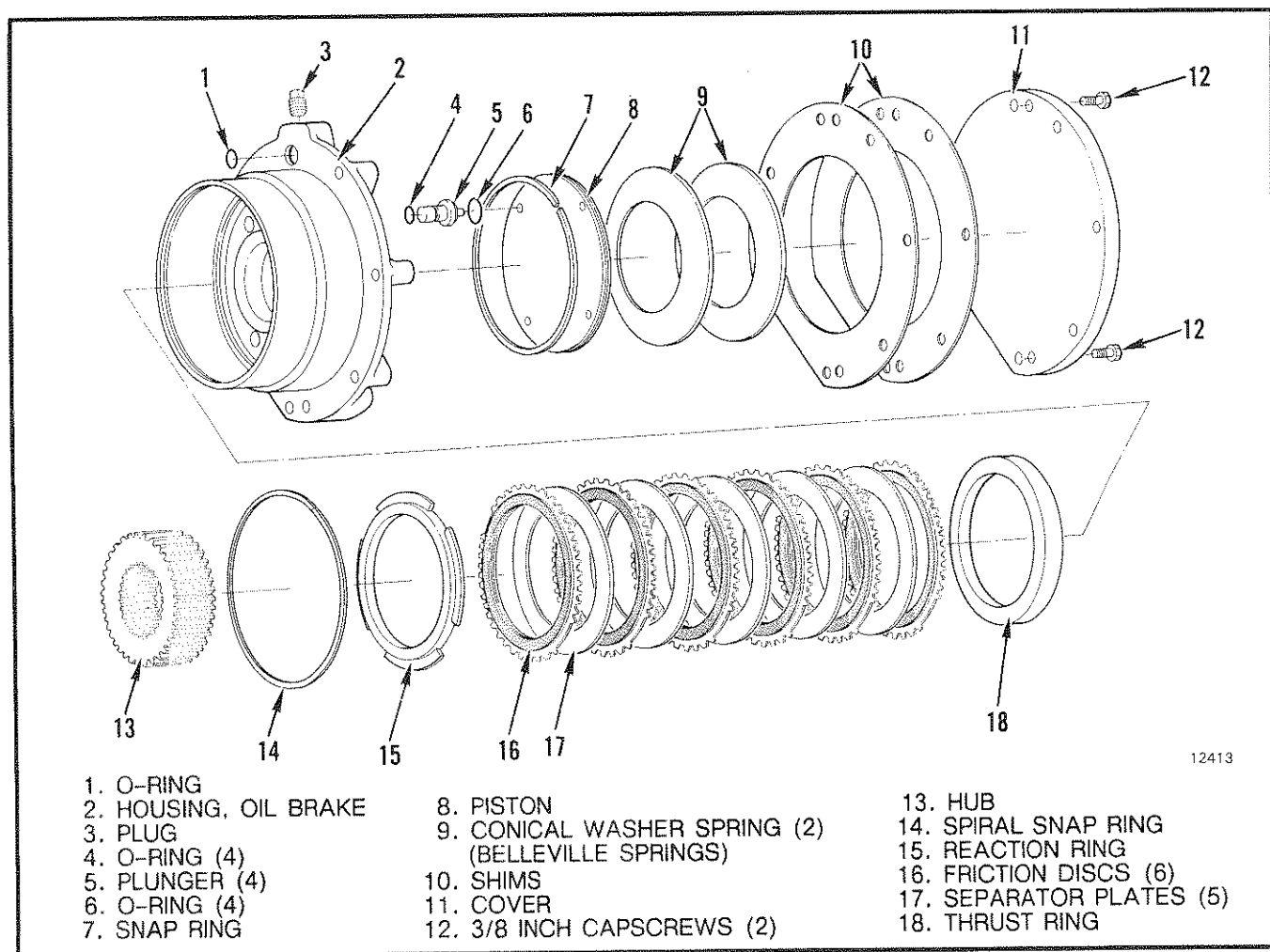
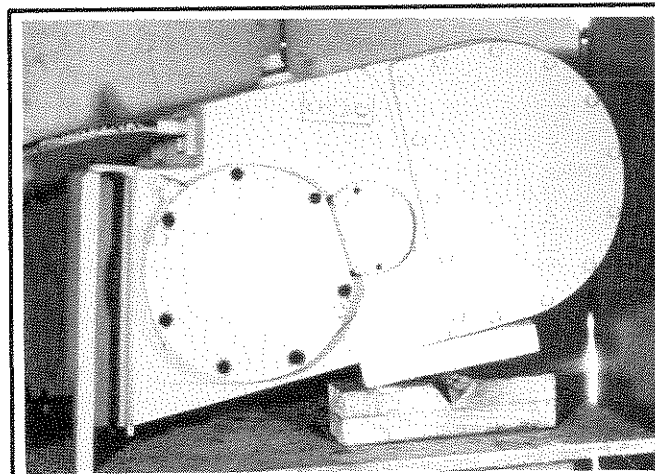
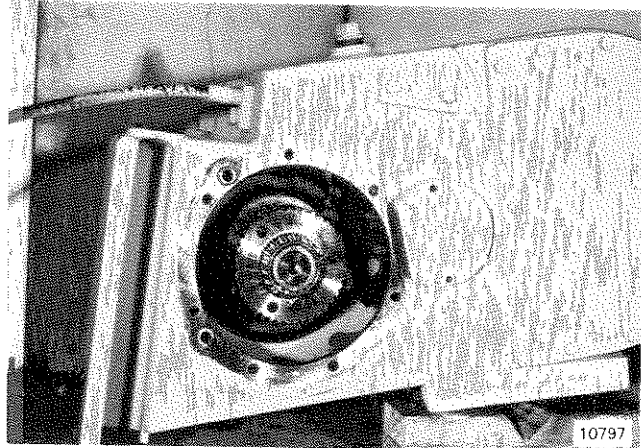


FIGURE 4-9. OIL BRAKE

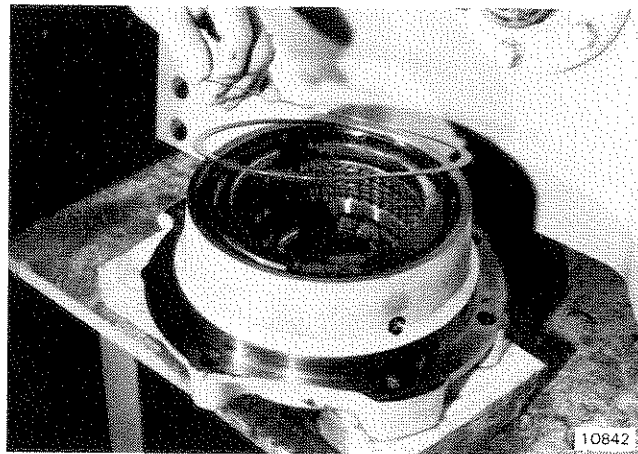


1. Loosen, but do not remove the two 3/8 UNC x 1-1/4 inch capscrews that hold the cover. Remove the seven 1/2 UNC capscrews that hold the oil brake to the winch case.

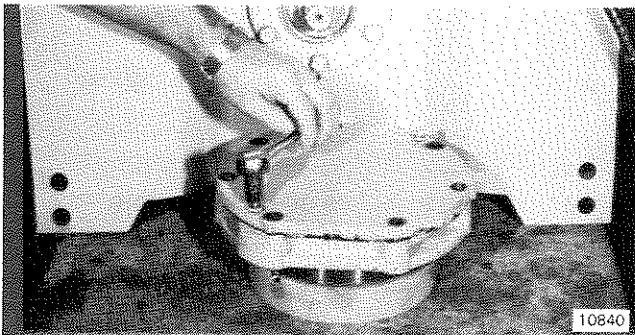
FIGURE 4-10. DISASSEMBLY OF THE OIL BRAKE (1 of 3)



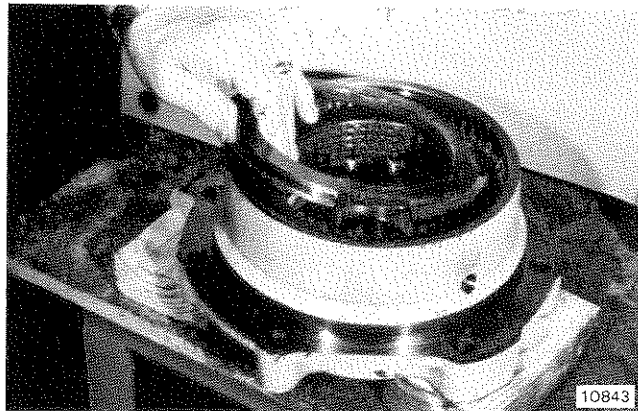
2. Remove the brake from the winch. The hub normally stays on the shaft.



5. Put the brake on blocks. Remove the double spiral snap ring. If the reaction ring fits against the snap ring too tightly, hit the reaction ring with a soft hammer to loosen the snap ring.



