TORO®

Residential Products

2014
TITAN® ZX/MX
Service Manual

ABOUT THIS MANUAL

This service manual was written expressly for authorized Toro dealer 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 service information on drive systems, please refer to the Hydro-Gear ZT-2800/ZT-3100/ZT-3400 service manual (BLN 52441). For information specific to the engines used on this unit, refer to the appropriate engine manufacturer's service and repair instructions.

TITAN® model year 2014 is covered in this manual. The manual may also be specified for use on later model products.

The hydrostatic transaxle is a sophisticated component. 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.

If you have any questions or comments regarding this manual, please contact us at the following address:

The Toro Company
Residential and Landscape Contractor Service Training Department
8111 Lyndale Avenue South
Bloomington, MN 55420

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

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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 TITAN® zero turn mowers.

The TITAN operator's manuals contain safety information and operating tips for safe operating practices. Operator's manuals are available online 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.

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Torque Specifications

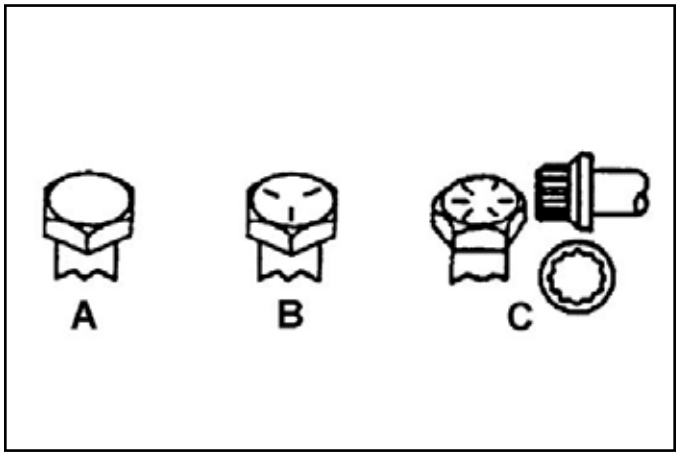
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in the service manual.

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 (e.g. 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.

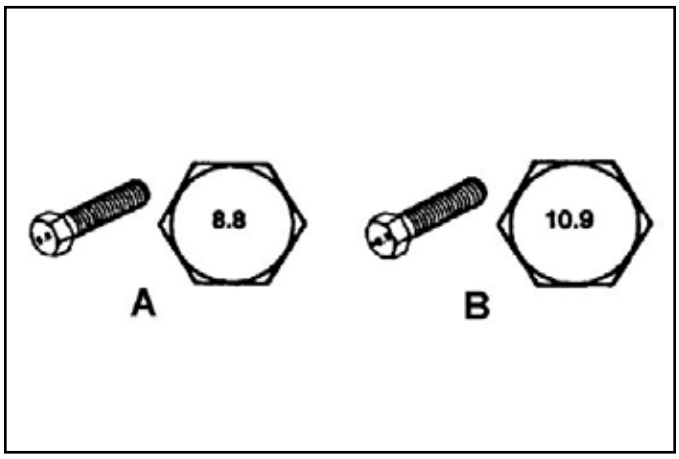
As noted in the following tables, torque values should be reduced by 25% for lubricated fasteners to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the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



Inch Series bolts and Screws	
(A) Grade 1 & 2 (B) Grade 5	(C) Grade 8



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

SPECIFICATIONS

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	169 ± 23	23 ± 2	260 ± 34
# 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 ± 15	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.

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	644 ± 68 N-cm	78 ± 8 in-lb	881 ± 90 N-cm
M6 X 1.0	96 ± 10 in-lb	1085 ± 113 N-cm	133 ± 14 in-lb	1503 ± 158 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	28 ± 3 ft-lb	38 ± 4 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	54 ± 6 ft-lb	73 ± 8 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	93 ± 10 ft-lb	126 ± 14 N-m
M16 X 2.0	166 ± 15 ft-lb	225 ± 23 N-m	229 ± 23 ft-lb	310 ± 31 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 36 ft-lb	610 ± 62 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.

SPECIFICATIONS

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 nonlubricated fasteners.

Conversion Factors

in-lb X 11.2985 = N-cm

ft-lb X 1.3558 = N-m

Conversion Factors

N-cm X - 0.08851 = in-lb

N-cm X 0.73776 = ft-lb

Equivalents & Conversions

Decimal & 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. = 0.0254mm		

SPECIFICATIONS

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 Flows	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32° 2. Multiply by 5/9

TITAN ZX Specifications

Configurations	ZX4800	ZX5400	ZX6000
21.5 HP Kawasaki V-Twin	48” SD, 3-blades		
23 HP Kawasaki V-Twin		54” SD, 3-blades	
24 HP Kawasaki V-Twin			60” SD, 3-blades

Power Systems

Clutch	Electric	Electric	Electric
Transaxles	Twin Hydro-Gear ZT-3100 w/charge pumps	Twin Hydro-Gear ZT-3100 w/charge pumps	Twin Hydro-Gear ZT-3100 w/charge pumps
Drive	Belt Drive with self-tensioning system	Belt Drive with self-tensioning system	Belt Drive with self-tensioning system
Maximum Ground Speed	8.5 mph/4.0 mph	8.5 mph/4.0 mph	8.5 mph/4.0 mph
Rear Drive Tires	22” x 10”-10	22” x 10”-10	22” x 10”-10
Front Caster Tires	13 x 5 smooth	13 x 5 smooth	13 x 5 smooth
Fuel/Capacity	5 gallons (18.9 L)	5 gallons (18.9 L)	5 gallons (18.9L)

Mowing Deck

Type	Side Discharge	Side Discharge	Side Discharge
Deck Construction	10 gauge fabricated steel	10 gauge fabricated steel	10 gauge fabricated steel
Spindle Housings	Die cast aluminum	Die cast aluminum	Die cast aluminum
Spindle Shaft/Bearings	Three 25mm diameter spindles in permanently lubed ball bearings	Three 25mm diameter spindles in permanently lubed ball bearings	Three 25mm diameter spindles in permanently lubed ball bearings
Blade Tip Speed	18,800 ft/min @ 3700 RPM	18,644 ft/min @ 3700 RPM	18,908 ft/min @ 3700 RPM
Cutting Height	1.5” to 4.5” 13 positions	1.5” to 4.5” 13 positions	1.5” to 4.5” 13 positions
Anti-Scalp Rollers	3 Adjustable	3 Adjustable	3 Adjustable
Frame Construction	1.5” X 3” (.109” wall) Mechanical Steel Tubing	1.5” X 3” (.109” wall) Mechanical Steel Tubing	1.5” X 3” (.109” wall) Mechanical Steel Tubing

Dimensions

Weight	735 lbs. (estimated)	750 lbs. (estimated)	773 lbs. (estimated)
Width Outside Tires	44.3” (117.6cm)	46.4” (117.9cm)	46.4” (117.9cm)
Overall Width	61.5” Deflector Down 52.4” Deflector Up	67.9” Deflector Down 57.7” Deflector Up	75.0” Deflector Down 63.0” Deflector Up
Wheel Base	49.4” (125.5cm)	49.4” (125.5cm)	49.4” (125.5cm)
Overall Length	77.3” (196.3cm)	77.3” (196.3cm)	77.3” (196.3cm)
Height	72.4” ROPS Up 45.6” ROPS Down	72.4” ROPS Up 45.6” ROPS Down	72.4” ROPS Up 45.6” ROPS Down

SPECIFICATIONS

TITAN MX Specifications

Configurations	MX5400	MX6000
23 HP Kawasaki V-Twin	54” SD, 3-Blades	
24 HP Kawasaki V-Twin		60” SD, 3-Blades

Power Systems

Clutch	Electric	Electric
Transaxles	Twin Hydro-Gear ZT-3100 with Charge Pump, Shock Valves and Heavy Duty Gears	Twin Hydro-Gear ZT-3100 with Charge Pump, Shock Valves and Heavy Duty Gears
Drive	Belt Drive self-tensioning system	Belt Drive self-tensioning system
Maximum Ground Speed	8.5 mph/4.0 mph	8.5 mph/4.0 mph
Rear Drive Tires	22” x 10”-12	22” x 10”-12
Front Caster Tires	13” x 6” Smooth	13” x 6” Smooth
Fuel / Capacity	5 gallons (18.9L)	5 gallons (18.9L)

Mower Decks

Type	Side Discharge	Side Discharge
Deck Construction Material	10 gauge fabricated steel	10 gauge fabricated steel
Spindle Housing	Die cast aluminum	Die cast aluminum
Spindle Shaft/Bearings	Three 25mm diameter spindles in permanently lubed ball bearings	Three 25mm diameter spindles in permanently lubed ball bearings
Blade Tip Speed	18,644 ft/min @ 3700 RPM	18,908 ft/min @ 3700 RPM
Cutting Height	1.5” to 4.5” 13 Positions	1.5” to 4.5” 13 Positions
Anti-Scalp Rollers	3 Adjustable	3 Adjustable
Frame Construction	1.5” X 3” (.109” wall) Mechanical Steel Tubing	1.5” X 3” (.109” wall) Mechanical Steel Tubing

Dimensions

Weight	813 lbs. (estimated)	
Width Outside Tires	47.2” (119.9cm)	47.2” (119.9cm)
Width Outside Deck	67.9” Deflector Down 57.7” Deflector Up	75.0” Deflector Down 63.0” Deflector Up
Wheel Base	49.2” (125.0cm)	49.2” (125.0cm)
Overall Length	77.4” (196.6cm)	77.4” (196.6cm)
Overall Height	73.4” ROPS Up 46.9” ROPS Down	73.4” ROPS Up 46.9” ROPS Down

Engine RPM Information

Model #	Model	Engine Information
74846	ZX 4800 (INTL)	Kawasaki, 21.5hp, High Idle: 3000 ± 100 RPM
74848	ZX 5400 (INTL)	Kawasaki, 23hp, High Idle: 3000 ± 100 RPM
74851	ZX 4800	Kawasaki, 21.5hp, High Idle: 3600 ± 100 RPM
74852	ZX5400	Kawasaki, 23hp, High Idle: 3600 ± 100 RPM
74853	ZX 6000	Kawasaki, 24hp, High Idle: 3600 ± 100 RPM
74855	ZX 4800	Kawasaki, 21.5hp, High Idle: 3600 ± 100 RPM
74882	MX 5400	Kawasaki, 23hp, High Idle: 3600 ± 100 RPM
74883	MX 6000	Kawasaki, 24hp, High Idle: 3600 ± 100 RPM

Hydro-Gear ZT-3100 Hydrostatic Transaxles

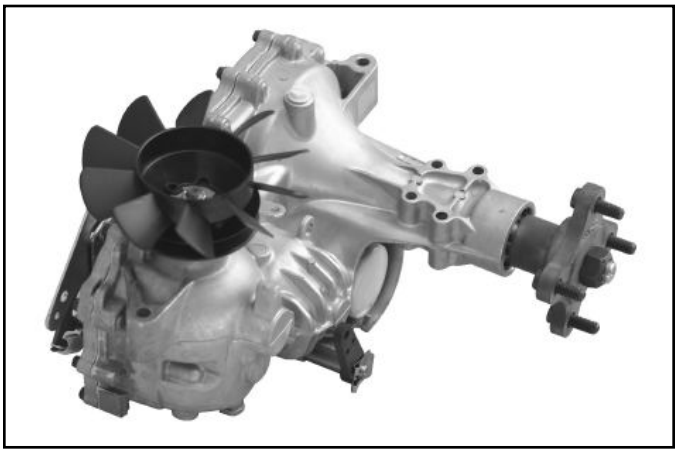


Fig. 001 PICT-1002

Lubrication	Toro HYPR-OIL® 500 or 20w50 Engine Oil
Oil Capacity ZT-3100	77.23 fl. oz. (2284ml) each (not including reservoir or hose volume)
Oil Level Check	Check expansion reservoir and if necessary add the specified oil to the **FULL COLD** line. See illustration below. Also see the Hydro-Gear ZT-2800 / ZT-3100 service manual (BLN-52441).
Fluid Change Interval	After the First 50 hours - change the oil and filters for the hydraulic system and bleed the system. Every 400 Hours - change the oil and filters for the hydraulic system and bleed the system.

Checking the Hydraulic Oil Level

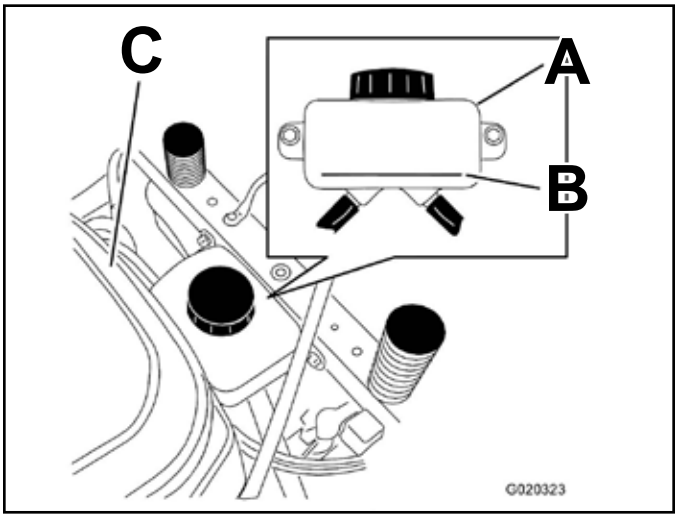


Fig. 002 fig. 51 G020323

A. Expansion reservoir
B. Full cold line
C. Engine

Model and Serial Number Identification

The model and serial number identification plate is located on the frame, near the engine, on the RH side of the unit (Fig. 003).

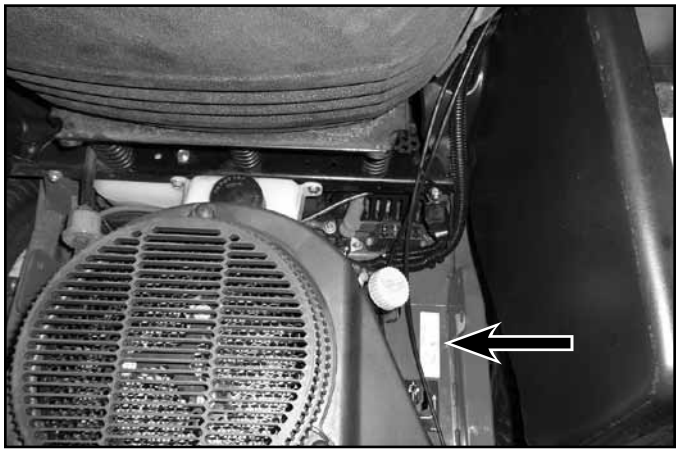


Fig. 003 PICT-2057

Grease and Lubrication Point

Grease Type – No. 2 general-purpose lithium base grease

A grease fitting is located on each of the front wheel hubs.

The front wheel hubs should be greased every 25 hrs. (Fig. 004).

Fig. 004 PICT-3006

Frame and Chassis Exploded View

(Fig. 005)

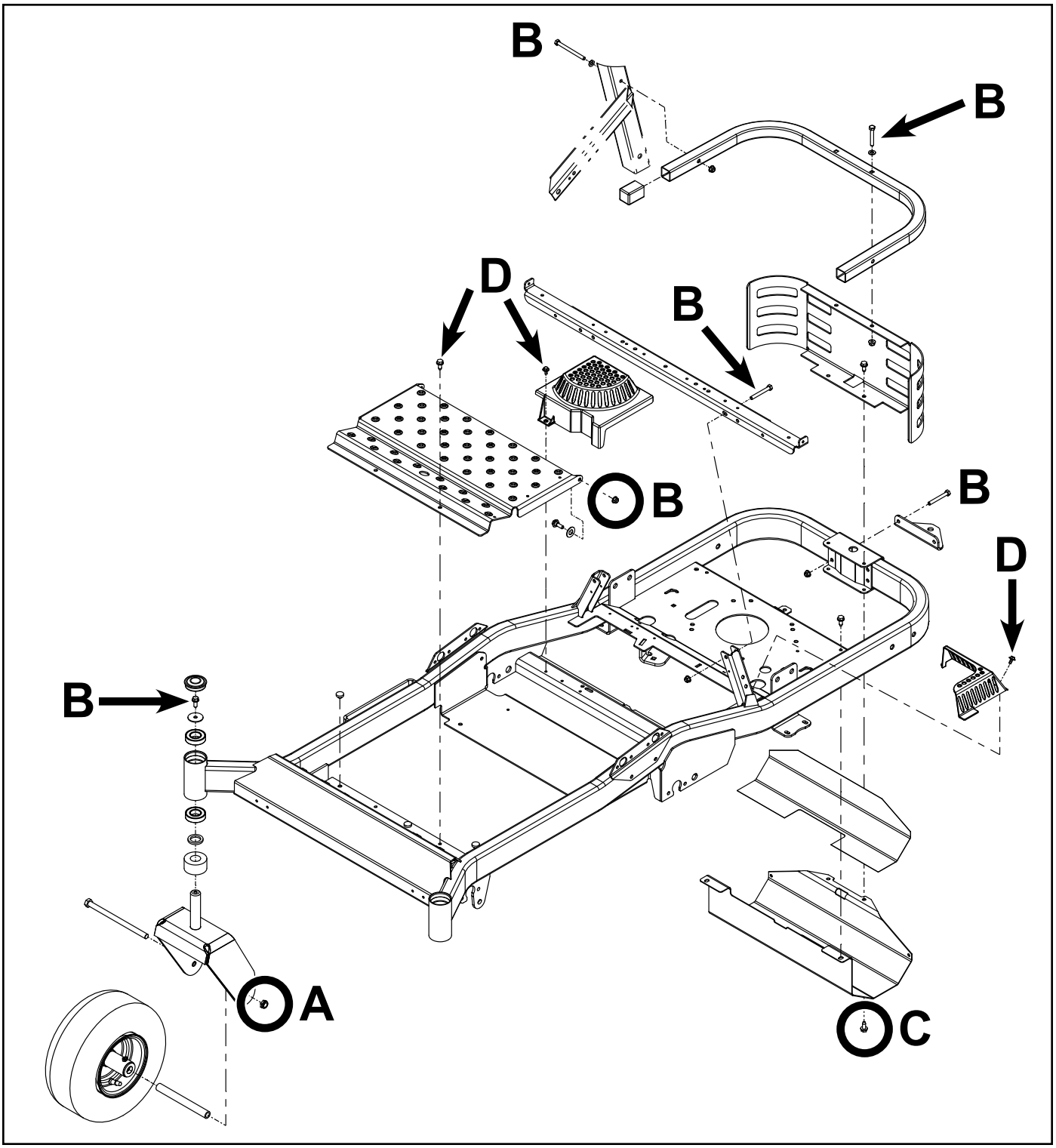


Fig. 005 PICT-3027

A. 35 ft-lbs. (47 Nm)
B. 17 ft-lbs. (23 Nm)
C. 5 ft-lbs. (7 Nm)
D. 50 in-lbs. (4 Nm)

ROPS Exploded View

(Fig. 006)

