TORO®

400XT Series Tractor

Service Manual

ABOUT THIS MANUAL

This service manual was written expressly for Toro service technicians. The Toro Company has made every effort to make the information in this manual complete and correct.

Basic shop safety knowledge and mechanical/electrical skills are assumed. The Table of Contents lists the systems and the related topics covered in this manual.

For additional information on the electrical system, please refer to the Toro Electrical Demystification Guide (492-4404). For service information on drive systems, please refer to the Hydro-Gear (330-3000) service manual. For information information specific to the engines used on this unit, refer to the appropriate engine manufacturer's service and repair instructions.

Tractor model years 2003 - 2004 are covered in this manual. The manual may also be specified for use on later model products.

The hydrostatic transaxle is a sophisticated piece of machinery. Maintain strict cleanliness control during all stages of service and repair. Cover or cap all hose ends and fittings whenever they are exposed. Even a small amount of dirt or other contamination can severely damage the system.

We are hopeful that you will find this manual a valuable addition to your service shop. If you have questions or comments regarding this manual, please contact us at the following address:

The Toro Company
Consumer Service Department
8111 Lyndale Avenue South
Bloomington, MN 55420-1196

The Toro Company reserves the right to change product specifications or this manual without notice.

TABLE OF CONTENTS

TABLE OF CONTENTS

ELECTRICAL SYSTEMS (con'd)

TABLE OF CONTENTS

ELECTRICAL SYSTEMS (con'd)

General Information

This symbol means WARNING or PERSONAL SAFETY INSTRUCTION - read the instruction because it has to do with your safety. Failure to comply with the instruction may result in personal injury or even death.

This manual is intended as a service and repair manual only. The safety instructions provided herein are for troubleshooting, service, and repair of the 400XT Series tractors. The 400XT Series tractors tractors and attachment operator's manuals contain safety information and operating tips for safe operating practices. Operator's manuals are available through your Toro parts source or:

The Toro Company
Publications Department
8111 Lyndale Avenue South
Bloomington, MN 55420

Think Safety First

Avoid unexpected starting of engine...

Always turn off the engine and disconnect the spark plug wire(s) before cleaning, adjusting, or repair.

Avoid lacerations and amputations...

Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

Avoid burns...

Do not touch the engine, muffler, or other components which may increase in temperature during operation, while the unit is running or shortly after it has been running.

Avoid fires and explosions...

Avoid spilling fuel and never smoke while working with any type of fuel or lubricant. Wipe up any spilled fuel or oil immediately. Never remove the fuel cap or add fuel when the engine is running. Always use approved, labeled containers for storing or transporting fuel and lubricants.

Avoid asphyxiation...

Never operate an engine in a confined area without proper ventilation.

Avoid injury from batteries...

Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes, and clothing. Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.

Avoid injury due to inferior parts...

Use only original equipment parts to ensure that important safety criteria are met.

Avoid injury to bystanders...

Always clear the area of bystanders before starting or testing powered equipment.

Avoid injury due to projectiles...

Always clear the area of sticks, rocks, or any other debris that could be picked up and thrown by the powered equipment.

Avoid modifications...

Never alter or modify any part unless it is a factory approved procedure.

Avoid unsafe operation...

Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Electrical section in this manual for more information.

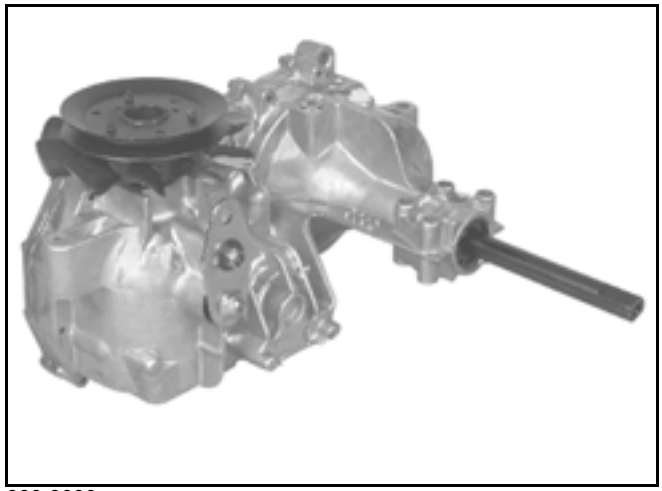
SPECIFICATIONS

General Specifications

Item	Specification
Engines	16 H.P. Kohler OHV Command Single Cylinder 17 H.P. Kawasaki OHV Twin Cylinder 19 H.P. Kawasaki OHV Twin Cylinder For more information on servicing the engines, contact either Briggs & Stratton or Kawasaki.
RPM Setting, All Models	High RPM Setting (no load) – 3250 + or -100 RPM
Construction	Frame: 2” X 2” X 1/4” Welded Angle Frame
Fuel Capacity	3.9 Gallons (14.7 liter)
Wheel Base	49.5” (125.7cm)
Overall Length	71.0’ (180.3cm)
Overall Width	35.5” (90.1cm) without the mower
Weight	416XT net weight 530 lbs. (240.4kg) 417XT net weight 560 lbs. (254kg) 419XT net weight 580 lbs. (263kg)
Traction System	Hydro-Gear Transaxle model 330-3000
Ground Speed	Forward - Infinite 0 to 6.8 MPH 90 (10.9 km/hr) Reverse - Infinite 0 to 3.2 MPH (0 - 4.8 km/hr)
Steering	Four (4) position tilt wheel Turning Radius: 16” (40.6cm) RH and LH
Tires	Front: 16 X 6.50 - 8 Super Turf Tread Rear: 23 X 10.50 - 12 Super Turf Tread
Tire Pressure	Front Tires 20 p.s.i (138 kpa) Rear Tires 20 p.s.i. (138 kpa)
Attachment Drive	Electric Clutch, Maintenance Free, No Adjustments
Electrical System	416XT: 15 amp Regulated DC Charging System Battery Voltage - 12 volt negative ground Battery Type: BCI Group U1, 260 CCA 417XT: 13 amp Regulated DC Charging Battery Voltage - 12 volt negative ground Battery Type: BCI Group U1, 340 CCA 417XT: 13 amp Regulated DC Charging Battery Voltage – 12 volt negative ground Battery Type: BCI Group U1, 340 CCA 25 amp, Charge Circuit 30 amp, Main Circuit 10 amp, Light Circuit 10 amp, Dash Circuit

Hydrostatic Transaxle

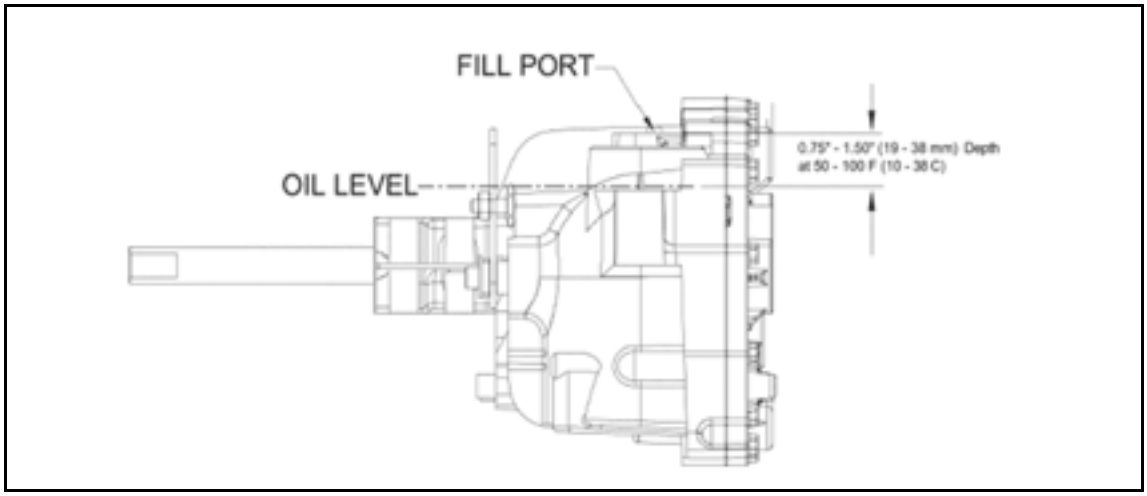
Identification:
Hydro-Gear Model 330-3000 Transaxle



330-3000

General Specifications

Lubrication	SAE 20W-50 API Classification SH/CD Oil
Oil Capacity	3.8 qts. (3.6l)
Oil Level	The transaxle is a sealed system and does not require periodic checking. If the oil needs to be checked, **IT CAN ONLY BE CHECKED COLD**. There is a plug located on the right rear side of the transaxle. Using a ¼ inch Allen wrench, slowly remove the plug. Oil level should be to the bottom of the port.



SPECIFICATIONS

Torque Specifications

Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in the service manual.

These torque specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in the service manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath of the fastener's head, or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification

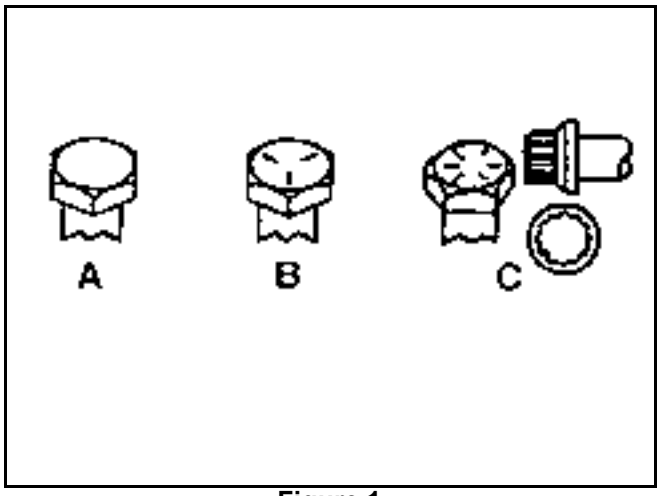


Figure 1

Inch Series Bolts and Screws	
(A) Grade 1 (B) Grade 5	(C) Grade 8

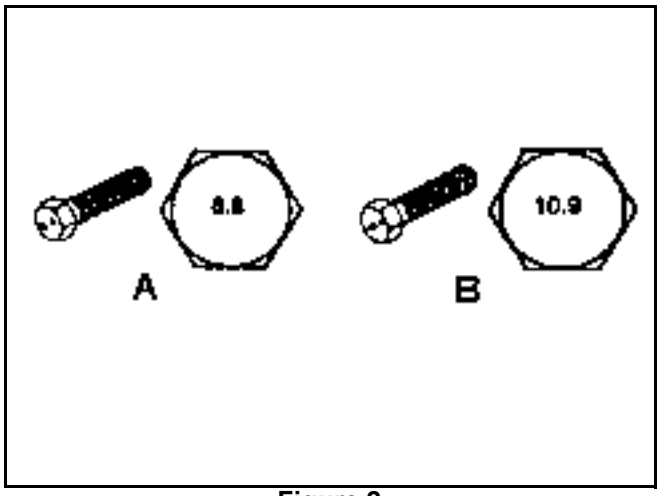


Figure 2

Metric Bolts and Screws	
(A) Class 8.8	(B) Class 10.9

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)	
	In-lb	In-lb	N-cm	In-lb	N-cm	In-lb	N-cm
# 6 - 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 - 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 - 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 - 36 UNF				31 ± 3	350 ± 30	43 ± 4	31 ± 3
# 10 - 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	674 ± 70
#10 - 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 - 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 - 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 - 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 - 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft-lb	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m
3/8 - 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 - 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 - 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	68 ± 9
7/16 - 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 - 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 - 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 - 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 - 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 - 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	374 ± 35	508 ± 47
3/4 - 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 - 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 - 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

Note: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

Note: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

Note: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

SPECIFICATIONS

Standard Torque for Dry, Zinc, and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Strong Nuts)		Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Strong Nuts)	
M5 X 0.8	57 ± 5 in-lb	640 ± 60 N-cm	78 ± 7 in-lb	885 ± 80 N-cm
M6 X 1.0	96 ± 9 in-lb	1018 ± 100 N-cm	133 ± 13 in-lb	1500 ± 150 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	27 ± 2 ft-lb	36 ± 3 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	53 ± 5 ft-lb	72 ± 7 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	92 ± 9 ft-lb	125 ± 12 N-m
M16 X 2.0	166 ± 15 ft-lb	225 ± 20 N-m	229 ± 22 ft-lb	310 ± 30 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 37 ft-lb	610 ± 50 N-m

Note: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

Note: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

Note: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 - 20 UNC	140 ± 20 in-lb	73 ± 12 in-lb
5/16 - 18 UNC	215 ± 35 in-lb	145 ± 20 in-lb
3/8 - 16 UNC	35 ± 10 ft-lb	18 ± 3 ft-lb
1/2 - 13 UNC	75 ± 15 ft-lb	50 ± 10 ft-lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 - 20 UNF Grade 5	65 ± 10 ft-lb	88 ± 14 N-m
1/2 - 20 UNF Grade 5	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.25 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m
M12 X 1.5 Class 8.8	80 ± 10 ft-lb	108 ± 14 N-m

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23, or Type F	
Thread Size	**Baseline Torque***
No. 6 - 32 UNC	20 ± 5 in-lb
No. 8 - 32 UNC	30 ± 5 in-lb
No.10 - 24 UNC	38 ± 7 in-lb
1/4 - 20 UNC	85 ± 15 in-lb
5/16 - 18 UNC	110 ± 20 in-lb
3/8 - 16 UNC	200 ± 100 in-lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in-lb
No. 8	15	18	30 ± 5 in-lb
No. 10	12	16	38 ± 7 in-lb
No. 12	11	14	85 ± 15 in-lb

* Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Conversion Factors

in-lb X 11.2985 - N-cm
ft-lb X 1.3558 = N-m

N-cm X - 0.08851 = in-lb
N-cm X 0.73776 - ft-lb

SPECIFICATIONS

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	0.397	33/64	0.515625	13.097
1/32	0.03125	0.794	16/32	0.53125	13.484
3/64	0.046875	1.191	35/64	0.546875	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.078125	1.984	37/64	0.578125	14.684
3/32	0.9375	2.381	19/32	0.59375	15.081
1/8	0.1250	3.175	5/8	0.6250	15.875
9/64	0.140625	3.572	41/64	0.640625	16.272
5/32	0.15625	3.969	21/32	0.65625	16.669
11/64	0.171875	4.366	43/64	0.671875	17.066
3/16	0.1875	4.762	11/16	0.6875	17.462
13/64	0.203125	5.159	45/64	0.703125	17.859
7/32	0.21875	5.556	23/32	0.71875	18.256
15/64	0.234375	5.953	47/64	0.734375	18.653
1/4	0.2500	6.350	3/4	0.7500	19.050
17/64	0.265625	6.747	49/64	0.765625	19.447
9/32	0.28125	7.144	25/32	0.78125	19.844
19/64	0.296875	7.541	51/64	0.796875	20.241
5/16	0.3125	7.541	13/16	0.8125	20.638
21/64	0.328125	8.334	53/64	0.828125	21.034
11/32	0.34375	8.731	27/32	0.84375	21.431
23/64	0.359375	9.128	55/64	0.859375	21.828
3/8	0.3750	9.525	7/8	0.8750	22.225
25/64	0.390625	9.922	57/64	0.890625	22.622
13/32	0.40625	10.319	29/32	0.90625	23.019
27/64	0.421875	10.716	59/64	0.921875	23.416
7/16	0.4375	11.112	15/16	0.9375	23.812
29/64	0.453125	11.509	61/64	0.953125	24.209
15/32	0.46875	11.906	31/32	0.96875	24.606
31/64	0.484375	12.303	63/64	0.984375	25.003
1/2	0.5000	12.700	1	1.000	25.400
1 mm = 0.03937 in.			0.001 in. = 0.0254 mm		

U.S. to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32° 2. Multiply by 5/9

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Model and Serial Number Location

The model and serial number plate location is under the seat (Figure 3).

Figure 3 MVC-742

Greasing and Lubrication

The machine should be greased every 50 hours or yearly, whichever occurs first. You should grease more frequently when operating conditions are extremely dusty or sandy.

Grease Type: General-purpose grease.

There are 5 grease fittings located in the front axle area:

1. One located on the inside of each wheel hub (2 total).

2. One located on each end of the front axle for the spindles (2 total).

3. One located on the front axle pivot area (1 total) (Figure 4).

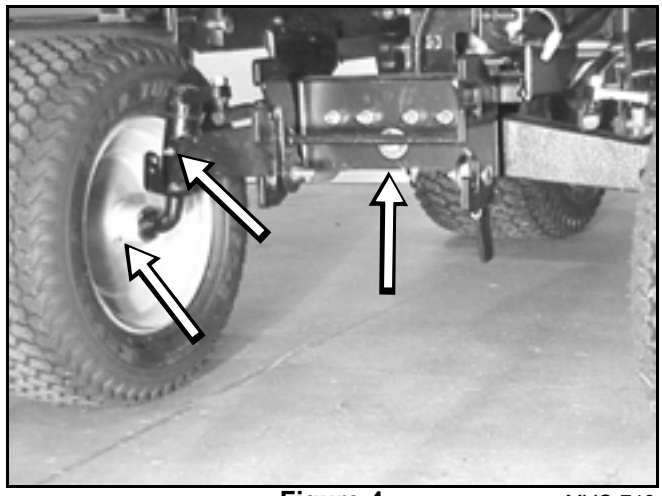


Figure 4 MVC-746

4. **NOTE:** On 2004 models, there is a grease zerk located on the forward/reverse pedal.

Front Wheel Toe-in

If there is uneven tire wear, lawn scuffing, or hard steering, toe-in may need to be adjusted. The front toe-in measurement should be 1/8” to ¼” (3 to 6mm). This should be checked every 100 hours or once a year, whichever occurs first.

MEASUREMENT:

1. Disengage the PTO, set the parking brake, and turn the ignition key to ***OFF*** to stop the engine. Remove the key.

2. Push the front of the tires out to remove normal looseness in the linkage (Figure 5).

Figure 5 MVC-747

3. Measure the distance between both the front rims at spindle level, in front and rear of the wheels. You can also measure between the tread mold marks if the tires are new (Figure 6).

Figure 6 MVC-749

4. The front measurement should be 1/8” to ¼” (3mm to 6mm) less than the rear measurement (Figure 7). If needed, follow the adjustment procedure.

Figure 7 MVC-752

Front Wheel Toe-in Adjustment

1. Remove the tie rod from one steering arm.

2. Loosen the jam nut securing the ball joint to the steering rod. Rotate the ball joint one turn: clockwise to increase toe-in; counterclockwise to decrease toe-in (Figure 8).

   IMPORTANT: If more than one turn is required to meet specifications, alternate between the right and left steering rods to maintain steering wheel alignment.

Figure 8 MVC-095X

3. Hold the flats on the ball joint to align with the flats on the tie rod and tighten the jam nut (Figure 9).

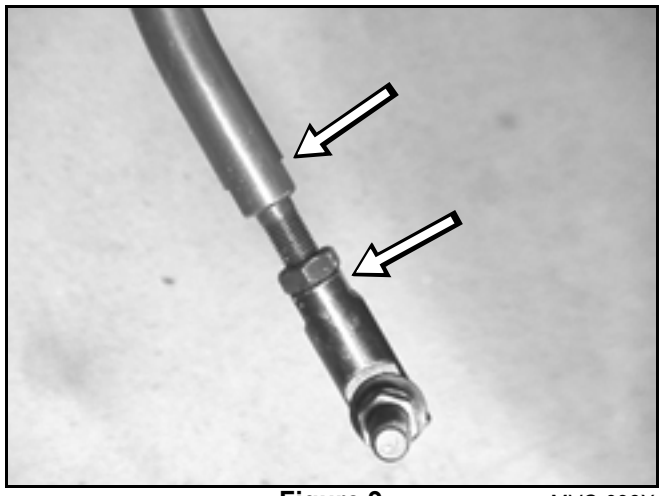


Figure 9 MVC-098X

4. Install the ball joint to the steering arm and check the toe-in as described in the measurement section (Figure 10).

Figure 10 MVC-099X

Front Wheel and Spindle Removal and Installation

Removal

1. Disengage the PTO. Set the parking brake, and turn the ignition key to ***OFF*** to stop the engine. Remove the key.

2. Raise the front axle by putting a jack under the side you are removing the wheel or spindle from.

3. Remove the outer hub cap, cotter pin, washer, and hub cap washer. Slide the wheel and tire off the spindle (Figure 11).

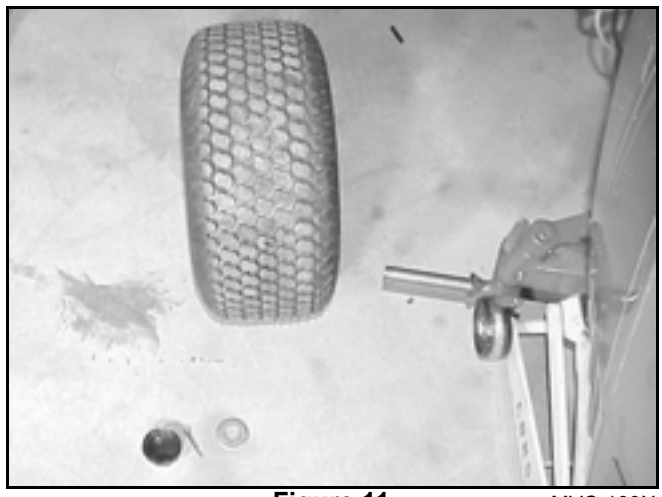


Figure 11 MVC-100X

4. Remove the tie rod from the front spindle arm. With a drift punch and hammer, drive the roll pin out of the front spindle arm (Figure 12).

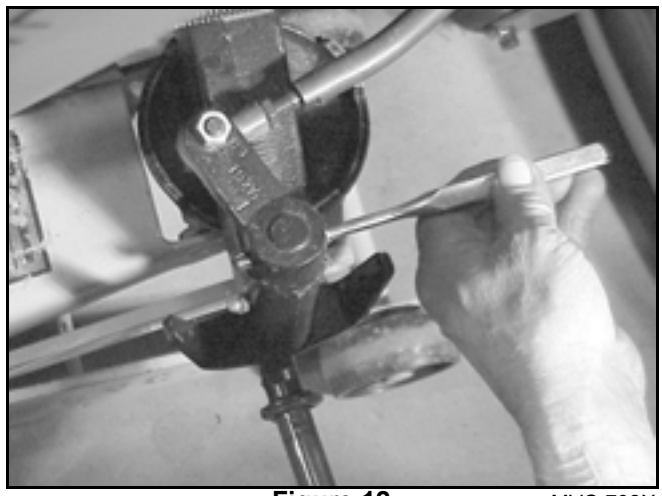


Figure 12 MVC-732X

5. The spindle can now be removed out the bottom of the front axle assembly (Figure 13).

Figure 13 MVC-102X

6. Installation – reverse the order of removal.

Front Axle Removal and Installation

1. Jack-up the front of the tractor. Put jack stands under the frame, just behind the front axle assembly (Figure 14).

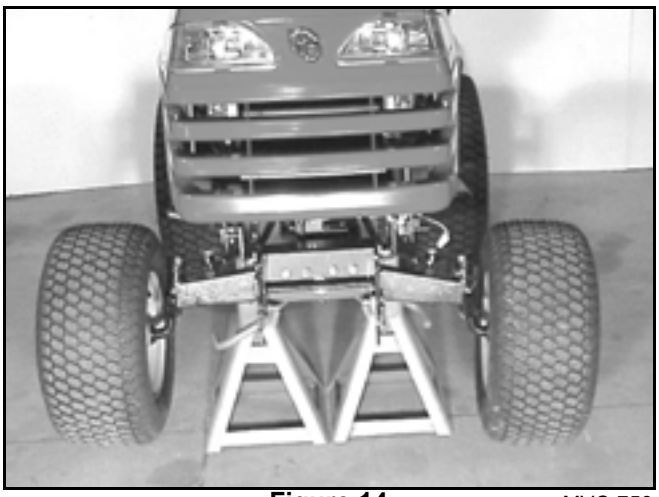


Figure 14 MVC-756

2. Using a drift punch and hammer, drive the roll pin out of the front spindle arms and remove the arms from the spindles (Figure 15). Remove the wheels with steering spindles, from the axle.