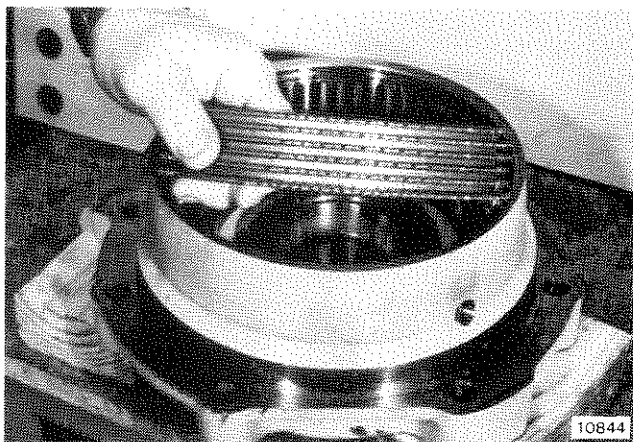
3. Loosen the two 3/8 UNC x 1-1/4 inch capscrews evenly and remove the cover. Make a note of the shim arrangement.



6. Remove the reaction ring.

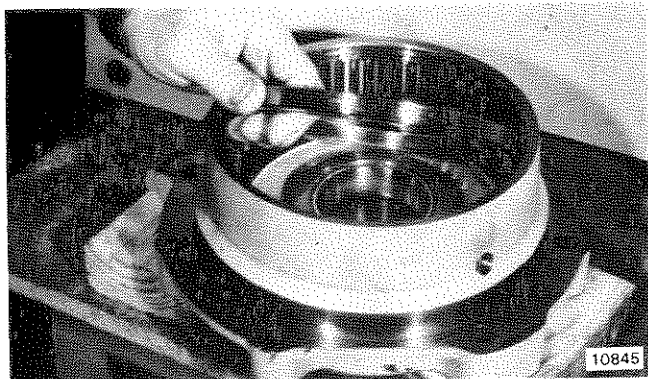


4. Remove the two conical washer springs (belleville springs).

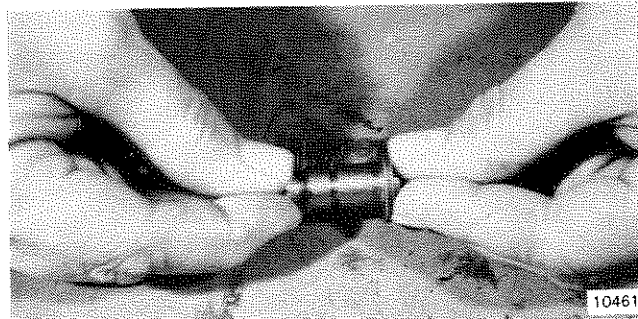


7. Remove the friction discs and the separator plates.

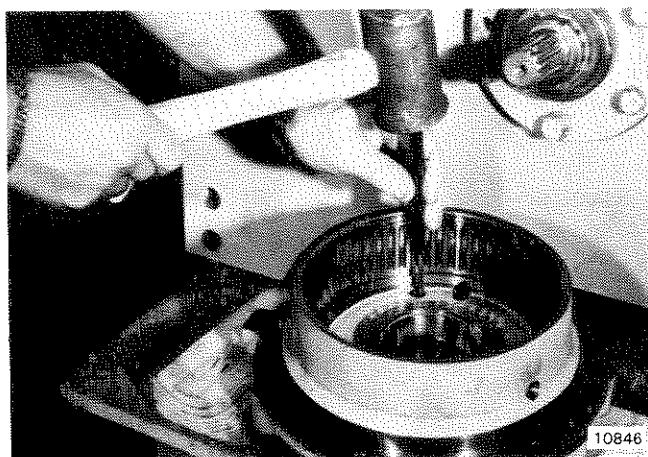
FIGURE 4-10. DISASSEMBLY OF THE OIL BRAKE (2 of 3)



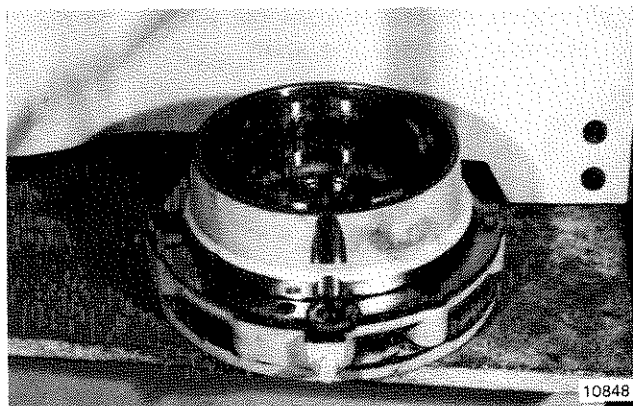
8. Remove the thrust ring.



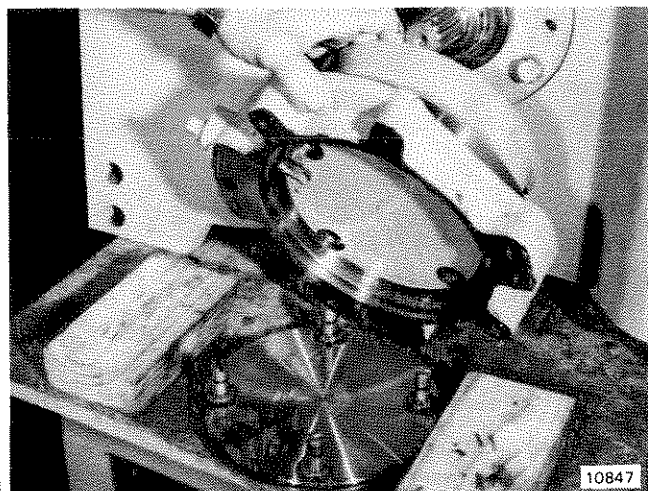
11. Remove the two O-rings on each plunger. Make sure the plungers are not worn.



9. Use a drift to remove the plungers and the piston from the brake housing. Hit the plungers evenly so that the piston is pushed straight from the brake housing.

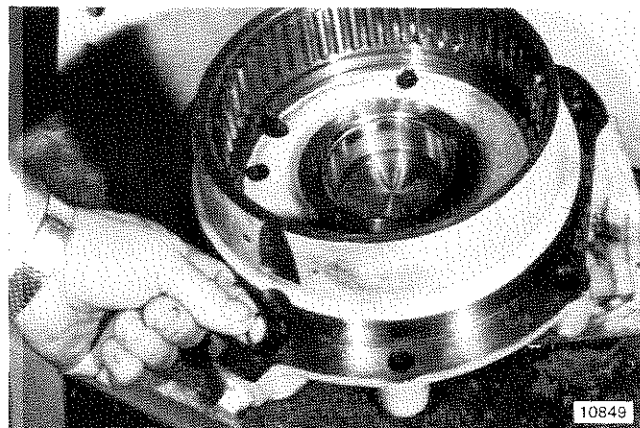


12. Clean the joint surfaces of the brake housing and shims. Make sure that the surfaces do not have damage or there will be oil leaks.

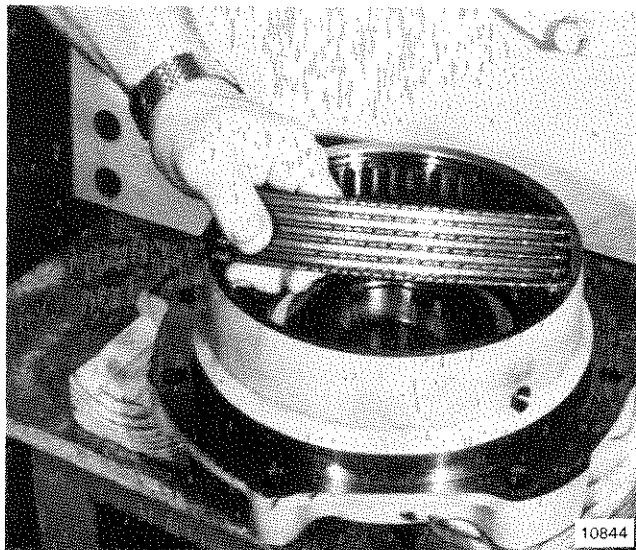


10. Remove the brake housing from the piston. Remove and discard the large circumference seal from the piston.

FIGURE 4-10. DISASSEMBLY OF THE OIL BRAKE (3 of 3)



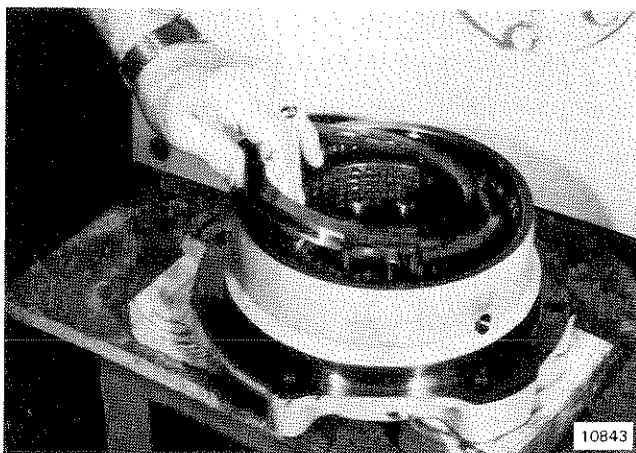
1. Install a new O-ring in the joint for the hydraulic oil supply.