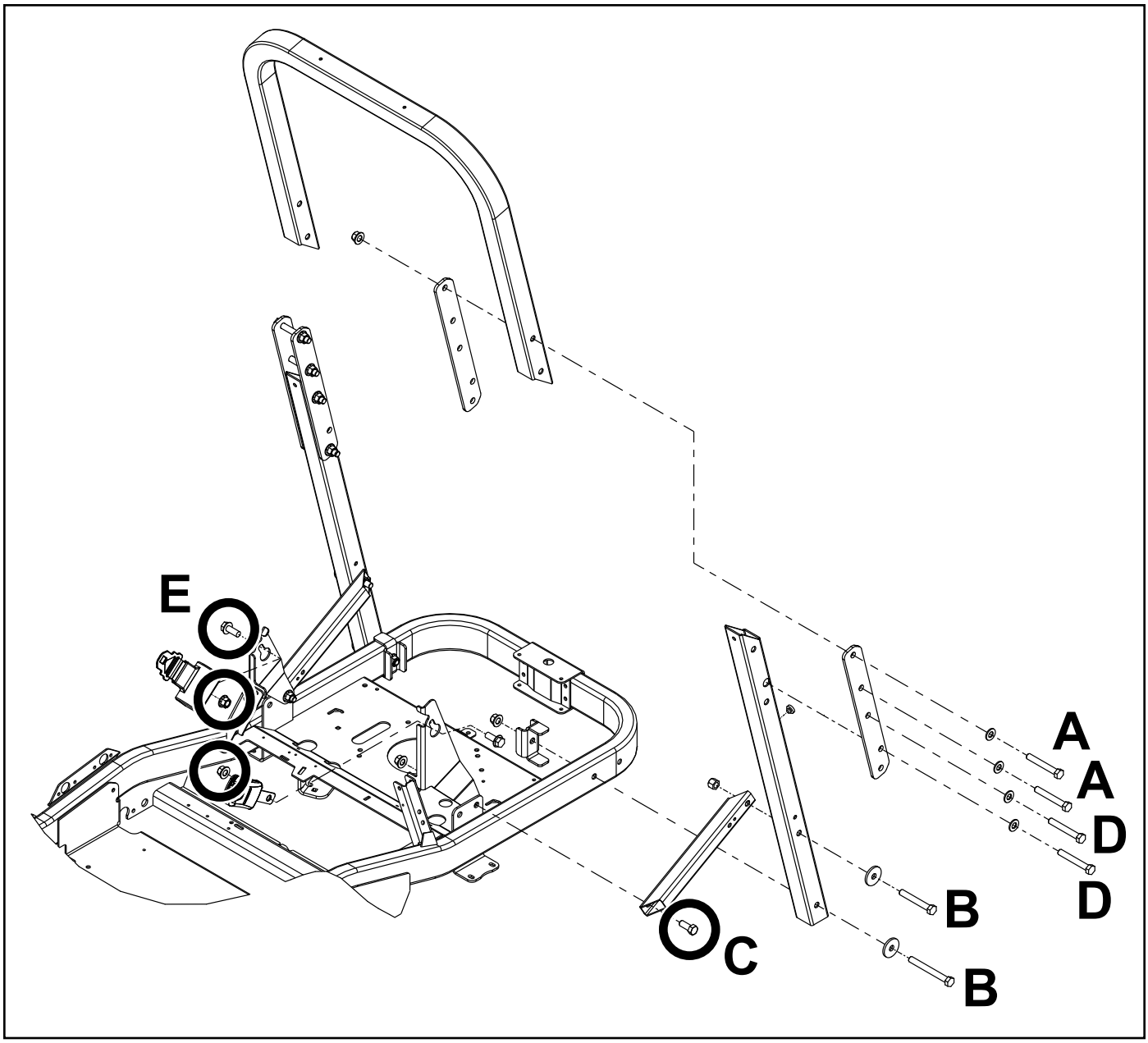


Fig. 006 PICT-3005

ROPS Mounting Torque Sequence:

1. Install, but do not tighten all ROPS mounting fasteners.
2. Torque the (4) fasteners (A) to specification – 35 ft-lbs. (47 Nm)
3. Torque the (4) fasteners (B) to specification – 25 ft-lbs. (34 Nm)
4. Torque the (2) fasteners (C) to specification – 75 ft-lbs. (101 Nm)
5. Torque the (4) fasteners (D) to specification – 35 ft-lbs. (47 Nm)

Other Torque Values:

E. Seat Belt Mounting Fasteners – 75 ft-lbs. (101 Nm)

Front Axle / Caster Fork / Bearing Service (MX)

Front Axle / Caster Fork / Bearing Disassembly

1. Safely raise and support unit so front wheels are off the ground.
2. Remove dust cap (A).
3. Support under caster wheel and remove the fastener (B).
4. Remove caster fork (C) from frame hub. Inspect the caster fork shaft and thrust washer (D) for excessive wear, replace if necessary.
5. Using an appropriate punch, tap out and remove the LOWER bearings from the frame hub.
6. Using an appropriate punch, tap out and remove the UPPER bearings from the frame hub.
7. Properly clean and inspect the frame hub bearing area.

Front Axle / Caster Fork / Bearing Assembly

1. Use a proper bearing installation tool to install and fully seat new upper and lower bearings into the frame hub.
2. Install thrust washer (D) onto the caster fork shaft.
3. Install the caster assembly up through the bearings and hold in position.
4. Install washer (E).
5. Install fastener (B) and torque to specification - 17 ft-lbs. (23 Nm).
6. Install the dust cap (A) until fully seated.
7. Safely lower unit and verify proper function (Fig. 007).

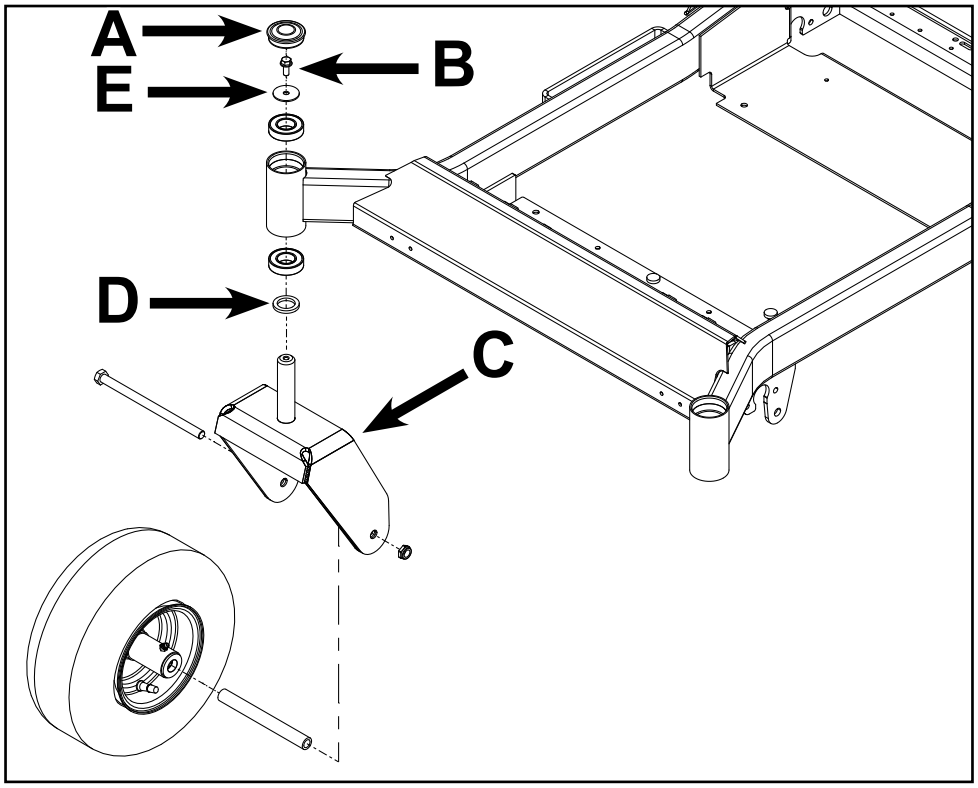


Fig. 007 PICT-3002

Front Axle / Caster Fork / Bearing Service (ZX)

Front Axle / Caster Fork / Bearing Disassembly

1. Safely raise and support unit so front wheels are off the ground.
2. Remove the dust cap (A).
3. Support under caster wheel and remove the fastener (B).
4. Remove caster fork (C) from front frame hub. Inspect the caster fork shaft, thrust washer (D) and spacer (E) for excessive wear, replace if necessary.
5. Using an appropriate punch, tap out and remove the LOWER bearings from the frame hub.
6. Using an appropriate punch, tap out and remove the UPPER bearings from the frame hub.
7. Properly clean and inspect the front axle bearing area.

Front Axle / Caster Fork / Bearing Assembly

1. Use a proper bearing installation tool to install and fully seat new upper and lower bearings into the frame hub.
2. Install spacer (E) and thrust washer (D) onto the caster fork shaft.
3. Install the caster assembly up through the bearings and hold in position.
4. Install washer (F).
5. Install fastener (B) and torque to specification -17 ft-lbs. (23 Nm).
6. Install the dust cap (A) until fully seated.
7. Safely lower unit and verify proper function (Fig. 008).

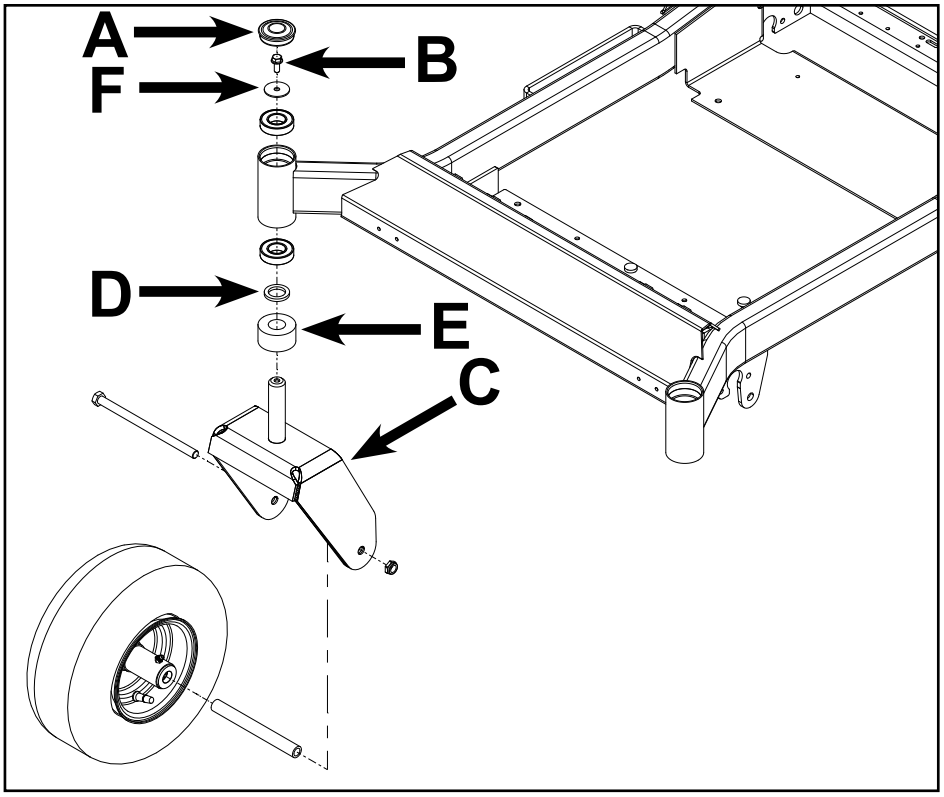


Fig. 008 PICT-3001

Caster Wheel, Bushing and Bearing Service (MX)

Caster Wheel, Bushing and Bearing Disassembly

1. Safely raise and support unit so front wheels are off the ground.
2. Support under caster wheel and remove the nut / bolt fastener (A).
3. Remove and inspect wheel spanner (B). Replace if excessively worn.
4. Use an appropriate punch to remove the (2) bushings (C) from the wheel hub. Inspect bushings and replace if excessively worn.
5. Remove the (2) bearings (D) from the wheel hub. Replace if excessively worn.
6. Properly clean and inspect the front wheel hub area.

Caster Wheel, Bushing and Bearing Assembly

1. Lightly lubricate bearings (D), bushings (C) and wheel spanner (B) with No. 2 general-purpose lithium base grease. Fill center of wheel hub with grease.
2. Install the (2) bearings (D) and (2) bushings (C) into front wheel hub, making sure they are fully seated.
3. Install wheel spanner (B) into the front wheel assembly.
4. Install front wheel assembly into the front caster.
5. Install the nut / bolt (A) and torque nut to specification - 35 ft-lbs. (47 Nm).
6. Lubricate bushings / bearings through grease fitting with No. 2 general-purpose lithium base grease.
7. Safely lower unit and verify proper function (Fig. 009).

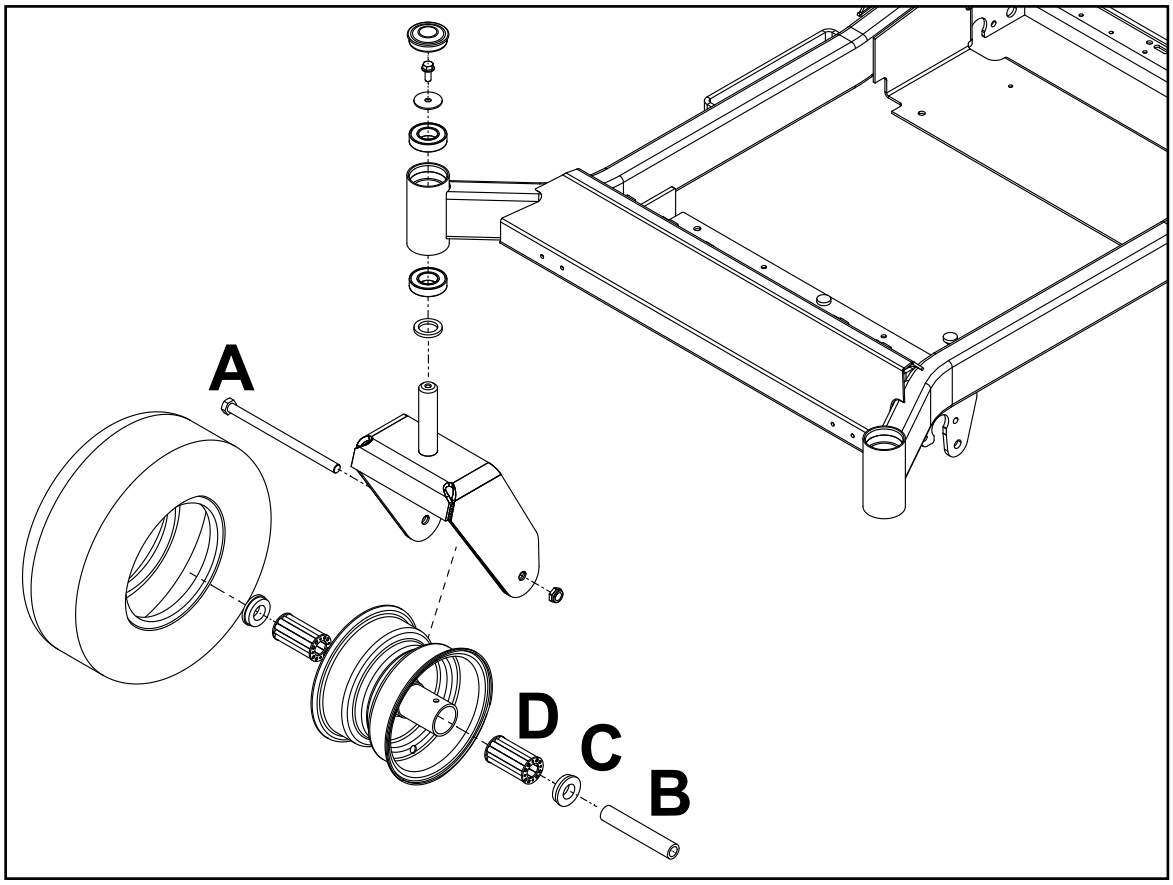


Fig. 009 PICT-3003

Caster Wheel and Bushing Service (ZX)

Caster Wheel / Bushing Disassembly

1. Safely raise and support unit so front wheels are off the ground.
2. Support under caster wheel and remove the nut / bolt (A).
3. Remove and inspect wheel spanner (B). Replace if excessively worn.
4. Using an appropriate punch, remove the (2) bushings (C) from the wheel hub. Inspect bushings and replace if excessively worn.
5. Properly clean and inspect the front wheel hub area.

Caster Wheel / Bushing Assembly

1. Lightly lubricate bushings (C) and wheel spanner (B) with No. 2 general-purpose lithium base grease. Fill center of wheel hub with grease.
2. Install the (2) bushings (C) into front wheel hub, making sure they are fully seated.
3. Install wheel spanner (B) into the front wheel assembly.
4. Install front wheel assembly into the front caster.
5. Install the nut / bolt (A) and torque nut to specification - 35 ft-lbs. (47 Nm).
6. Lubricate bushings / spanner through grease fitting with No. 2 general-purpose lithium base grease.
7. Safely lower unit and verify proper function (Fig. 010).