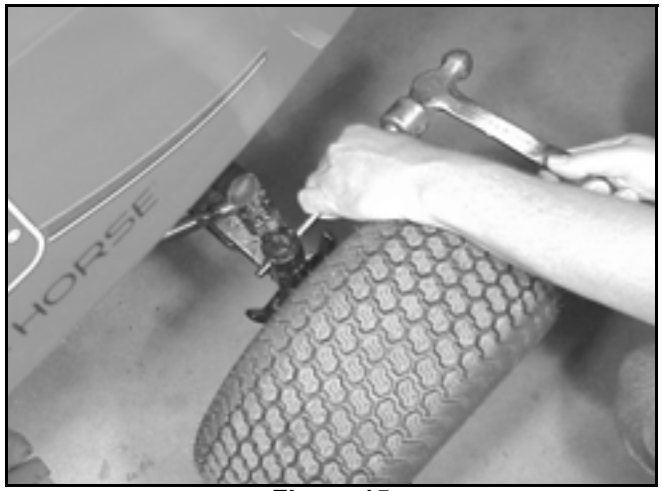


Figure 15 MVC-757

3. On the front of the axle, in the center, remove the E-ring and washers (Figure 16).

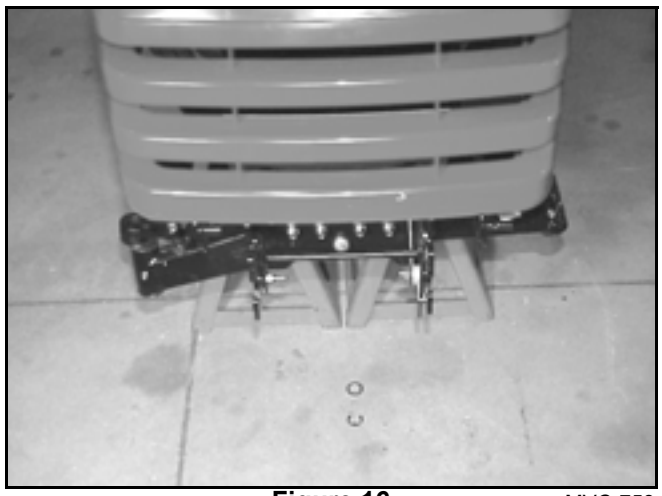


Figure 16 MVC-758

4. On the back side of the axle assembly, remove the bolt securing the axle pin (Figure 17).

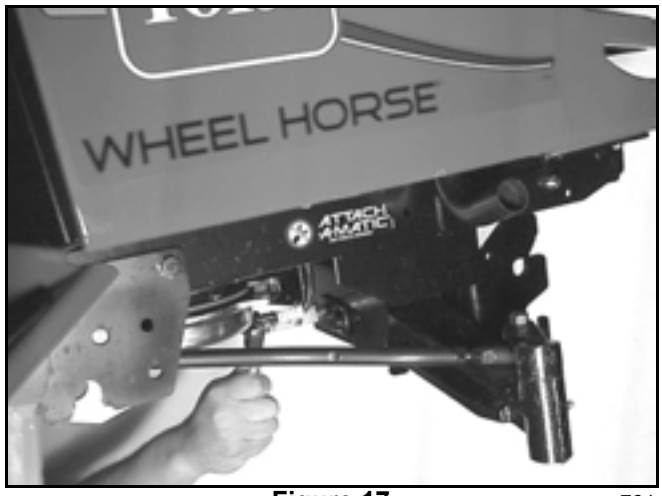


Figure 17 mvc-761

5. Remove the axle pin; use a drift punch and hammer to tap the axle pin out; if needed. Lower the axle assembly out of the tractor frame (Figure 18).

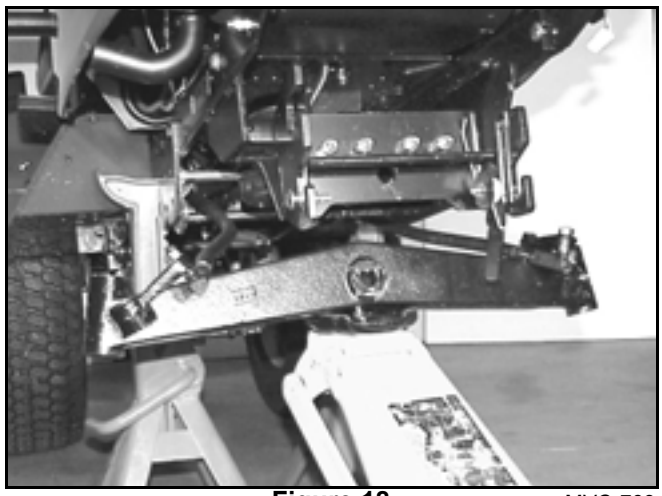


Figure 18 MVC-763

6. Installation - reverse the order of removal.

Steering Gear

Description

The steering gear assembly is made up of a vertically mounted steering shaft and a horizontal sector gear. The sector gear is adjustable so that excessive backlash play in steering gears can be removed (Figure 19).

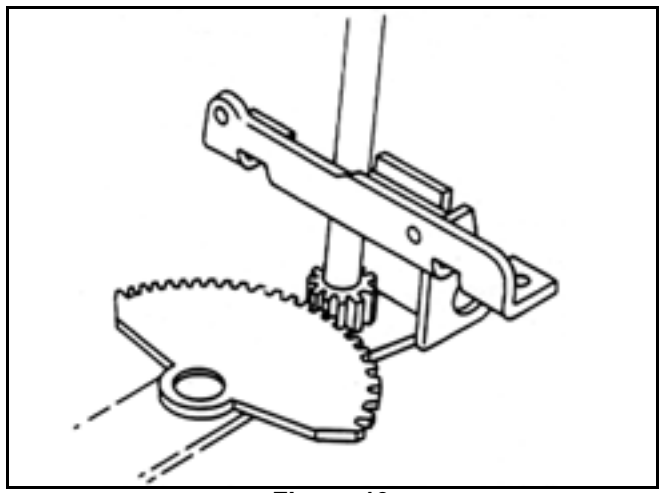


Figure 19 6-8

Steering Backlash Adjustment

Use the following procedure if there is excessive steering backlash.

1. Remove battery and battery tray from the tractor.

2. Disconnect the right and left tie rod assemblies (Figure 20).

Figure 20 MVC-099X

3. Loosen the locking nut on the eccentric. Position the steering wheel spokes so they extend outward left to right.

4. Tighten the nut until the eccentric turns with a small amount of friction (Figure 21).

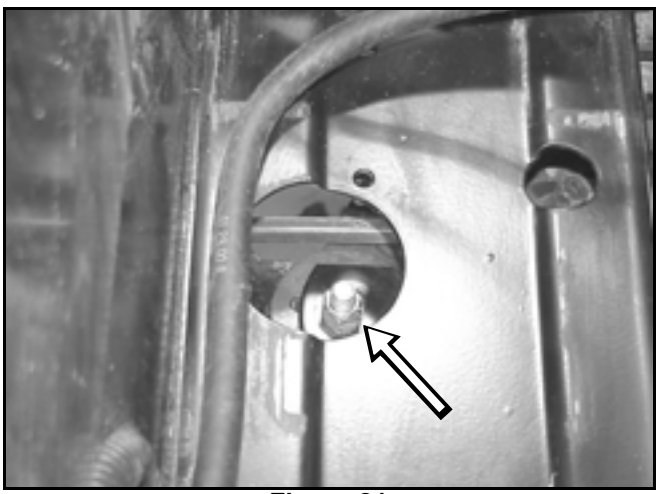


Figure 21 MVC-110X

5. Using a punch, turn the eccentric clockwise until zero clearance is obtained between the end of the steering shaft gear and the steering sector (Figure 22).

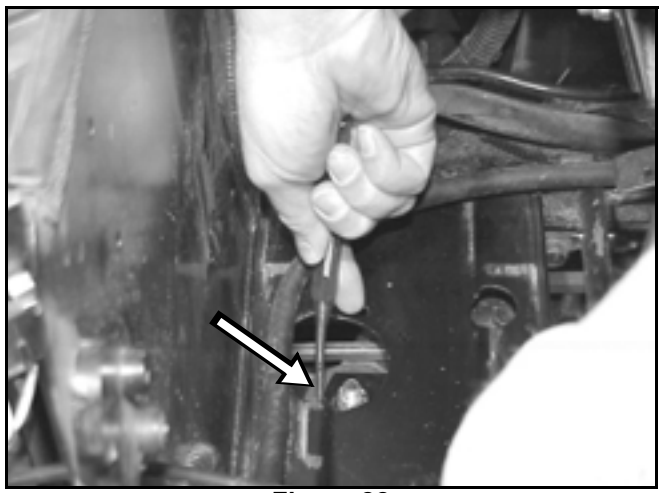


Figure 22 MVC-113X

6. Tighten the nut to 25 – 35 ft lb (34 – 48 Nm). DO NOT OVERTIGHTEN.

7. Apply some multipurpose grease to the steering gear teeth.

8. Connect the tie rod ends to the steering arms.

9. Turn the wheels left and right. Recheck for zero clearance (Figure 23).

Figure 23 MVC-115X

10. Reinstall the battery tray and battery.

11. Check wheel alignment and toe-in.

Steering Gear Shaft Disassembly

1. Disconnect the battery cables. Remove the right side plate and battery from the tractor.

2. Remove the center steering wheel cover. Remove the nut, lock washer, and pull the steering wheel off the steering shaft (Figure 24).

Figure 24 MVC-765

3. Remove the boot clip from the inside of the dash and remove the rubber boot from the steering shaft console (Figure 25).

Figure 25 MVC-766

4. Rotate the steering shaft until the top bolt of the universal joint faces the rear of the tractor. Remove the bolt (Figure 26).

Figure 26 MVC-729X

5. Pull the top shaft from the universal joint and remove it from the top of the tractor (Figure 27).

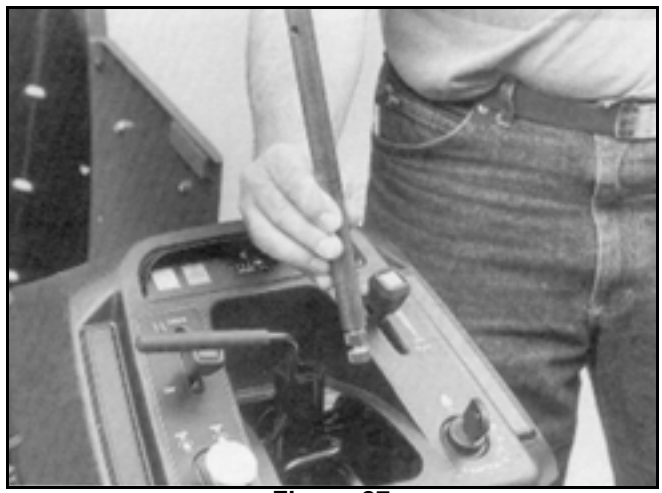


Figure 27 6-12

6. Rotate the steering gear shaft until the bottom bolt of the universal joint faces the front of the tractor. Remove the bolt (Figure 28).

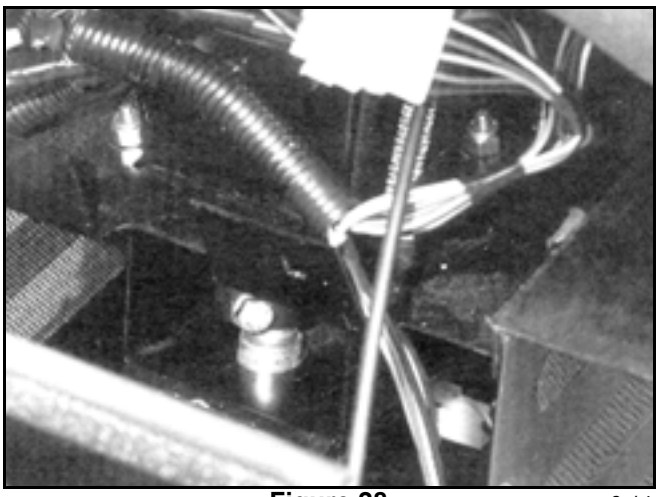


Figure 28 6-14

7. Tilt steering to the rear position and remove the universal joint from the steering shaft gear. Remove the universal joint from the top of the tractor (Figure 29).

Figure 29 6-15

8. Expand the snap ring found on the steering gear shaft and slide if halfway down the shaft. Loosen the setscrew on the locking collar of the steering gear shaft and move it until it meets the snap ring (Figure 30).

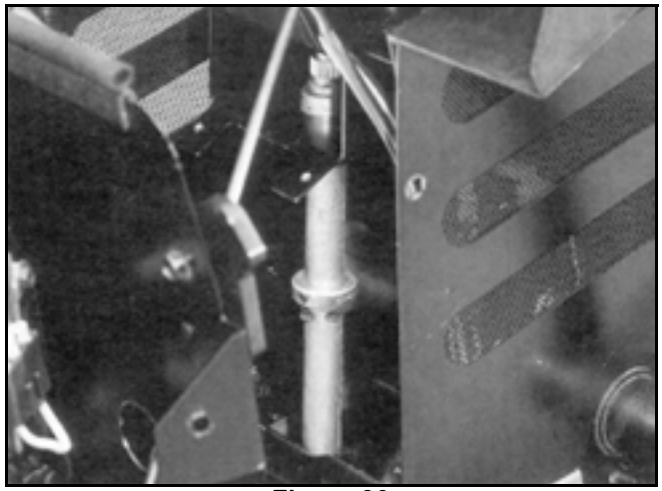


Figure 30 6-16

9. Lift the steering shaft upwards, out of the lower bushing and through the opening in the mounting bracket. Tilt the shaft towards the front of the tractor and remove it (Figure 31).

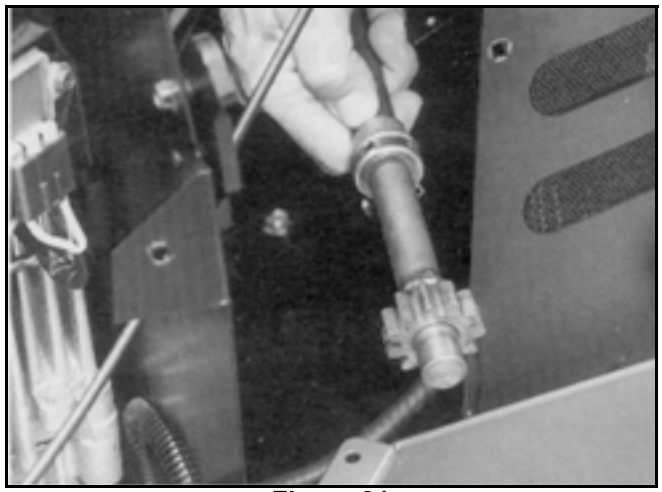


Figure 31 6-17

10. Remove the shims from the top of the lower bushing and set aside for installation process (Figure 32). **Important:** Check the bushing, shaft, and gears for wear and replace with new parts if necessary. Refer to “Steering Specifications” on page 2 - 14.

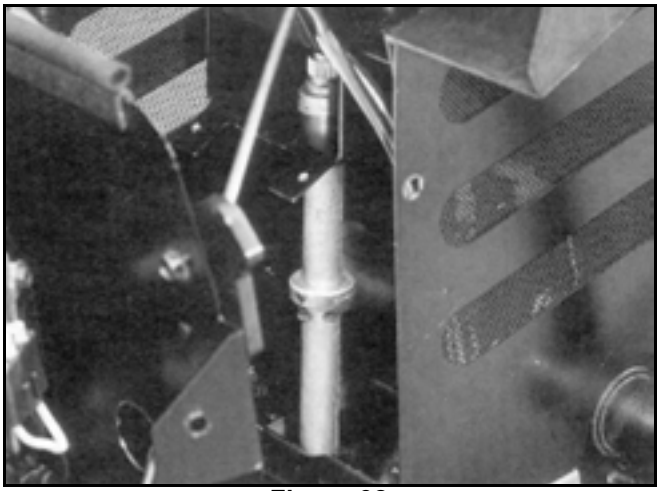


Figure 32 6-16

11. Installation - reverse the order of removal.

Steering Gear Assembly

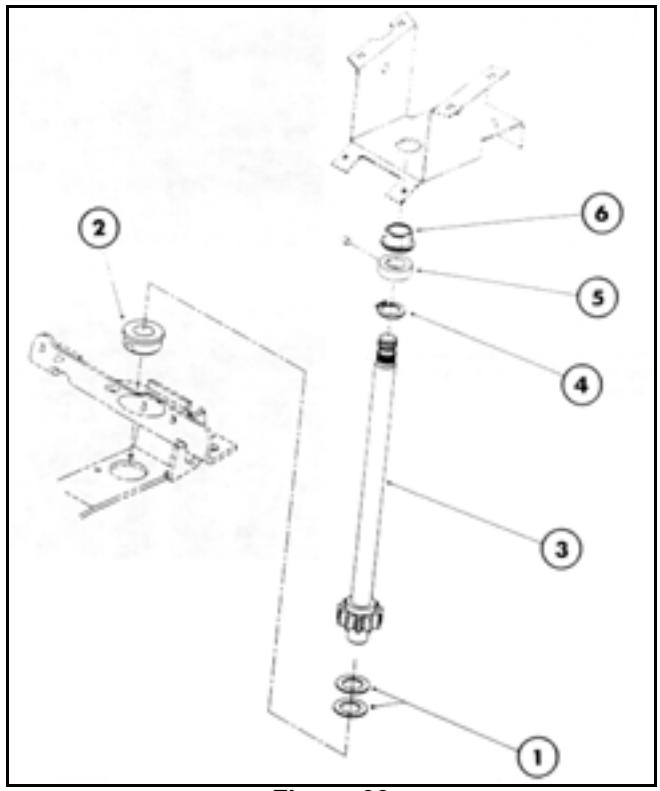


Figure 33 6-19

(1) Shims	(4) Snap Ring
(2) Lower Bushing	(5) Locking Collar
(3) Steering Gear Shaft	(6) Mid Bushing

1. Place two 0.05” (1.27mm) shims,1, between the top of the bushing, 2, and the steering gear shaft, 3.

   Note: Lubricate the bushing with general purpose grease during assembly.

2. Align the front wheels so that they face straight ahead.

3. Install snap ring, 4; locking collar, 5; and upper bushing, 6, onto the steering gear shaft.

4. Insert the steering gear shaft through the opening in the mounting bracket and onto the lower bushing.

   Note: The shims must be in place.

5. Move the locking collar upward on the shaft until it touches the column support mid bushing. Tighten the collar set screw, then move the snap ring upward on the shaft until it meets the bottom of the locking collar (Figure 33).

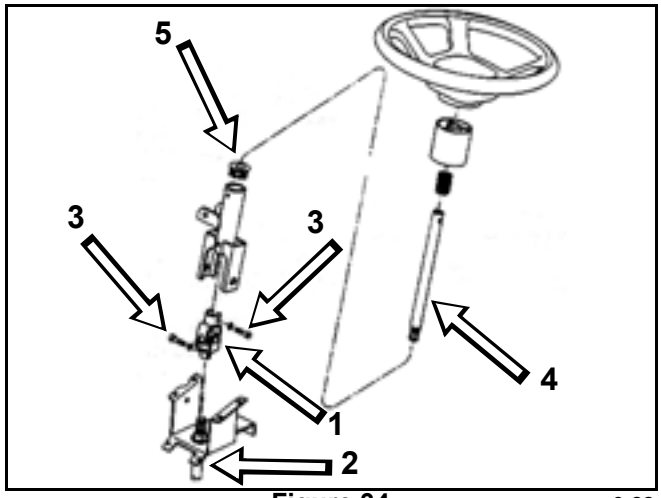


Figure 34 6-22

(1) Universal Joint	(4) Upper Steering Shaft
(2) Lower Steering Gear Shaft	(5) Steering Bushing
(3) Retaining Bolts	

6. Tilt steering to the rear position and place the universal joint,1, onto the top end of the lower steering gear shaft, 2. Install the retaining bolt, 3, of the universal joint through the joint and steering gear shaft.

7. Place upper steering shaft, 5, onto the upper end of the universal joint,1. Install the retaining bolt 3, through the upper end of the universal joint and upper steering.

   Note: Ensure that electrical wiring can not come into contact with upper steering shaft of universal joint in any position.

8. Install the rubber boot over the steering shaft and console with a boot clip (Figure 35).

Figure 35 MVC-766

9. Place the steering wheel on the steering shaft and install the lock washer and nut. Reinstall the steering wheel cover.

   Important: Ensure that all hardware is securely fastened that the steering wheel is centered when the wheels are straight ahead, and that the steering operates properly.

   Note: Ensure that electrical wiring can not come into contact with upper steering shaft of universal joint in any position.

Sector Gear Disassembly

1. Remove the battery and battery bracket from the tractor. Disconnect both steering tie rods from the sector gear. Using the access hole in the mounting bracket, remove the lock nut and carriage bolt holding the sector in place (Figure 36).

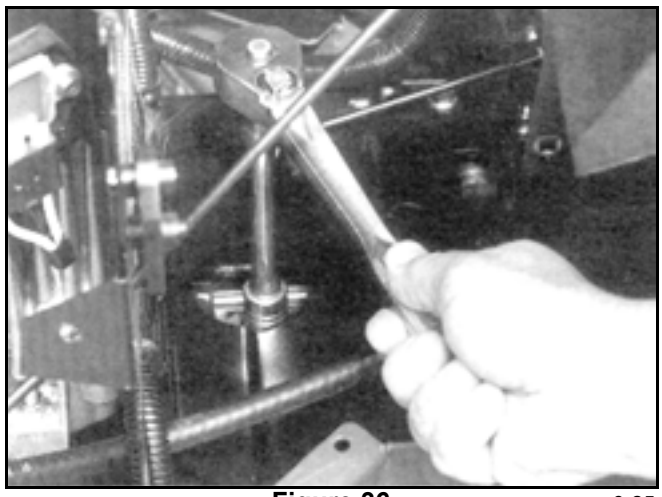


Figure 36 6-25

2. Remove the locking plate from the top of the sector gear (Figure 37).

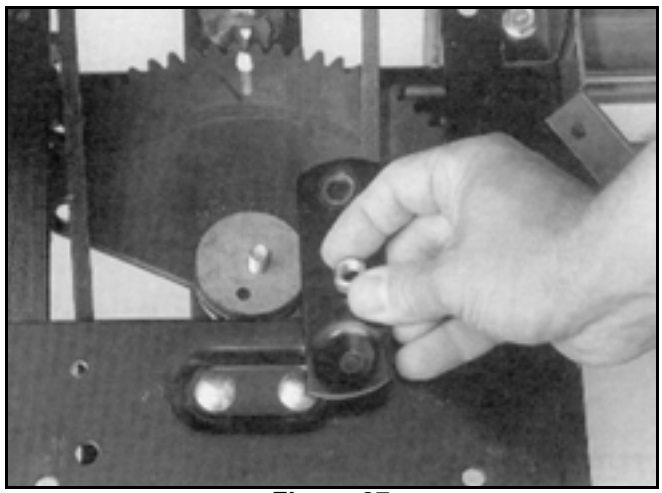


Figure 37 6-26

3. Remove the cam bushing, 3, and the sector gear, 2, from the mounting bracket (Figure 38).

   Important: Inspect the sector gear teeth and cam bushing for wear and replace if necessary.