3. Install a friction disc on the thrust ring. Next, install a separator plate. Install the remainder of the friction discs and separator plates in the same sequence. There are missing teeth in the outer circumference of the friction discs. Make sure these spaces on the friction discs are aligned.

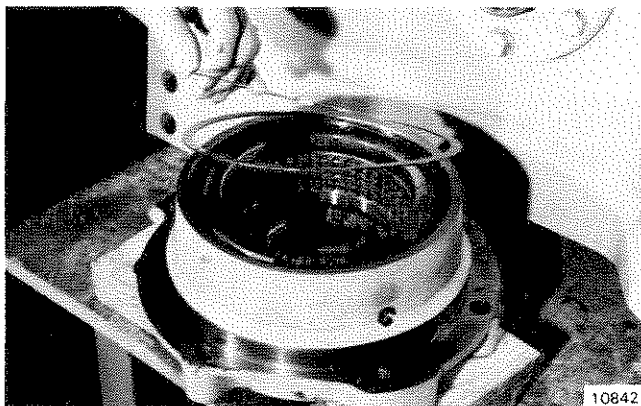


2. Install the thrust ring. The side of the thrust ring with a groove goes against the plungers.



4. Install the reaction ring. Make sure that the spaces in the reaction ring are aligned with the spaces in the outer circumference of the friction discs.

FIGURE 4-11. ASSEMBLY OF THE OIL BRAKE (1 of 3)



5. If the reaction ring is not below the groove for the snap ring, hit the reaction ring with a soft hammer to push the clutch assembly below the groove. Install the double spiral snap ring.

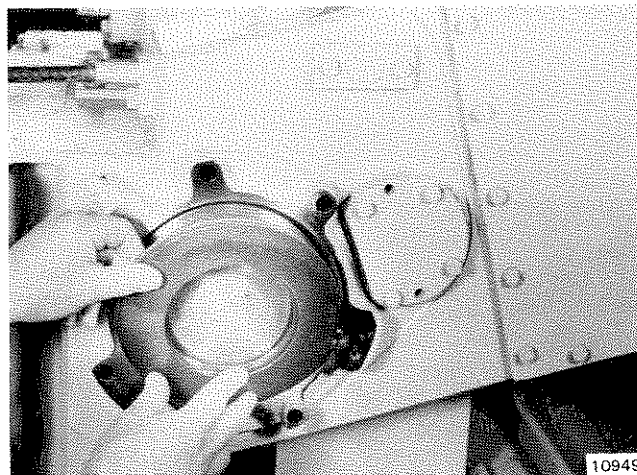


8. Install a new circumference seal in the piston. Use O-ring lubricant or hydraulic oil on the seal.

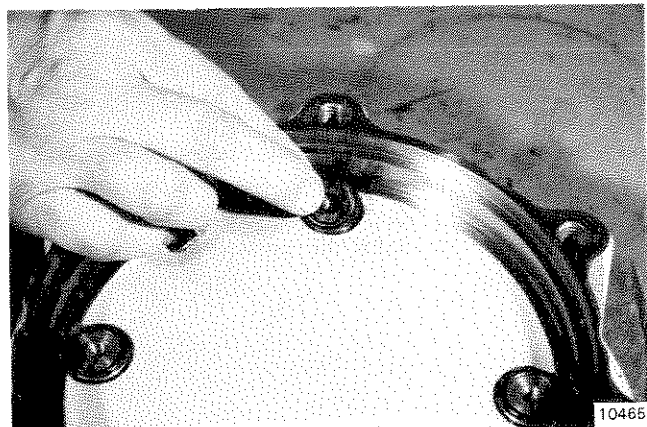
Align the holes in the piston with the plungers. Install the piston in the housing.



6. Install new O-rings in the shank of each plunger. Lubricate the plungers with O-ring lubricant or hydraulic oil and push the plungers into the bores of the housing. Make sure the O-rings are not damaged or the brake oil pressure will be low and the brake will not operate correctly.



9. Install the conical washer springs (belleville springs). Make sure the inner diameter of the springs are against the brake piston.



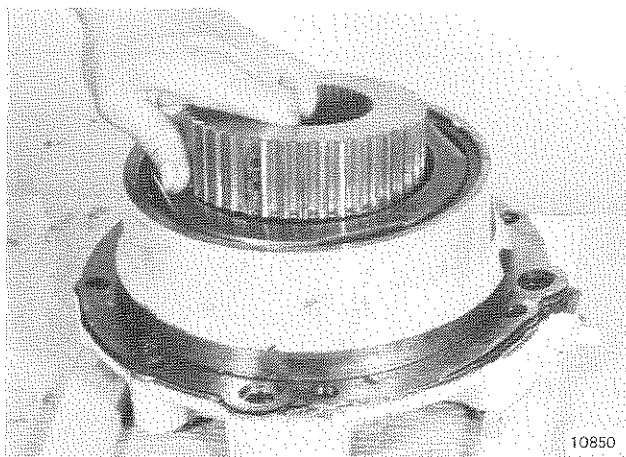
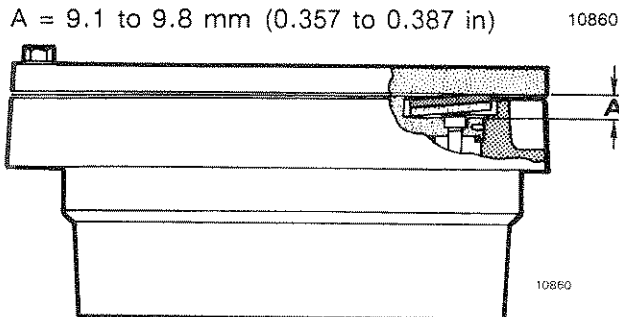
7. Install a new O-ring in each head of the four plungers.

FIGURE 4-11. ASSEMBLY OF THE OIL BRAKE (2 of 3)

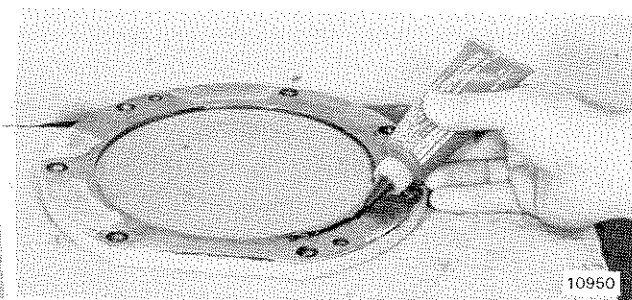
NOTE: Dimension "A" is used for first assembly. This distance is between the indicated place on the piston and the brake cover.

The actual distance is according to the checks and adjustments described in the **Service** section, Page 3-8.

A = 9.1 to 9.8 mm (0.357 to 0.387 in)

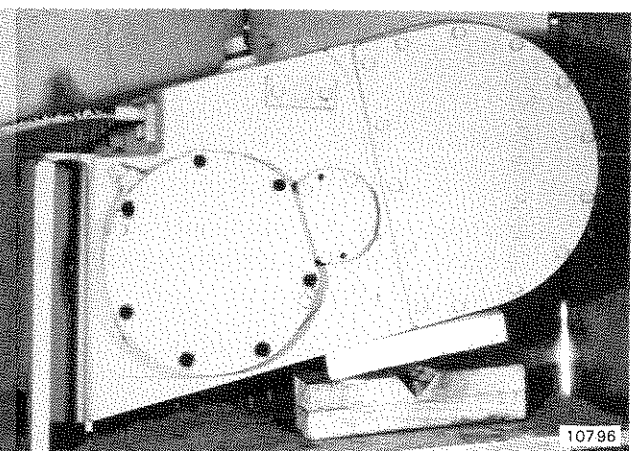


12. Use the hub to align the teeth of the separator plates. Leave the hub in the brake assembly for installation in the winch case.

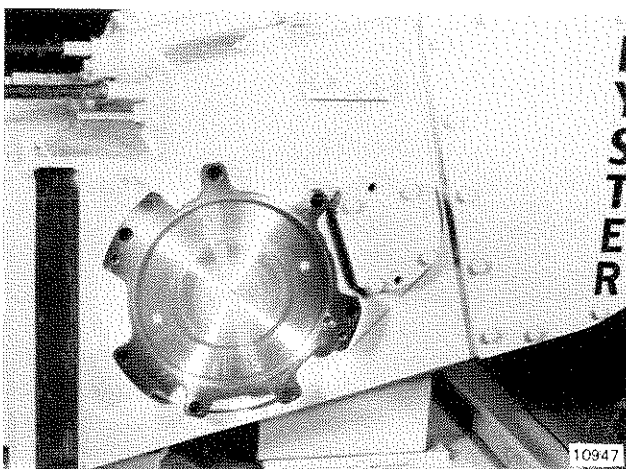


10. Put liquid sealer on the joint surfaces of the brake housing, shims, and cover.

13. If the winch was disassembled for repairs and replacement of parts on the bevel gear shaft, see the **Pinion And Bevel Gear Adjustment** to adjust the preload on the shaft. Install the bearing on the end of the shaft.