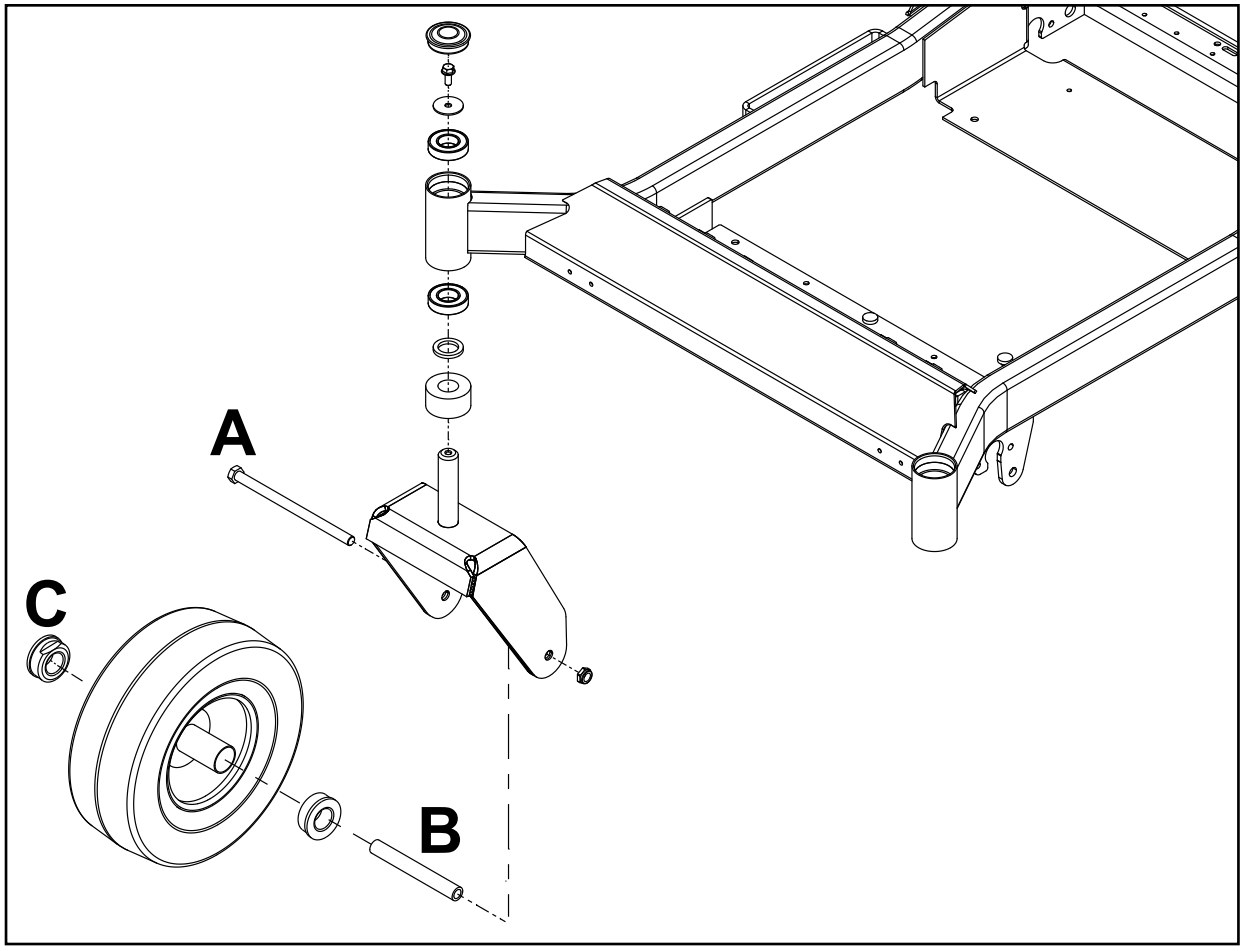


Fig. 010 PICT-3004

Pod / Fender Service

Pod / Fender Removal – RH

1. Raise seat and disconnect battery terminals.
2. Remove the (4) screws securing control panel (A) to RH fender. Move control panel inward towards the center of the unit.
3. Remove the (3) screws (B) securing the RH fender to frame.
4. Maneuver RH fender up and off frame.

Pod / Fender Installation – RH

1. Maneuver RH fender into position.
2. Install the (3) screws (B) that secure the RH fender to frame and torque to specification – 7 ft-lbs. (9 Nm).
3. Position control panel (A) back onto RH fender. Install and sufficiently tighten the (4) screws that secure the control panel to the RH fender.
4. Verify choke cable, throttle cable and wiring are properly routed.
5. Connect battery terminals and lower seat (Fig. 011).

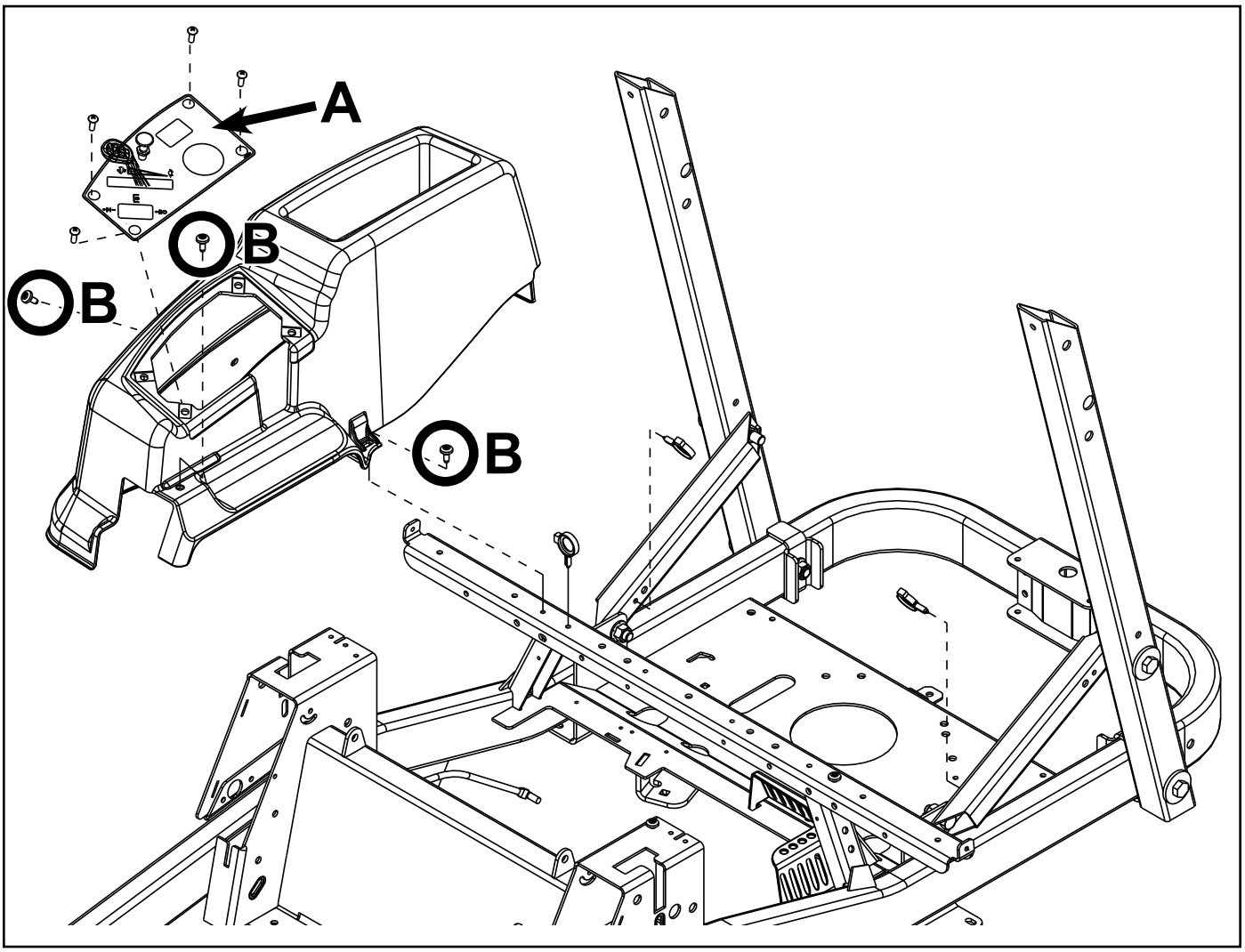


Fig. 011 PICT-2061

Pod / Fender Removal – LH

1. Raise seat and disconnect battery terminals
2. Remove the (3) screws (A) securing the LH fender to the unit frame.
3. Lubricate rubber fuel tank neck grommet with soapy water (Fig. 012).

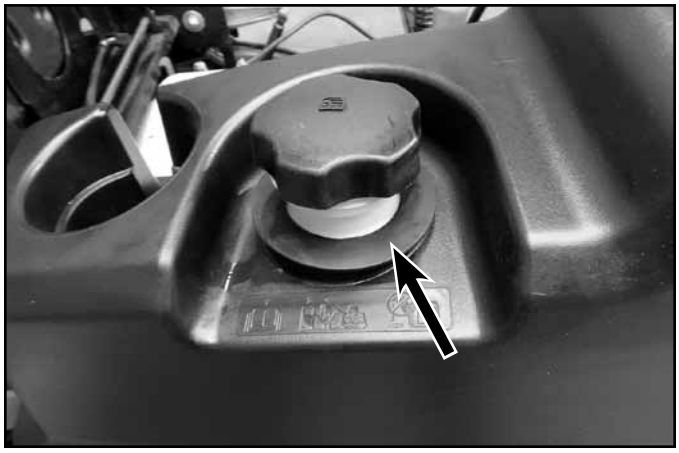


Fig. 012 PICT-2065

4. Remove fuel cap from fuel tank.
5. Lift LH fender assembly upward and off the frame. Use care while lifting fender upward as the fuel tank neck slips through the grommet.
6. Reinstall fuel cap.

Pod / Fender Installation – LH

1. Lubricate rubber fuel tank neck grommet with soapy water.
2. Remove fuel cap from fuel tank.
3. Install LH fender assembly onto unit frame. Use care while installing LH fender as the fuel tank neck slips through the grommet.
4. Install fuel cap.
5. Install the (3) screws (A) that secure the fender to the unit frame and torque to specification 7 ft-lbs. (9 Nm).
6. Connect battery terminals and lower seat (Fig. 013).

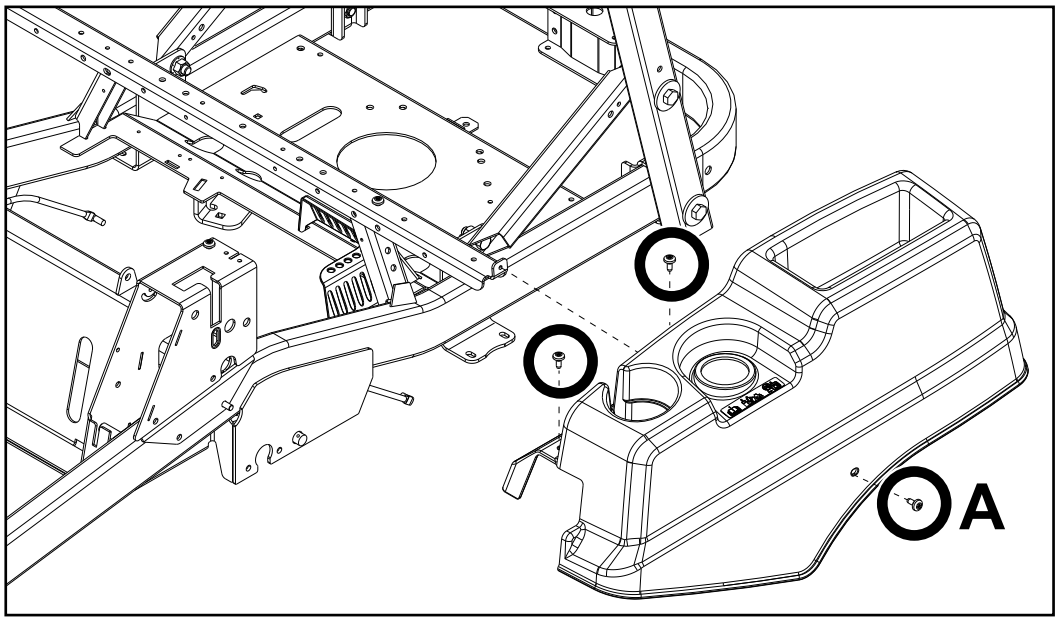


Fig. 013 PICT-2064

Fuel Tank Service

Fuel Tank Removal (MX Shown)

1. Raise seat and disconnect battery terminals
2. Remove the RH and LH pod / fender as shown in this chapter.
3. Remove the (2) bolts that secure the hydro expansion tank (A) to the seat support. Move the tank rearward for fuel tank removal clearance.
4. Remove the (1) fastener securing the fuel tank retaining rod (B) and remove it from the chassis.
5. Remove the (2) bolts and nuts (C) that secure the seat support to the frame brackets.
6. Note the location of and remove any cable ties / loom clamps securing wiring / cables to the seat support bar.
7. Disconnect and properly secure the fuel / vent line(s) from the top of the fuel tank assembly
8. Remove the seat support bar from the frame.
9. The fuel tank is now loose and can be removed from the unit frame.

(Fig. 014)

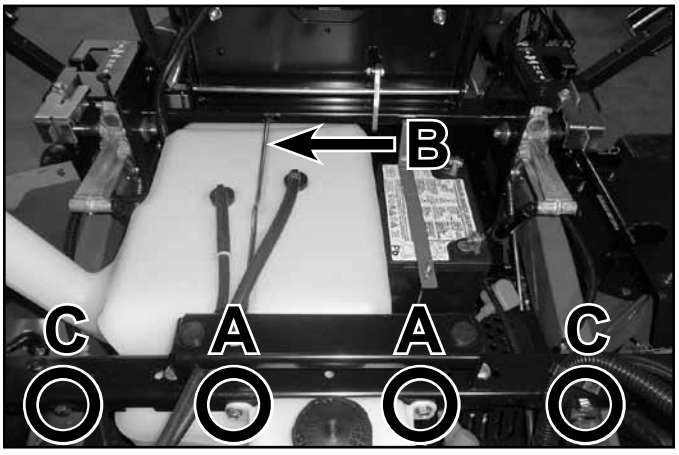


Fig. 014 PICT-3016

Fuel Tank Installation (MX Shown)

1. Position the fuel tank assembly into the unit frame.
2. Install the (2) bolts and nuts (C) that secure the seat support to the frame brackets and torque to specification – 17 ft-lbs. (23 Nm).
3. Install the fuel tank retaining rod (B) and torque retaining bolt to specification – 8 ft-lbs. (11 Nm). Be sure the front rod end is engaged into the control box assembly (Fig. 015).

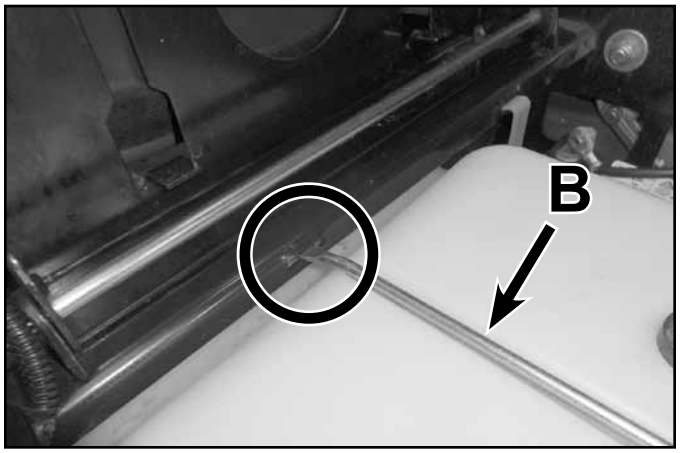


Fig. 015 PICT-2069

4. Install the (2) bolts (A) that secure the hydro expansion tank to the seat support and torque to specification – 5 ft-lbs. (7 Nm).
5. Properly route cables / wiring and reinstall cable ties / loom clams to secure them to the seat support.
6. Properly route and reconnect the fuel / vent line(s).

Note: The fuel tank is labeled “FUEL” for the fuel hose fitting connection and “VENT” for the fuel tank vent fitting connection.

7. Install the RH and LH pod / fender as outlined in this chapter.
8. Connect the battery cables and lower seat.
9. Verify proper function.