Sector Gear Assembly

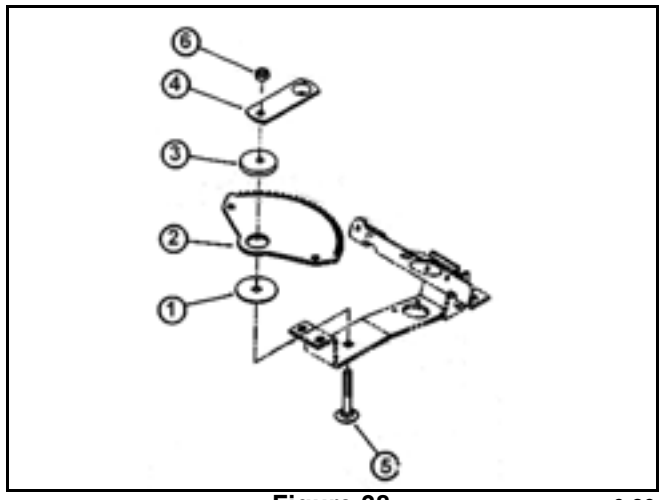


Figure 38 6-28

(1)	Washer Bearing	(4)	Locking Plate
(2)	Sector Gear	(5)	Carriage Bolt
(3)	Bushing	(6)	Locknut

1. Install the bearing washer, 1, on the mounting bracket (Figure 38).

2. Place the sector gear, 2, on top of the bearing washer with the teeth facing the rear of the tractor (Figure 38).

3. Ensure the steering wheel is centered, then center the steering shaft with the sector gear (Figure 39).

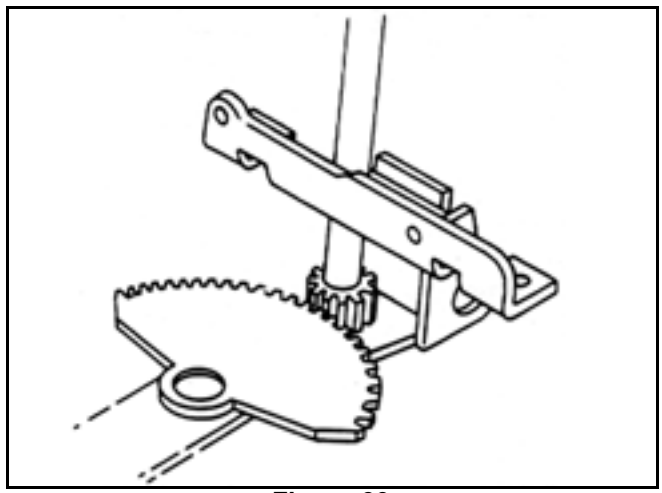


Figure 39 6-8

4. Insert the cam bushing, 3, into the bore of the sector gear (Figure 38).

5. Place the locking plate, 4, on the cam bushing (Figure 38).

6. From the bottom, insert the carriage bolt, 5, through the bearing washer, cam bushing, and the locking plate. Secure the bolt with the locknut, 6 (Figure 38).

7. Adjust the steering gear, refer to “Steering Backlash Adjustment” on page 2 - 5.

8. Fasten both steering arms onto the sector gear. Check wheel alignment and toe-in.

NOTE: On 2004 models and on new replacement steering sector gears, make sure the angle of the teeth are facing down.

Tilt Steering

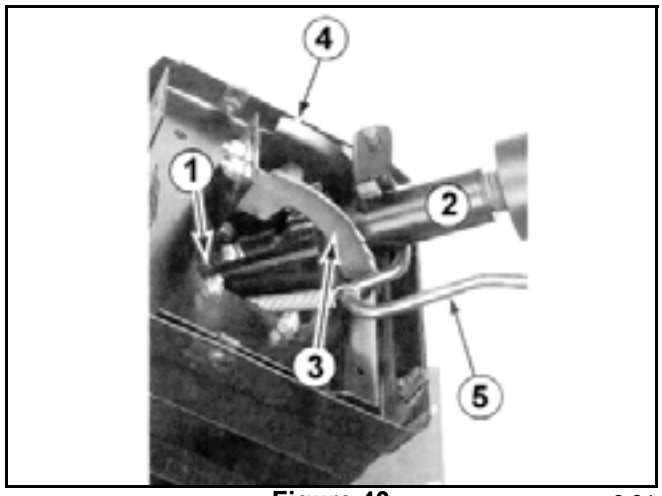
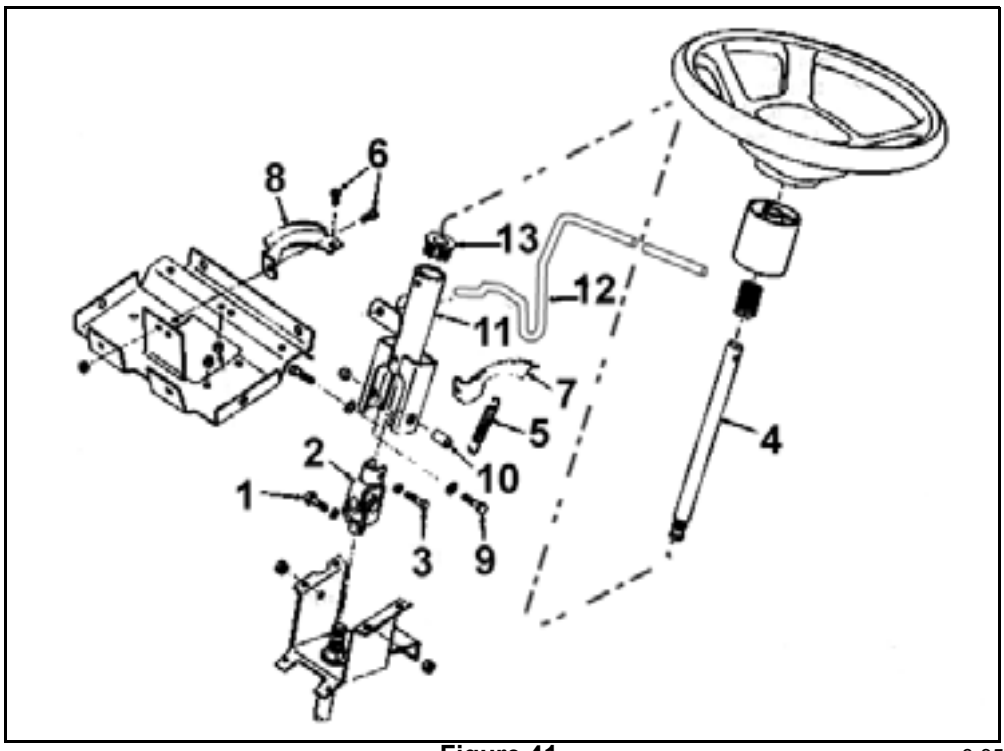


Figure 40 6-34

Description

The tilt steering assembly is made up of the following components (Figure 40):

1. Universal joint.
2. Steering column (bushing mounted).
3. Detent bracket (left side).
4. Support bracket (right side).
5. Spring-loaded control handle.



(1) Retaining Bolt
(2) Universal Joint
(3) Retaining Bolt
(4) Upper Steering Shaft
(5) Spring Extension
(6) Bolts
(7) Detent Bracket
(8) Support Bracket
(9) Retaining Bolt
(10) Spacer-Yoke
(11) Column
(12) Tilt Lever
(13) Steering Bushing

Figure 41 6-35

Tilt Steering Disassembly

1. Remove the steering wheel cover, nut, lock washer, and steering wheel from top of the steering shaft (Figure 42).

Figure 42 Mvc-765

2. Remove the boot clip, from the inside of the dash and remove the rubber boot from the steering console (Figure 43).

Figure 43 MVC-766

3. Remove the bottom retaining bolt, 1, from the universal joint, 2 (Figure 41).

4. Remove the top retaining bolt, 3, from the universal joint and disconnect the top steering shaft, 4, from the tractor (Figure 41).

5. Tilt steering to the rear position and detach the universal joint from the steering gear shaft. Take the universal out of the tractor from the top side.

6. Remove the spring, 5, from the left pivot spacer and tilt control handle (Figure 41).

7. Remove the four bolts, 6, and nuts from the left and right support brackets, 8, and 9, and remove the brackets (Figure 41).

8. Remove the two side pivot bolts, 9, and spacers, 10, from the steering column. Lift the column, 11, out of the tractor (Figure 41).

9. Slide the tilt control handle, 12, off the steering column bracket (Figure 41).

10. Remove the bushing, 13, from the top of the steering column (Figure 41).

    Important: Inspect all bushings and pivot areas for wear and replace as necessary. Refer to “Steering Specifications” on page 2 - 14.

Tilt Steering Assembly

1. Place bushing, 13, on top of the steering column (Figure 41).

2. Insert the tilt control handle, 12, into the steering column bracket (Figure 41).

3. Secure the steering column to the mounting bracket with pivot bolts, 9; spacers, 10; and locknuts (Figure 41).

    Note: The longer spacers should be positioned on the left-hand side.

4. Install the left, 7, and right, 8, support brackets, using four bolts, 6, and nuts. The notched bracket goes on the left side. Adjust the brackets to obtain minimal side play between the column and brackets (Figure 41).

5. Attach the spring, 5, to the tilt handle and left pivot spacers (Figure 41).

6. Tilt steering to its farthest rearward position and place the universal joint, 2, on the steering gear shaft. Pass the bottom bolt, 1, of the universal joint through the universal and steering gear shaft and secure (Figure 41).

7. Insert the top steering shaft, 4, onto the upper end of the universal joint check the front wheel alignment, wheels should be straight ahead. Install the retaining bolt, 3, through the upper end of the universal joint and steering shaft (Figure 41).

   Note: Ensure electrical wiring can not come into contact with upper steering shaft or universal joint in any position.

8. Install the rubber boot over the steering shaft and secure the boot to console with the rubber clip (Figure 44).

Figure 44 MVC-766

9. Align the steering wheel on the steering shaft. Secure the steering wheel with lock washer and nut. Install steering wheel cover (Figure 45).

Figure 45 MVC-765

Steering Specifications

Item	Specification
Free Play – front axle pivot pin	0 – 0.015” (0 – 0.4mm)
End Play – front wheel on spindle	0 – 0.015” (0 – 0.4mm)
Toe-In	1/8” – ¼” (3 – 6mm)
Steering Wheel Free Play (Backlash)	0.5” – 1.0” (13 – 25mm)
Steering Shaft Bushings (standard dimensions)	
Top (Fiber)	ID 0.752 – 0.756” (19.1 – 19.2mm) OD 1.310 – 1.320” (33.3 – 33.5mm)
Mid (Metal)	ID 0.755 – 0.760” (19.2 – 19.3mm) OD 0.988 – 1.00” (25.3 – 25.4mm)
Bottom (Metal)	ID 0.753 – 0.758” (19.1 – 19.2mm) OD 1.380 – 1.385” (35.0 – 35.2mm)

Hood Removal

1. Disconnect the headlight wiring harness at the plug and jack connection (Figure 46).

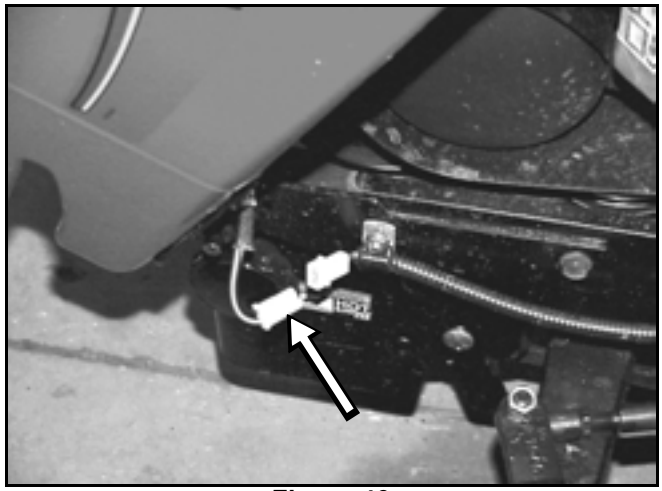


Figure 46 MVC-003

2. On 2003 model units, remove the rubber O-ring, located on the left side hinge bracket, and raise the hood. Slide the hood to the left and off the hinge brackets. (Figure 47).

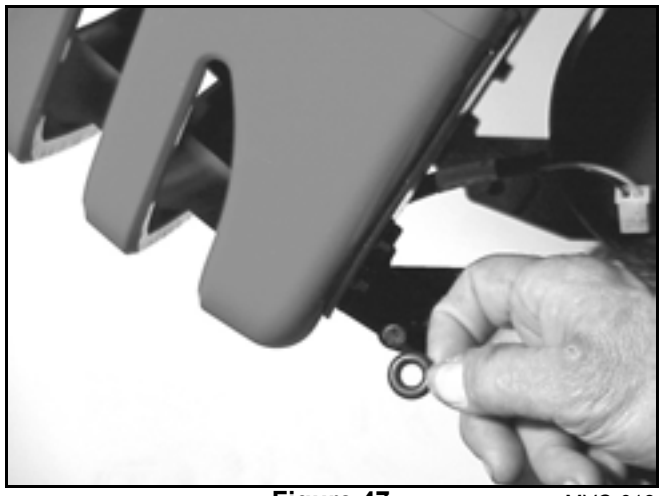


Figure 47 MVC-018

3. On 2004 and later model units, raise the hood in the full up position, then bring the hood back slightly and slide the hood toward the left side of the tractor (Figure 48).

Figure 48 MVC-015

4. Reinstall the hood in reverse order.

Seat and Fender Removal

1. Unplug the seat switch, and the KeyChoice™ Reverse operating switch (Figure 49).

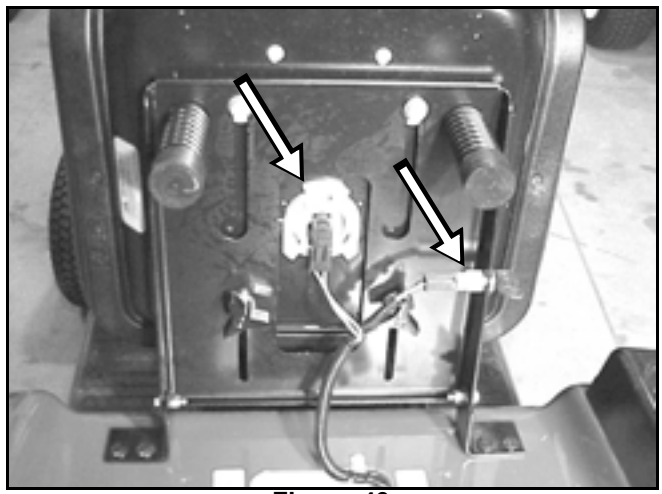


Figure 49 MVC-865F

2. To make it easier to remove the fasteners for the fender assembly, jack the tractor up in the rear and remove both rear tires.

3. Remove the two rear carriage bolts, washers, and nuts located in the rear of the fender assembly (Figure 50).

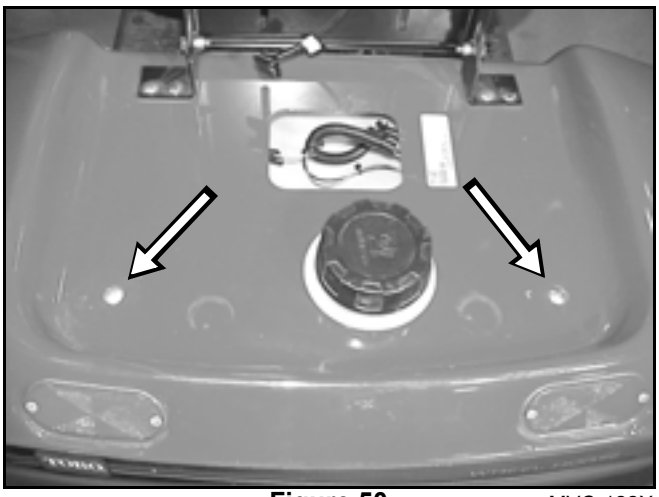


Figure 50 MVC-122X

4. Remove the four carriage bolts, washers, and nuts, (two on the right and two on the left), located between the footrest and fender (Figure 51).

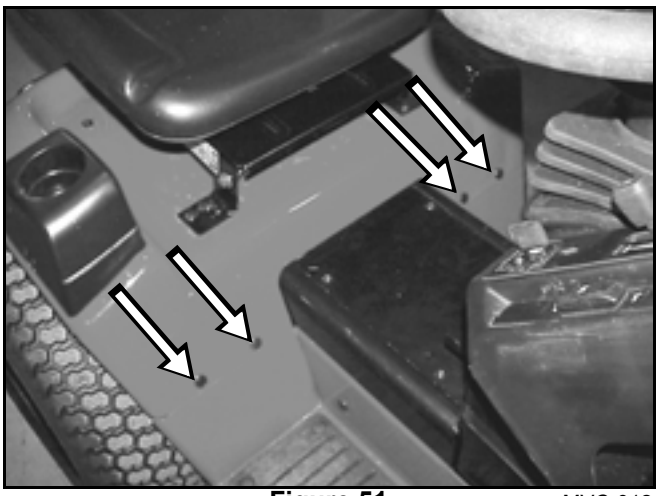


Figure 51 MVC-012

5. Remove the seat and fender together as one piece (Figure 52).

Figure 52 MVC-029

6. Installation - follow the removal procedure in reverse.

Gas Tank Removal

1. Follow the procedure for removing the rear fender and seat.

2. Remove the two screws and spacers in the front of the gas tank (Figure 53).

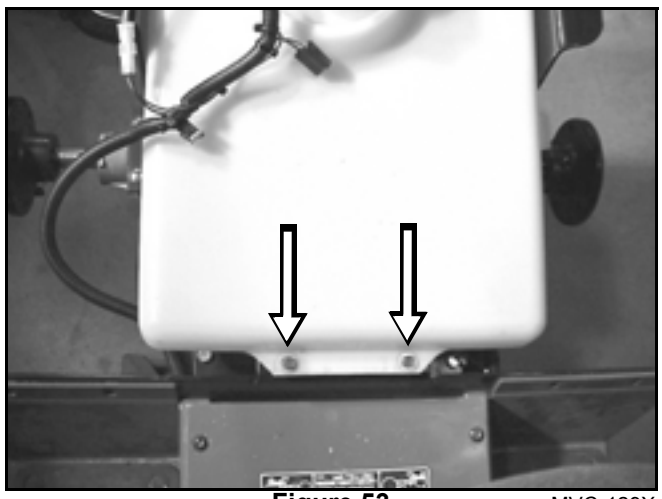


Figure 53 MVC-129X

3. Lift the gas tank from the frame, close the gas shut-off valve, and disconnect the gas line from the shut-off valve (Figure 54).

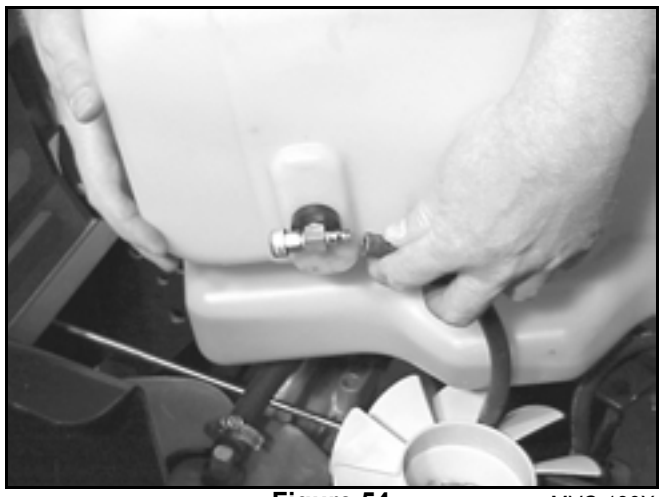


Figure 54 MVC-130X

4. Carefully remove the gas tank.

Installation

Reverse the order of removal.

Lift Bar Assembly

Removal

1. Remove the bolt, washer, and nut retaining the lift chain to the lift bar (Figure 55).

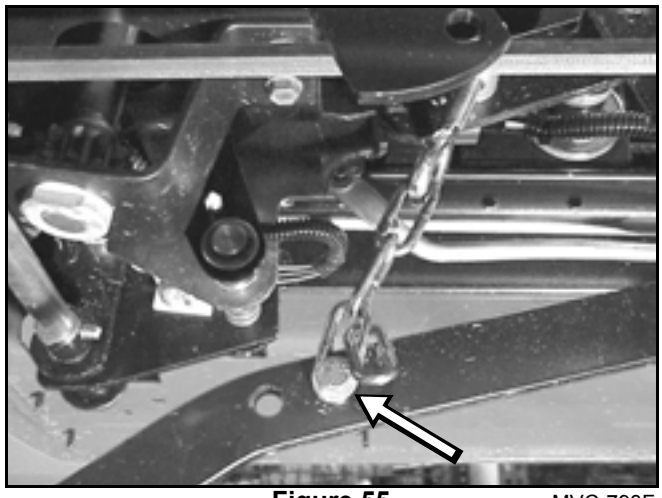


Figure 55 MVC-798F

2. Remove the right and left washers and e-rings located on each end of the lift bar assembly (Figure 56).

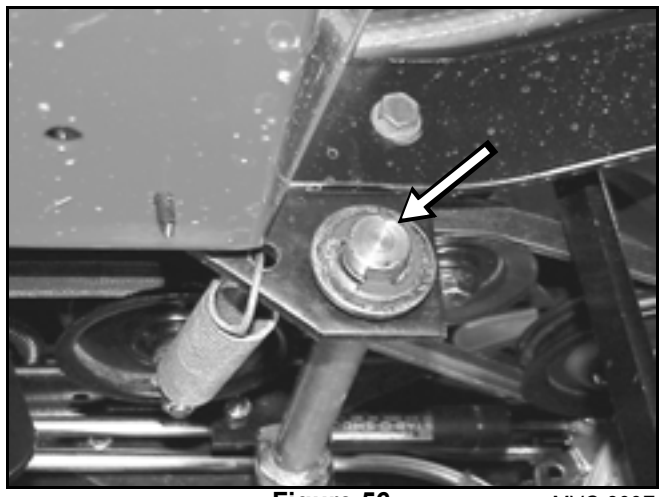


Figure 56 MVC-800F

3. Slide the lift bar out of the flange bushings and the rear lift plates (Figure 57).

Figure 57 MVC-803F

Lift Lever Assembly

Removal

1. Remove the center access plate. Remove the pin clip and clevis pin retaining the two lift strap links to the lift lever (Figure 58).