11. Install the cover and install the two 3/8 UNC x 1-1/4 inch capscrews and washers. Install the seven 1/2 UNC capscrews and washers that hold the brake to the winch case.



14. Apply liquid sealer on the surfaces of the shims and the machined surface of the brake housing. Make sure the liquid sealer does not cause a plug in one of the oil passages. Install the oil brake on the winch case.

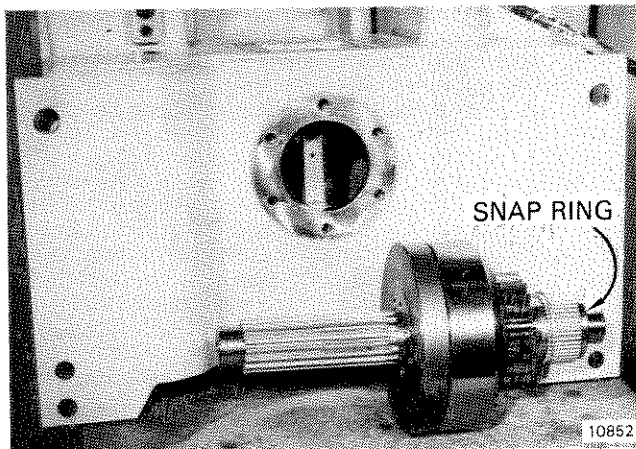
FIGURE 4-11. ASSEMBLY OF THE OIL BRAKE (3 of 3)



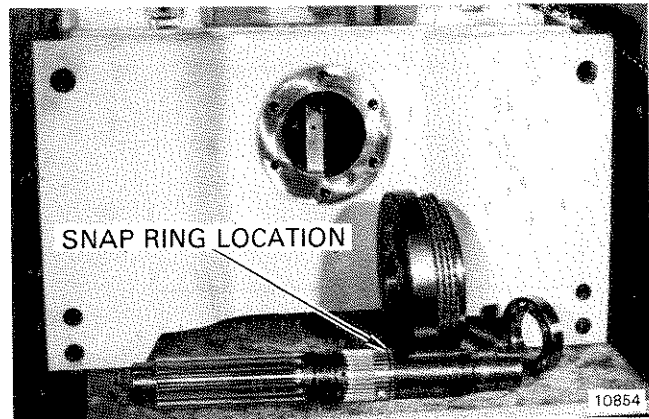
OIL CLUTCH

This procedure describes the disassembly and the assembly of the clutch. The bevel gear shaft and the

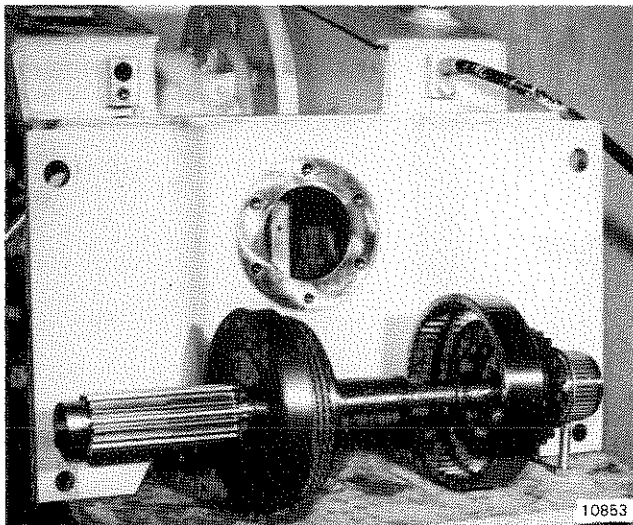
clutch assembly must be removed from the winch before this procedure is used. See FIGURE 4-5. (step 1 – step 18).



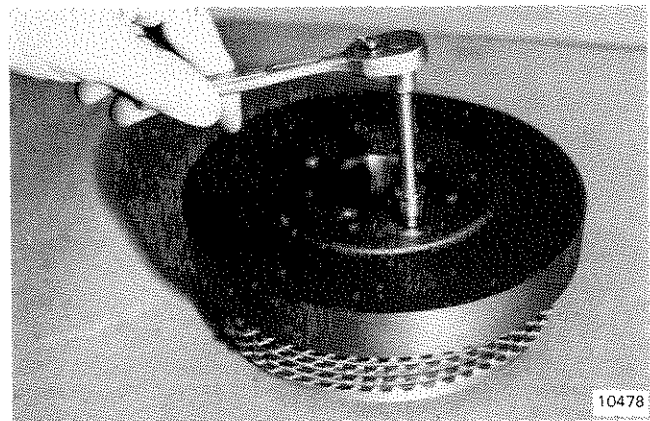
1. Remove the internal snap ring that holds the needle bearing in the brake end of the carrier extension.



3. Remove the snap ring from the bevel gear shaft and use a soft hammer to remove the shaft from the clutch and bearing. Make a note of this arrangement. It is an easy error to not install the snap ring during assembly.

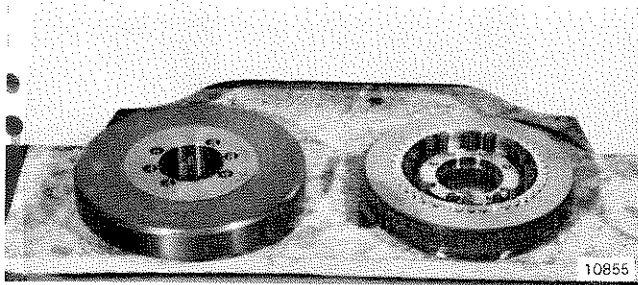


2. Hold the clutch and shaft in a vertical position with the brake end of the shaft down. Hit the end of the shaft against a wood surface to cause the carrier and carrier extension to slide away from the clutch. The ball bearing between the clutch and the carrier is held on the bevel gear shaft with a snap ring and fits tightly into the carrier.

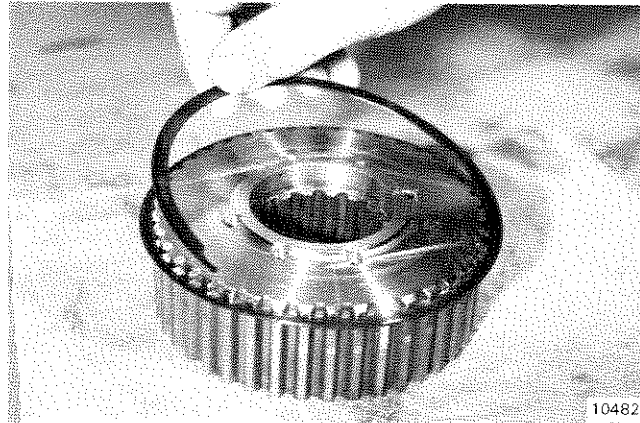


4. Put the clutch on the bench and remove the six 12 point capscrews. Lift the clutch housing from the clutch discs.

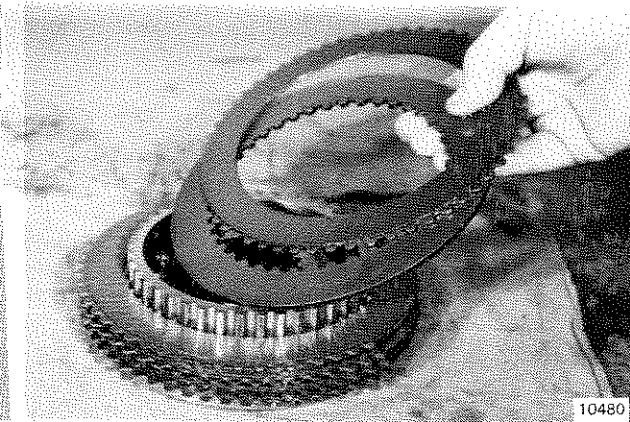
FIGURE 4-12. DISASSEMBLY OF THE OIL CLUTCH (1 of 2)



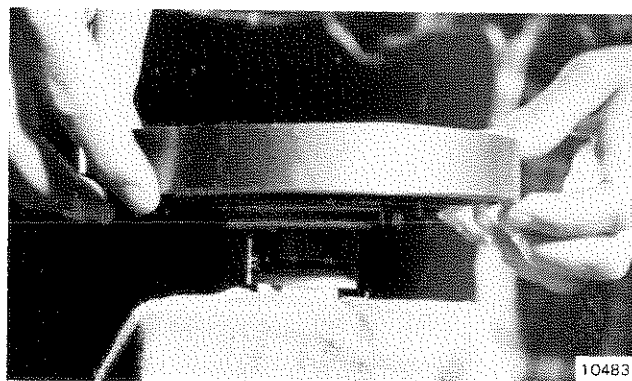
5. Remove the clutch return springs. Replace the clutch return springs if the inspection of the friction discs and separator plates indicates that the clutch has been too hot. The heat generated in the clutch will make them weak. Weak clutch return springs will cause additional friction and the clutch will become too hot during operation.