Fuel & Vent Line Routing

Fuel & Vent Line Routing - ZX Models

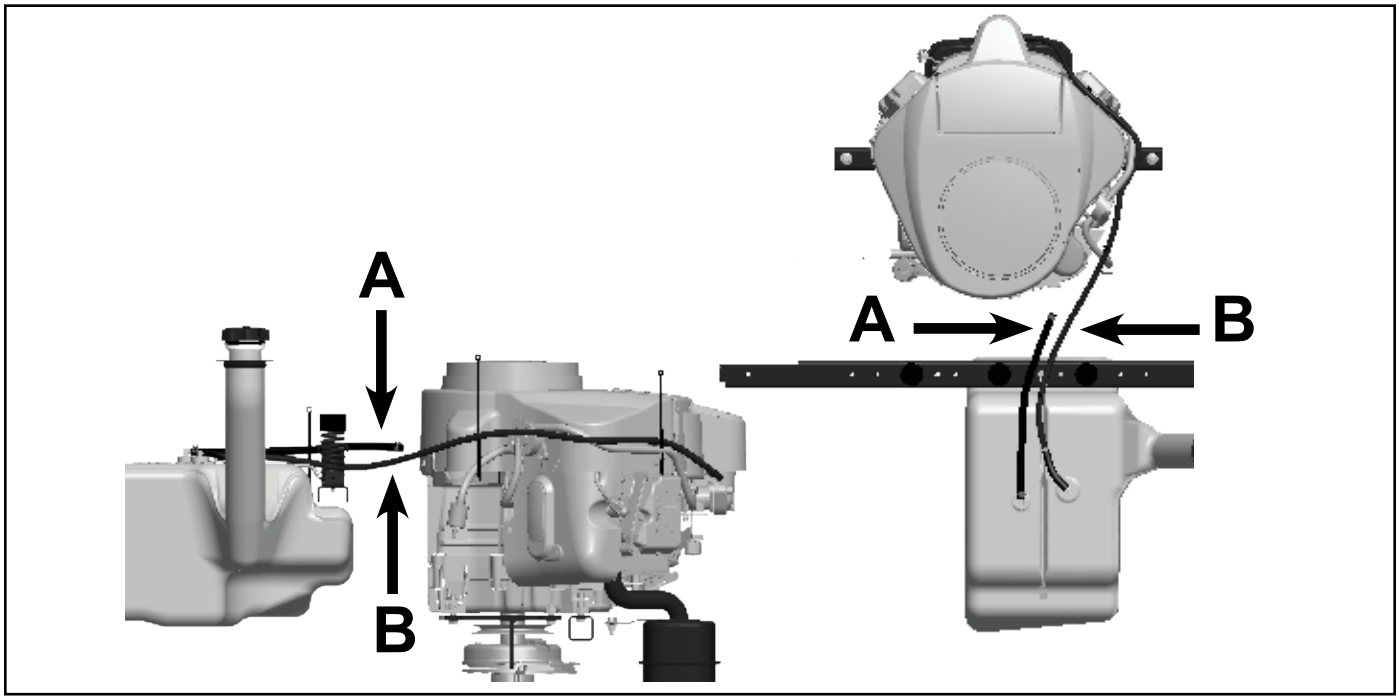


Fig. 016 PICT-3048

Fuel & Vent Line Routing - MX Models

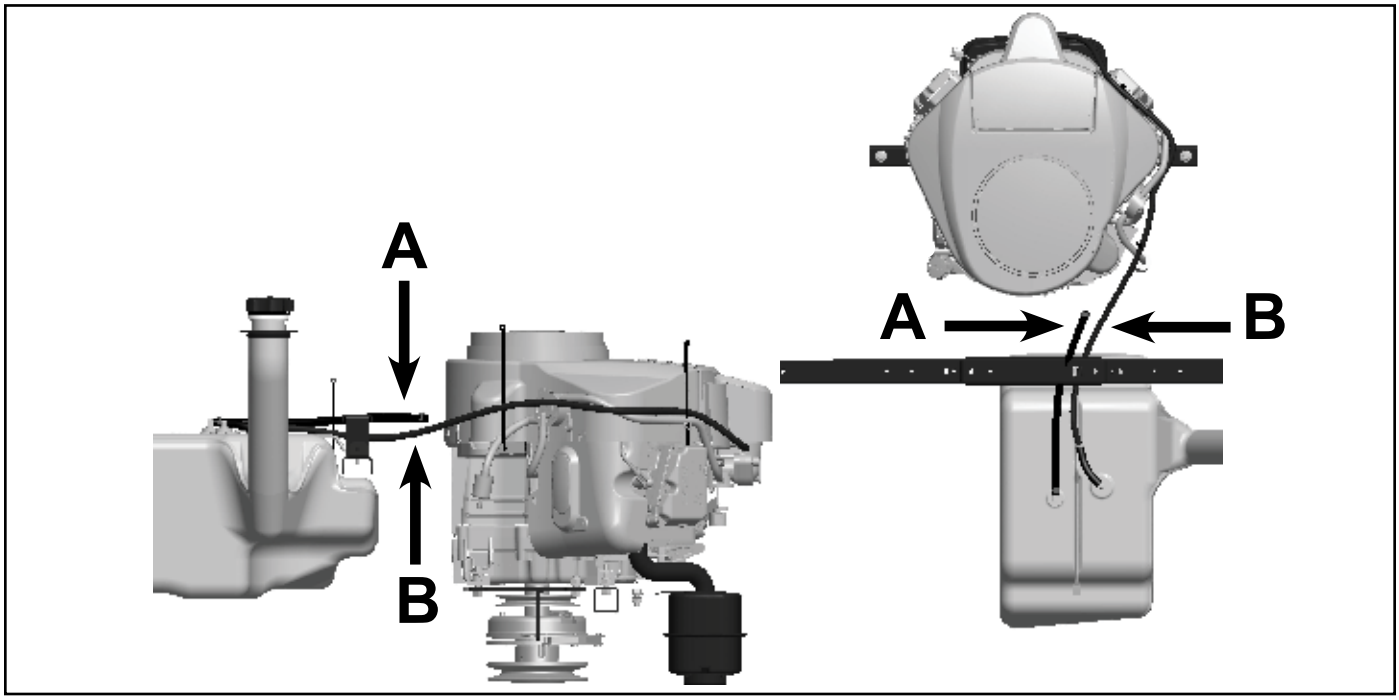


Fig. 017 PICT-3046

A. Fuel supply line to fuel filter and pump
B. Vent line

Fuel & Vent Line Routing - CARB Models

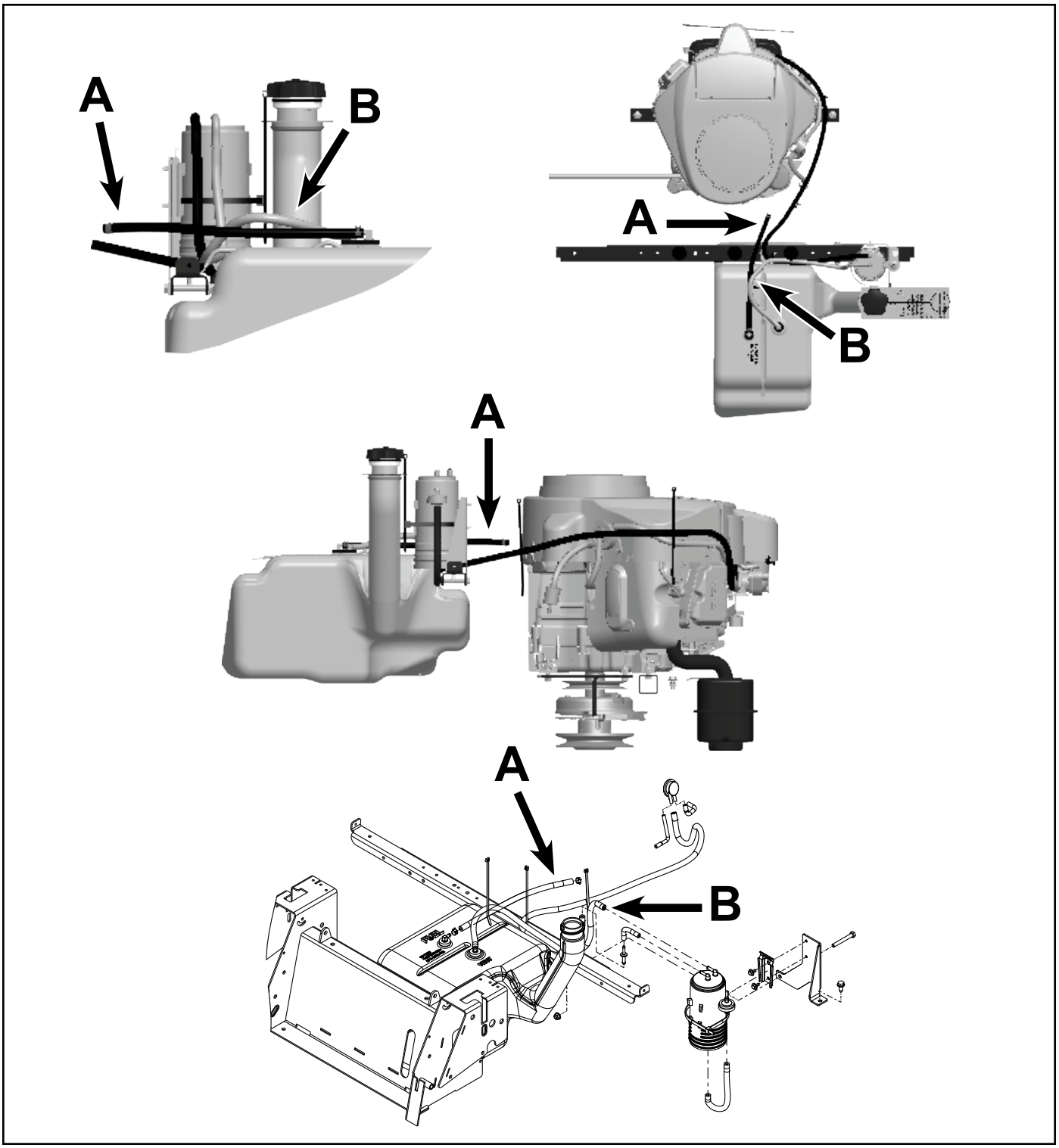


Fig. 018 PICT-3047

A. Fuel supply line
B. Vent line

Motion Control Damper Service

Motion Control Damper Removal (LH side shown)

1. Tilt seat forward and disconnect the battery.
2. Remove the appropriate fender / pod as shown in this chapter.
3. Remove the (1) shoulder bolt (A) and washer that secures the upper motion control damper eyelet to the actuator arm.
4. Remove the nut and bolt (B) that secure the lower motion control damper eyelet to the control box (Fig. 019).

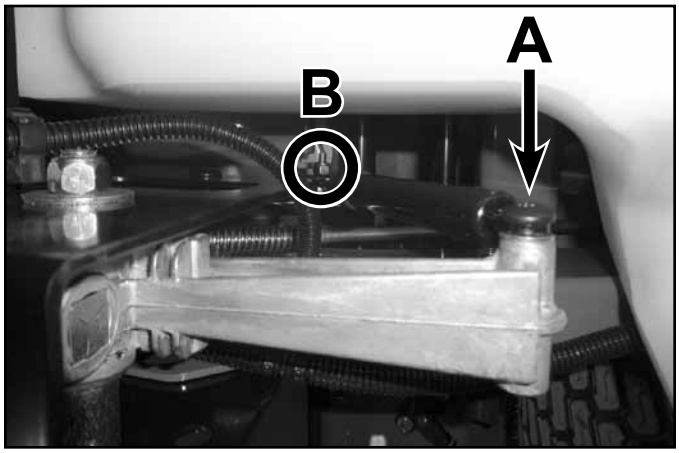


Fig. 019 PICT-3008

5. Remove the motion control damper from the unit.

Motion Control Damper Installation

1. Install the washer and upper damper eyelet to the actuator arm and torque the shoulder bolt (A) to specification – 7.5 ft-lbs. (10 Nm).
2. Install the lower damper eyelet to the Control Box and torque the nut (B) to specification – 7.5 ft-lbs. (10 Nm).
3. Install the fender / pod as shown in this chapter.
4. Check the motion control system for proper function. (Fig. 020)

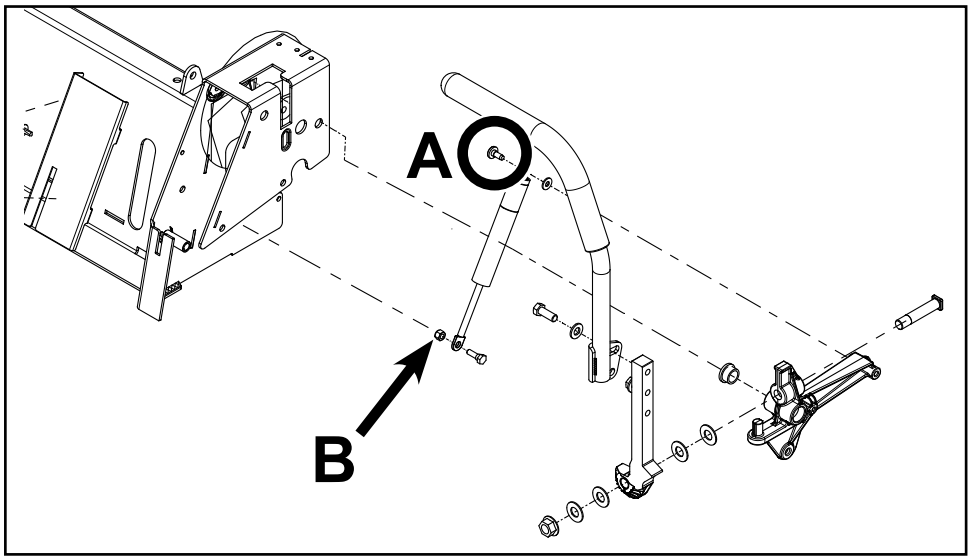


Fig. 020 PICT-2072

Motion Control Box / Seat Pivot Service (MX shown)

Note: The entire Control Box / Motion Control assembly does not need to be removed to service the Actuator Arm assembly. The Control Box is shown removed from the frame for clarity and ease of service.

Motion Control Box / Seat Pivot Removal

1. Raise seat, disconnect battery terminals and remove the battery from the unit.
2. Remove the (2) control handles.
3. Disconnect the seat switch harness connection and remove seat switch harness from the routing clip on the Motion Control Box.
4. Disengage the seat stop (A), from the seat support. Remove the cotter pins (B) and seat pivot rod (C), then remove the seat assembly from the unit (MX Shown) (Fig. 021).

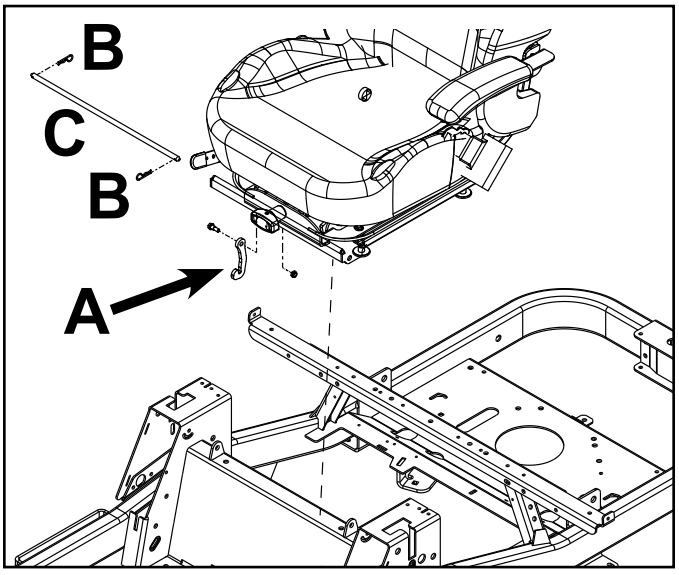


Fig. 021 PICT-3009

5. Remove the RH and LH fenders as shown in this chapter.
6. Safely remove the fuel tank as shown in this chapter.
7. Remove the (2) control covers (D) (Fig. 022).

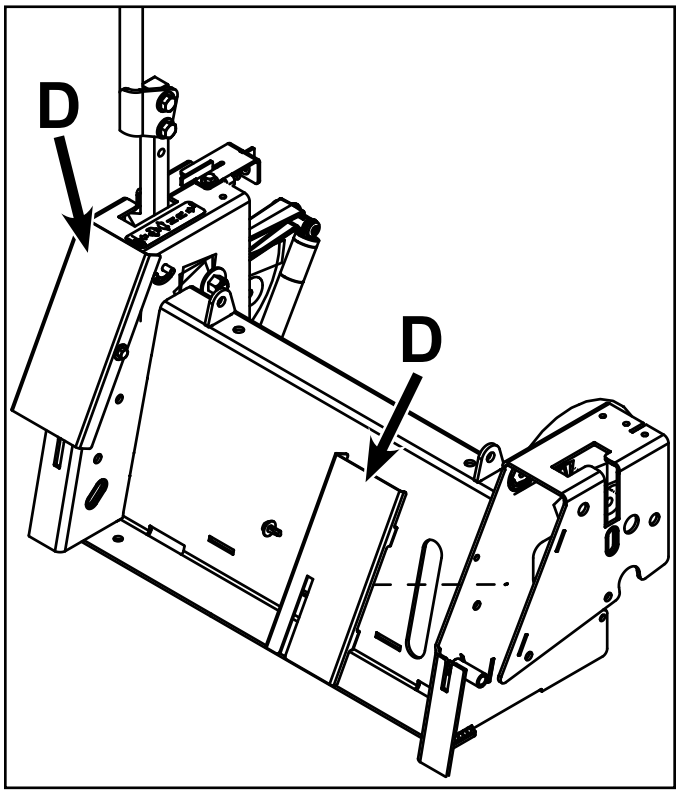


Fig. 022 PICT-2010

8. Make note of wire harness routing. Disconnect the RH and LH neutral switches and the parking brake switch. Open the loom routing clip and remove harness from the Control Box.

9. Remove the motion control rod clips and pins (F) (Fig. 023).

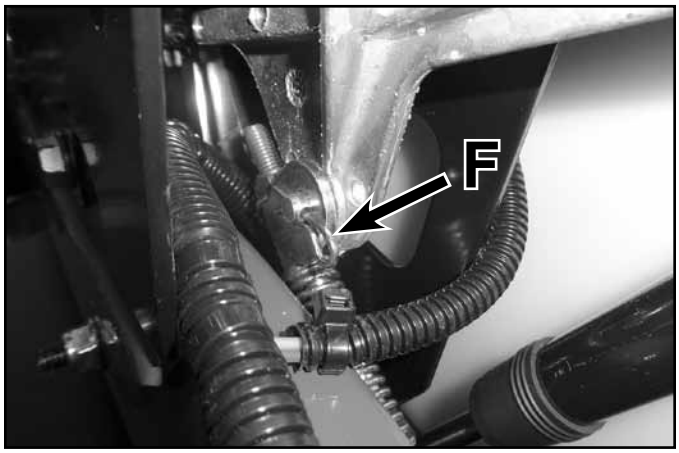


Fig. 023 PICT-3010

10. Remove the parking brake pin and washer (G). Remove the parking brake links from the handle stud (Fig. 024).

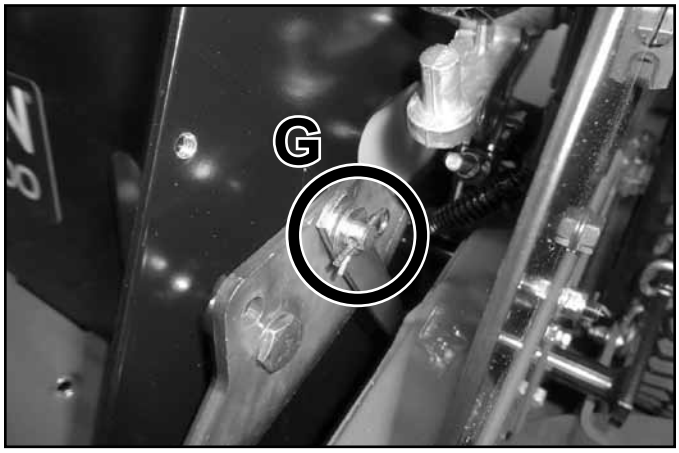


Fig. 024 PICT-3011

11. Remove the (4) fasteners (H) that secure the Control Box to the frame.

12. Remove the (2) nuts and (2) carriage bolts (I) that secure the Control Box to the frame (Fig. 025).

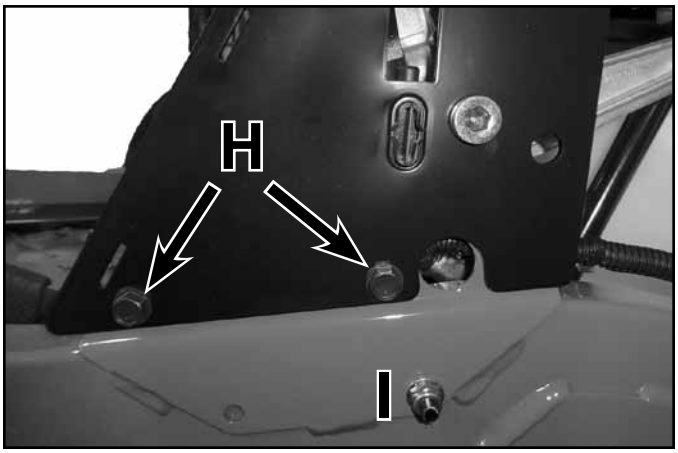


Fig. 025 PICT-3012

13. Remove the (2) bolts/nuts (J) that secure the front control box and floor pan to the frame. Remove the floor pan from the unit (Fig. 026).

Fig. 026 PICT-3013

14. The Motion Control Box is now loose and can be removed from the frame.

Motion Control Box / Seat Pivot Installation

1. Install the control box / motion control assembly onto the frame.

2. Install the (6) fasteners securing the control box assembly (G) to the frame and torque to specification:
   - (H) Bolts - 7 ft-lbs. (10 Nm)
   - (I) Carriage Bolt Fasteners - 14 ft-lbs. (18 Nm)

(Fig. 027)

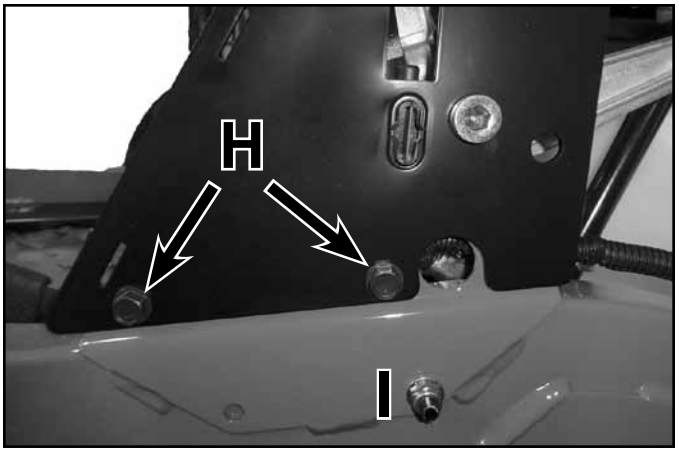


Fig. 027 PICT-3010

3. Install the (2) bolts/nuts (J) that secure the floor pan and front motion control bolt to the frame and torque to specification - 17 ft-lbs. (10 Nm) (Fig. 028).