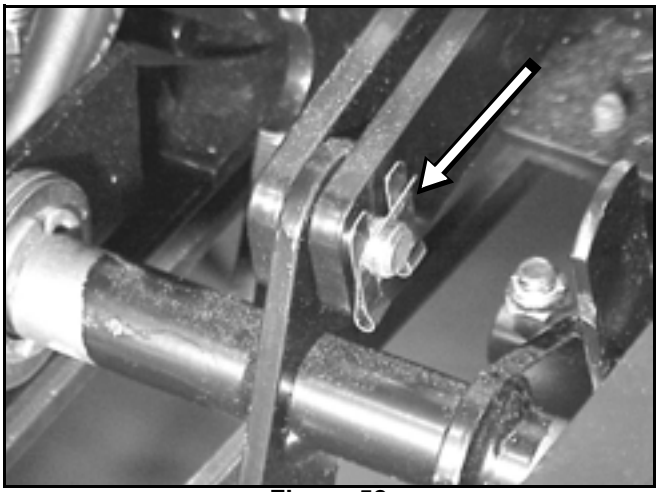


Figure 58 MVC-804F

2. Remove the two retaining rings that are located on each side of the lift lever assembly (Figure 59).

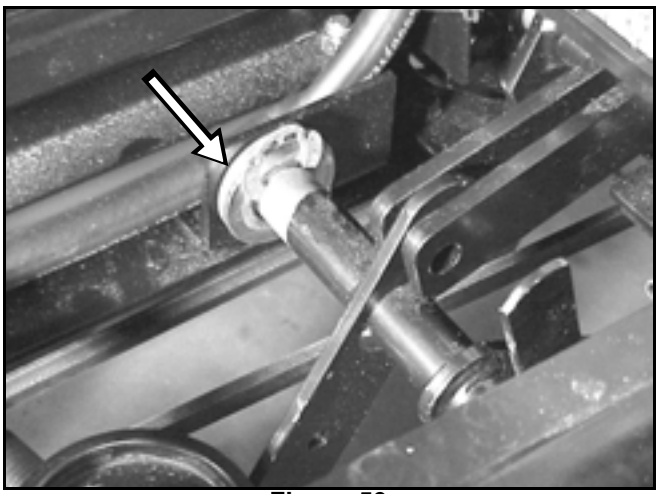


Figure 59 MVC-806F

3. Slide the right and left flange bearings inward from the pivot linkage brackets, so you will have enough clearance to remove the lift lever assembly (Figure 60).

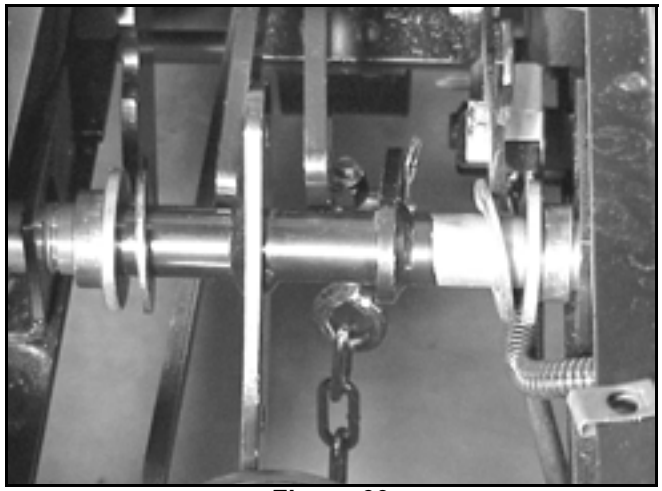


Figure 60 MVC-807F

4. Remove the lift lever assembly from the pivot linkage brackets (Figure 61).

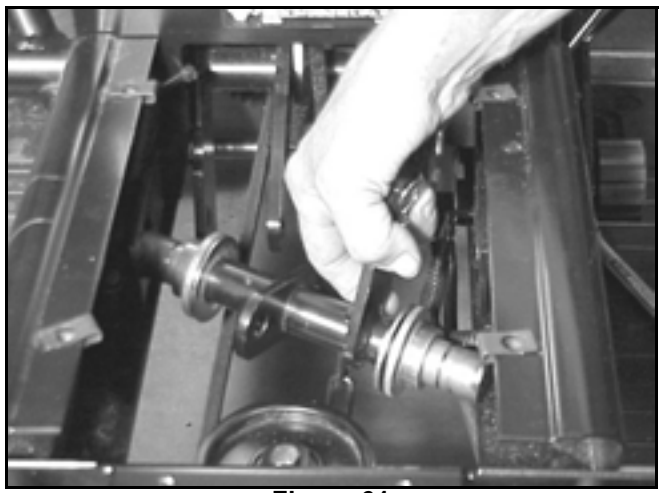


Figure 61 MVC-809F

Assembly

Reverse the order of removal.

Lift Arm/Lift Lever Assembly

Removal

1. Remove the right and left side panels. Remove the center access plate. Disconnect the battery cables and remove the battery from the tractor.

2. Remove the two bolts holding the battery support and remove the support (Figure 62).

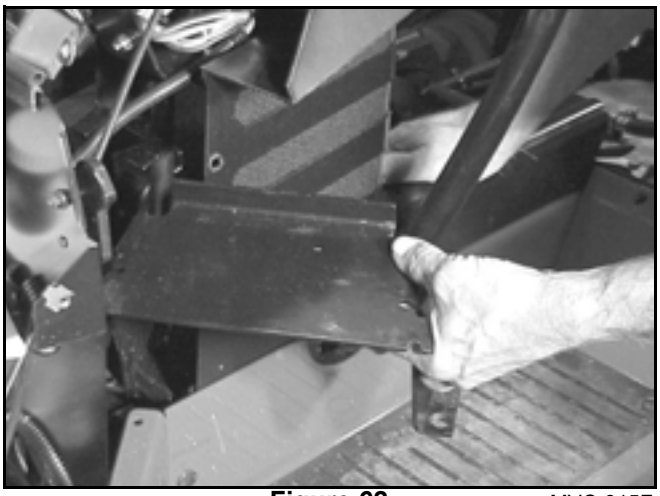


Figure 62 MVC-815F

3. Remove the 4 screws and 2 nuts from the base of the dash. Remove the bolt and nut located in the center of the hood stand, just below the large decal (Figure 63).

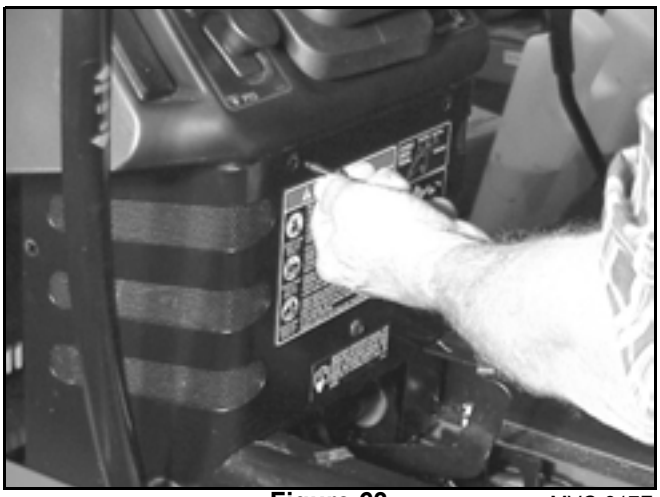


Figure 63 MVC-817F

4. Pull the dash upwards, with the steering shaft, and move carefully toward the front of the tractor to give you enough clearance to get to the lift assembly (Figure 64).

Figure 64 MVC-820F

5. Remove the six bolts, three located on the right and three on the left side, inside of the hood stand (Figure 65).

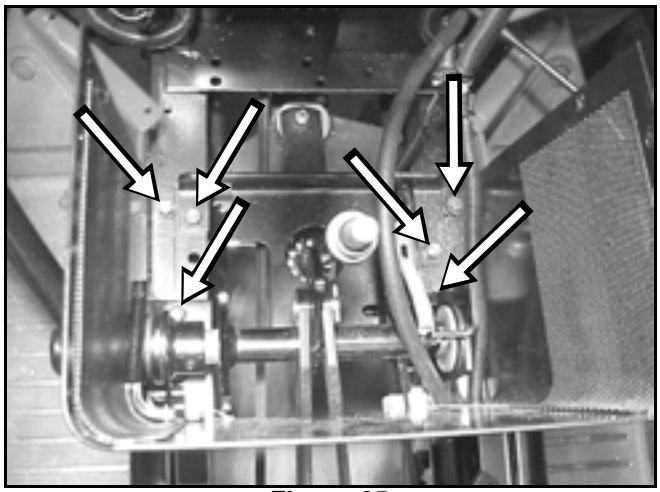


Figure 65 MVC-821F

6. Remove spring for the brake assembly (Figure 66).

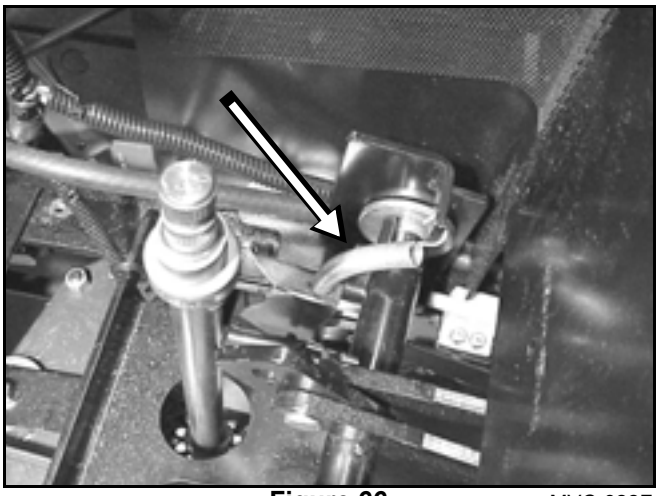


Figure 66 MVC-822F

7. Lift the hood stand off the frame of the tractor (Figure 67).

Figure 67 MVC-827F

8. Lift the lift assembly up and off the frame of the tractor (Figure 68).

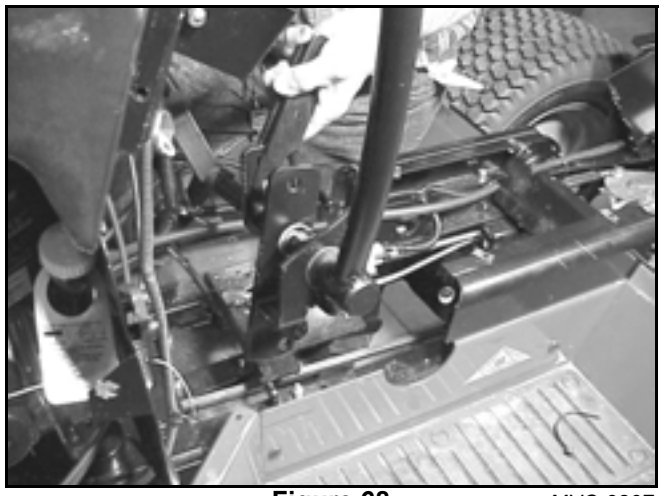


Figure 68 MVC-826F

Installation

Reverse the order of removal.

Electric Lift

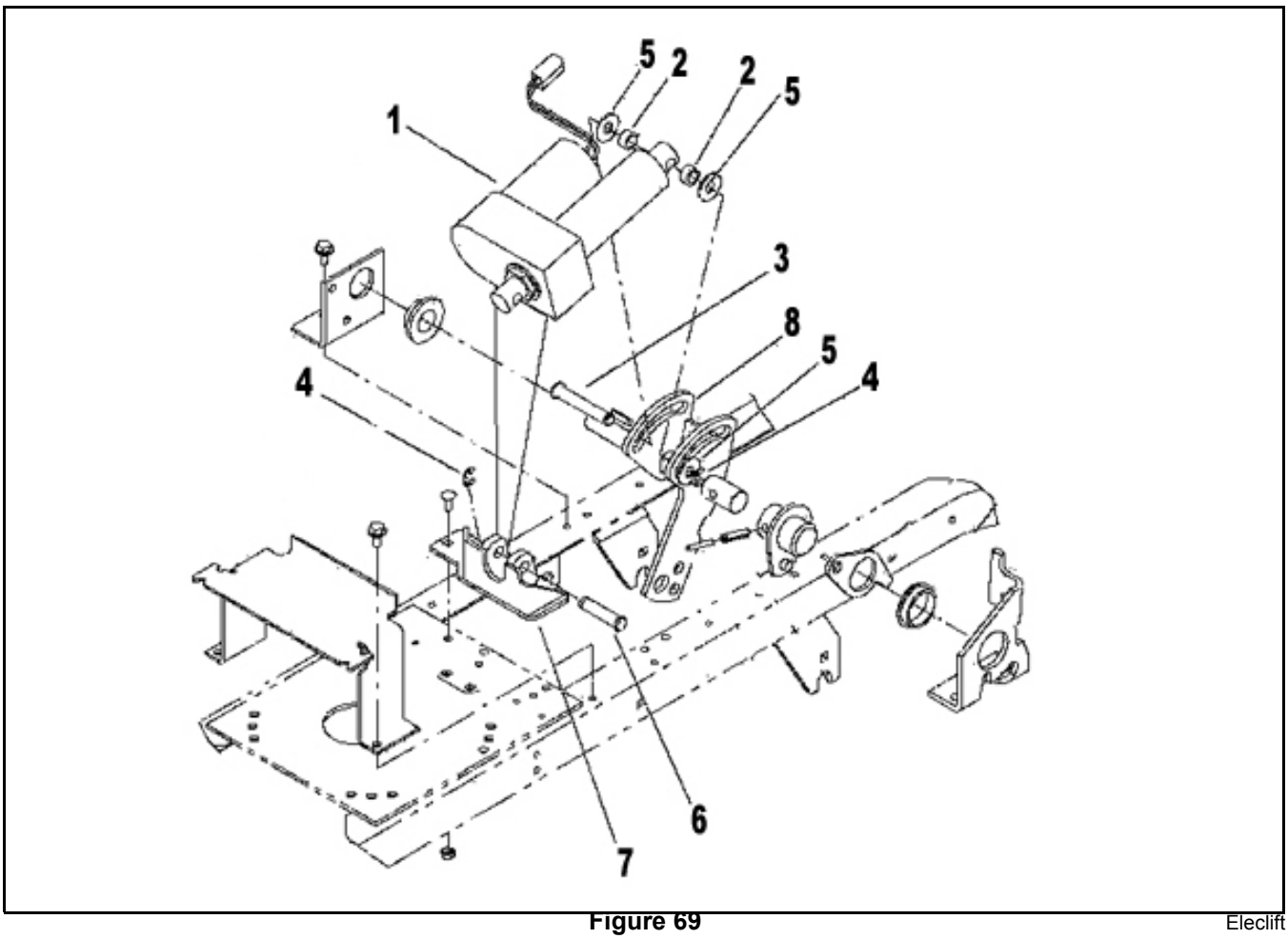


Figure 69 Eleclift

(1)	Actuator	(5)	Washer
(2)	Spacer	(6)	Clevis Pin
(3)	Clevis Pin	(7)	Actuator Bracket Assembly
(4)	Clip Pin	(8)	Lift Arm Assembly

Removal

1. Remove the right and left hood stand panels to the battery compartment.
2. Disconnect the negative and positive cables from the battery.
3. Remove the two screws holding the battery support and remove the support.
4. Unplug the actuator, 1, from the wiring harness.
5. Remove the clip pin, 4, and clevis pin, 6, that holds the actuator, 1, to the actuator bracket assembly, 7.
6. Remove the clip pin, 4, spacers, 2, washers, 5, and clevis pin, 3, from the lift arm assembly, (8).
7. Remove the actuator, 1, from the tractor. The actuator is serviced as an assembly; no repair parts are available.
8. Remove the actuator

Installation

Reverse the order of removal.

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Hydro-Gear Hydrostatic Transaxle

Internal Service

Internal service information is contained in the Hydro-Gear Transaxle Service Manual, Form #492-0682. Under warranty, internal service work should not be performed unless authorized by your Distributor Service Manager or the Toro Company.

Fluid Change

The Hydro-Gear transaxle is factory filled, sealed, and does not require oil changes. However in the event of oil contamination or degradation, oil replacement may correct certain performance problems.

Transaxle Removal

1. Disconnect the negative battery cable from the battery.

2. Raise the rear of the tractor and remove the right and left rear tires. Support the rear frame, just in front of the transaxle. Remove the center access plate, fender, seat, and gas tank. Refer to the “Chassis” section on page 2 - 15 and page 2 - 16. Remove the center plate between the seat and the hood stand (Figure 117).

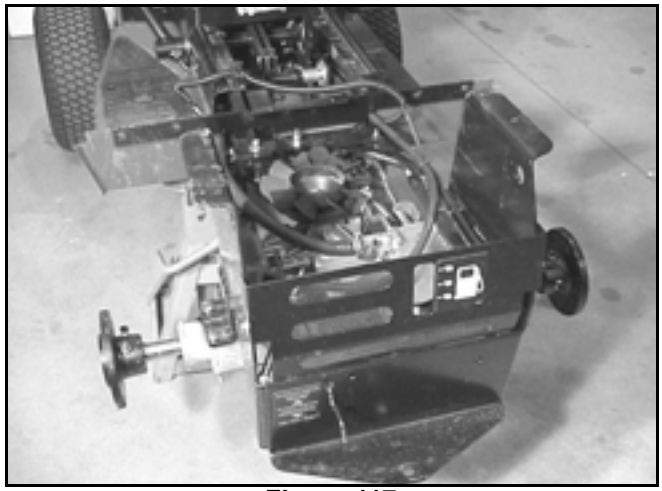

Figure 117 MVC-061F

3. Disconnect the free wheeling valve I rod and the vent hose clamp (Figure 118).

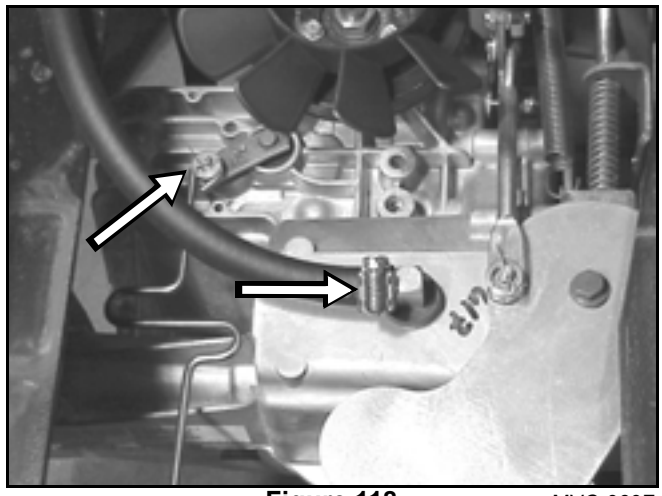

Figure 118 MVC-060F

4. Remove the cotter pin located on the crown nut for adjusting the brakes. Remove the crown nut, brake bracket, brake arm spring and brake rod (Figure 119).

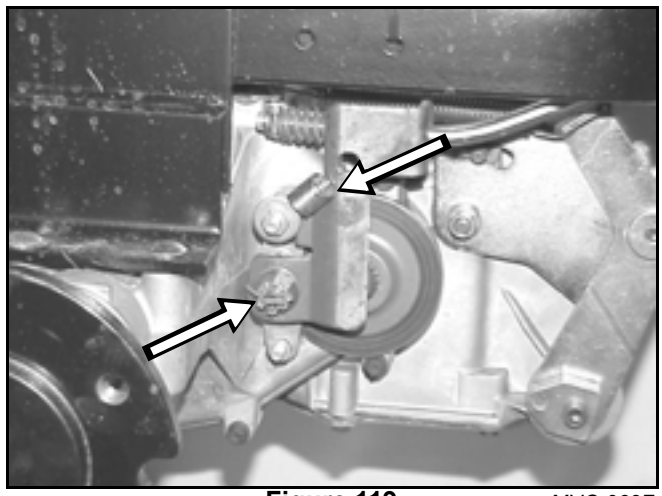

Figure 119 MVC-063F

5. If the tractor is equipped with cruise control, unplug the cruise control magnet wiring connectors (Figure 120).

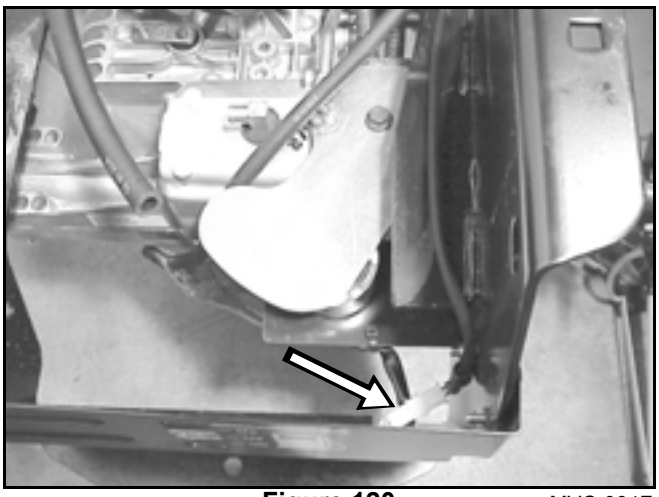

Figure 120 MVC-064F

6. Unbolt the cruise control magnet bracket from the side of the frame (Figure 121).

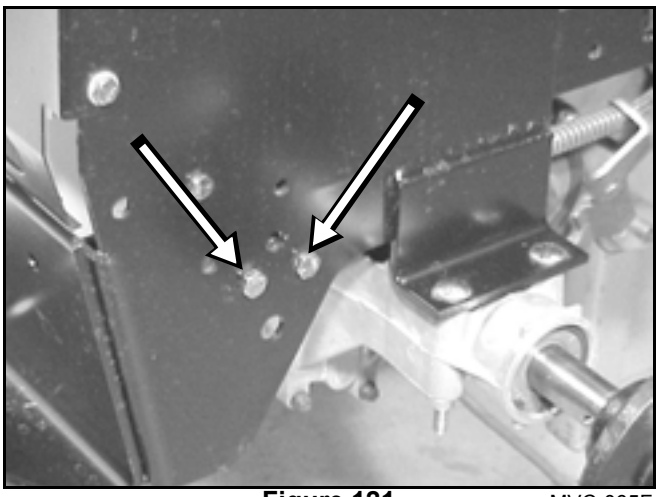

Figure 121 MVC-065F

7. Unhook the idler spring from the bottom of the idler pulley (Figure 122).

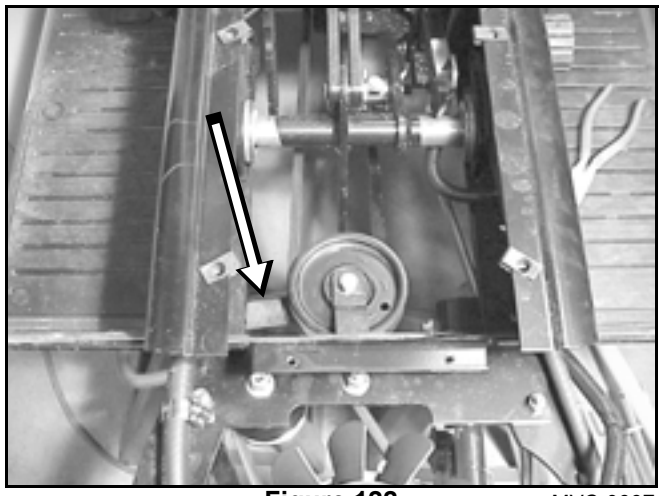

Figure 122 MVC-066F

8. Remove the three bolts retaining the transmission fan to the pulley (Figure 123).

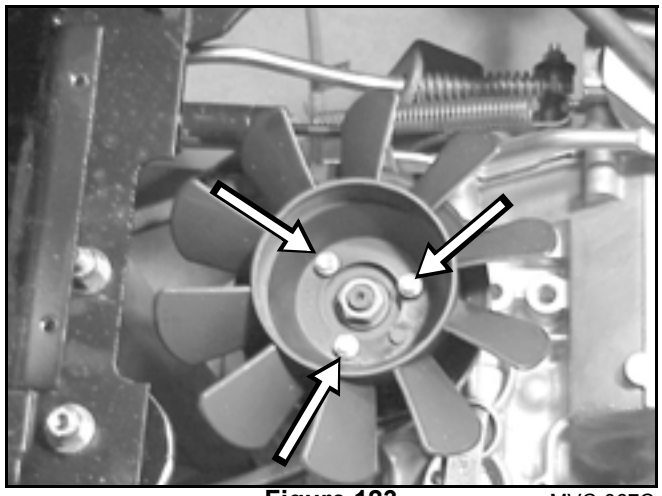

Figure 123 MVC-067C

9. Remove the damper cylinder located next to the transaxle input pulley. To remove the fastener on the end of the cylinder, insert the blade of a screwdriver between the back side of the fastener and the shaft. Apply a little pressure toward the back of the fastener and pull the damper cylinder off the shaft (Figure 124).