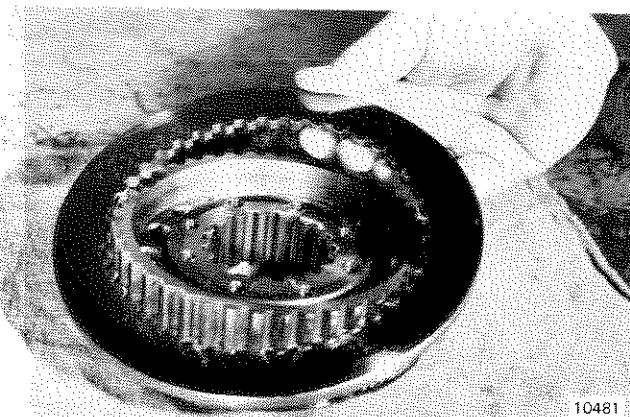
8. Remove the double spiral snap ring. Check the groove for the snap rings and the splines of the hub for damage.



6. Remove the friction discs and the separator plates. Inspect the friction discs and the separator plates to make sure that they are flat. See the specifications in the **VISUAL INSPECTION** Table.



9. Hit the center of the housing against a wood block. The piston will fall from the housing. Remove and discard the two large O-rings from the piston. Clean the O-ring grooves.

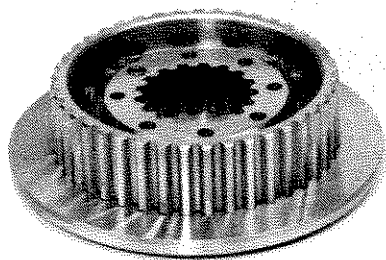


7. Remove the reaction ring. Inspect that the reaction ring is flat.

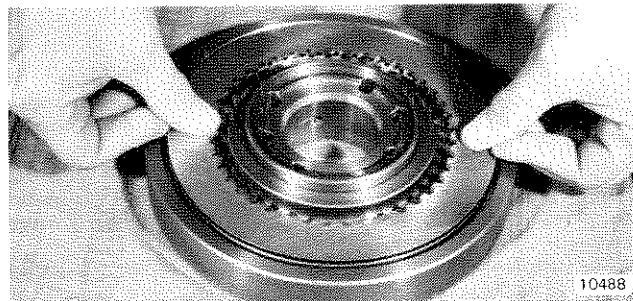


10. Inspect the O-ring surfaces of the housing for wear or damage. Inspect the right angle corners of the housing for cracks.

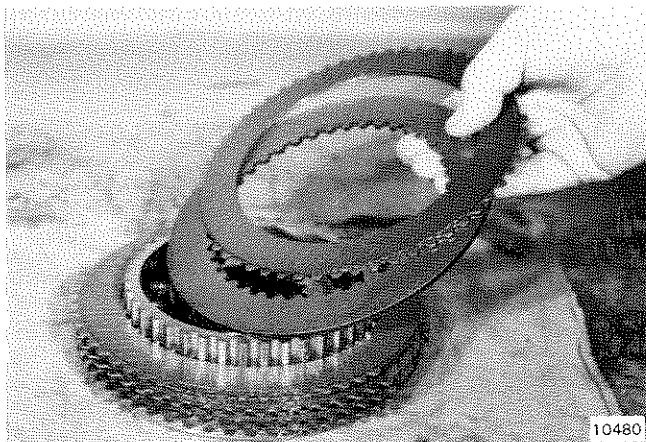
FIGURE 4-12. DISASSEMBLY OF THE OIL CLUTCH (2 of 2)



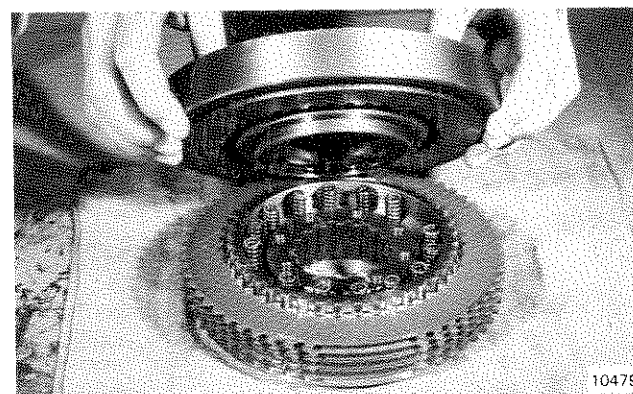
1. Install the snap ring and the reaction ring on the clutch hub.



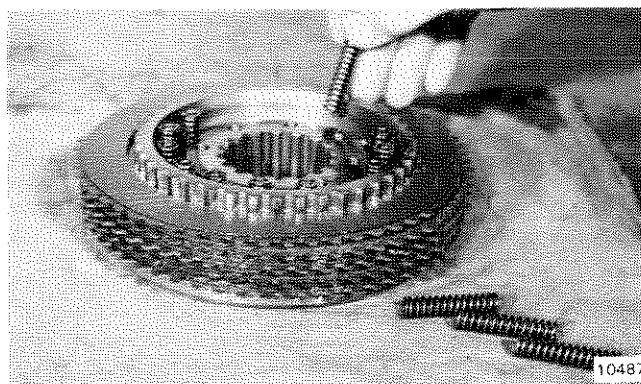
4. Install the two seal rings on the piston. Use new seal rings. Lubricate the seal rings. Push the piston into the housing. The seal rings must not be damaged or the clutch will not operate correctly.



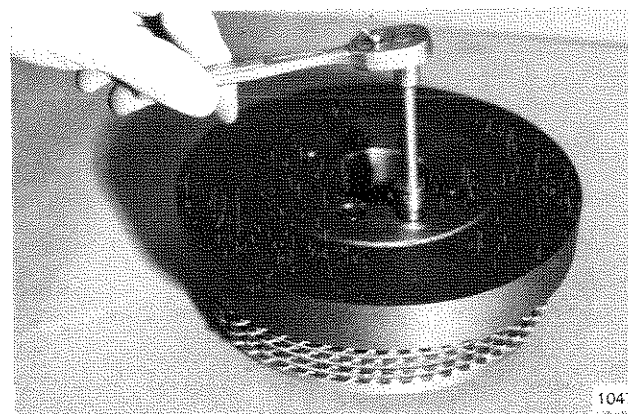
2. Install a friction disc on the reaction ring. Next, install a separator plate. Install the remainder of the friction discs and separator plates in the same sequence.



5. Install the housing on the clutch hub. The holes for the capscrews must be aligned.

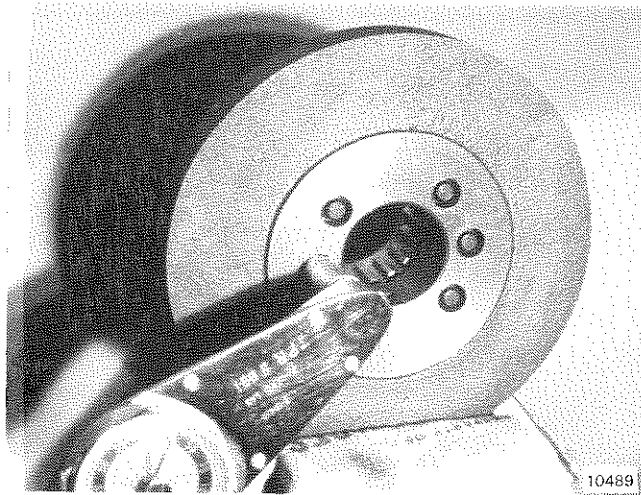


3. Install two new clutch return springs in each hole. Align the spaces caused by the missing teeth in the friction discs.

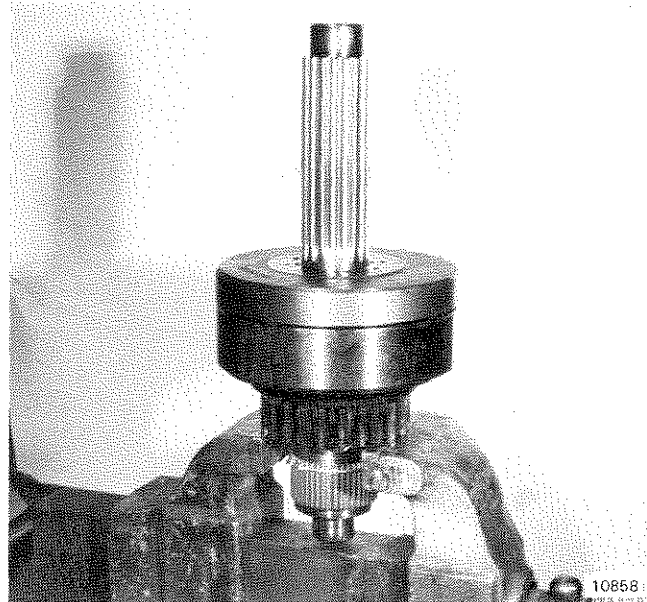


6. Install the 12 point capscrews and lock washers. The lock washers are special and must be in good condition if they are used again.