Fig. 028 PICT-3013

4. Install the motion control rod and clips and pins (F) (Fig. 029).

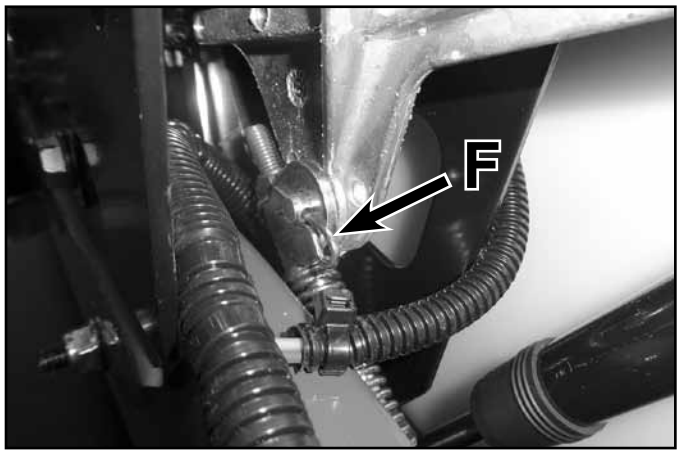


Fig. 029 PICT-3010

5. Install the parking brake linkage, washer and pin, and (G) (Fig. 030).

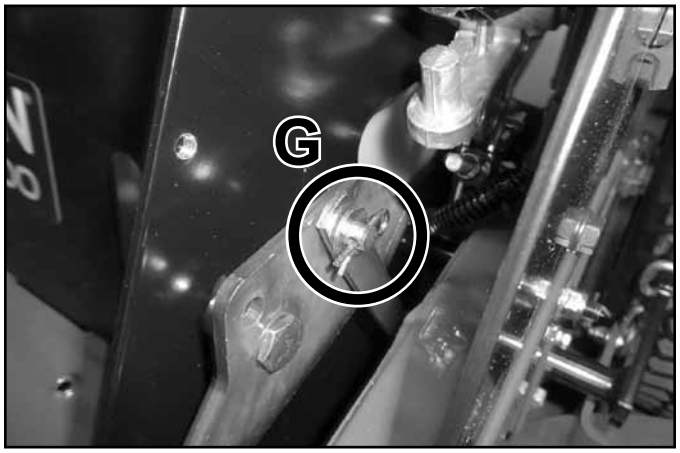


Fig. 030 PICT-3011

6. Properly route the wire harness and connect the RH and LH neutral switches, and parking brake switches.

7. Install the control covers and torque the fasteners to specification – 5 ft-lbs. (7 Nm).

8. Safely install the fuel tank as shown in this chapter.

9. Install the RH and LH fenders as shown in this chapter.

10. Install the seat assembly.

11. Install the seat switch harness connection and verify proper harness routing.

12. Install the (2) control handles and torque the (4) fasteners to specification - 30 ft-lbs. (40 Nm).

13. Install the battery and battery cables.

14. Verify proper function.

Motion Control / Actuator Arm Service

Note: The entire Control Box / Motion control assembly does not need to be removed from the chassis to service the Actuator Arm assembly (A). The fenders and control box are shown removed from the chassis for clarity and ease of service.

Motion Control Disassembly (LH Side Shown)

1. Remove the control lever handle.

2. Remove the upper damper shoulder bolt and washer (A) (Fig. 031).

Fig. 031 PICT-3014

3. Remove the actuator arm nut (B) and (2) washers.

4. Remove the shoulder bolt (C), actuator arm (D) and the (2) washers from the activator arm (E) (Fig. 032).

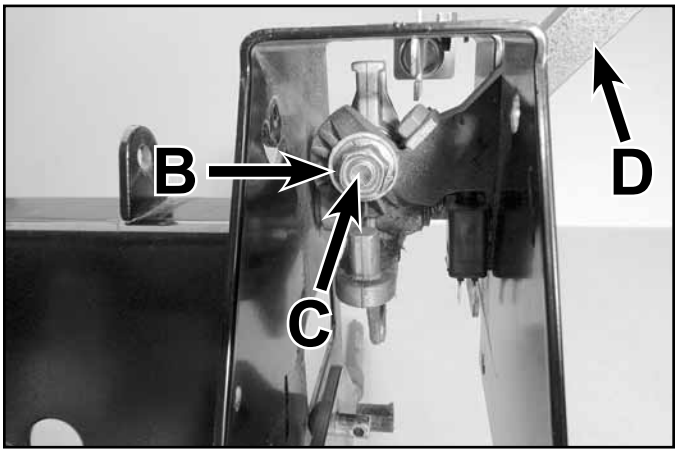


Fig. 032 PICT-2082

5. Remove the activator arm pivot bolt and nut (F) and the activator arm assembly (E) from the control box (Fig. 033).

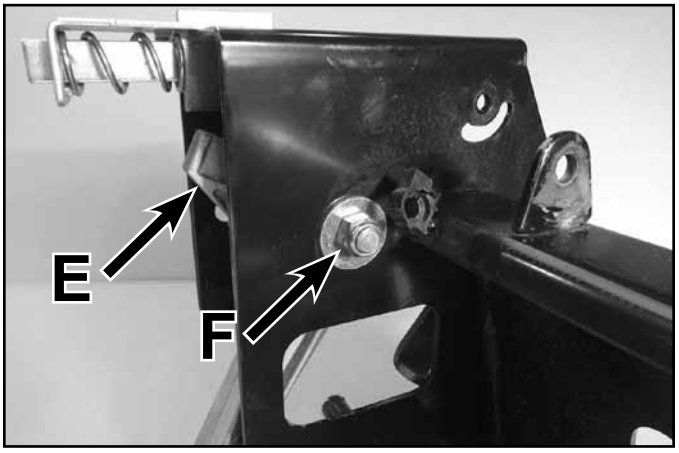


Fig. 033 PICT-2081

6. Inspect the pivot bolts, washers, nylon washers and bushings for excessive wear, replace if necessary.

Motion Control Assembly

1. Install the activator arm assembly (E) into the control box and torque the pivot bolt (F) to specification – 30 ft-lbs. (40 Nm). Do not apply lubrication to the activator arm pivot bolt (F).

2. Apply anti-seize compound to the actuator arm shoulder bolt (C) and the (4) washers. Install the actuator arm shoulder bolt (C) through the activator arm (E).

3. Install the actuator arm (D) and (4) washers to the activator arm assembly (E).

Be sure the (4) washers are positioned correctly:
- Washer 1: Standard Pivot Washer
- Washer 2: Standard Pivot Washer
- Washer 3: Standard Pivot Washer
- Washer 4: Teflon Washer

(Fig. 034)

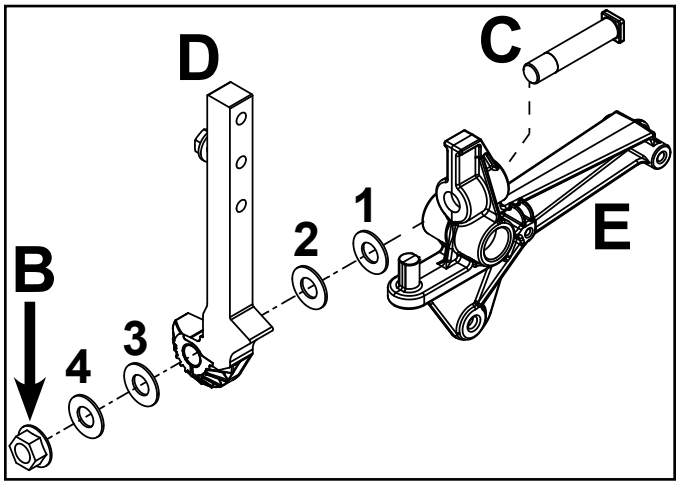


Fig. 034 PICT-2085

4. Apply Loctite® 242 to the actuator arm pivot bolt threads (C).

5. Tighten nut (B) until the control lever has an acceptable and safe resistance feel when moved from stop to stop.

   - Over tightening nut (B) may damage the Teflon washer and cause excessive resistance.

   - Under tightening nut (B) may cause the actuator arm to feel loose.

(Fig. 035)

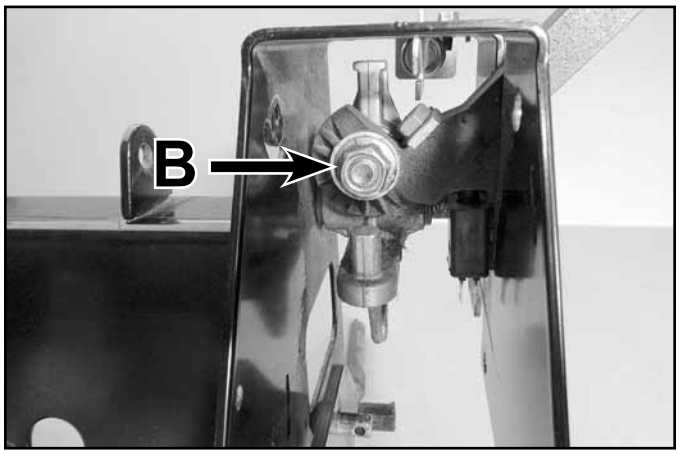


Fig. 035 PICT-2082

6. Install the upper motion control damper washer and shoulder bolt (A) to the activator arm (E) and torque to specification - 7.5 ft-lbs. (10 Nm).

7. If needed, install the control box back onto the frame as outlined in this chapter.

8. Install the control lever and torque the fasteners to specification - 30 ft-lbs. (40 Nm).

9. Perform the “Neutral Adjustment” and “Forward Tracking Adjustment” procedures on pages 5-4 and 5-5 (Fig. 036).

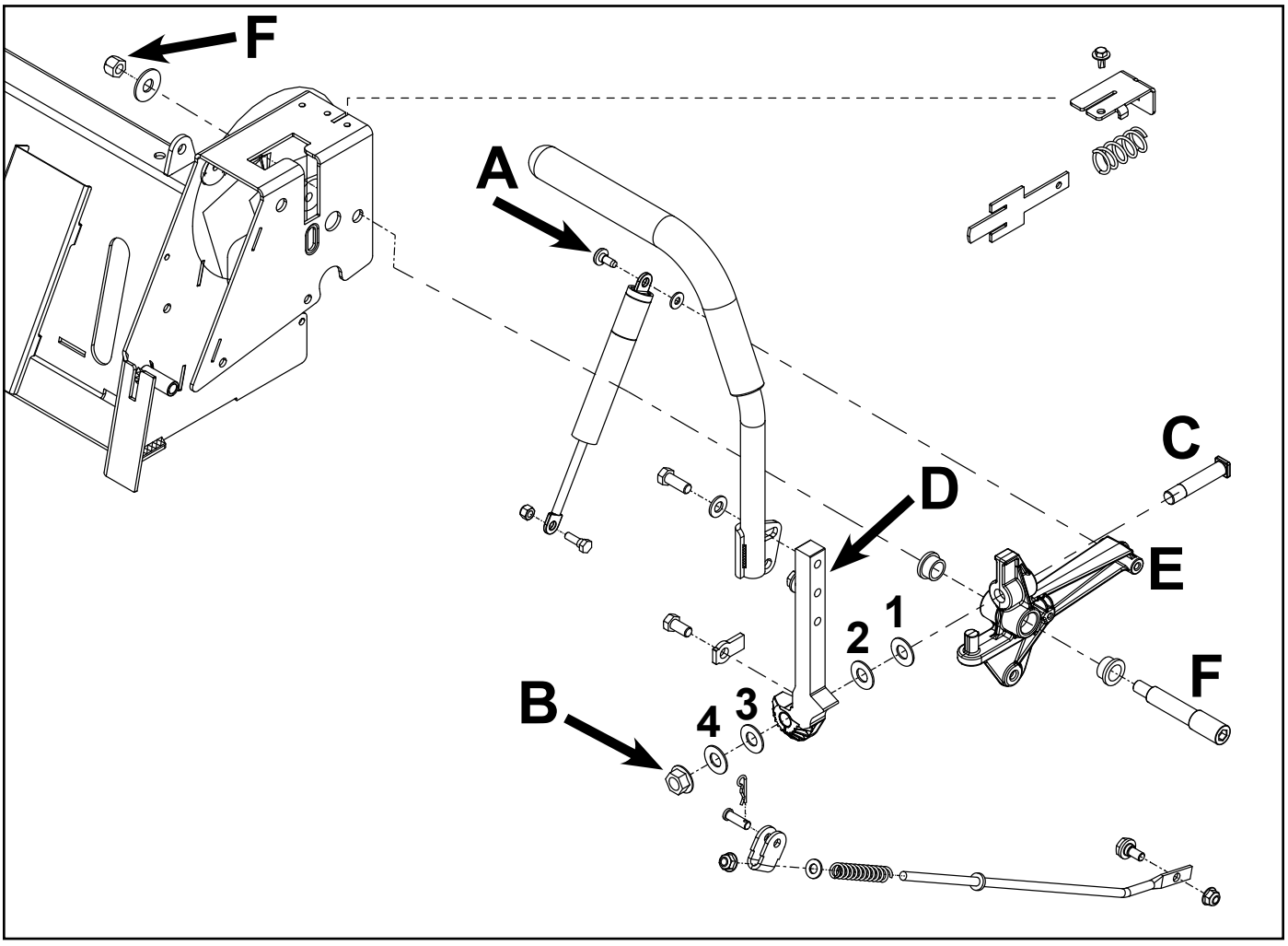


Fig. 036 PICT-3015

A. Shoulder bolt - 7.5 ft-lbs. (10 Nm)
B. Actuator arm nut
C. Actuator arm pivot bolt
D. Actuator arm
E. Activator arm
F. Activator arm pivot bolt

Washer 1: Standard Pivot Washer
Washer 2: Standard Pivot Washer
Washer 3: Standard Pivot Washer
Washer 4: Teflon Washer

Seat Support / Fender Support Service

Seat Support Removal (MX Shown)

1. Raise seat and disconnect battery terminals
2. Remove RH and LH pods / fenders as shown in this chapter.
3. Remove the (2) bolts that secure the hydro expansion tank (A) to the seat support.
4. Remove the (1) fastener securing the fuel tank retaining rod (B) to the seat support. Remove the fuel tank retaining rod from unit.
5. If necessary, disconnect and properly secure the fuel / vent line(s) from the top of the fuel tank assembly.

Note: The fuel tank is labeled "FUEL" for the fuel hose fitting connection and "VENT" for the fuel tank vent fitting connection.

6. Note the location of and remove any cable ties / loom clamps securing wiring and cables to the seat support bar.
7. Remove the (2) bolts and nuts (C) that secure the seat support to the frame brackets.
8. Remove the seat support bar from the frame (Fig. 037).

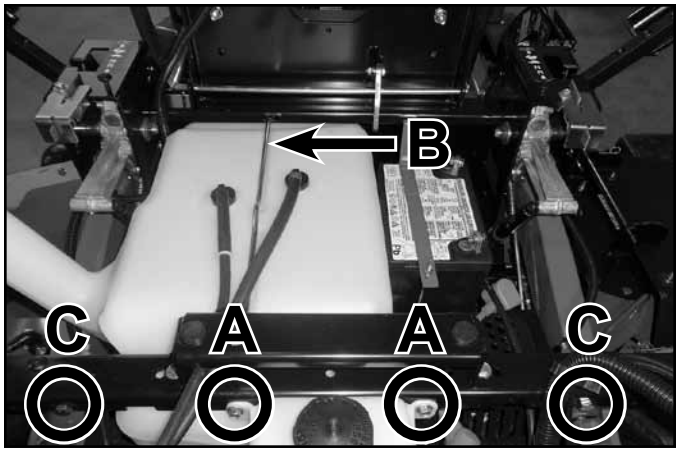


Fig. 037 PICT-3016

Seat Support Installation (MX Shown)

1. Position the Seat Support assembly into the unit frame.
2. Install the (2) bolts and nuts (C) that secure the seat support to the frame brackets and torque to specification – 17 ft-lbs. (23 Nm).
3. Install the fuel tank retaining rod (B) and torque retaining bolt to specification – 8 ft-lbs. (11 Nm). Be sure the front rod end is engaged into the control box assembly (Fig. 038).

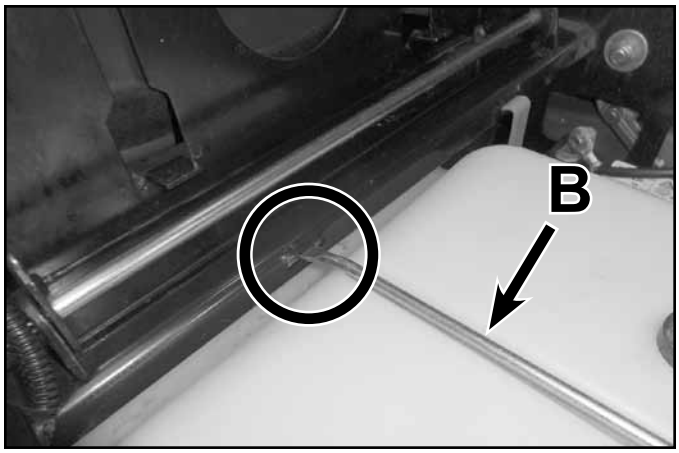


Fig. 038 PICT-2069

4. Install the (2) bolts that secure the hydro expansion tank (A) to the seat support and torque to specification – 5 ft-lbs. (7 Nm).
5. Properly route cables / wiring and reinstall cable ties / loom clams to secure them to the seat support.
6. If necessary, properly route and install the fuel / vent line(s) to the fuel tank assembly.
7. Install RH and LH pod / fender as outlined in this chapter.
8. Connect the battery cables and lower seat.
9. Verify proper function.

Deck Lift Service

Deck Lift Removal

Note: Exploded view shown on next page, 3-23.

1. Remove the PTO belt tensioner spring, then remove the PTO belt from the PTO clutch. See “PTO Belt Replacement - 48, 54 & 60 Inch Deck” on page 6-5.

2. Remove the deck from the frame. See “Mower Deck Removal - 48, 54 & 60 Inch Deck” on page 6-7.

3. Remove the deck lift foot pedal center pivot bolt (A).

4. Remove the rear lift arm pivot bolt (B).

5. Remove the (2) HOC plate assembly mounting bolts (C).

6. Remove the HOC plate and foot lift assembly from the chassis (Fig. 039).

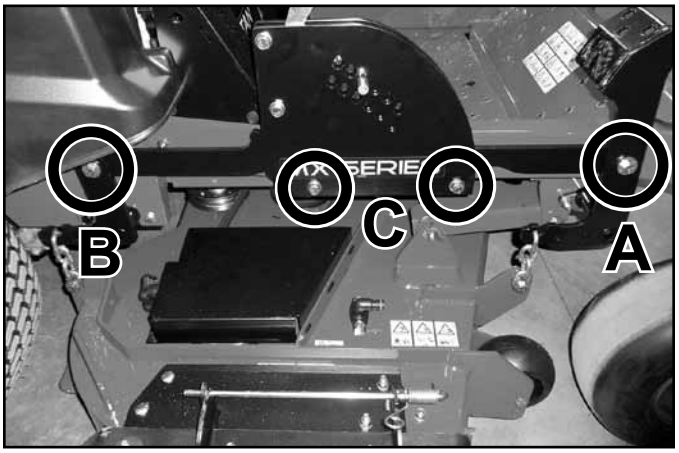


Fig. 039 PICT-3029

7. Remove the front lift pan spring (D), and (2) pivot bolts (E).

8. Support under the front foot lift pivot rod (F).Remove the (4) fasteners that retain the pivot bushings (G). Remove the pivot rod from the frame. Inspect the (2) bushings for wear and replace if necessary.