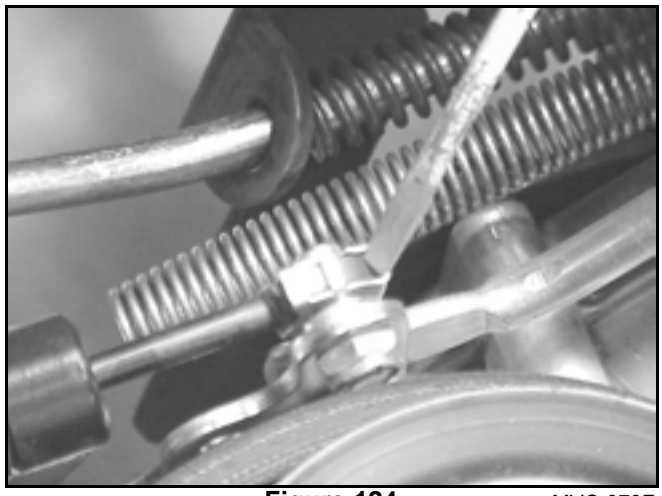

Figure 124 MVC-070F

10. Slip the belt off the transaxle input pulley (Figure 125).

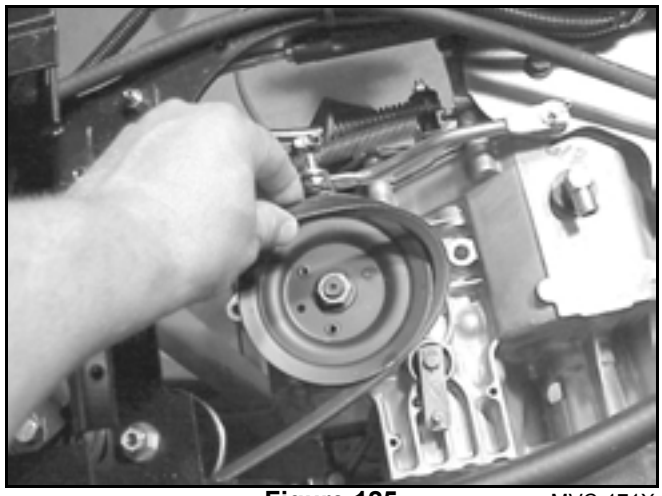

Figure 125 MVC-171X

11. Use a floor jack under the transaxle to help lower the transaxle from the frame of the tractor (Figure 126).

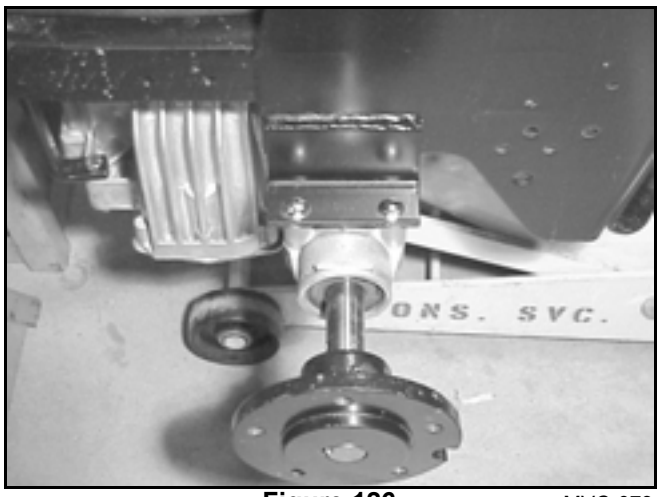

Figure 126 MVC-073

12. Remove the bolt, washer, and nut retaining the torque strap to the transaxle, located on the left front side (Figure 127).

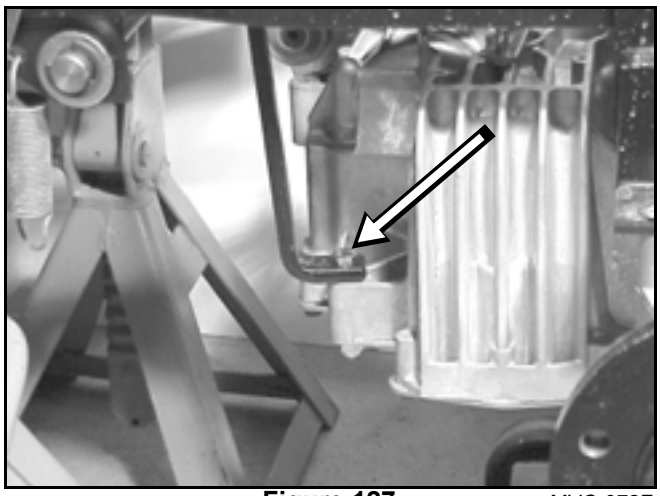

Figure 127 MVC-072F

13. Remove the two nuts and washers that are located on each side of the transaxle axle housing holding the transaxle to the frame (Figure 128).

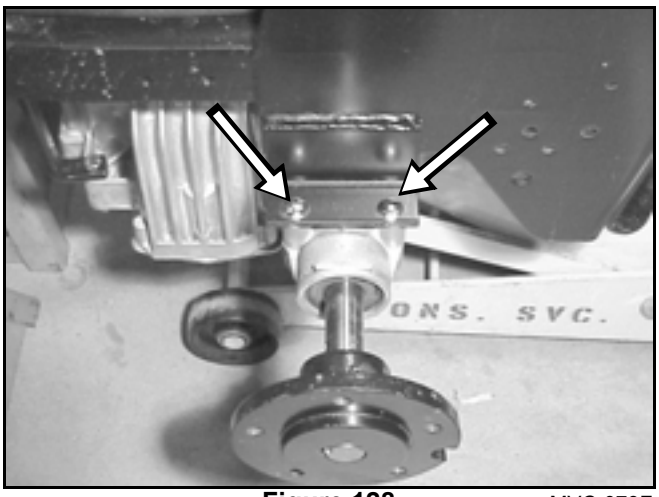

Figure 128 MVC-073F

14. Slowly lower the transaxle slightly and STOP. You will need to disconnect the hydro rod from the cruise control plate. Remove the cotter pin and washer (Figure 129).

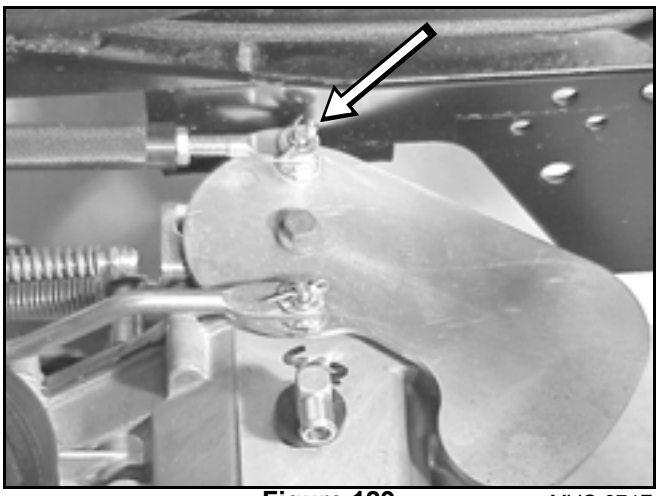

Figure 129 MVC-074F

15. Continue to lower the transaxle out of the tractor frame (Figure 130).

Figure 130 MVC-077F

Installation - Hydro-Gear Transaxle

1. Raise the transaxle up toward the frame allowing enough room to install the hydro rod to the cruise plate and secure with a cotter pin and washer (Figure 129).

2. Secure the transaxle to the frame brackets with four carriage bolts, washers, and nuts (Figure 131).

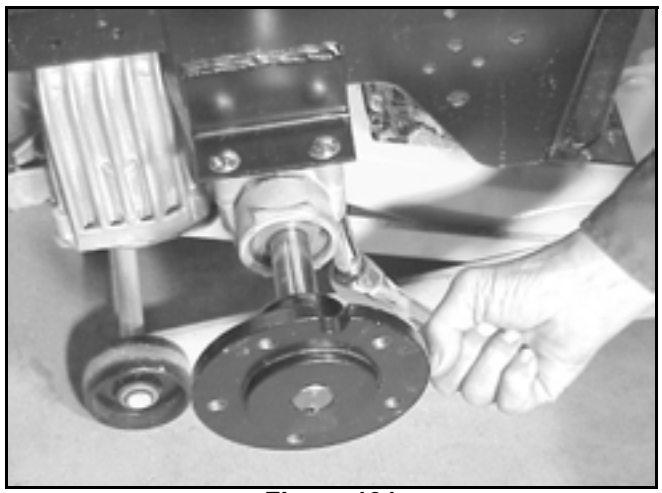

Figure 131 MVC-078F

3. Install the bolt, washer, and nut through the front of the transaxle to the torque strap (Figure 132).

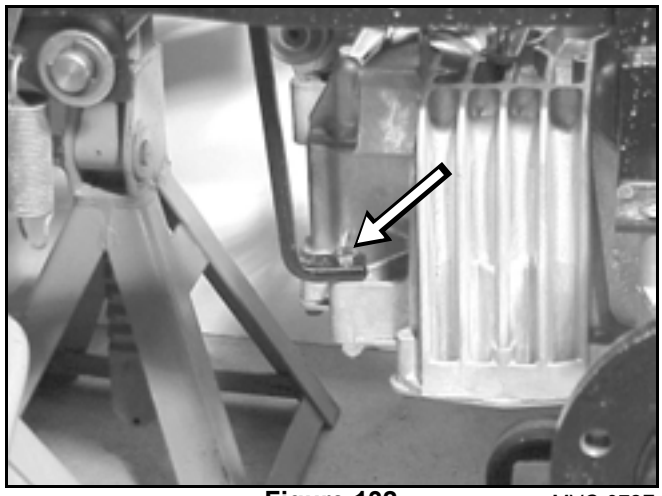

Figure 132 MVC-072F

4. Install the drive belt around the transaxle input pulley. Install the idler spring on the idler pulley (Figure 133).

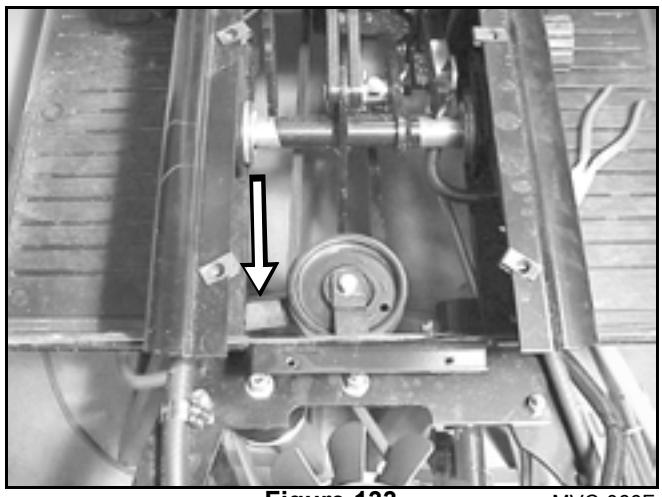

Figure 133 MVC-066F

5. Connect the damper cylinder to the control linkage (Figure 134).

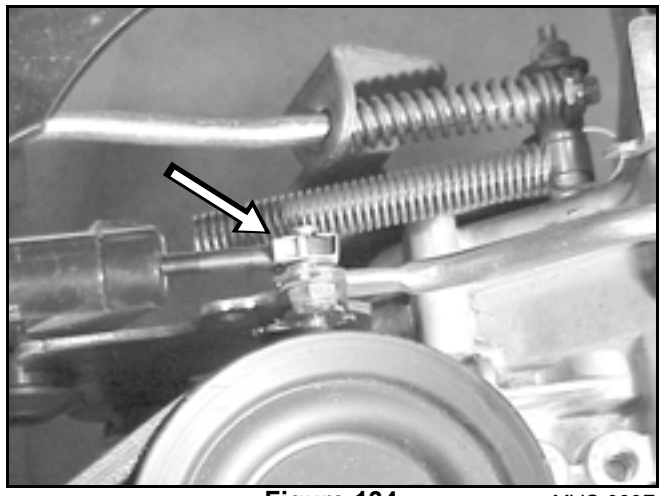

Figure 134 MVC-080F

6. Install the three bolts to secure the transaxle cooling fan to the transaxle pulley (Figure 135).

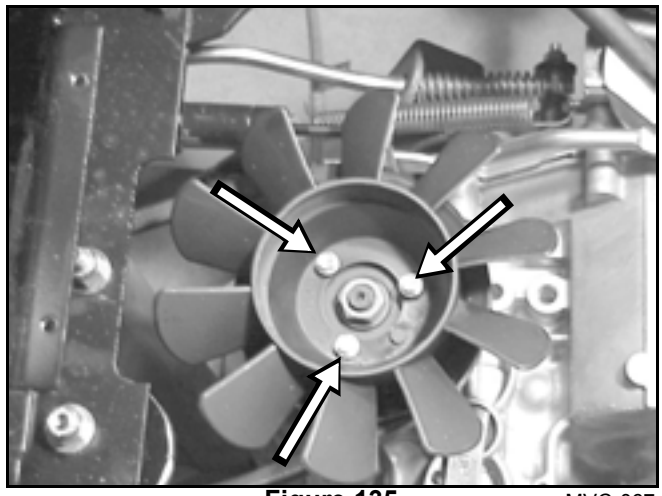

Figure 135 MVC-067

7. Install the cruise control bracket, with magnet, with two bolts and nuts (Figure 136).

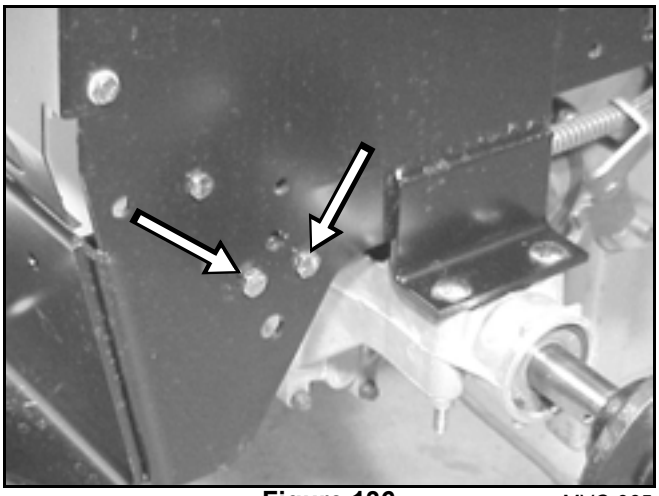

Figure 136 MVC-065

8. Reconnect the wire connector for the magnet (Figure 137).

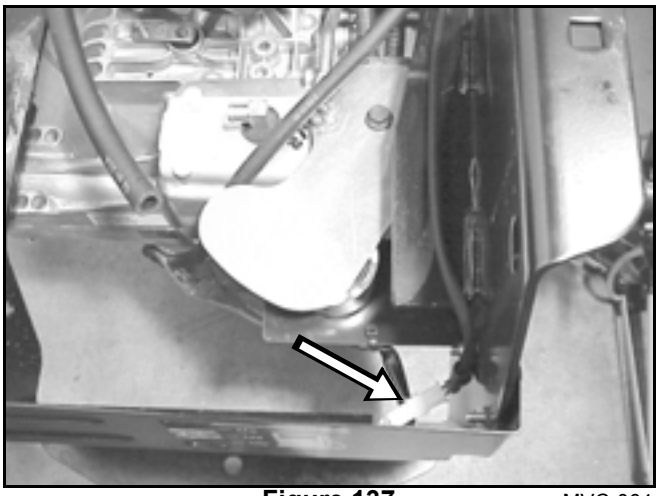

Figure 137 MVC-064

9. Install the brake arm with the brake spring, on the brake stud. Install the castle nut, but do not install the cotter pin until brake adjustment has been performed (Figure 138). Refer to “Brake Adjustment” on page 3 - 9.

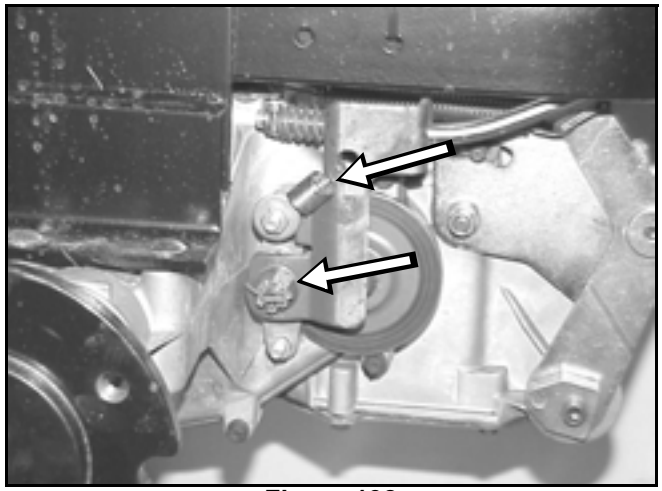

Figure 138 MVC-063

10. Connect the free wheeling valve rod and vent hose clamp (Figure 139).

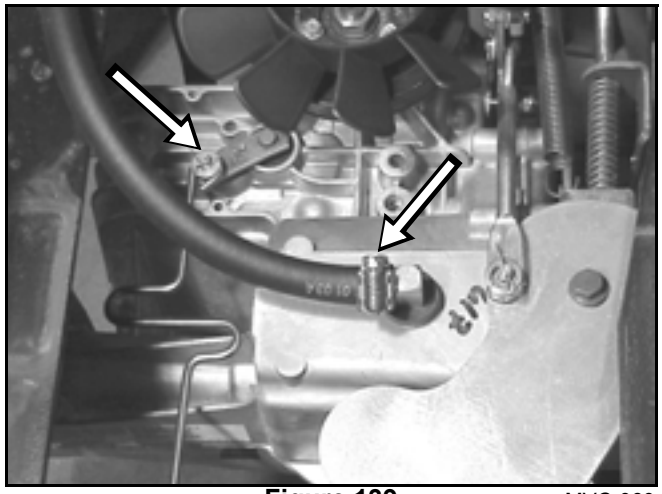

Figure 139 MVC-060

11. Reconnect the gas line to the gas tank and install the gas tank with two screws and washers (Figure 140).

Figure 140 MVC-081F

NOTE: When installing a new transaxle in the machine or if any work was performed internally on the transaxle, make sure the system is purged prior to doing any neutral adjustment. Refer to “Neutral Adjustment” on page 3 - 7.

12. Reconnect the negative battery cable.

13. Attach a jumper wire across the seat switch plug terminals so the tractor will run without an operator in the seat. Test to confirm proper operation of the transaxle. If adjustment is needed, refer to “Neutral Adjustment” on page 3 - 7.

14. Install fender and seat assembly and the center access plate. Install the right tire.

15. Operate the tractor and make sure all safety features are working. Check the forward and reverse operation of the tractor. If you find there is not enough speed in reverse or forward, follow the adjustment procedures for the foot control; refer to “Foot Control Adjustment” on page 3 - 10.

Neutral Adjustment

Before making a neutral adjustment, the transaxle must be warmed up, usually 5 to 10 minutes. Steps to perform neutral adjustment:

1. Jack-up and support the right rear end of the tractor, allowing enough clearance to remove the right rear tire. Make sure the left tire stays on the ground (Figure 141). (Optional: remove the fender and seat assembly. If they are removed, you will need to temporarily bypass the seat switch.)

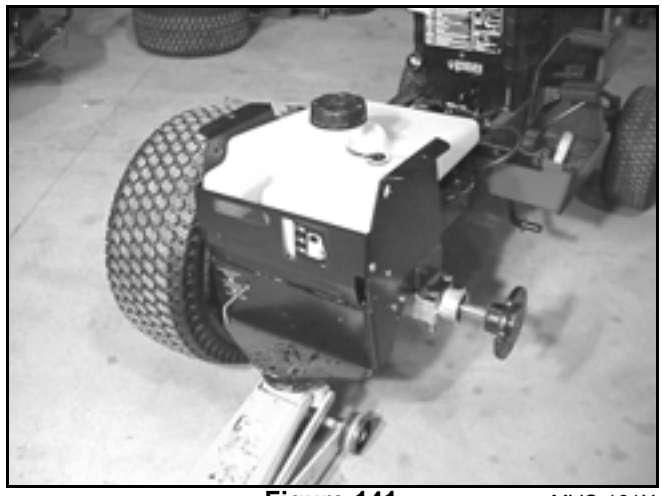

Figure 141 MVC-161X

2. Locate the adjusting puck and loosen the Allen head set screw (Figure 142).

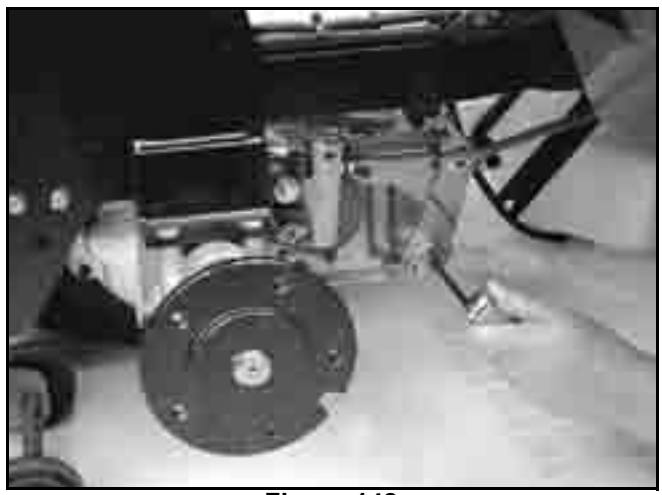

Figure 142 1703-07

3. Start the engine and run at 3/4 to full throttle.

4. Rotate the adjusting puck in both directions and watch the axle direction. You want to adjust the puck so it is set in the mid-point between forward and reverse axle rotation. Make sure the axle is not moving (Figure 143).

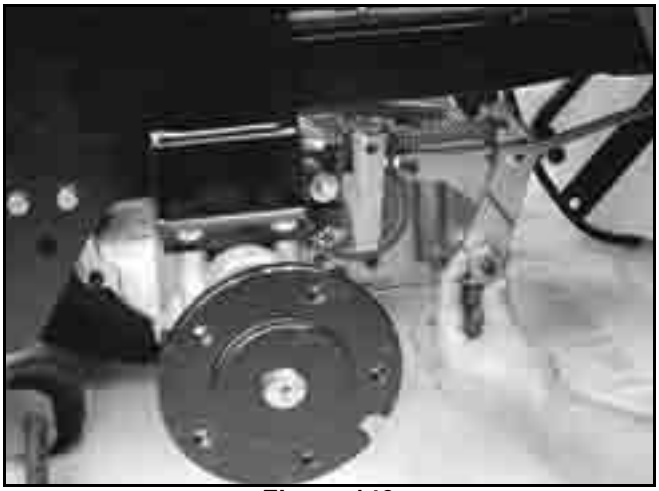

Figure 143 1703-08

5. Once you are in neutral, hold the puck with an adjustable wrench so it won't move when you re-tighten the Allen set screw (Figure 144).