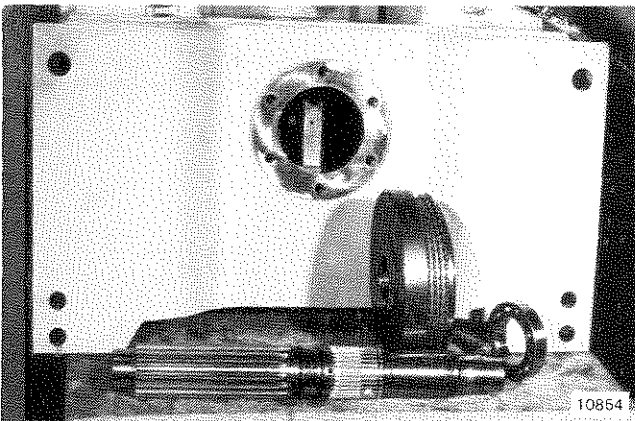
FIGURE 4-13. ASSEMBLY OF THE OIL CLUTCH (1 of 2)



7. Put the clutch assembly in a vise with soft jaws. Tighten the capscrews evenly to 24 N.m (18 lbf ft).

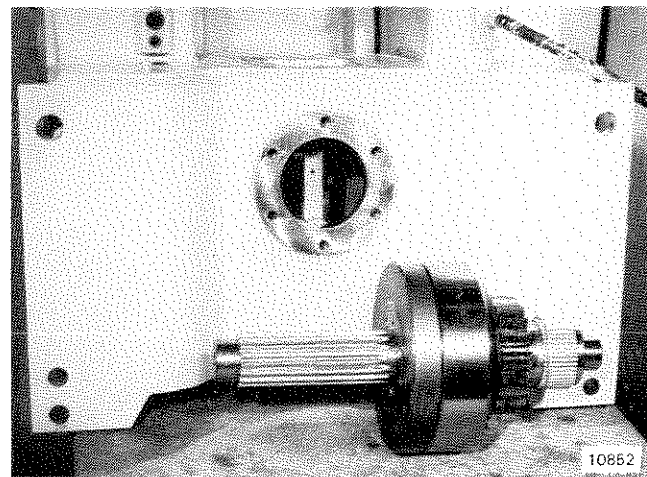


9. Align the teeth of the friction discs. Install the clutch into the clutch carrier. The ball bearing fits tightly into the clutch carrier. Be careful that the teeth of the friction discs are not bent when the clutch carrier is installed.



8. Lubricate and install new O-rings on the bevel gear shaft. Install the clutch on the bevel gear shaft. Install the ball bearing and the snap ring. Make sure this snap ring is installed correctly or the preload adjustment will not be correct.

Install the needle bearings and the internal snap ring in the end of the extension for the clutch carrier.



10. See **Assembly Of The Winch, FIGURE 4-6.**) for installation of the clutch and brake shaft into the winch.

FIGURE 4-13. ASSEMBLY OF THE OIL CLUTCH (2 of 2)