9. Support under the rear pivot rod (H). Remove the (4) fasteners that retain the pivot bushings (G). Remove the pivot rod from the frame. Inspect the (2) bushings for wear and replace if necessary.

10. Inspect the front lift pan, front pivot rod (F), the rear pivot rod (H) and all pivot points for excessive wear, bends and cracks. Replace if necessary.

Deck Lift Installation

1. Install the front and rear pivot rods (F and H) into the frame slots and support in position.

2. Install the (4) pivot bushings (G), (4) gusset plates and (8) fasteners that secure the pivot rods to the frame. Torque the (8) fasteners to specification – 5 ft-lbs. (7 Nm) (Fig. 040).

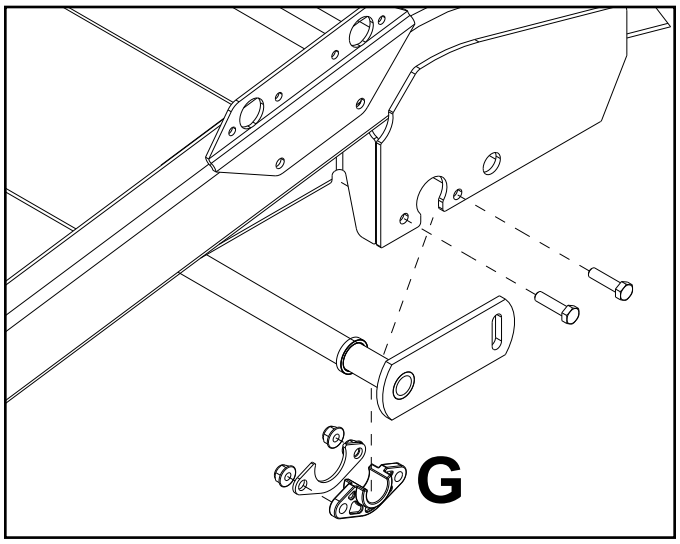


Fig. 040 PICT-2087

3. Install the front lift pan and spring (D) to the frame and torque fasteners to specification - 30 ft-lbs. (40 Nm).

4. Install the (2) HOC plate assembly mounting bolts (C).

5. Install the deck lift foot pedal center pivot bolt (A).

6. Install the rear lift arm pivot bolt (B).

7. Torque fasteners A, B and C to specification - 30 ft-lbs. (40 Nm).

8. Install and level the deck as shown in “Mower Deck Installation - 48, 54 & 60 Inch Deck” on page 6-8 and “Mower Deck Leveling” on page 6-15.

9. Install and properly route the PTO belt, then install the PTO belt tensioner spring.

10. Verify proper operation.

(Fig. 041)

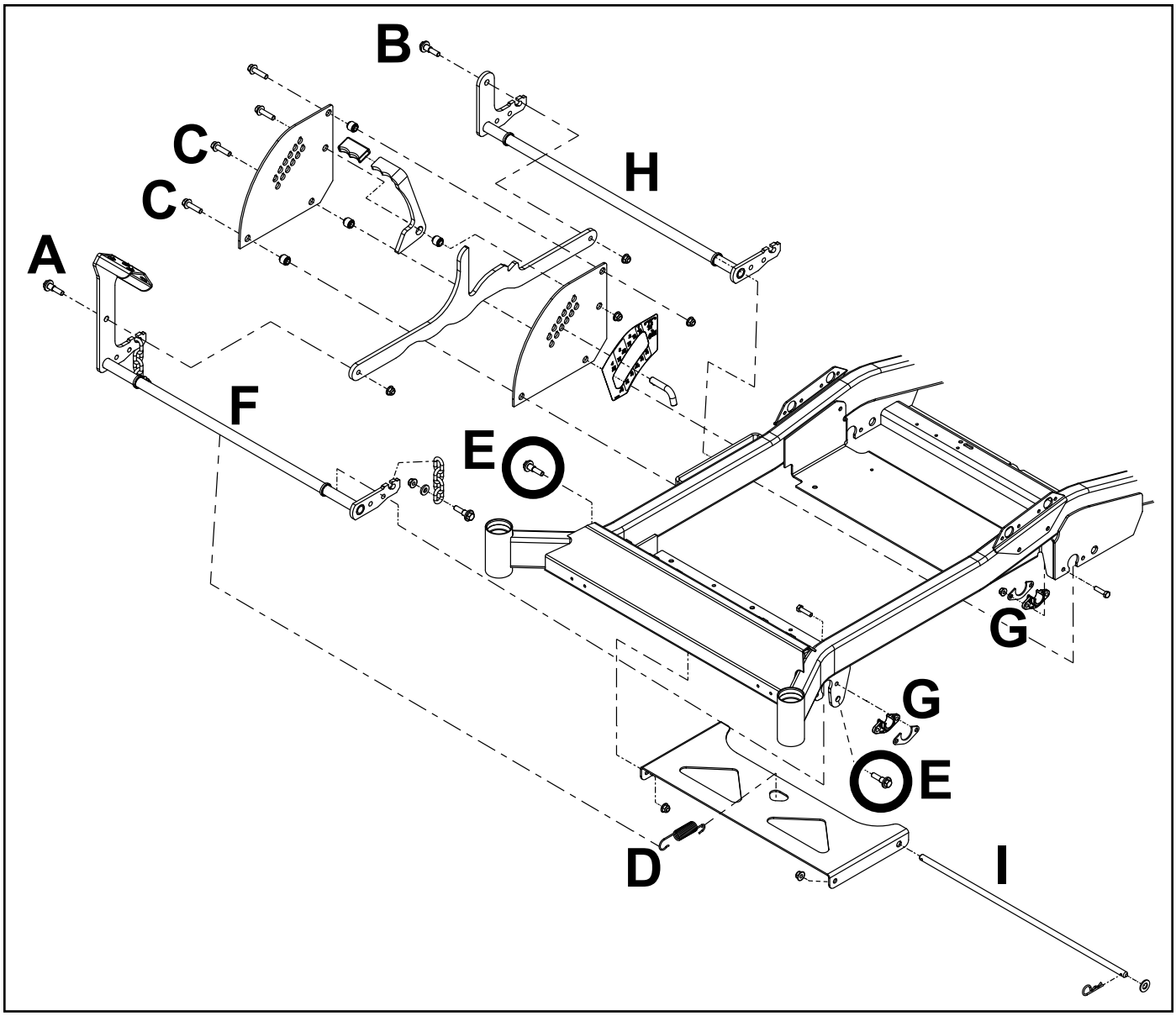


Fig. 041 PICT-3017

Parking Brake & Linkage Service

Parking Brake & Linkage Removal

1. Tilt seat forward, disconnect and remove the battery.
2. Remove the LH control cover to access the parking brake handle area.
3. Remove the parking brake pin and washer (A). Remove the parking brake link from the handle stud.
4. Remove fastener (B) that secures the parking brake handle to the control box assembly. Remove the handle from the unit (Fig. 042).

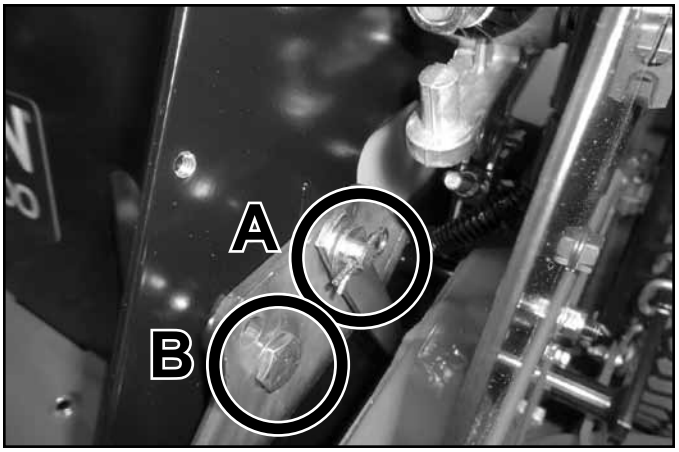


Fig. 042 PICT-3011

5. Remove the brake return spring (C) and the clip and washer (D) from the brake rod on the hydro (Fig. 043).

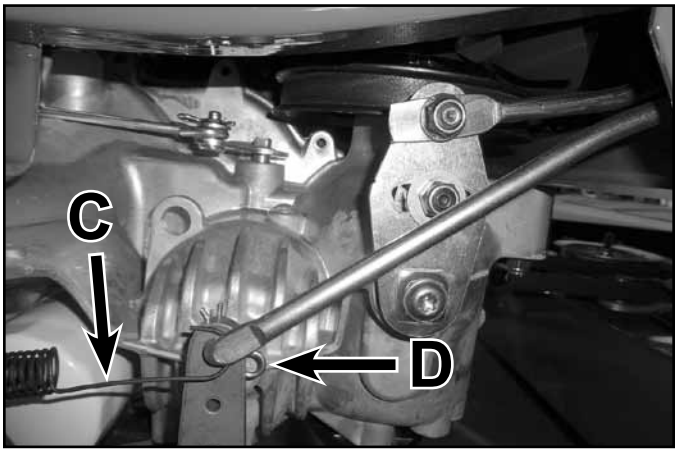


Fig. 043 PICT-3030

6. Remove all of the clips and washers (E), then remove the (3) linkage rods from the chassis.
7. Remove the (2) cotter pins (F), (2) washers and (2) bushings (G) from the brake bell crank (H) (Fig. 044).

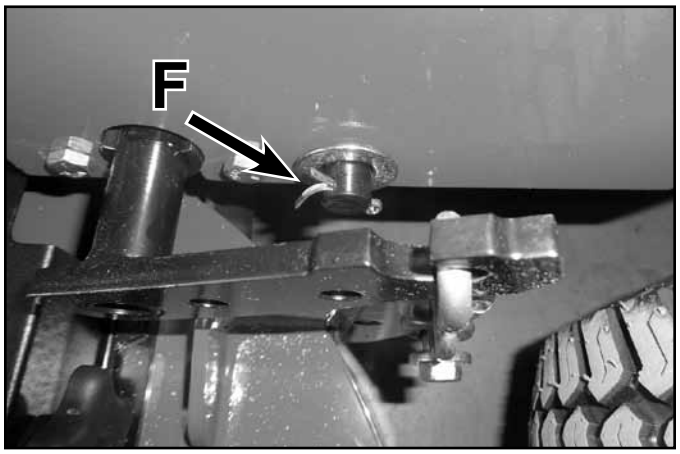


Fig. 044 PICT-3018

8. Slide the brake bell crank (H) to one side and remove the bell crank from the frame.
9. Inspect all linkage rods, pivot points and bushings for excessive wear, replace if necessary.

Parking Brake & Linkage Installation

1. Position the brake bell crank (H) into the frame pivot holes.
2. Install the pivot bushings (G), washers and cotter pins to secure the bell crank into the frame.
3. Install the (3) linkage rods to the bell crank and install retaining washers and clips.
4. Install the brake return spring (C) (Fig. 045 and 046).

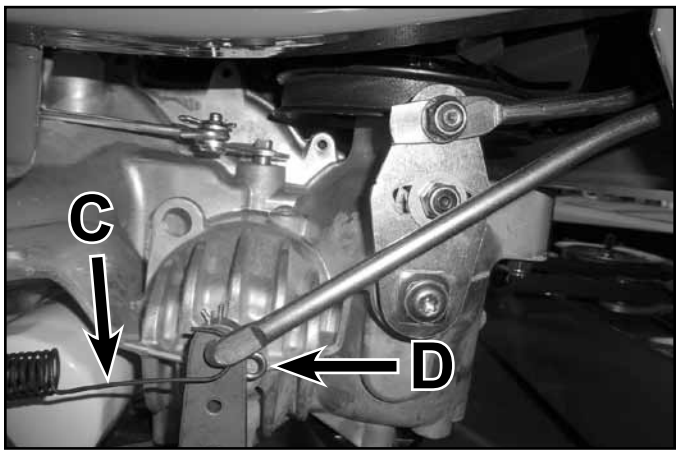


Fig. 045 PICT-3030

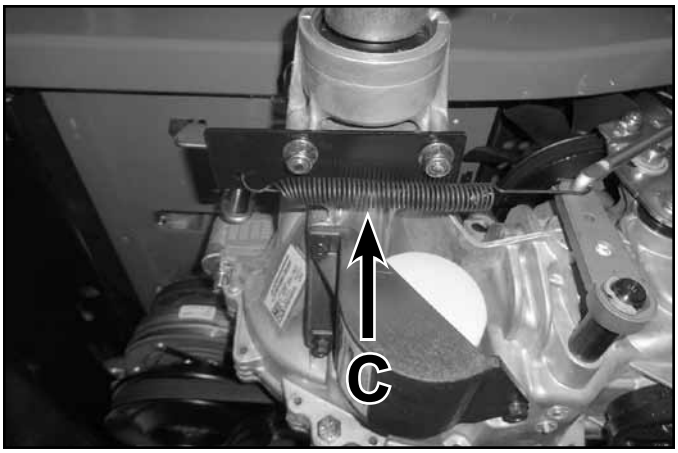


Fig. 046 PICT-3037

5. Lubricate the brake handle pivot bolt (B) friction surface with a light coating of engine assembly lube.
6. Install the parking brake handle into the motion control box and torque the mounting fastener (B) to specification – 17 ft-lbs. (23 Nm).
7. Install the parking brake linkage rod to the handle stud using the washer and clip (A).
8. Install the LH control cover and torque the (1) mounting fastener to specification - 5 ft-lbs. (7 Nm).
9. Install and connect the battery.
10. Verify proper parking brake function. (Fig. 047)

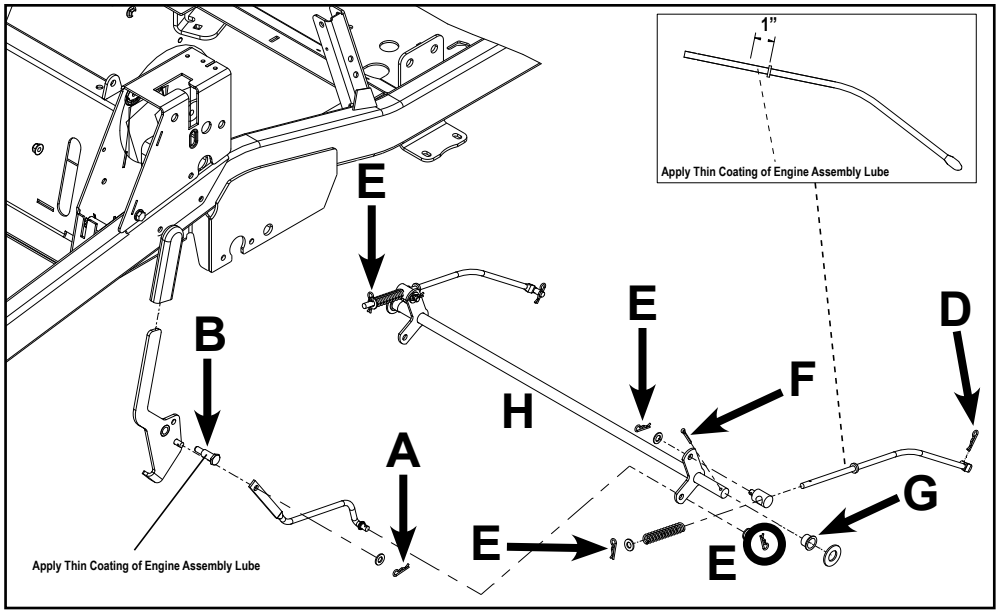


Fig. 047 PICT-2078

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Engine Replacement

Note: For engine service information, please see the service information provided by the engine manufacturer.

PTO Clutch & Clutch Stop Mounting (All Models)

(Fig. 048)

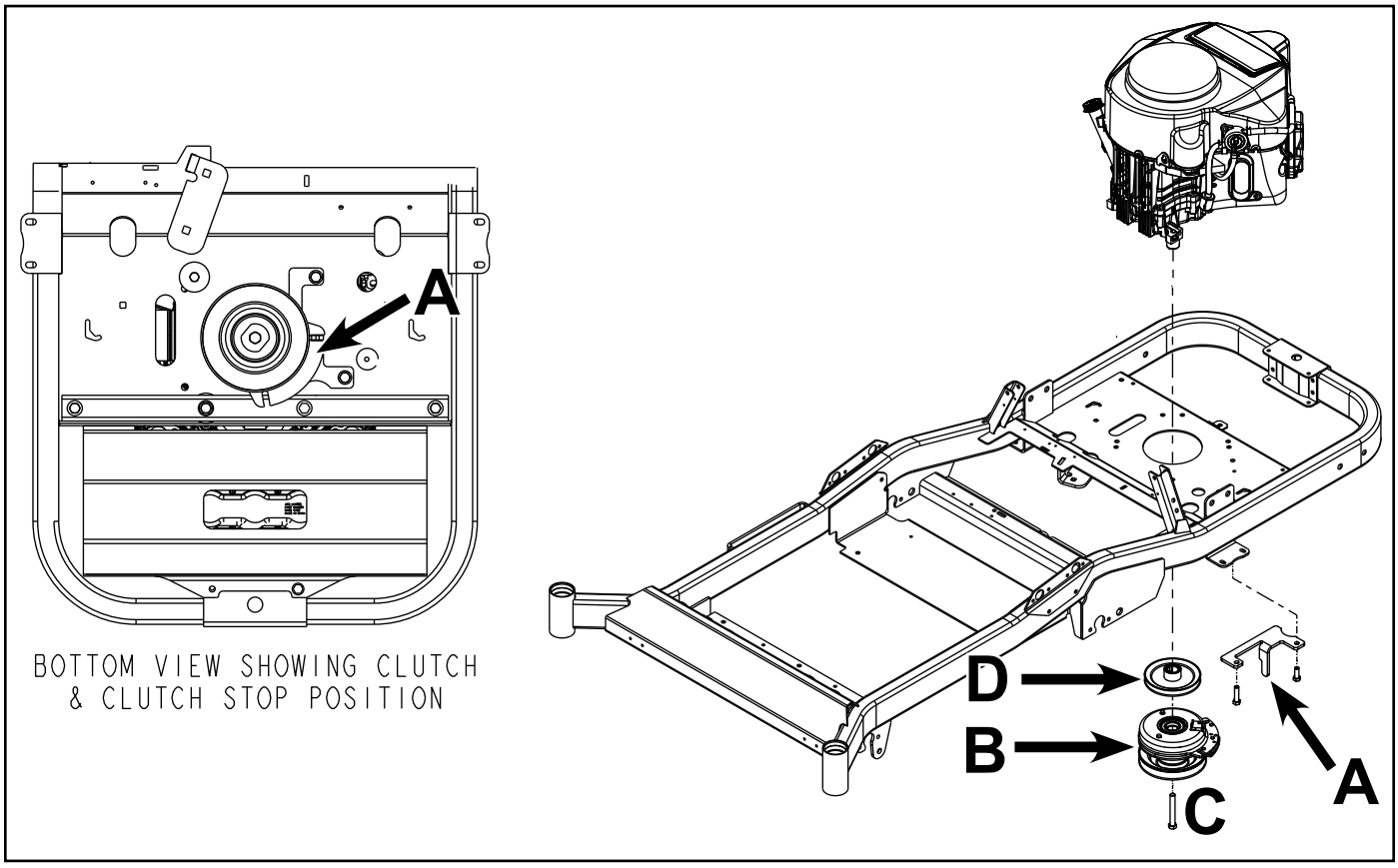

Fig. 048 PICT-3024

A. Clutch stop bracket
B. PTO clutch
C. PTO clutch bolt - apply Loctite® 242 - 55 ft-lbs. (76 Nm)
D. Drive pulley - marked for orientation