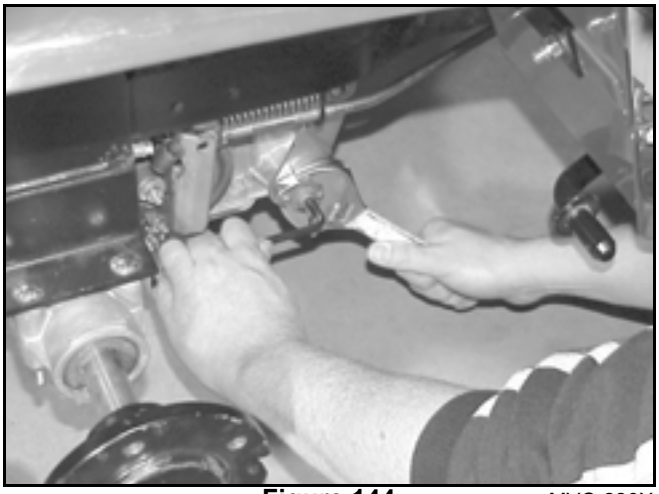

Figure 144 MVC-226X

6. Operate the foot control in forward and reverse and allow the pedal to return to the neutral position to test the adjustment.

NOTE: You may not be able to eliminate creep entirely, due to the narrow neutral zone of this transaxle. In this case, adjust for the smallest amount of reverse creep possible. Correctly adjusted, a very light tap on the foot control pedal should be all that is needed to stop the reverse creep.

Transaxle Purging Procedures

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that it be purged from the system.

These purge procedures should be implemented any time oil has been added to the system, when a new transaxle is installed, or after a transaxle has been repaired.

Air creates inefficiency because its compression and expansion rate is higher than that of the oil normally approved for use in hydrostatic drive systems.

The resulting symptoms in hydrostatic systems may be:

1. Noisy operation.

2. Lack of power or drive after short term of operation.

3. High operation temperature and excessive expansion of "oil"; in the latter case, oil may overflow.

Before starting, make sure the transaxle is at the specified oil level; refer to page 1 - 3.

The following procedures should be performed with the vehicle drive wheels off the ground, then repeated under normal operating conditions.

1. With the bypass valve open and the engine running, slowly move the directional control (foot control) in both forward and reverse directions 5 to 6 times; as air is purged from the unit, the oil level will drop.

2. With the bypass valve in the closed position and the engine running, slowly move the directional control valve (foot control) in both forward and reverse directions 5 to 6 times. After stopping the engine, check the oil level and add oil as required.

3. It may be necessary to repeat steps 1 and 2 until all the air is completely purged from the system. When the transaxle moves forward and reverse at normal speed, purging is complete.

CAUTION – DO NOT OVERFILL. If you overfill the transaxle while the unit is “cold”, it may overflow as it reaches normal operating temperatures. The oil level should not be above the level described on page 1 - 3. This will allow the space needed for the oil to expand as it warms up.

Brake

Always set the parking brake when you stop the machine or leave it unattended. If the parking brake does not hold securely, an adjustment is required.

Checking the Brake

1. Park the machine on a level surface, disengage the power take off (PTO), set the parking brake, and turn the ignition key to “OFF” to stop the engine. Remove the ignition key.

2. Rear wheels must lock and skid when you try to push the tractor forward. Adjustment is required if the wheels turn and do not lock; refer to “Brake Adjustment” on page 3 - 9.

3. Release the brake and move the free-wheeling lever to the “PUSH” position. Wheels should rotate freely.

4. If both conditions are met, no adjustment is required.

Brake Adjustment

1. Check the brake before you adjust it; refer to “Checking the Brake” on page 3 - 9.

2. Release the parking brake.

3. To adjust the brake, remove the cotter pin and loosen the castle nut slightly (Figure 145).

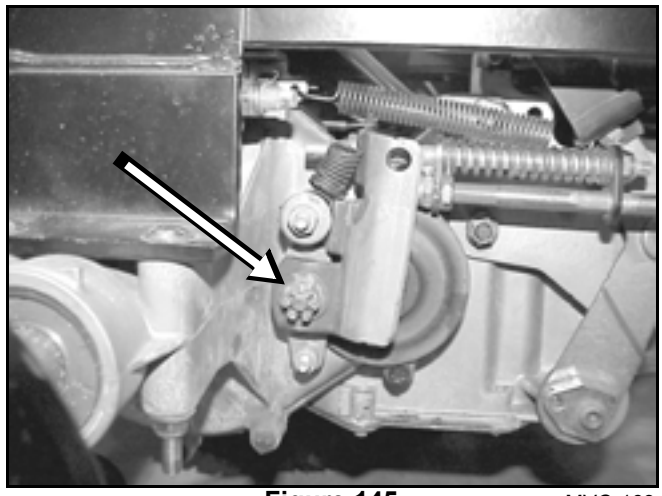

Figure 145 MVC-163

4. Carefully insert a 0.020” (.508mm) feeler gauge between the outer brake pad and rotor disc (Figure 146).

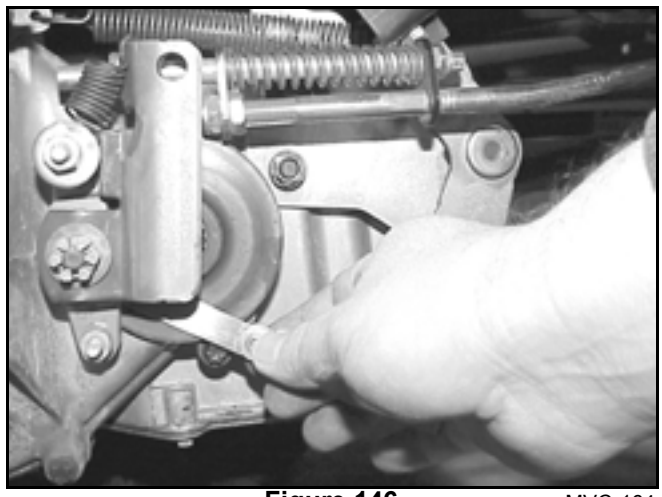

Figure 146 MVC-164

5. Tighten brake adjusting (crown) nut until slight resistance is felt on the feeler gauge when sliding it in and out. Install cotter pin.

6. Check the brake operation again.

IMPORTANT: With the parking brake released, the rear wheels must rotate freely when you push the tractor. If the 0.020” (.508mm) clearance cannot be achieved, new brake pucks may need to be installed.

Foot Control Adjustment

If there is not enough ground speed in reverse and too much in forward, check the adjustment of the foot control.

1. Measure the distance between the footrest and the back of the forward/reverse control pedal. There should be 1¼" (31.75mm) to 1-3/8" (34.925mm) gap (Figure 147).

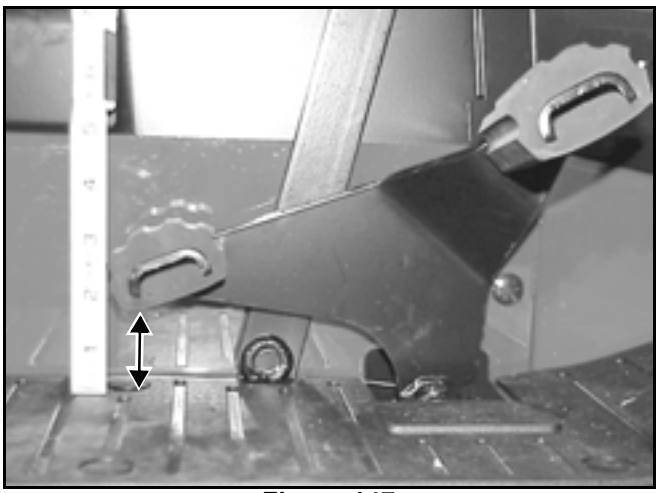

Figure 147 MVC-776F

2. If adjustment is needed, unbolt the hydro control rod where it connects to the hydro forward/reverse pedal. The location is under the tractor on the inside of the frame (Figure 148).

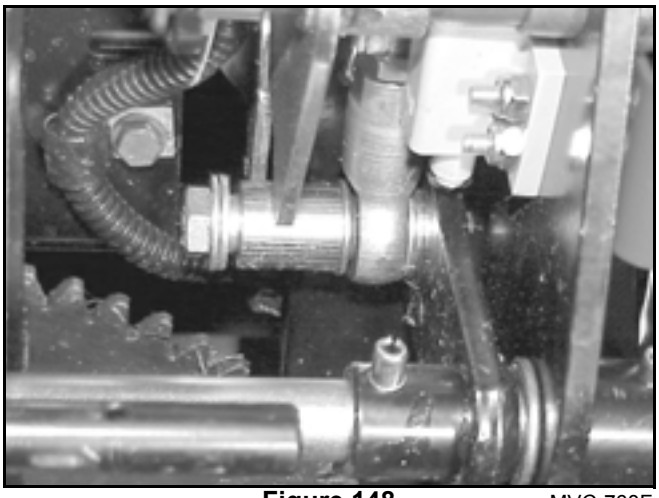

Figure 148 MVC-768F

3. Loosen the jam nut and turn the rod end until you achieve 1¼" (31.75mm) to 1-3/8" (34.925mm) gap between the footrest and the back side of the forward/reverse control pedal (Figure 149).

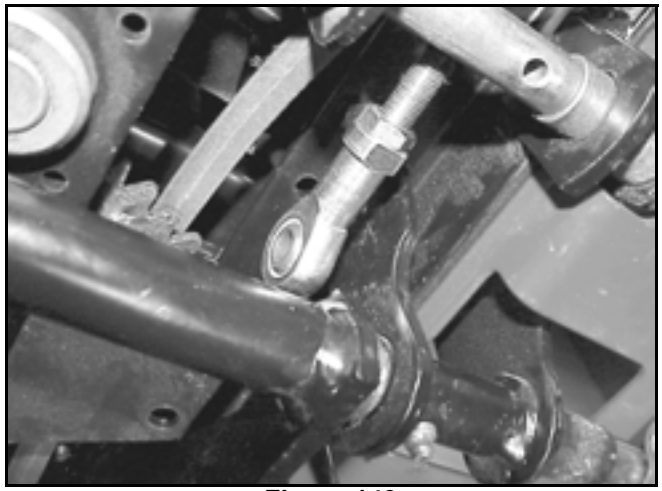

Figure 149 MVC-184X

4. Another way of adjusting the forward/reverse control rod is with the seat, fender, and gas tank removed. Located on the hydro control rod are two stop nuts and a turnbuckle. Loosen the stop nuts and turn the turnbuckle to achieve 1¼" (31.75mm) to 1 3/8" (34.92mm) gap between the footrest and the back side of the forward/reverse control pedal.

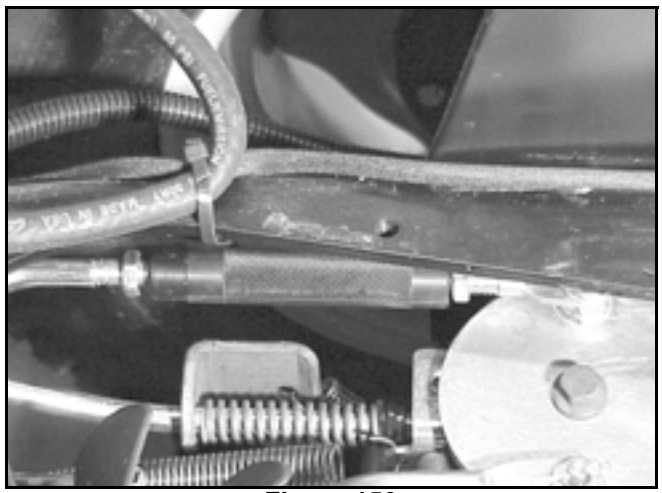

Figure 150 MVC-770F

Traction Belt Replacement

1. If the mower deck is installed, remove the mower deck. Remove the power take off (PTO) belt between the pulley box and the electric clutch.

   Note: Perform belt installation, routing, and inspection procedures from beneath the tractor.

2. Disconnect the electric PTO clutch wire clutch (Figure 151).

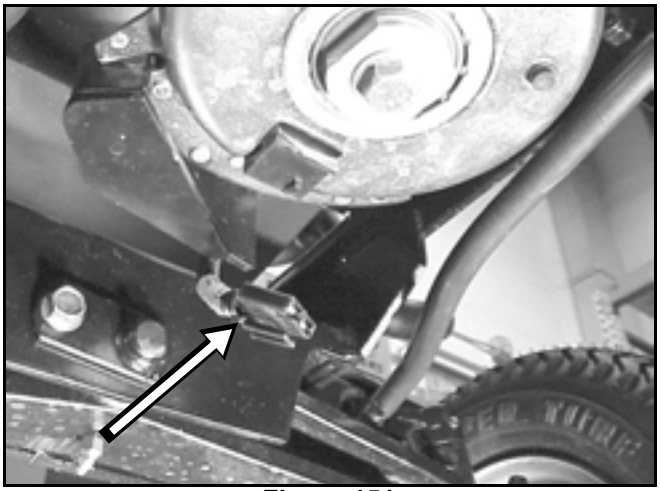

Figure 151 MVC-778

3. Remove the RH bolt that holds the PTO stop assembly. Loosen the LH bolt enough so you can turn the PTO stop assembly enough to disengage it from the slot in the electric PTO clutch housing (Figure 152).

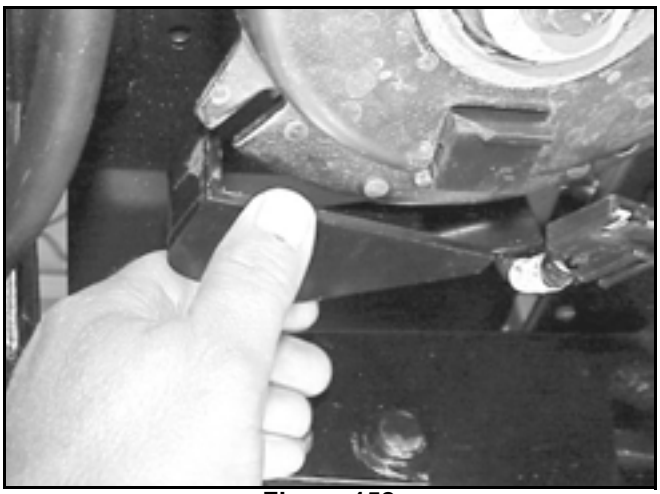

Figure 152 MVC-780F

4. Unhook the idler spring at the idler pulley located toward the rear of the tractor (Figure 153). Remove the existing belt from the tractor.

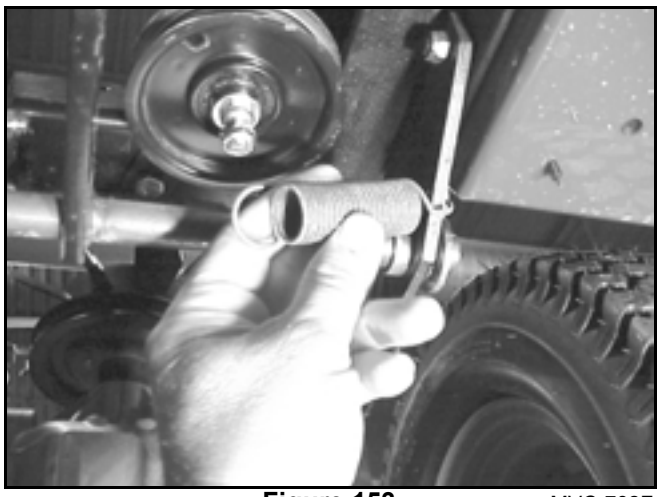

Figure 153 MVC-782F

5. Install drive belt around the transaxle pulley, leaving the belt underneath the transaxle pulley (Figure 154).

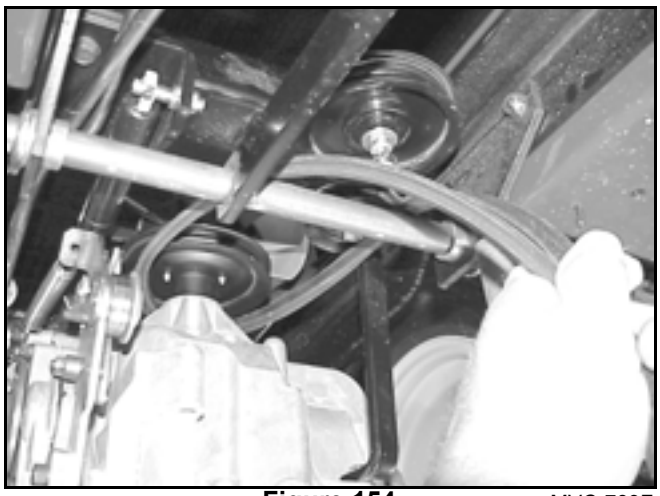

Figure 154 MVC-783F

6. Route the belt over the lift bar assembly (Figure 155).

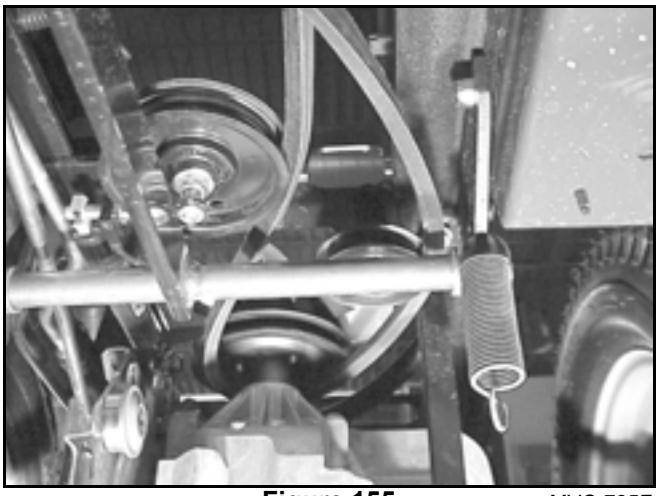

Figure 155 MVC-785F

7. The belt then goes forward over the hydro pivot shaft and steering sector (Figure 156).

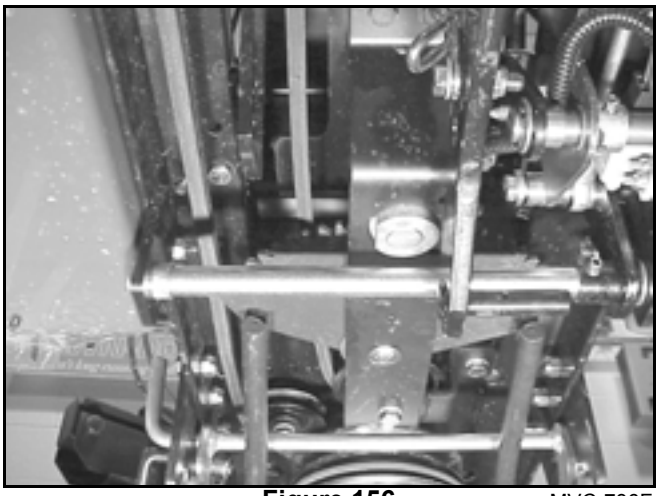

Figure 156 MVC-786F

8. Route the drive belt around the flat and v-idler pulleys and then around the engine drive pulley (Figure 157).

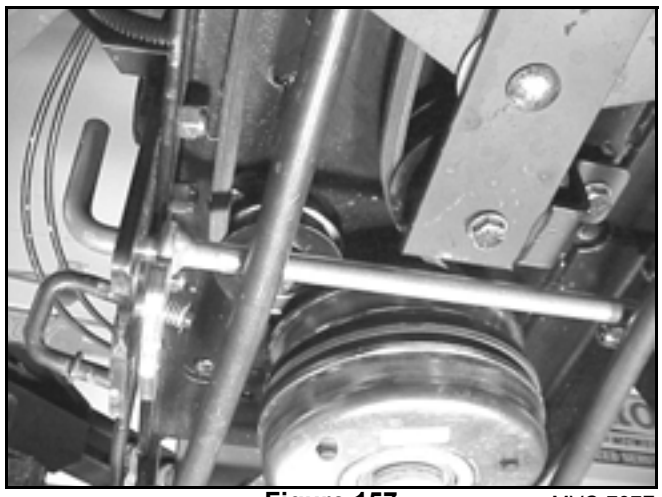

Figure 157 MVC-787F

9. Go back to the transaxle pulley and install the belt around the pulley.

10. Check the routing of the belt around both the engine and transaxle pulleys, the front flat and v-idlers and the rear flat and v-idler pulleys (Figure 158).

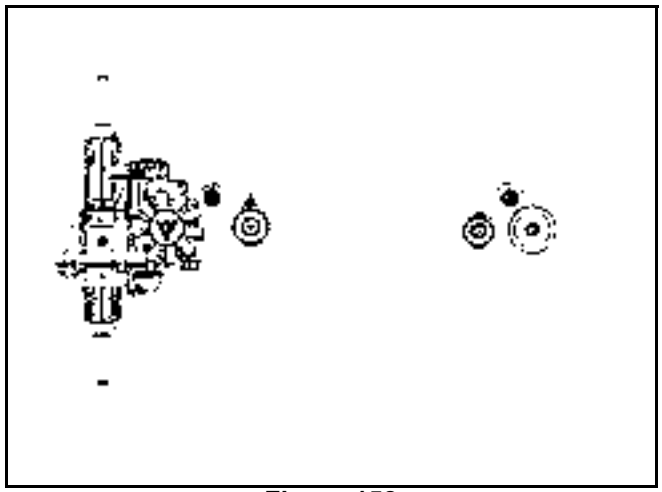

Figure 158 belt routing top

11. Install the idler spring to the idler pulley, located toward the rear of the tractor (Figure 159).

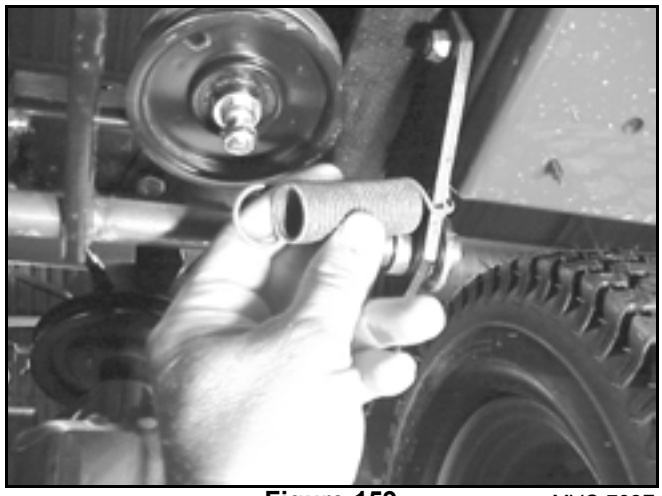

Figure 159 MVC-782F

12. Turn the electric PTO clutch housing and align the PTO stop bracket in the slot of the clutch housing. Install the RH bolt and lock washer in the PTO stop bracket and tighten. Tighten the LH bolt in the PTO stop bracket (Figure 160).