HYDRAULIC SYSTEM

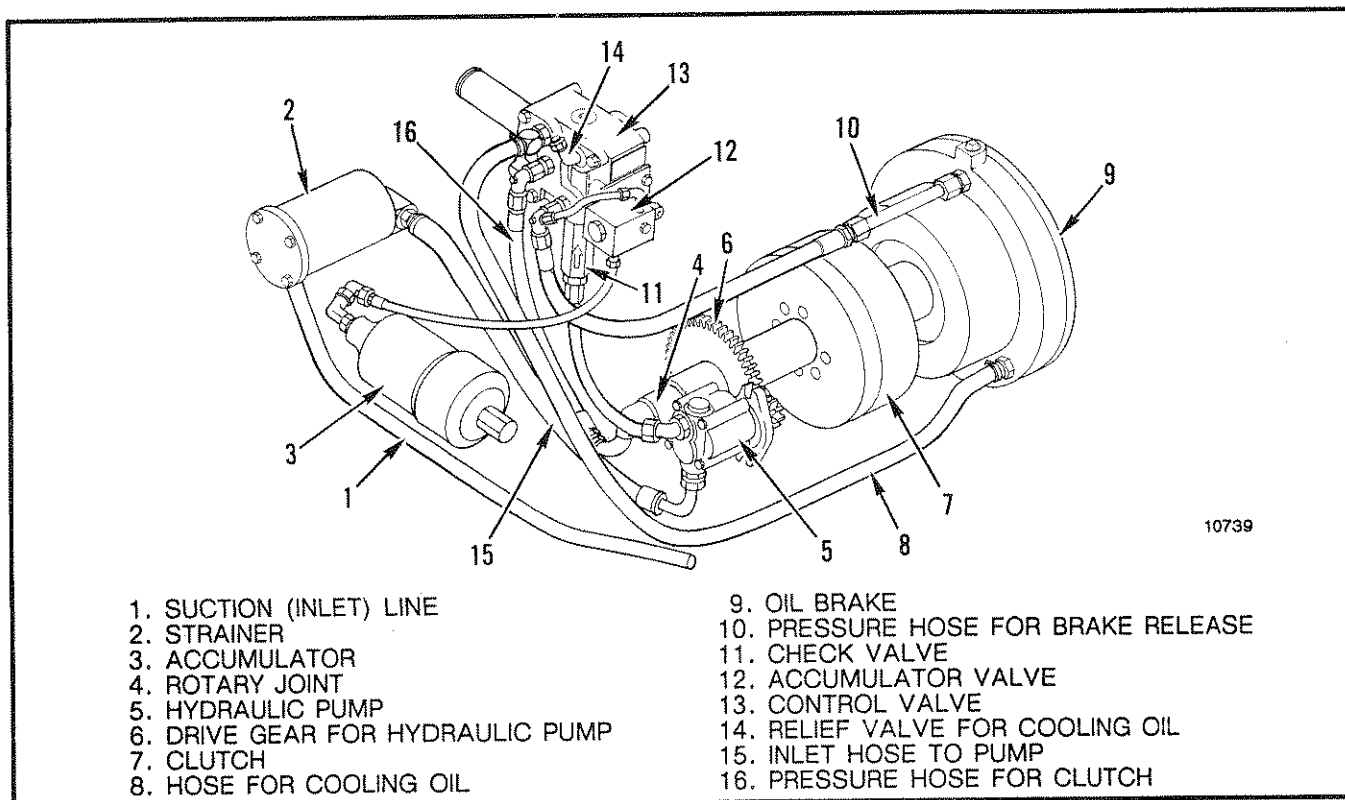


FIGURE 4-14. HYDRAULIC SYSTEM, W3.5B WINCH

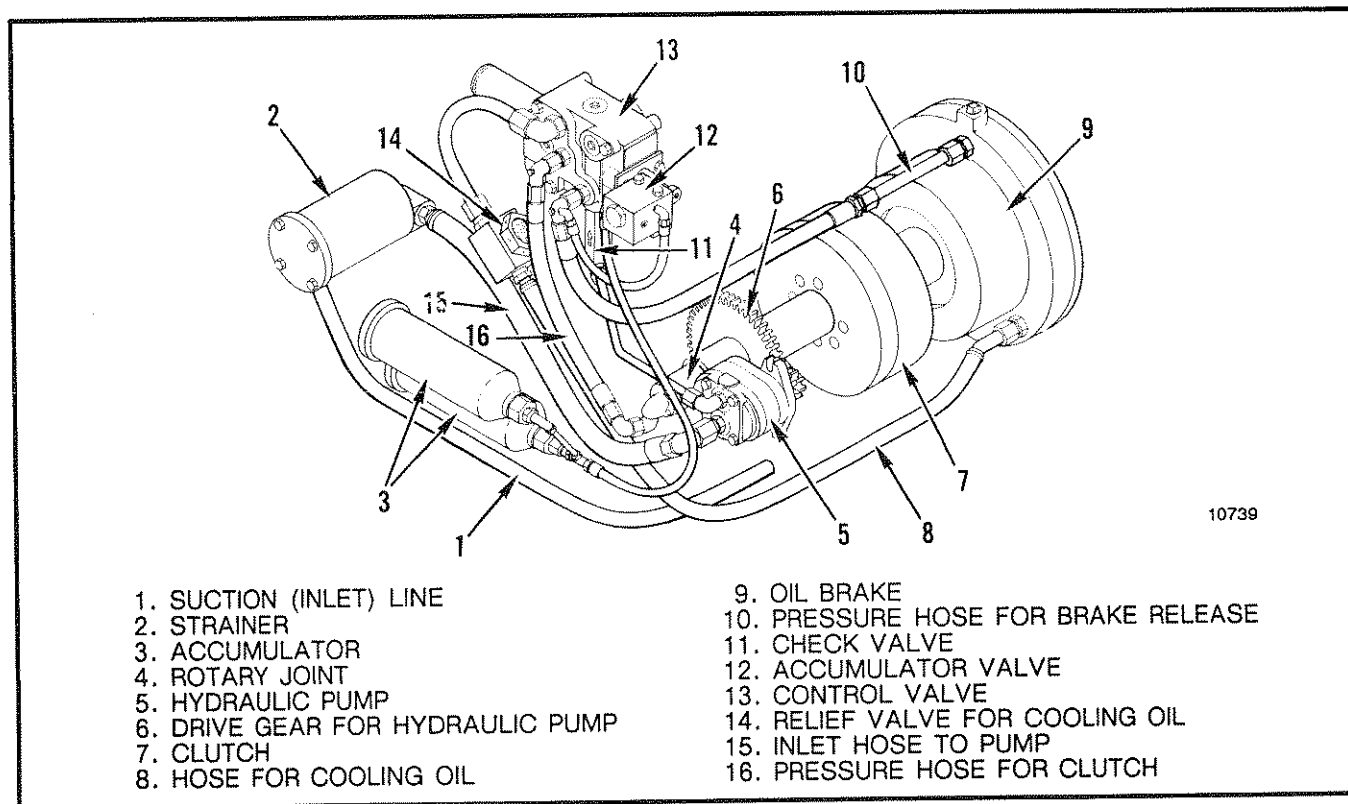


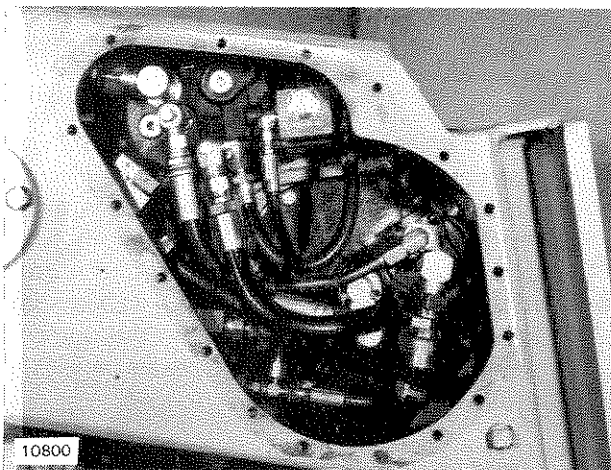
FIGURE 4-15. HYDRAULIC SYSTEM, W3A WINCH



Removal And Installation Of The Control Valve

Most of the parts of the control valve can be replaced. If the bore for the control spool is damaged so that the performance is changed, the valve must

be replaced. The smaller access cover is normally for making checks and adjustments to the control valve. Most service persons drain the hydraulic oil and remove the large access cover when doing work on the hydraulic system.



WARNING

Make sure the accumulators are discharged before any work is done on the hydraulic system. If the hand lever is connected, move the hand lever to the BRAKE OFF position seven times until the accumulators are discharged. If the hand lever is disconnected, use a screwdriver to lift the accumulator valve pin until the accumulators are discharged.

Disconnect the hoses and tubes at the control valve. Disconnect the control cable from the control spool. Remove the three capscrews that hold the control valve in the winch case. The control valve and the accumulator valve are normally removed as a unit. When the repairs are completed, install the control valve in the winch again. The checks and adjustments for the hydraulic system are described in **Section 3**.

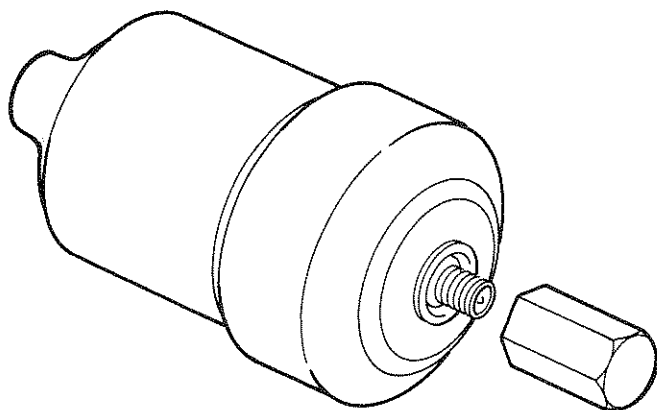
FIGURE 4-16. ACCESS TO THE CONTROL VALVE



Accumulators

A defective accumulator valve is normally replaced. A common defect is a leak in the valve seat so that the accumulator will not stay charged. See **Section 3** for the **Accumulator Pressure Test** and the **Accumulator Volume Test**.

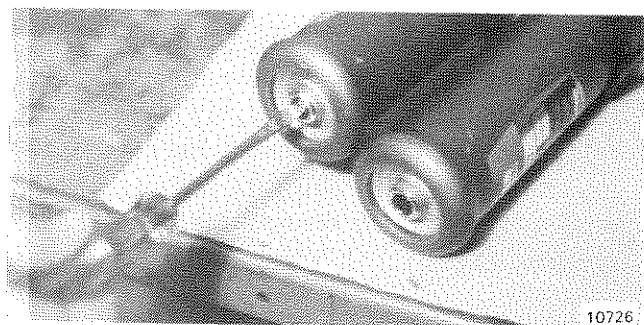
The accumulators can be checked or replaced without removing the control valve. The hydraulic oil must be drained before doing any work on the accumulators. Some hydraulic hoses must be removed so that there is space to remove the accumulators.



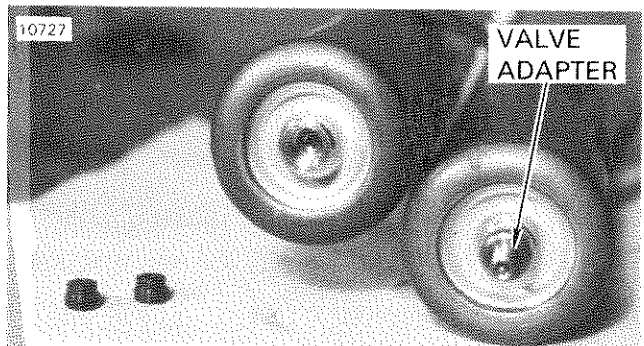
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1. Remove the accumulator from the winch case. Remove the hex valve cover from the end of the accumulator.
2. Push on the valve pin. If the rubber bladder inside the accumulator is bad, oil will come out of the valve when the valve pin is pushed.
3. Test the pressure in the accumulators. The correct pressure is 690 kPa (100 psi) of nitrogen gas. In areas where nitrogen gas is not available, dry compressed air can be used. Charge the accumulators to the correct pressure. Make sure you do not discharge the accumulators below the correct pressure when you test the pressure with a pressure gauge.
4. Install the hex valve cover over the valve in the end of the accumulator. Install the accumulator in the winch case and connect the hydraulic hoses.

FIGURE 4-17. ACCUMULATOR FOR THE W3.5B WINCH



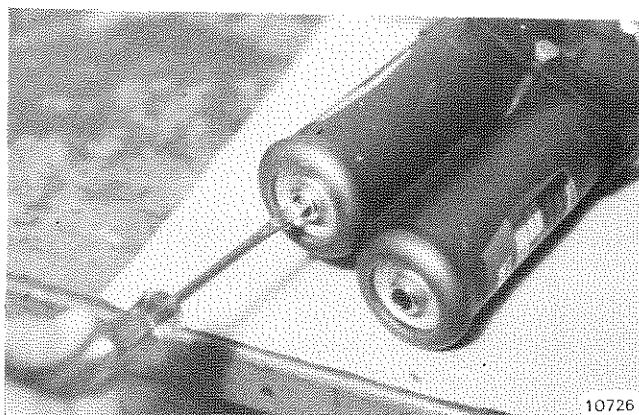
1. Remove the accumulators from the winch case. Remove the plugs from the ends of the accumulators.



2. Install a valve adaptor to charge the accumulator (part number SKS 6495). If the rubber bladder inside the accumulator is bad, oil will come out of the valve adaptor when the valve pin is pushed. Make sure that the valve stem in the accumulator valve is tight after the valve adaptor has been removed.



3. Test the pressure in the accumulators. The correct pressure is 690 kPa (100 psi) of nitrogen gas. In areas where nitrogen gas is not available, dry compressed air can be used. Charge the accumulators to the correct pressure. Make sure you do not discharge the accumulators below the correct pressure when you test the pressure with a pressure gauge.



4. Remove the adaptor and install the plugs in the ends of the accumulators. Install the accumulators in the winch case and connect the hydraulic hoses.

FIGURE 4-18. ACCUMULATORS FOR THE W3A WINCH

Hydraulic Pump

Disconnect the hydraulic input and output at the 90° fittings at the pump. Remove the hydraulic pump and gear from the bearing retainer. A seal repair kit and parts are available from Hyster Company for repairing the hydraulic pump.

Rotating Joint (See FIGURE 4-20.)

NOTE: The rotating joint is connected to the bevel gear shaft with a **LEFT HAND THREAD**. A special wrench (crowfoot wrench) is required to remove

the rotating joint from the bevel gear shaft on the W3A winch.