Engine Mounting Exploded View

Engine Mounting – Kawasaki Engine
(Fig. 049)

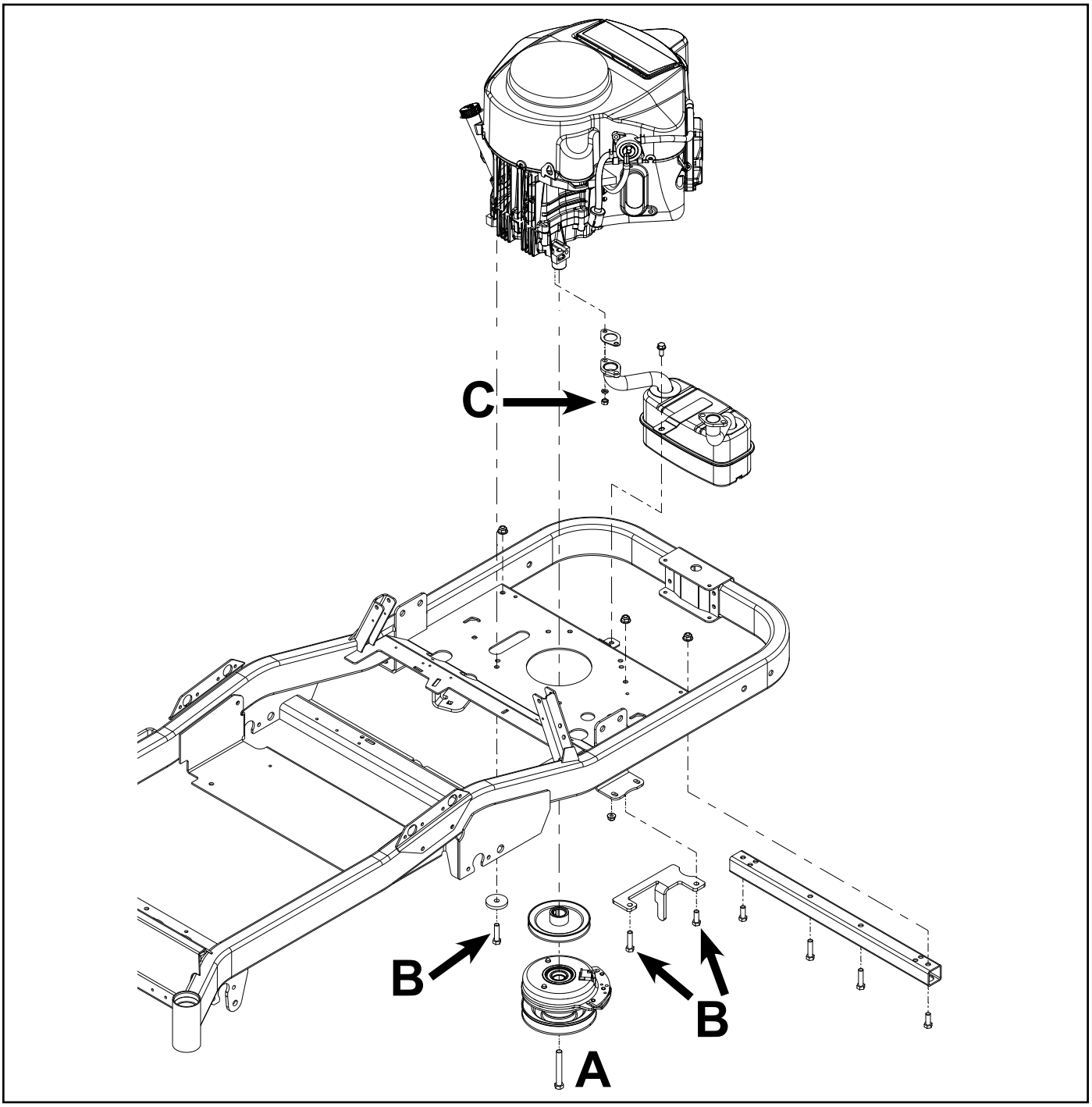

Fig. 049 PICT-3025

A. PTO clutch bolt - apply Loctite® 242 - 55 ft-lbs. (76 Nm)
B. Engine/clutch stop mounting bolts - Loctite 242 - 33 ft-lbs. (44 Nm)
C. Muffler to engine fastener - 13 ft-lbs. (17.5 Nm)

Engine Removal

1. Raise seat and disconnect battery terminals.

2. Safely raise and support rear of unit so rear wheels are off the ground.

3. Remove PTO belt tensioner spring (A) from the deck to relieve PTO belt tension (Fig. 050). See PTO Belt Replacement 48, 54 & 60 Inch Deck on page 6-5.

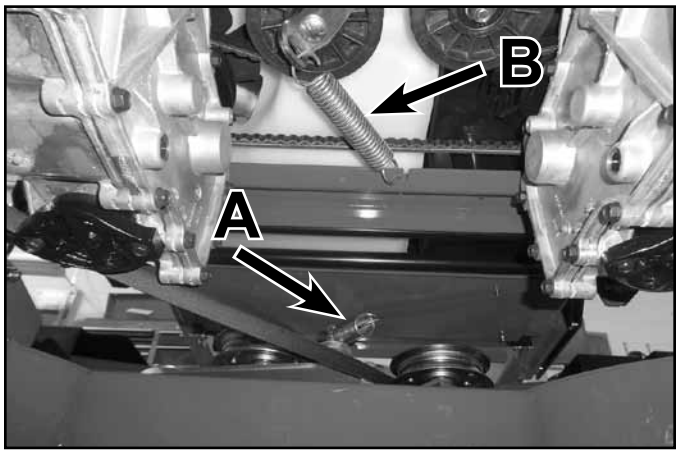

Fig. 050 PICT-3028

4. Remove PTO belt from PTO clutch.

5. Disconnect the wire harness connection from the PTO clutch.

6. Remove the PTO clutch bolt and then remove the clutch from the engine crankshaft.

7. Remove the drive belt tensioner spring (B) (Fig. 050).

8. Remove the belt from around the crankshaft drive pulley and remove the drive pulley from the engine crankshaft. Make note of pulley orientation for assembly.

9. If necessary, remove rear engine guard.

10. Remove the fasteners that secure the heat shield to the muffler and frame and remove the heat shield. If necessary, remove the muffler from the engine.

11. Remove the (4) engine to frame mounting bolts. Make note of clutch stop bracket (C) mounting and orientation (Fig. 051).

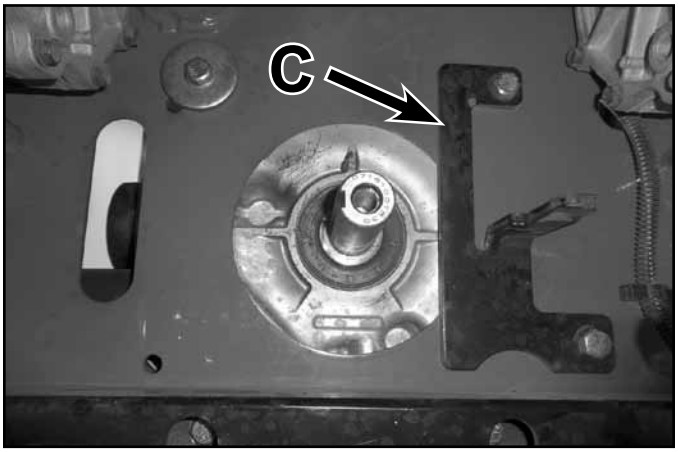

Fig. 051 PICT-2055

12. Safely disconnect the fuel and vent lines from engine.

13. Remove the throttle and choke cable from carburetor linkage.

14. Disconnect the chassis-to-engine electrical connection (D).

15. Disconnect the ground wires from the engine block (E)

16. Disconnect the positive battery cable (F) from the starter motor (Fig. 052).

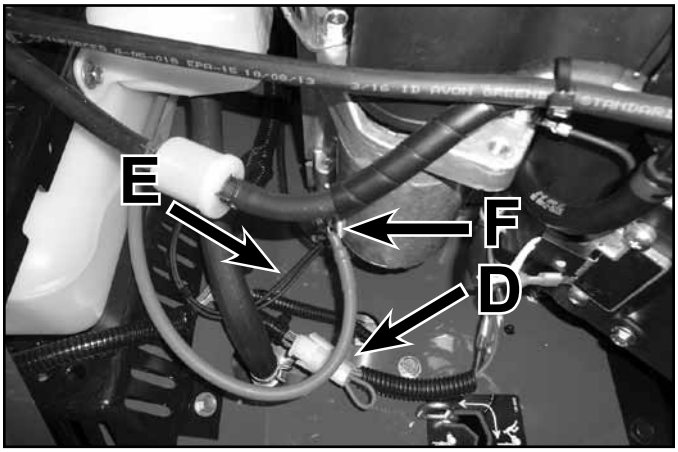

Fig. 052 PICT-3026

17. The engine can now be lifted vertically from the frame.

Engine Installation

1. Position the engine onto the frame.

2. Connect the battery ground wires (E) to the engine block, and connect the positive battery wire (F) to the engine starter motor.

3. Connect the chassis to engine harness connector (D) (Fig. 053).

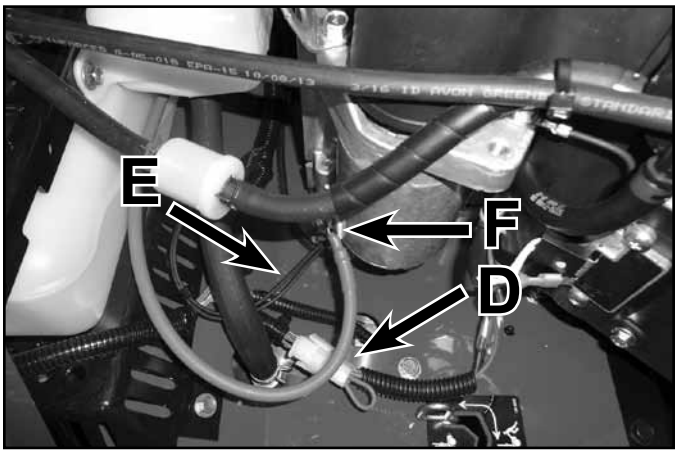

Fig. 053 PICT-3026

4. Install the fuel and vent lines to the engine.

5. Install the throttle and choke cables to carburetor linkage.

6. Apply Loctite® 242 to the (4) engine mounting bolts.

7. By hand, install the (4) engine mounting bolts.

Note: Some of the engine mounting bolts also secure the clutch stop bracket and stiffener tube to the frame. See the exploded views for application and mounting location.

8. In a cross pattern, torque the (4) engine mounting bolts to specification - 33 ft-lbs. (44 Nm).

9. Install muffler and new muffler gaskets, if necessary, to the engine and torque muffler fasteners to specification - 13 ft-lbs. (17.5 Nm).

10. Install heat shield to the muffler mounting screws and torque to specification - 5 ft-lbs. (7 Nm).

11. Install the heat shield and muffler to frame mounting screws and torque to specification - 17 ft-lbs. (23 Nm).

12. Apply anti-seize to the engine crankshaft and the ends of the drive pulley shaft.

13. Install the drive pulley onto the crankshaft and hold in position.

Note: The drive pulley is marked “CLUTCH SIDE” for proper installation (Fig. 054).

Fig. 054 PICT-2044

14. Install the drive belt around the drive pulley.

15. Install the drive belt tensioner spring as oriented below (Fig. 055).

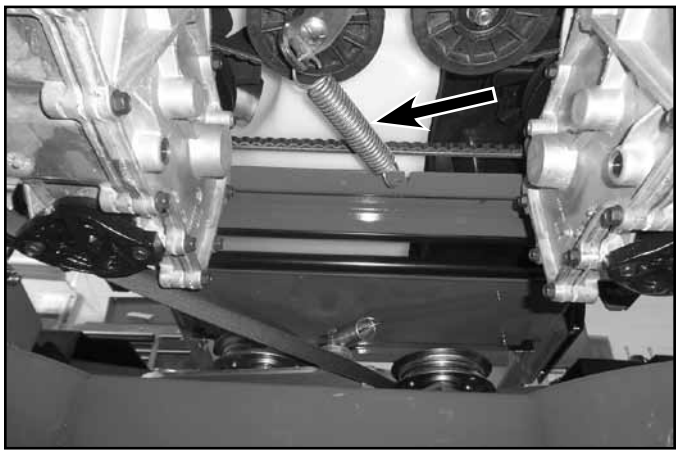

Fig. 055 PICT-3028

16. Apply Loctite® 242 to the PTO clutch bolt threads.

17. Install the PTO clutch onto crankshaft. Be sure PTO clutch engages with the clutch stop bracket.

18. Install and torque the PTO clutch bolt to specification – 55 ft-lbs. (76 Nm).

19. Install PTO belt onto PTO clutch. Verify proper PTO belt routing; see “PTO Belt Replacement and Belt Routing” on page 6-4. Install the PTO belt tensioner spring to the deck.

20. Connect battery cables and verify engine oil level.

21. Safely start engine and verify proper operation.

4

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Hydrostatic Drive Exploded View

(Fig. 056)

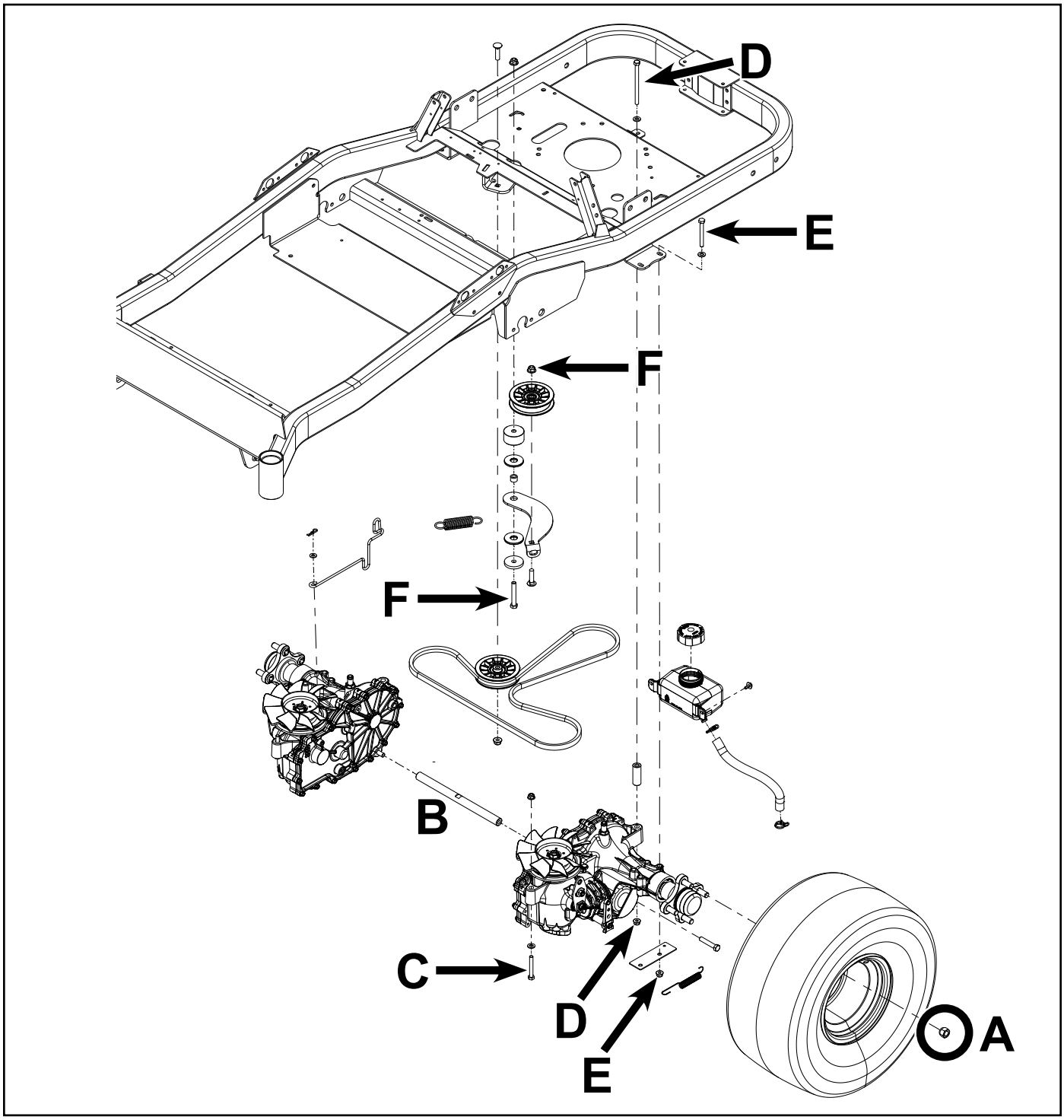
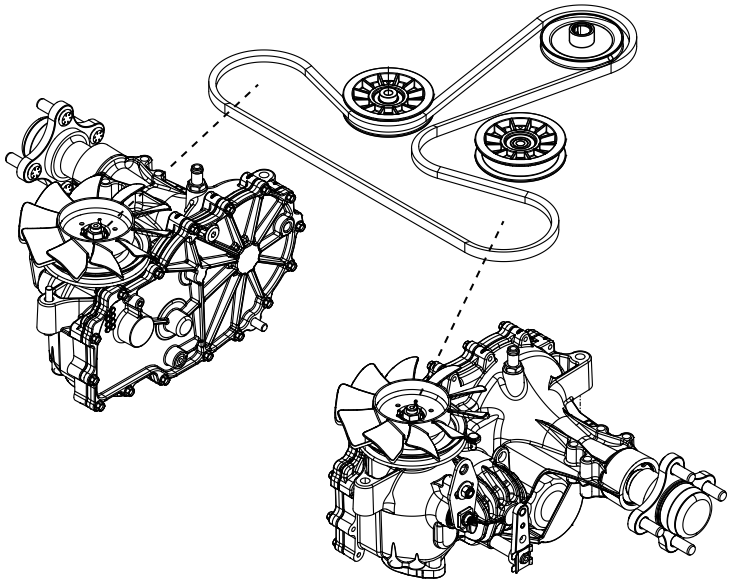