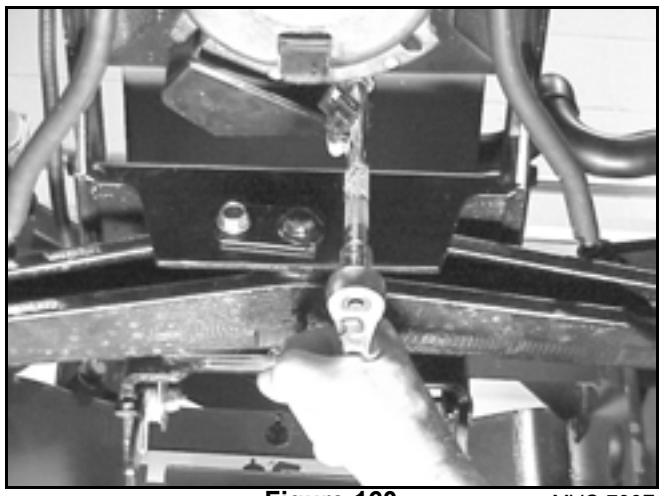

Figure 160 MVC-796F

13. Reconnect the electric PTO clutch wire (Figure 161).

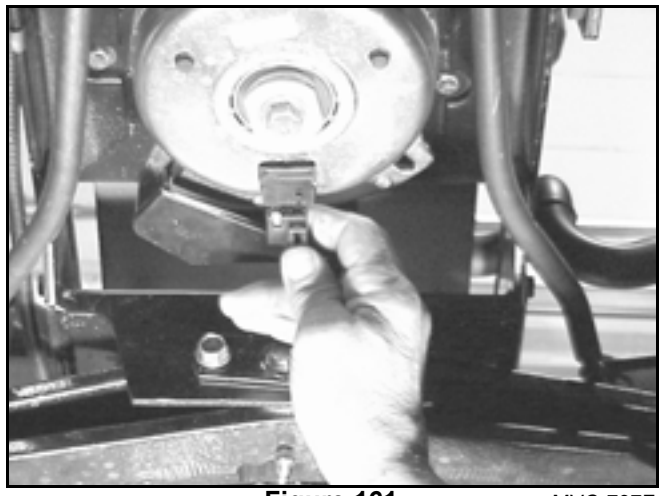

Figure 161 MVC-797F

14. Test the tractor to make sure the tractor and the safety system is operating properly.

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Electrical Systems

Two things happen when turning the ignition switch to the “START” position. (1) Current flows from the ignition switch through the PTO (Power Take Off) switch, brake switch, seat switch, and activates the interlock relay, which sends voltage to the coil of the starter solenoid. The solenoid actuates and allows voltage to the starter motor of the engine. (2) At the same time, with the ignition in the “START” position, current will flow to the kill relay, which activates and takes the electronic ignition ground wire off of ground to allow the engine to have spark.

Once you have the tractor running, you can now engage the PTO (Power Take Off) switch which will engage the electric clutch for the mower or attachments only if you are in the seat, activating the seat switch. Anytime you vacate the seat with the electric clutch activated for the mower, the seat switch will open and cut off voltage to the kill relay, which will deactivate and ground the electronic ignition and stop the engine. If you vacate the seat with the PTO switch disengaged and the park brake engaged, the engine will continue to run.

The following electrical section covers most of the electrical components used on the 400XT Series Garden Tractors. It covers each electrical component’s purpose, how it works, testing procedures and location on the tractor. To help you further to troubleshoot electrical problems, the Riding Products Electrical Demystification Guide, Form 492-4761 is available with complete wiring and circuit diagrams to help diagnose electrical problems.

Relay

Purpose

The 400XT Series Garden Tractors use relays to direct current flow to different areas of the tractor. The most complex models have three relays: cruise control relay, interlock relay, and a kill relay. Electrically, they all operate the same.

Location

The relays are located on the firewall of the tractor (Figure 218).

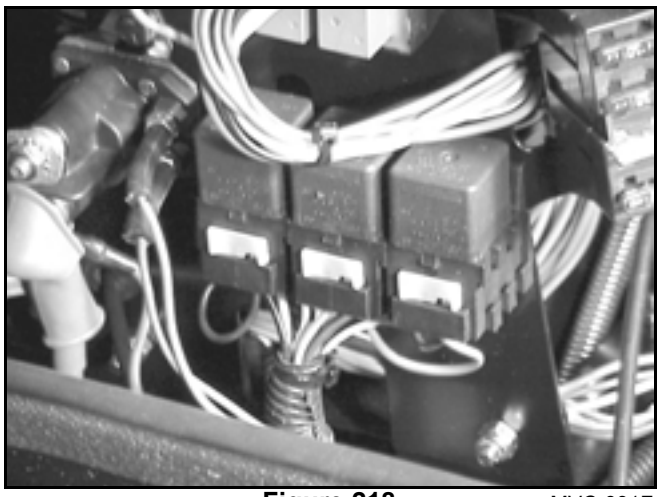

Figure 218 MVC-831F

How It Works

A relay is an electrically actuated switch.

1. Coil: Terminals 85 and 86 are connected to a coil. Applying 12 volts to these terminals energizes the coil turning it into an electromagnet.

2. Switch: Terminals 30, 87, and 87a are actually part of a single pole, double throw (SPDT) switch. Terminal 30 is the common lead. The switch is spring loaded so that 30 and 87a are connected when the coil is not energized. When the coil is energized, the switch is “thrown” and 30 and 87 are connected (Figure 219).

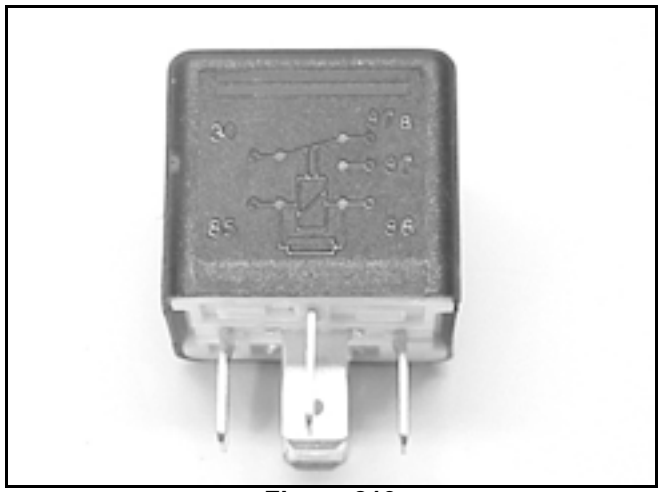

Figure 219 MVC-671X

Testing

1. Disconnect the relay from the harness.

2. Verify the coil resistance between terminals 85 and 86 with a multimeter (ohms setting). Resistance should be from 70 to 90 ohms. There should be continuity between terminals 87a and 30.

3. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as 12 VDC is applied and removed from terminal 85.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87a. Apply +12 VDC to terminal 85. With terminal 86 still grounded, the relay should break and make continuity between terminals 30 and 87a as 12 VDC is applied and removed from the terminal.

5. Disconnect voltage and multimeter leads from relay terminals.

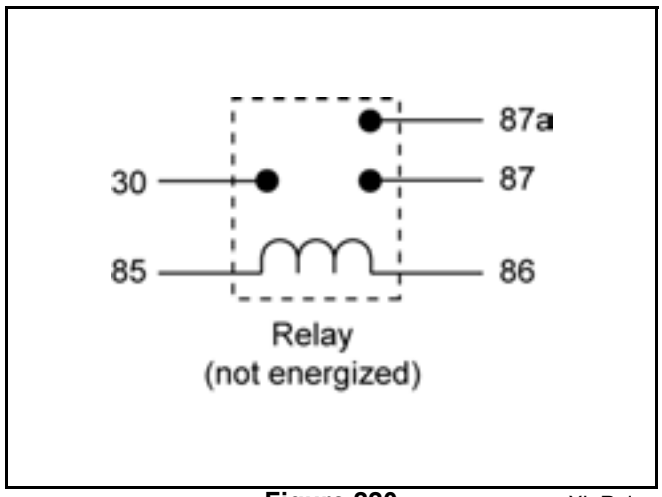

Figure 220 XL Relay

Solenoid

Purpose

The solenoid’s purpose is simply to connect the battery to the starter motor when the ignition switch is turned to “START”. The solenoid is used to protect the ignition switch from the high current drawn by the starter motor.

Location

The solenoid is located under the front hood, mounted to the firewall of the tractor (Figure 221).

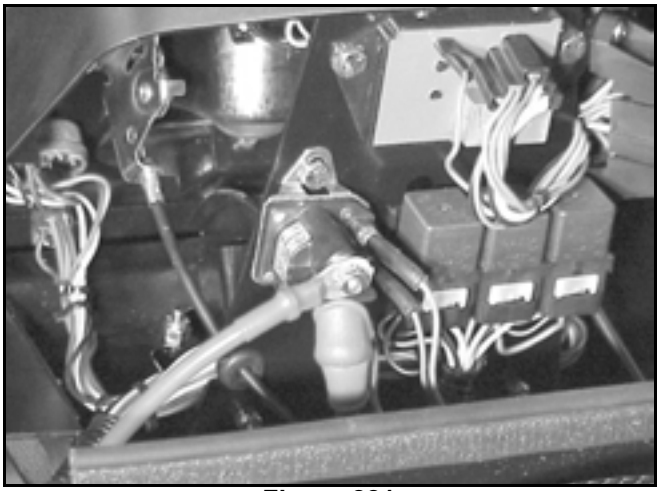

Figure 221 MVC-833F

How it Works

The solenoid has two primary parts. One is a coil of wire wrapped around an iron core. Whenever 12 volts is applied to the coil, it becomes a magnet. The other part is a bar type switch. Because it has a large contact area with the contact terminals it can easily handle the high current loads required by the starter motor.

When 12 volts is applied to the coil, it becomes an electromagnet. This quickly pulls the bar toward contacts and closes the switch. When power is removed from the coil, the spring loaded bar returns to its “normally open” position. The solenoid closes and opens the switch very quickly. This minimizes the “arcing” that can damage other types of switches.

The ignition switch is protected because only a small amount of current is needed to activate the coil.

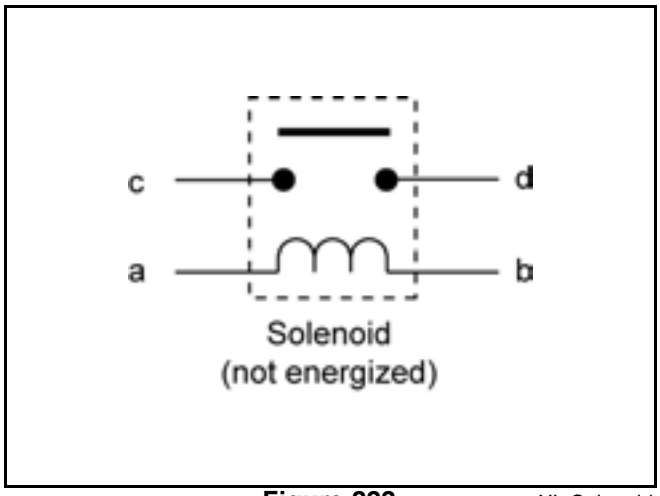

Figure 222 XL Solenoid

Testing

1. Disconnect the solenoid from the wiring harness.

2. With a multimeter (ohms setting), check to ensure that terminals “c” and “d” are open (no continuity) (Figure 222).

3. Apply +12 VDC to terminal “a” and ground terminal “b”. Terminals “c” and “d” should now be closed (continuity) (Figure 222).

4. You should be able to hear the solenoid “click” when you make the connection (Figure 223).

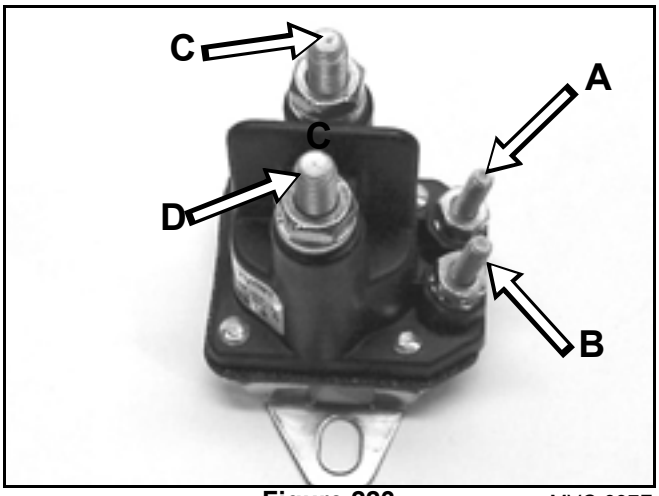

Figure 223 MVC-837F

(A) & (B) Coil Terminals	(C) & (D) Contact Terminals

Ignition Switch

Purpose

This component provides the proper switching for the starter, ignition, PTO, lights, safety, and accessory circuits if so equipped.

Location

The ignition switch is located on the lower right side of the tractor’s dash (Figure 224).

Figure 224 MVC-007

How It Works

Detents inside the switch give it four positions: OFF, LIGHTS (ACCESSORIES), RUN, and START. The START position is spring loaded so the cylinder automatically returns to RUN once the key is released.

Terminals of the ignition switch as viewed from the terminal end.

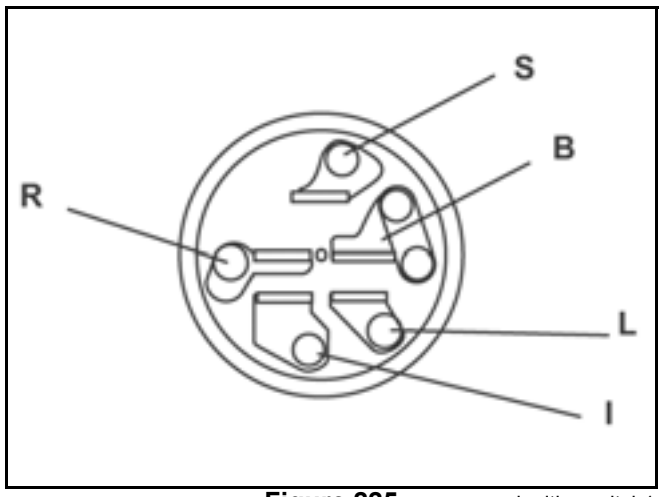

Figure 225 ignitionswitch1

B = Battery voltage “in” S = Starting Circuit I = Safety & Ignition Circuit	R = Regulator Circuit L = Light Circuit

Testing

1. Disconnect the switch from the wiring harness.

2. Verify that continuity exists between the terminals listed for the switch position. Verify that there is **NO** continuity between terminals not listed for the switch position.

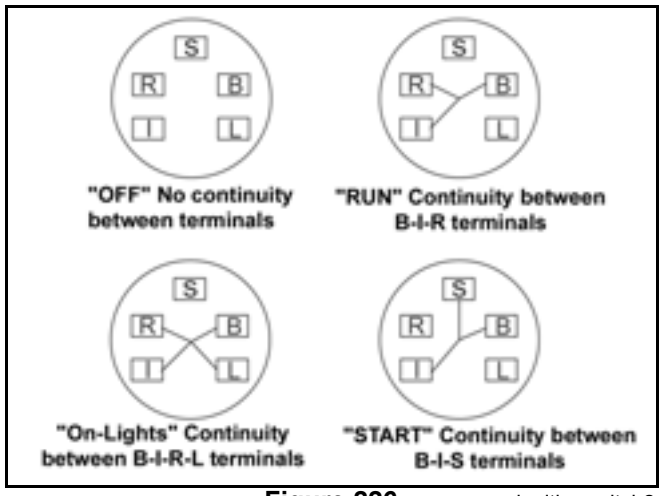

Figure 226 ignitionswitch2

Electric (PTO) Clutch

Purpose

This clutch electrically controls the engagement and disengagement of the Power Take Off (PTO) pulley.

Location

The electric clutch is located on the PTO end of the engine crankshaft (Figure 227).

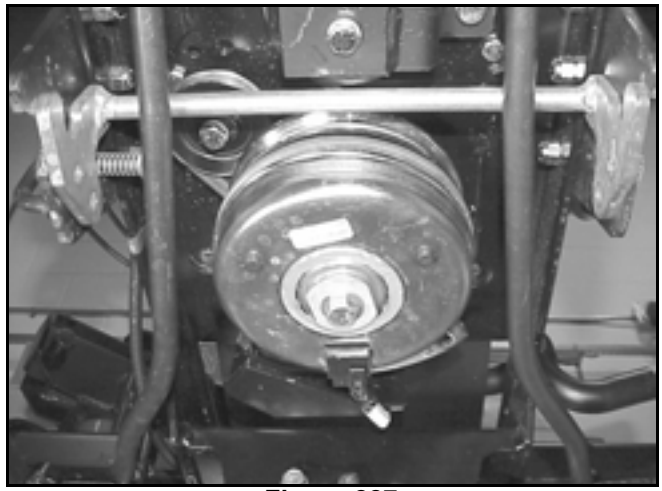

Figure 227 MVC-838F

How It Works

The PTO clutch is composed of three major components; the field, the clutch plate, and the friction plate. The clutch plate always turns with the engine. The field is a coil of wire on an iron core, which becomes an electromagnet when power is applied.

The friction plate is the only piece that can slide up and down on the crankshaft axis. It is normally spring loaded so that it is not in contact with the clutch plate and is pressed against the brake material opposite the clutch. When power is applied, the friction plate is drawn toward the clutch plate and the two rotate as one.

Testing

If the electric PTO clutch is not engaging or is suspected as a cause of electrical problems, use the troubleshooting steps. These procedures will help you determine if the clutch has failed or is the cause of the electrical problem.

Coil Resistance Measurement

1. Disengage the PTO, set the parking brake, turn the ignition key to ***OFF*** and remove the key.

2. Disconnect clutch wire connector.

3. Set the multimeter or volt/ohm meter to check resistance (ohms).

4. Connect the meter lead wires to the wires in the clutch connector (Figure 228).

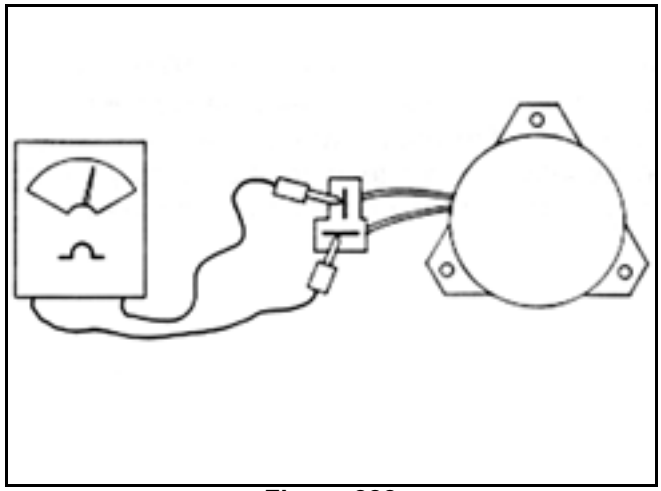

Figure 228 3-6

5. The meter should read between 2.40 ohms and 3.40 ohms. If the reading is above or below these readings, the field has failed and needs to be replaced. If the reading is between these two limits, measure the clutch current draw.

Measuring Clutch Current Draw

1. Disengage the PTO, set the parking brake, and turn the ignition to ***OFF***.

2. Disconnect the clutch wire connector.

3. Set the multimeter to check amps (10 amp scale).

4. Connect the positive meter lead to the tractor terminal (1) of the clutch wire, Figure 229.

5. Connect the negative meter lead to the corresponding wire terminal (3), Figure 229.

6. Connect a short jumper lead from terminal (2) to (4), Figure 229.

7. Turn the ignition switch to the “RUN” position and the PTO switch to the “ON” position.

8. If the meter reading is 3.5 amps or above, the system is functioning properly. If the meter reading is below 3.5 amps, check the electrical system for problems (i.e., the battery, ignition switch, PTO switch, or wiring harness may be malfunctioning).

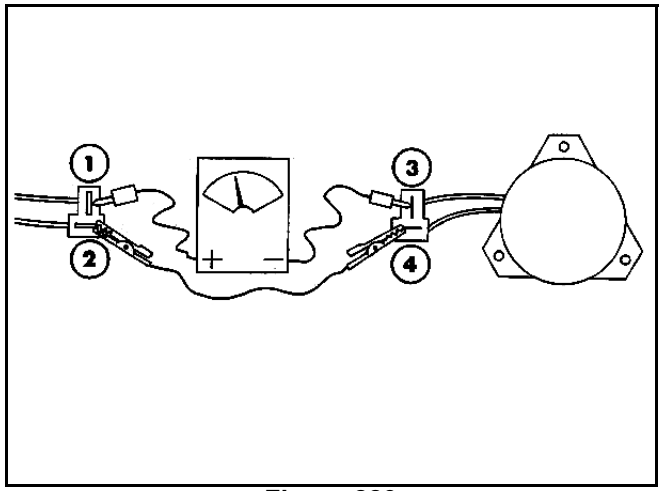

Figure 229 3-7

Clutch Burnishing Procedure

The clutch should be burnished as part of the pre-delivery service, or whenever a new clutch is installed. Burnishing polishes the clutch plate, allowing for smooth clutch engagement.

With a PTO driven attachment installed (i.e., mower, snowthrower, or tiller), run the engine at half throttle. Engage and disengage the clutch 5 times (10 seconds on/10 off).

Increase engine RPM to ¾ to full throttle. Engage and disengage clutch 5 times (10 seconds on/10 seconds off).

PTO Switch

Purpose

The PTO switch is typically used to turn on the Electric PTO Clutch and to function as part of the safety interlock system.

Location

The PTO switch is located on the lower left side of the dash (Figure 230).

Figure 230 MVC-387X

How it Works

When the PTO switch is pulled out to the “ON” position, contacts inside the switch electrically connect various terminals. One terminal is connected to the wire that goes directly to the electric clutch. When the PTO is pulled out to the “ON” position, voltage flows to the electric clutch and engages.

Testing

1. Disengage the PTO, set the parking brake, and turn the ignition to ***OFF*** and remove the key.

2. Disconnect the wiring harness from the PTO switch.

3. Press in on the locking tabs, on each side of the switch, and pull the switch out of the dash (towards the rear of the tractor).

4. Verify that there is continuity between the appropriate terminals in the “ON” and “OFF” positions, Figure 231.

5. Replace the switch if your test results do not correspond with those given in Figure 231.

6. Mount the PTO switch back into the dash and reinstall the wiring harness.

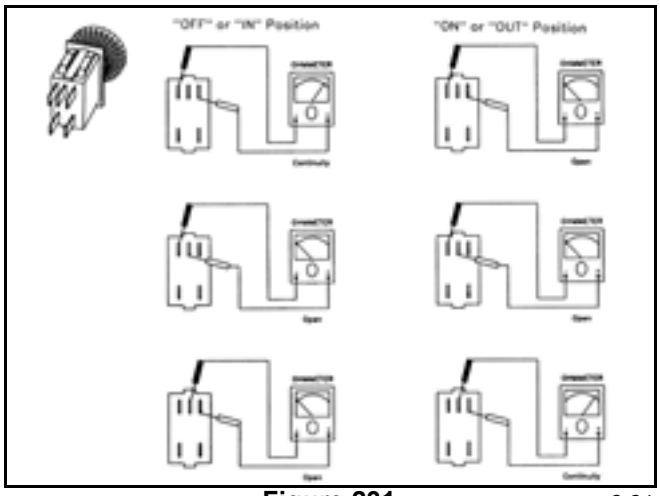

Figure 231 2-24

Seat Switch

Purpose

The switch is in the safety circuit. If the engine is running and the operator vacates the seat with either PTO engaged or the parking brake off, the engine will shut down.

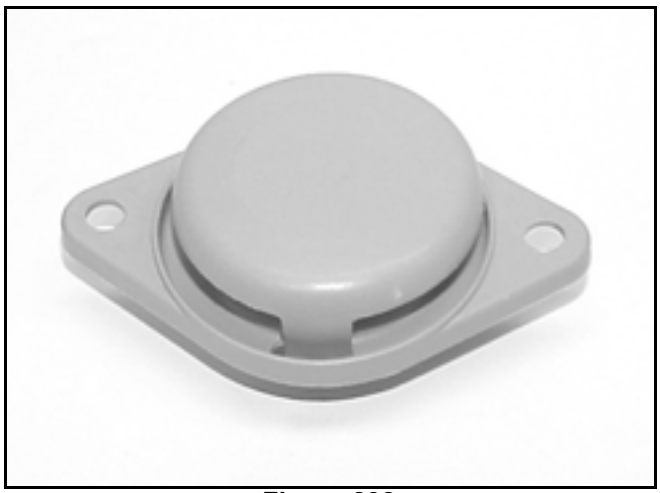

Figure 232 MVC-390X

Location

The seat switch is located on the bottom of the seat (Figure 233).