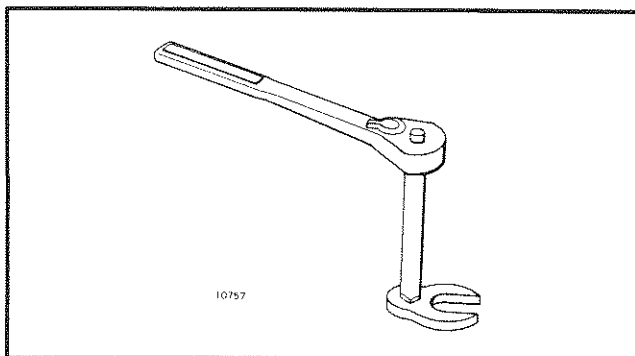


FIGURE 4-19. CROWFOOT WRENCH

A rebuild kit and a repair kit to repair leaks are available from Hyster Company. Remove the rotating joint from the winch to install the rebuild kit.

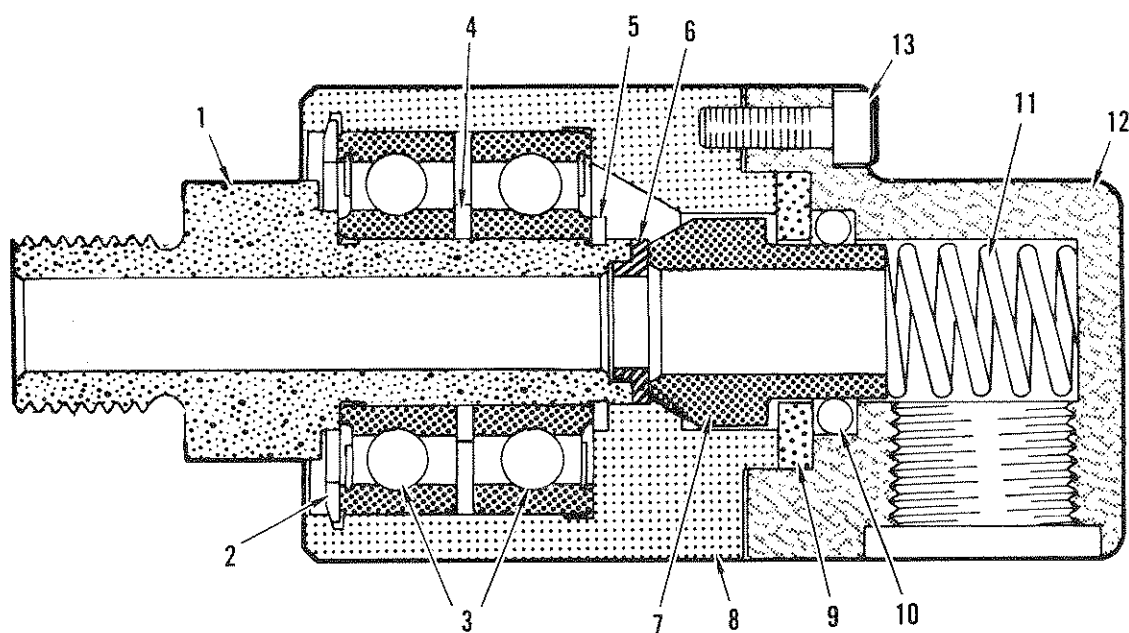
WARNING

The end cap contains a compressed spring. Do not permit the spring to be suddenly released and cause an injury.

Loosen evenly the three socket head capscrews that hold the end cap to the housing. Remove the end cap (12), spring (11), retainer plate (9), O-ring (10), and floating seal (7). The floating seal is a machined part made of graphite. Remove the steel seal (6). The floating seal, spring, and the O-ring are the parts in the repair kit to repair leaks.

If the rebuild kit is to be installed, disassemble the parts described in the paragraph above. Remove the internal snap ring (2) that holds the bearing assembly in the housing. Assemble the ball bearings (3), spacer (4), and the snap ring (5) on the rotor (1). Make sure the ball bearings have the side with the lip towards each end of the housing. Install the rotor assembly in the housing and install the internal snap ring (2).

Install the steel seal (6) in the end of the rotor. Install the spring (11), O-ring (10), retainer (9), and the floating seal (7) in the end cap (12). Install the end cap assembly on the rotating joint and tighten evenly the three socket head capscrews. Install a new gasket and install the rotating joint in the winch.



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- 1. ROTOR *
- 2. INTERNAL SNAP RING
- 3. BALL BEARING (2) *
- 4. SPACER *
- 5. SNAP RING *

- 6. STEEL SEAL
- 7. FLOATING SEAL * ▼
- 8. HOUSING
- 9. RETAINER
- 10. O-RING* ▼

- 11. SPRING * ▼
- 12. END CAP
- 13. SOCKET HEAD CAPSCREW (3)
- * INCLUDED IN REBUILD KIT
- ▼ INCLUDED IN REPAIR KIT

FIGURE 4-20. ROTATING JOINT

**VISUAL INSPECTION**

ITEM	INSPECTION	ACTION
Pinion gear and bevel gear	Check for a wear pattern that is not even. The pinion and bevel gear are a matched set.	Check gear clearance between the pinion gear and the bevel gear. The bevel gear and the pinion must be replaced as a unit.
Pinion shaft	Check the splines for wear and twist	Replace a worn or damaged pinion.
Pump drive	Check the gears for wear.	Replace a worn or damaged gear.
Bevel gear shaft	Check for grooves or other damage on the machined surfaces.	Repair the surface or replace the shaft.
	Check the rotating joint.	Repair a worn rotating joint.
	Check for worn or damaged bearings.	Replace a bad bearing.
	Check the snap rings.	Replace a snap ring that will not hold a bearing in position on the shaft.
Intermediate pinion gear	Check gear for broken or worn teeth. Check the splines for damage and wear.	Replace a worn or damaged gear.
Clutch assembly	Make sure that the oil passages are clean.	Clean and repair the clutch assembly.
	Check the friction discs for wear, distortion, or damage. Minimum thickness of wear surface per side: 0.5 mm (0.010 in). Maximum thickness of friction disc: 3.28 mm (0.129 in).	Replace the friction discs if the oil grooves are worn away, or the discs are burned, damaged, or not flat.
	Check that the separator plates are flat, do not have large blue areas from too much heat, or damaged surfaces.	Replace separator plates that have damage.
	Replace the clutch return springs if inspection of the friction discs and separator plates must be replaced.	Replace the clutch return springs if the friction discs and separator plates indicate they have been too hot.
	Inspect the piston housing and piston for cracks and damage. Make sure the O-ring grooves and sealing surfaces are good.	Replace a damaged piston or piston housing.
Control valve	Check for damaged or worn parts if the performance of the valve is not correct.	Replace a damaged part in the control valve.



VISUAL INSPECTION

ITEM	INSPECTION	ACTION
Oil brake assembly	Check plunger for wear and damage.	Replace a damaged plunger.
	Check for a cracked or broken conical washer spring.	Replace a damaged conical washer (belleville spring).
	Inspect the cover of the oil brake for leakage or damage.	Repair or replace the cover if the sealing surfaces are bad.
	Check that the friction surface of the thrust ring is smooth.	Replace a worn thrust ring.
	Check the friction discs for wear, distortion, or damage. Minimum thickness for wear surface per side: 0.5 mm (0.010 in). Maximum thickness of friction disc: 3.28 mm (0.129 in).	Replace the friction discs if the oil grooves are worn away, or the discs are burned, damaged, or not flat.
	Check that the separator plates are flat, do not have large blue areas from too much heat, or damaged surfaces.	Replace separator plates that have damage.
	Inspect the piston for damage. Make sure the sealing surfaces are good.	Replace a damaged piston.
	Inspect the brake housing for cracks and wear.	Replace a damaged housing.
	Inspect the brake hub for wear and damage.	Replace a damaged hub.
Intermediate gear shaft	Check for bad bearing surfaces.	Repair a surface with minor damage. Replace a damaged shaft.
Intermediate gear	Check for broken teeth. Inspect the leading edge of the teeth for wear.	Replace a damaged or worn gear.
Drum shaft	Check for worn or damaged bearing surfaces.	Replace a damaged shaft.
	Inspect the sealing surface for corrosion.	Remove corrosion with fine abrasive cloth or paper.
Drum adapter	Inspect the sealing surfaces.	Repair a damaged sealing surface or replace the drum adapter.
	Check for a bad bearing surface.	Replace a damaged adapter.
Drum gear	Inspect the leading edge of the teeth for wear.	Replace worn gear.



SPECIFICATIONS

Torque Specifications Capscrews to pinion retainer 12-point capscrews for oil clutch Retainer capscrew for drum gear Drum capscrews Turning torque of drum in FREESPOOL (measured at the drum capscrew) Capscrews for the bearing carrier, input shaft Shim requirements for bevel gear shaft and intermediate shaft	62 N.m (46 lbf ft) 24 N.m (18 lbf ft) 270 N.m (200 lbf ft) 163 N.m (120 lbf ft) 6 to 11 N.m (55 to 95 lbf in) 27 to 34 N.m (20 to 25 lbf ft) 0.00 to -0.10 mm (0.000 to -0.004 in)
Brake Release Pressures: Brake release pressure with new brake discs Brake release pressure with used brake discs	1140 to 1200 kPa (165 to 175 psi) 930 to 1035 kPa (135 to 150 psi)


NOTES

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**“THE
QUALITY
KEEPERS”**

**HYSTER
APPROVED
PARTS**

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6/90 AP Litho in U