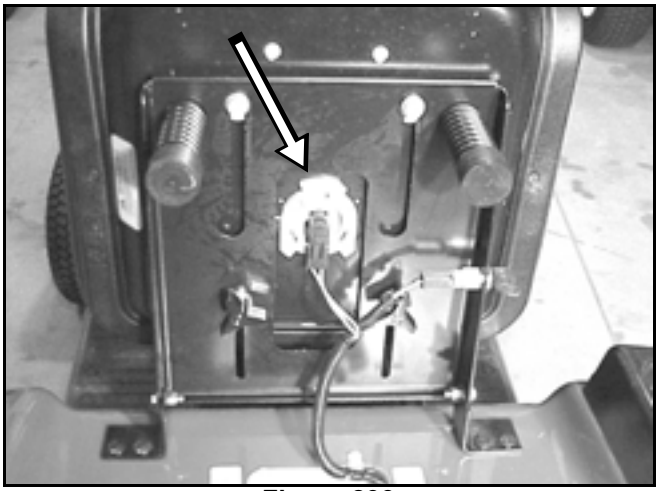

Figure 233 MVC-865F

How It works

When the seat is vacated, the switch is open and there is no continuity between the two terminals. When the seat is occupied, the switch closes and there should be continuity between the terminals.

Testing

1. Disconnect the switch from the wiring harness.
2. With a multimeter, check the continuity between the two terminals of the switch. There should be NO continuity.
3. With weight or pressure on the seat, check the continuity again on the two terminals of the switch. There should be continuity.

Hourmeter

Purpose

The hourmeter keeps track of the actual engine hours. This is accomplished by connecting the hourmeter to the engine oil pressure switch.

Location

The hourmeter is located in the top center of the dash (Figure 234).

Figure 234 MVC-864F

How It Works

Since a normal clock might be affected by variations in voltage and current, the hourmeter is made up of a combination of an electric "winder" and a mechanical clock movement. When power is applied, a coil is energized to wind the movement. The movement unwinds in about 2 seconds. As it finishes its rotation, it re-energizes the coil so that the cycle can start over.

Testing

Verify that 12 volts is present across the two terminals when the engine is running. If so, and the meter is not running, replace the meter. If 12 volts is not present, check the connections and the engine oil pressure switch. The meter is a permanently sealed unit and is not repairable.

Magnet Assembly - Cruise Control

Purpose

When engaging cruise control, the magnet assembly engages a cruise control plate that locks the control linkage to the speed that is set (Figure 235).

Location

The magnet assembly is located in the right rear of the tractor. The seat, fender, and fuel tank needs to be removed to gain access to the magnet assembly.

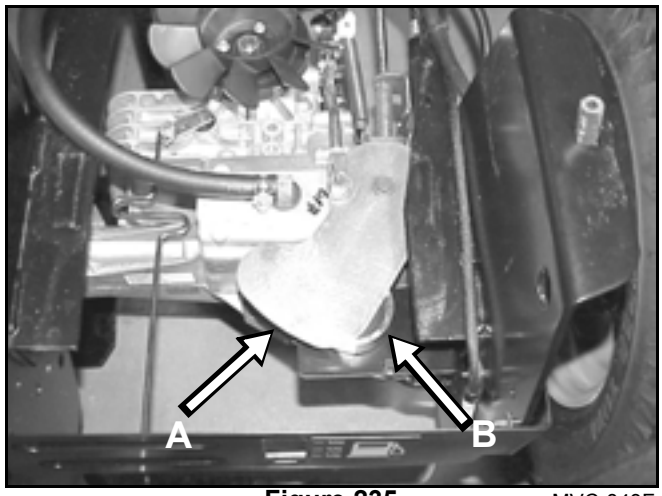

Figure 235 MVC-843F

(A) Control Plate	(B) Magnet Assembly

How It Works

When the desired forward speed is obtained, push the cruise control switch on the dash. Through a cruise control relay, 12 volts is sent to the magnet assembly and this locks the magnet to the cruise control plate and locks the traction control. This allows you to remove your foot from the traction control.

Testing

1. Unplug the wires and remove the magnet assembly from the tractor.
2. Place the magnet assembly on a metal surface and apply 12VDC positive and negative to the wire leads.
3. The magnet assembly should hold the metal surface. When voltage is removed, the magnet assembly can be removed from the metal surface.

Switch, Cruise Control

Purpose

This rocker switch is used to provide switching for the cruise control.

Location

The cruise control switch is located on the right side of the dash (Figure 236).

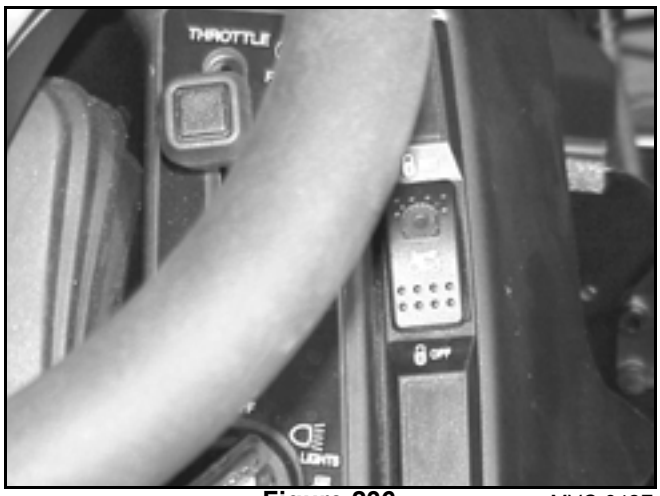

Figure 236 MVC-842F

How It Works

The switch has contacts inside which connect two terminals in one position while disconnecting then in the other. There are 3 positions to the switch; OFF, START, and RUN. The start position is spring loaded so that the switch automatically returns to the "RUN" position.

Testing

1. Disconnect the switch from the wiring harness.

2. Using a VOM or test lamp, test the continuity or the terminals using the following diagrams (Figure 237).

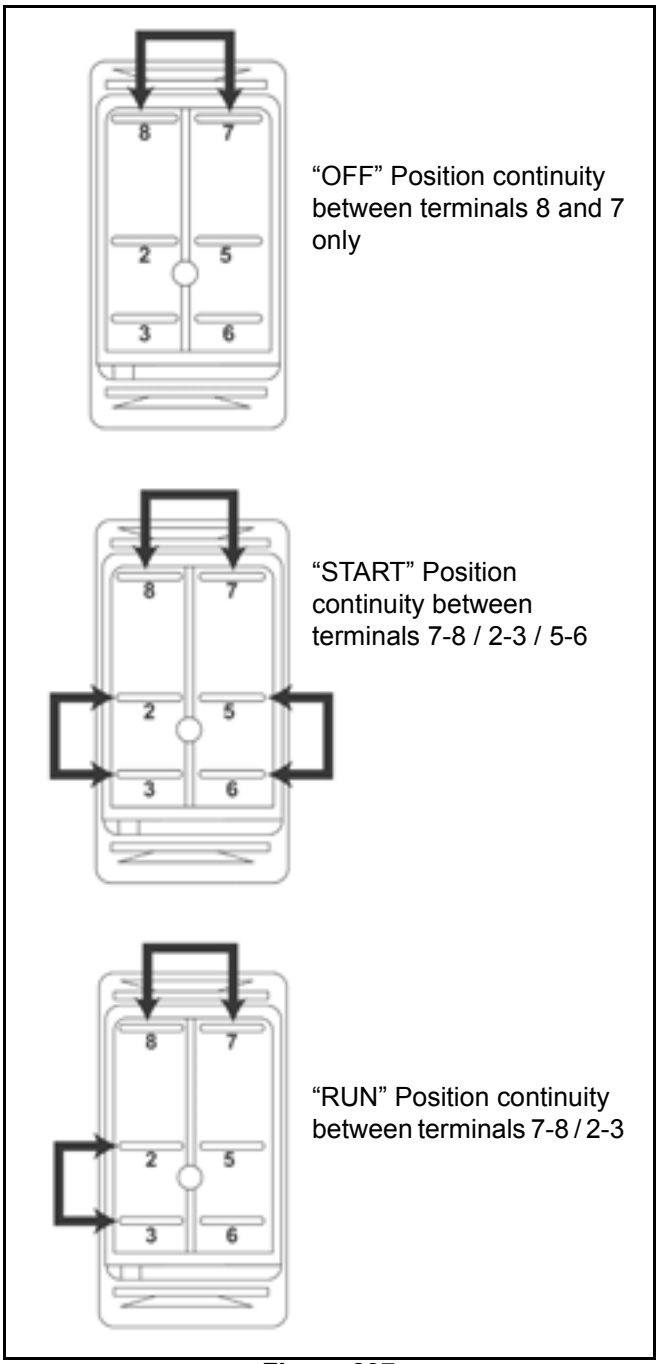

Figure 237 MVC-163art

Brake Switch

Purpose

The double pole plunger type switch has four terminals. When the brake pedal is depressed, it completes the safety circuit for start. In the "START" position, brake pedal depressed, current flows to the fuel solenoid on the engine and to the kill relay. On tractors with cruise control, the cruise control circuit is connected to the brake switch. When the brake pedal is depressed, the switch opens and the cruise control magnet disengages.

Location

The brake switch is located under the center access plate, next to the park brake linkage (Figure 238).

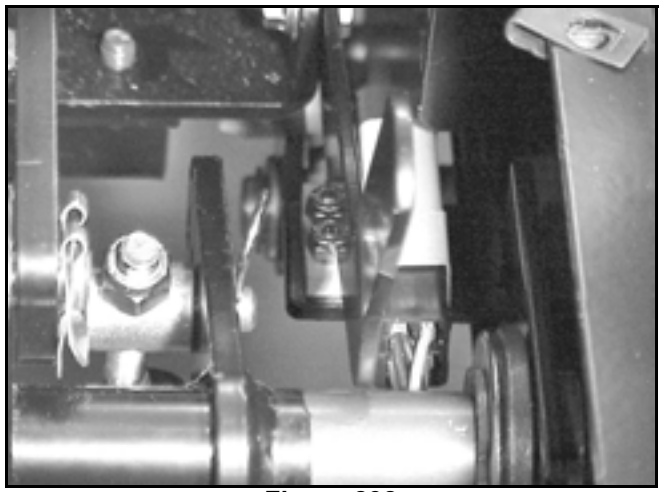

Figure 238 MVC-839F

How it Works

This double pole plunger switch has four terminals. When the brake pedal is depressed, it pushes on the plunger, closing and opening the contacts in the switch.

Testing

1. Disconnect the switch from the wiring harness.

2. Using a multimeter, follow the procedures listed below (Figure 239):

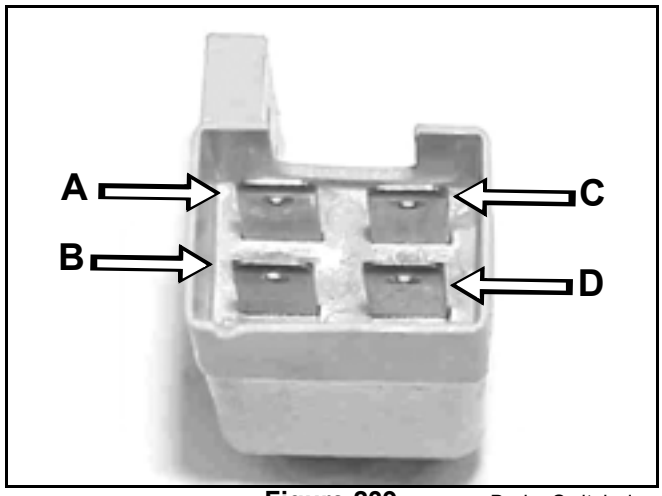

Figure 239 Brake Switch.doc

Plunger Not Depressed	Plunger Depressed
A/B Terminals - Closed Circuit - Continuity	A/B Terminals - Open Circuit - No Continuity
C/D Terminals - Open Circuit - No Continuity	C/D Terminals - Closed Circuit - Continuity

KeyChoice™ Reverse Operating System

This interlock feature is provided to prevent unintentional engine-powered attachment operation in reverse. If the tractor is shifted into reverse while the mower blade or other attachment is engaged, the electric clutch will stop. **DO NOT MOW WHILE BACKING UP UNLESS ABSOLUTELY NECESSARY.** If you need to mow while in reverse or use other PTO drive attachments (such as a snowthrower), this interlock feature may be temporarily deactivated.

Before deactivating this feature, be sure there are no children present on or near property where you are using the tractor and that are likely to appear while you are mowing or operating an attachment. Be extra observant after you have chosen to deactivate the interlock feature because the sound of the tractor's engine might prevent you from being aware that a child or bystander has entered the area where you are operating the tractor.

Once you are sure you can safely mow in reverse or operate an attachment, deactivate the reverse operating system by turning the KeyChoice™ switch, located on the right side of the seat, after engaging the PTO electric clutch. A red light will illuminate on the dash as a reminder that the reverse operating system interlock has been deactivated. Once the interlock is deactivated, it stays in this mode **WITH YOUR MOWER BLADE OR ATTACHMENT OPERATING WHENEVER YOU BACK-UP**, and the dash light stays on until either the electric PTO clutch is disengaged, or the engine is turned off.

Testing the Key Choice™ Reverse Operating System - Unactivated

1. With the parking brake released, seat occupied, turn the ignition key to “RUN” without starting the engine.

2. Pull the PTO electric clutch switch “ON”.

3. You should hear an audible click, indicating the PTO is activated and the PTO light will come on.

4. Move the forward/reverse pedal to reverse.

5. You should hear an audible click indicating the PTO is deactivated and PTO light, on the dash, should turn off.

Testing the KeyChoice™ Reverse Operating System - Activated

1. With the parking brake released, seat occupied, turn the ignition switch to “RUN” without starting the engine.

2. Pull the PTO electric clutch switch to “ON” (Figure 240).

Figure 240 MVC-387X

3. Turn the “Key Choice” key and release (Figure 241).

Figure 241 MVC-866F

4. The “Key Choice” warning light on the dash should come on (Figure 242).

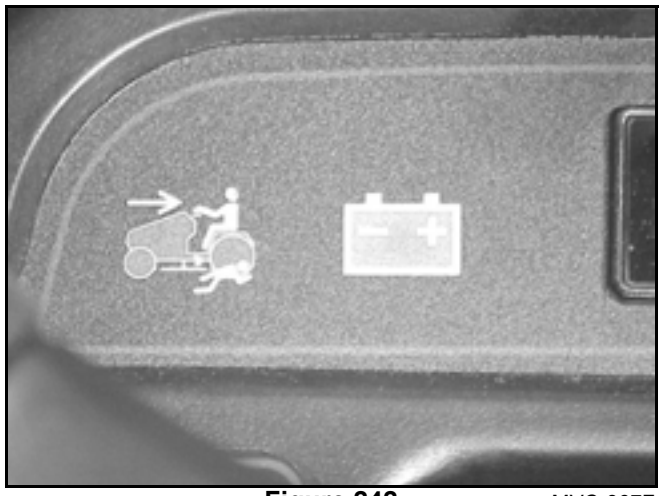

Figure 242 MVC-867F

5. Move the foot pedal to reverse.

6. The PTO and PTO light on the dash should remain “ON”.

7. Push the PTO switch to “OFF”.

8. The PTO light and the “Key Choice” warning light should turn off.

KeyChoice™ Reverse Operating System Switch

Purpose

This switch is used in the KeyChoice™ Reverse Operating System circuit. When turned to the ON position, it allows the operator to mow in reverse.

Location

The switch is located on the right side, below the operator's seat (Figure 243).

Figure 243 MVC-866F

How It Works

The switch is basically an on/off switch spring loaded to return to off position. When turned to the ON position with the PTO engaged, it activates circuits in the KeyChoice™ Reverse Operating System reverse module and allows the operator to mow in reverse (Figure 244).

Figure 244 MBC-422X

Testing

1. Disconnect the switch from the circuit.
2. With a mulitmeter, check the continuity across the two terminals. There should be NO continuity.
3. Turn the key to the "ON" position and hold, since the switch is spring loaded. There should be continuity across the two terminals.

Reverse Switch

Purpose

This switch works in the KeyChoice™ Reverse Operating System circuit when the mower (PTO) is engaged.

Location

The switch is located under the tractor frame, next to the hydro pivot shaft and the hydro linkage (Figure 245).

Figure 245 MVC-841F

How It Works

This single pole plunger type switch has two terminals. When the unit is shifted in reverse while the mower (PTO) electric clutch is engaged, the reverse switch opens and will stop the electric (PTO) clutch, unless the KeyChoice™ switch has been operated.

Testing

1. Disconnect the switch from the wiring circuit.

2. With a multimeter, check the continuity across the terminals. There should be continuity.

3. Depress the plunger on the switch and check the continuity across the terminals, there should be NO continuity (Figure 246).

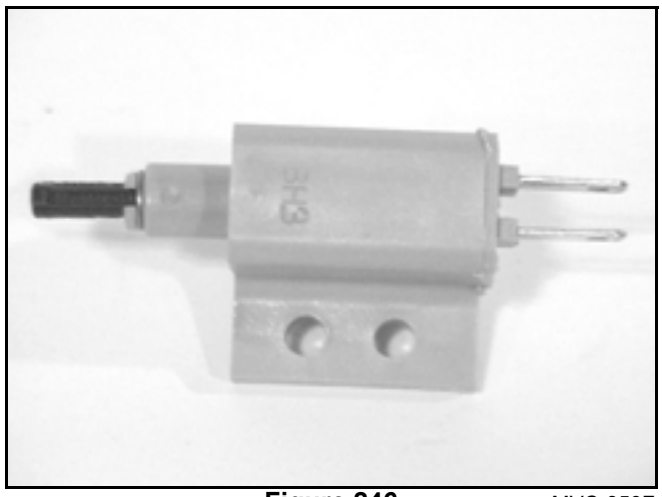

Figure 246 MVC-859F

Module Low Voltage/KeyChoice™ Reverse Operating System

Purpose

This module performs two functions. The functions are low voltage detection and KeyChoice™ Reverse Operating System control.

Low Voltage - The illumination of the battery light on the dash indicates the battery voltage is too low. This is controlled by the low voltage module.

KeyChoice ™ Reverse Operating System - The KeyChoice™ Reverse Operating System Module works with the KeyChoice™ switch, PTO switch, and the reverse switch. If the override switch (KeyChoice™ switch) is not activated and the PTO is engaged, it will stop the electric PTO clutch.

Location

The Low Voltage/KeyChoice™ Reverse Operating module is locate on the front side of the dash support, under the hood (Figure 247).

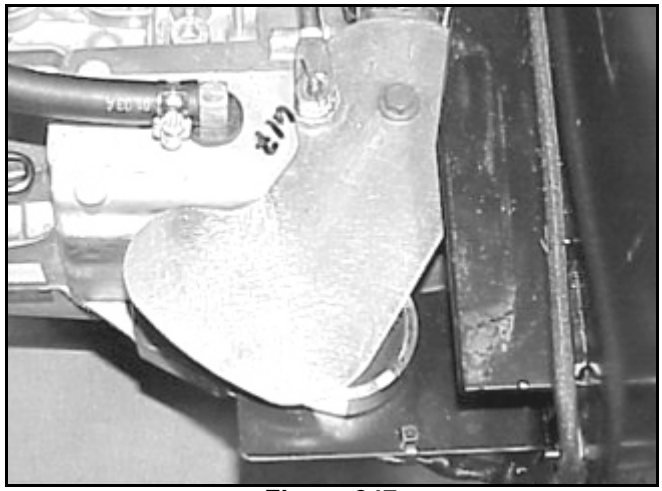

Figure 247 MVC-843F

How It Works

Low Voltage - The low voltage portion of the module is a voltage comparator, checking the charge voltage from the engine regulator/rectifier system. If the charge is less than 11 volts D.C., the low voltage module senses this and activates the indicator lamp on the dash which will light until the voltage is over 11 volts D.C.

KeyChoice™ Reverse Operating Module - The KeyChoice ™ Reverse Operating System Module is made up of several components, such as diodes and relays. When it is connected in the circuit, voltage is applied to certain terminals of the KeyChoice™ Reverse Operating System module from the PTO switch, reverse switch, and the override switch, which energizes certain relays in the module. If voltage is not applied to proper terminals on the KeyChoice™ Reverse Operating System Module, the electric PTO clutch will stop.

Testing - Low Voltage Testing

Before replacing the Low Voltage/KeyChoice™ Reverse Operating Module, Check the following:

1. Test the battery to make sure it is fully charged and is in good shape.

2. Next, check the charging system of the engine; follow the procedure in the appropriate engine service manual.

3. If the battery checks out and is in good condition and the charging system checks out and is charging properly and the battery light on the dash is on, replace the module. Without specialized test equipment, it is not practical to test the module in the field.

KeyChoice™ Reverse Operating System Module

Purpose

The KeyChoice™ Reverse Operating System Module must be removed from the wiring harness. Using a multimeter, check the following (Figure 248).

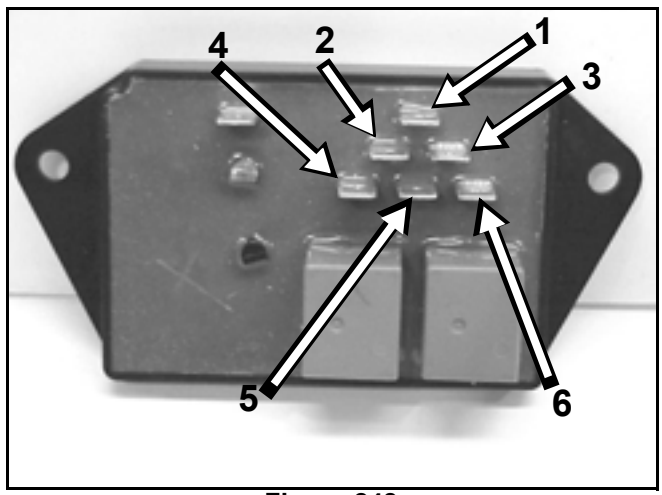

Figure 248 MVC-869F

Testing - No Power To Circuit (With Module Out of Circuit)

Meter Scale	Meter Probe Negative	Meter Probe Positive	Meter Reading
Ohms	Pin 3	Pin 5	Open (More than 100K ohms)
Diode*	Pin 3	Pin 6	.5 to 1 Volt
Diode*	Pin 3	Pin 1	.5 to 1 Volt
Diode*	Pin 3	Pin 4	.5 to 1 Volt
Ohms	Pin 1	Pin 4	350 to 400 ohms
Ohms	Pin 2	Pin 4	Open (more the 100K ohms)

***Note:** If the multimeter does not have a diode test feature, this test can not be performed. This is not a problem if powered tests are done. Powered tests must be performed to test relays (see table below).

Testing - Powered Circuit (With Module Out of Circuit)

	Volt Meter		Battery		
Meter Scale	**Neg Probe**	**Pos Probe**	**Neg Lead**	**Pos Lead**	**Meter Reading**
Ohms	Pin 3	Pin 5	Pin 3	Pin 6	< 10 Ohms
Volts (Caution)	Pin 1	Pin 2	Pin 1	Pin 4	12 Volts***
Volts (Caution)	Pin 3	Pin 2	Pin 3	Pin 4	12 Volts***

*** Same as battery voltage

Note: A 12 volt battery is needed for this test. **USE CAUTION WHEN MEASURING RESISTANCE WITH A POWERED CIRCUIT. CONTACTING A VOLTAGE SOURCE WITH A METER IN OHMS POSITION CAN SERIOUSLY DAMAGE THE METER.**

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400XT Series Tractor Service Manual

Form No. 492-4779