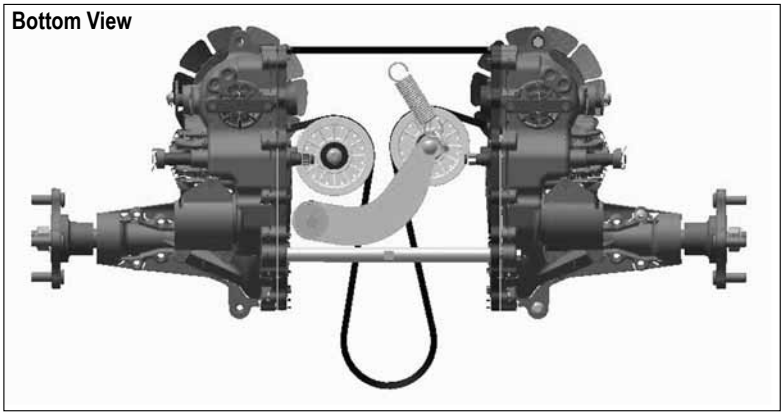
Fig. 056 PICT-2038

A. Lug nuts - 80 ft-lbs. (108 Nm)
B. Center support - apply Loctite® 242 - 17 ft-lbs. (23 Nm)
C. Front hydro mount - 17 ft-lbs. (23 Nm)
D. Rear hydro mount - 17 ft-lbs. (23 Nm)
E. Outside hydro mount - 17 ft-lbs. (23 Nm)
F. 30 ft-lbs. (40 Nm)

Hydrostatic Drive Belt Routing

(Fig. 057)





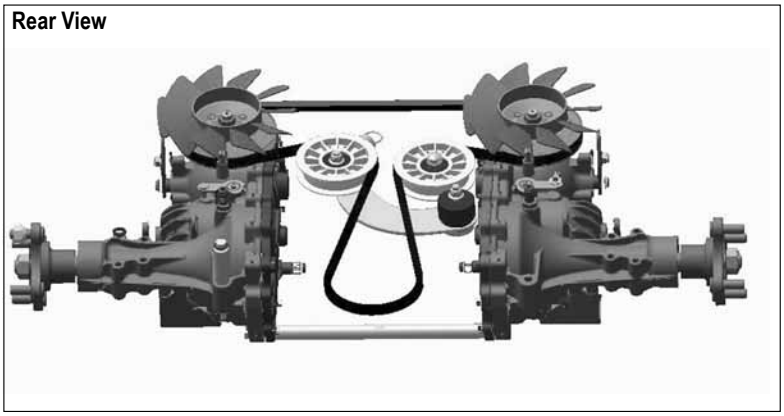


Fig. 057 PICT-2039

Hydro-Gear ZT-3100 Hydrostatic Transaxles

(Fig. 058)

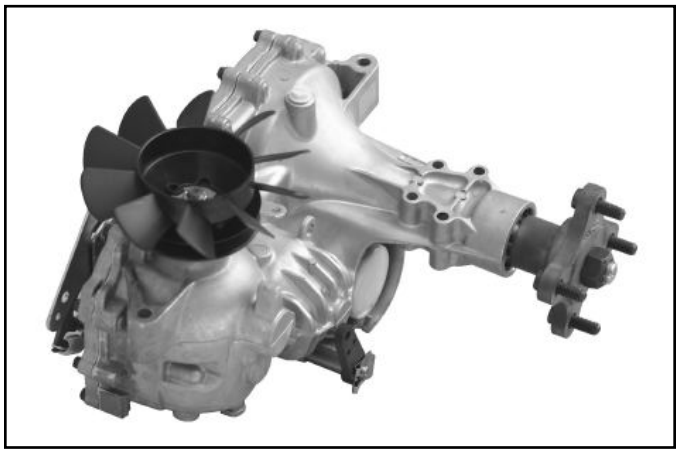


Fig. 058 PICT-1002

Lubrication	Toro HYPR-OIL® 500 or 20w50 Engine Oil
Oil Capacity ZT-3100	77.23 fl. oz. (2284ml) each (not including reservoir or hose volume)
Oil Level Check	Check expansion reservoir and if necessary add the specified oil to the **FULL COLD** line. See illustration below. Also see the Hydro-Gear ZT-2800 / ZT-3100 service manual (BLN-52441).
Fluid Change Interval	After the First 50 hours - change the oil and filters for the hydraulic system and bleed the system. Every 400 Hours - change the oil and filters for the hydraulic system and bleed the system.

5

Checking the Hydraulic Oil Level

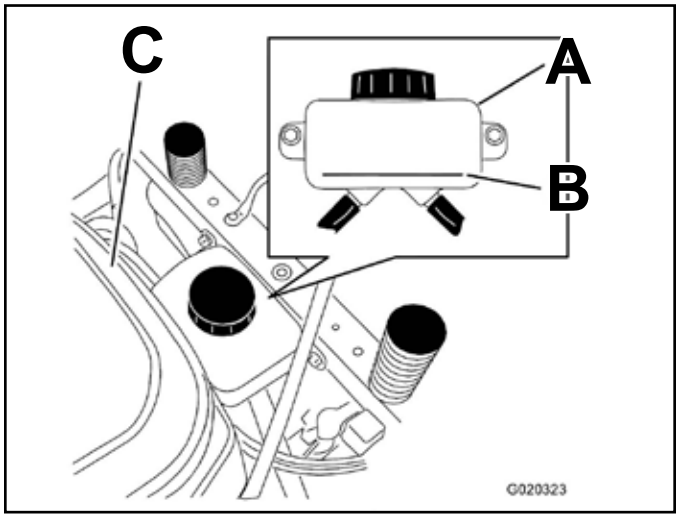


Fig. 059 fig. 51 G020323

A. Expansion reservoir
B. Full cold line
C. Engine

Neutral Adjustment

Note: Do not make neutral adjustments on cold hydrostatic drive systems. Safely warm the drive system before making adjustments.

1. Safely raise and support unit so rear wheels are off the ground.
2. Unplug the seat switch and install a jumper wire across the harness terminals (Fig. 060).

Note: Jumping the seat switch is for testing / adjustment procedures only.

Fig. 060 PICT-6459a

3. Safely start the engine and run at full RPM.
4. Verify the motion control handles are in the outward neutral position.
5. Release the parking brake and observe rear tire movement. If the tire is creeping in either forward or reverse, a neutral adjustment is required (Fig. 061).

Note: A slight amount of reverse creep is acceptable.

Fig. 061 PICT-6486a

6. Turn the engine off.
7. Remove the appropriate control cover (A) (Fig. 062).

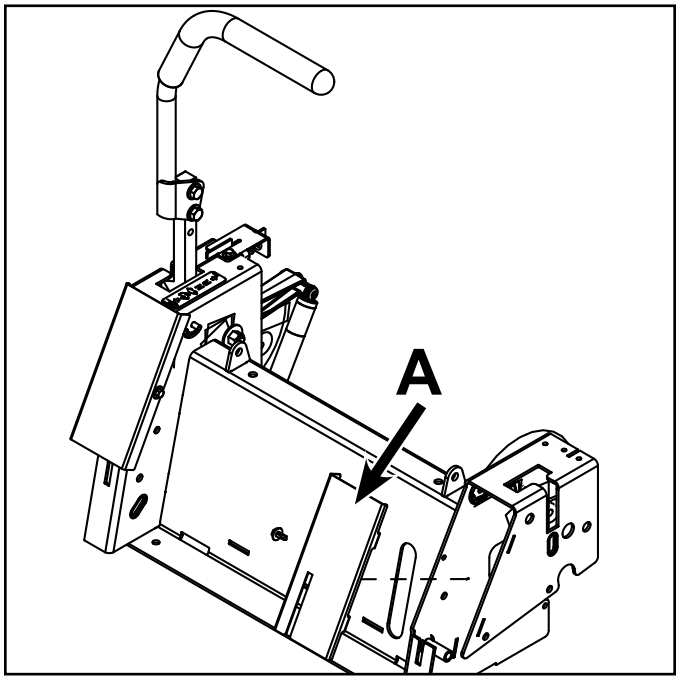


Fig. 062 PICT-3039

8. Turn the adjustment nut (B) clockwise or counter-clockwise until the tire has stopped rotating OR has only a slight creep in reverse (RH side shown).

Note: If the tire is creeping in forward, turn the adjustment nut clockwise, (tighten the nut).

If the tire is creeping in reverse, turn the adjustment nut counterclockwise, (loosen the nut) (Fig. 063) (RH side shown).

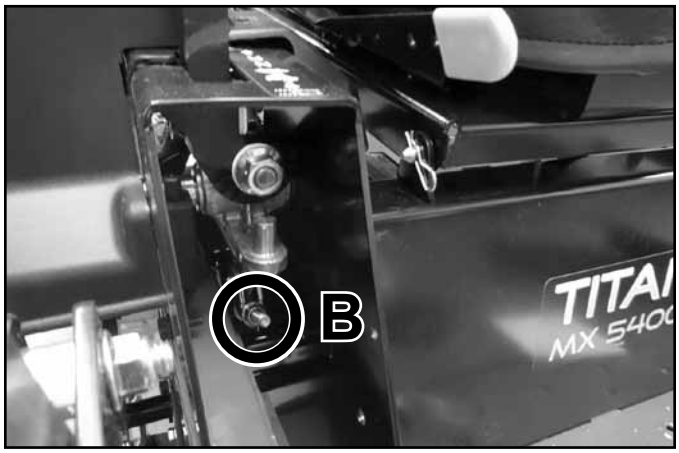


Fig. 063 PICT-3038

9. Safely start the engine and run at full RPM.

9. Stroke the control handles in forward and reverse. Move the control handles into the neutral position and verify the rear wheels do not rotate forward or reverse.

Note: A slight amount of reverse creep is acceptable.

9. Readjust neutral setting if required.

10. Turn engine off.

11. Install the control cover(s) and torque the fastener to specification – 5 ft-lbs. (7 Nm).

12. Remove the seat switch bypass jumper wire and reconnect the seat switch harness connection.

13. Safely lower the unit and verify proper drive system function.

Forward Tracking Adjustment

Note: Always adjust the neutral setting before the tracking adjustment.

Note: Do not make tracking adjustments on cold hydrostatic drive systems. Safely warm the drive system before making adjustments.

If the unit tracks or pulls to the RIGHT:

1. Remove the LH side control cover.
2. Turn the LH adjustment nut 1 full turn CLOCK-WISE (tightening the nut).
3. Test drive unit and verify tracking.
4. If unit still pulls to the right, repeat steps 2 and 3 until unit tracks straight.
5. Install the LH control cover and torque the fastener to specification – 5 ft-lbs. (7Nm).

If the unit tracks or pulls to the LEFT:

1. Remove the RH side control cover.
2. Turn the RH adjustment nut 1 full turn CLOCK-WISE (tightening the nut).
3. Test drive unit and verify tracking.
4. If unit still pulls to the right, repeat steps 2 and 3 until unit tracks straight.
5. Install the RH control cover and torque the fastener to specification – 5 ft-lbs. (7Nm) (Fig. 064) (RH side shown).

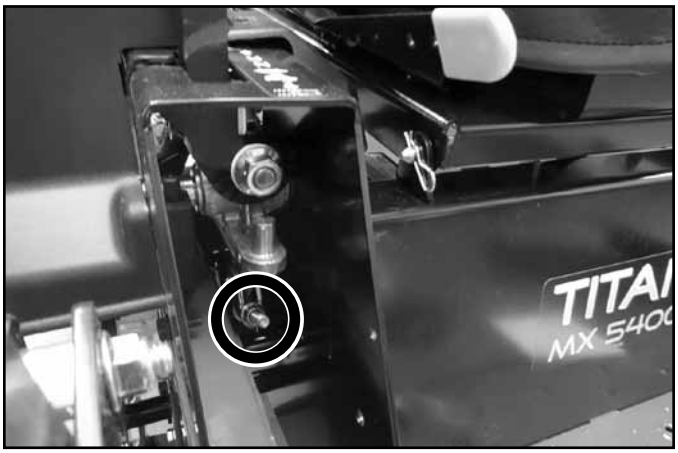


Fig. 064 PICT-3038

Purging Procedure

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

This purge procedure should be implemented any time a hydrostatic system has been opened to facilitate maintenance, any additional oil has been added to the system, or a replacement transaxle has been installed.

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

The resulting symptoms of air in hydrostatic systems may be:

- Noisy operation
- Lack of power or drive after short term operation.
- High operation temperature and excessive expansion of “oil”; in the latter case, oil may overflow.

The following procedure should be performed with the drive wheels off the ground and then repeated under operating conditions.

1. With the bypass valve open (push position) and the engine running, slowly move the control handles (forward/reverse levers) in both forward and reverse directions 5 to 6 times; as air is purged from the transaxles, the oil level will drop.
2. With the bypass valves in the closed position (drive position) and the engine running, slowly move the control handles in both forward and reverse directions 5 to 6 times.
3. It may be necessary to repeat steps 1 and 2 until all air is completely purged from the transaxles. When the transaxles move forward at normal speed, purging is complete.

Hydrostatic Drive Belt Replacement

Hydrostatic Drive Belt Removal

1. Safely raise and support unit so rear wheels are off the ground.
2. Remove PTO belt tensioner spring (A) from the deck to relieve PTO belt tension (Fig. 065). See “PTO Belt Replacement - 48, 54 & 60 Inc Deck” on page 6-5.

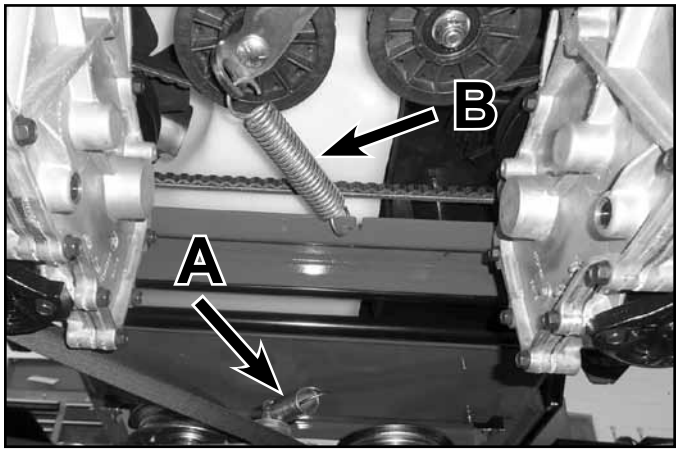


Fig. 065 PICT-3034

3. Remove PTO belt from PTO clutch.
4. Disconnect the wire harness connection to the PTO clutch.
5. Remove the PTO clutch bolt and then remove the clutch from the engine crankshaft.
6. Remove the drive belt tensioner spring (B) (Fig. 065).
7. Remove the belt from around the crankshaft drive pulley then remove the drive pulley from the engine crankshaft. Make note of pulley orientation for assembly.
8. Disengage the drive belt from the tensioner pulley and idler pulley.
9. Remove the belt from around both hydro input pulleys. Do not bend or damage the hydro cooling fans while walking the belt upward off the input pulleys.
10. Remove the belt from the unit and inspect. Replace if necessary.

11. Inspect the idler arm / tensioner pivot and pulley bearings for excessive wear and replace if necessary (Fig. 066).

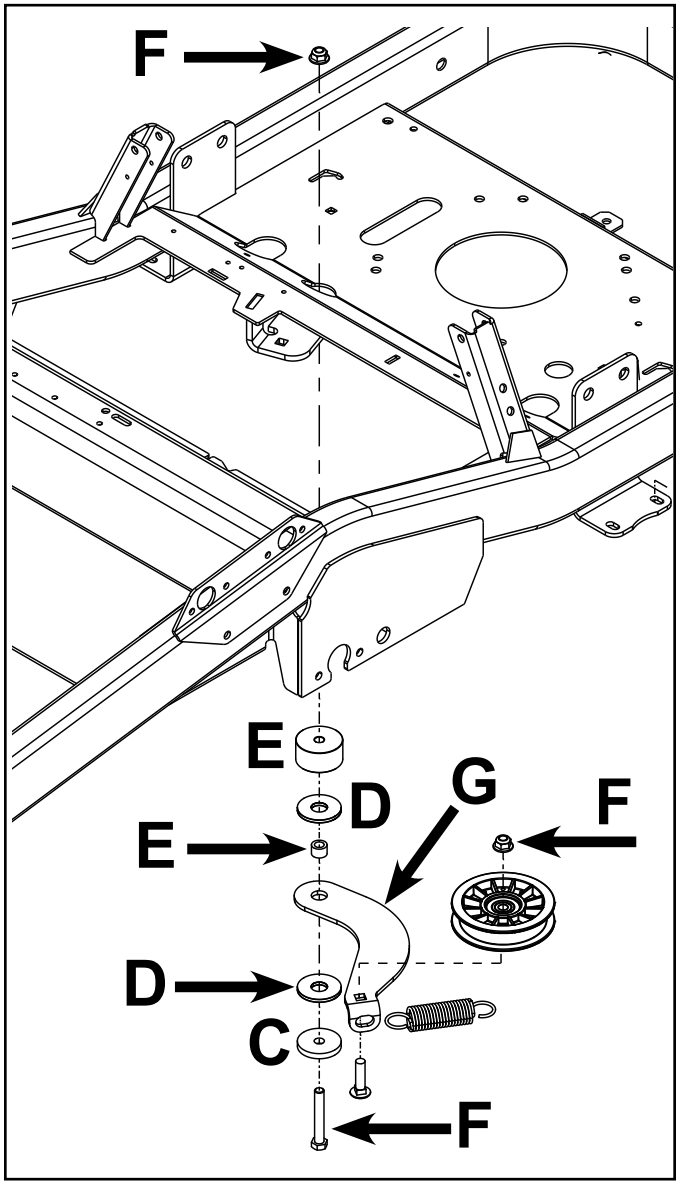


Fig. 066 PICT-2042

C. Washer
D. Friction washer - composite
E. Spacer
F. 30 ft-lbs. (40 Nm)
G. Arm

Hydrostatic Drive Belt Installation

1. Properly route the belt around the (2) hydro input pulleys, and (2) tensioner / idler pulleys (Fig. 067).

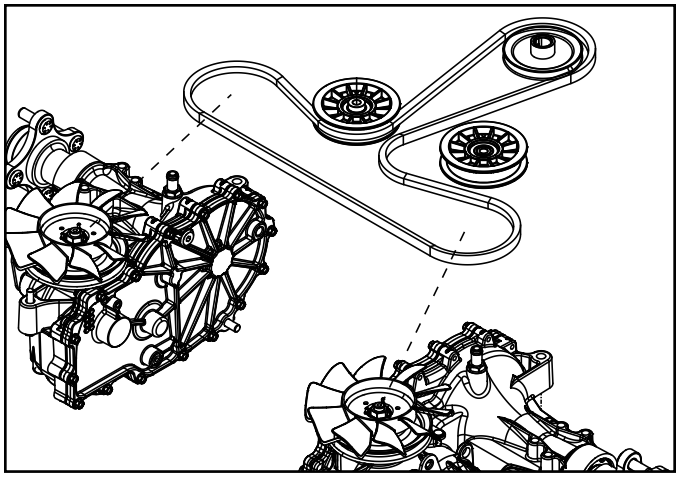


Fig. 067 PICT-2043

2. Install the drive pulley onto the crankshaft and hold in position.

Note: The drive pulley is marked "CLUTCH SIDE" for proper installation (Fig. 068).

Fig. 068 PICT-2044

5

3. Install the drive belt around the drive pulley.

4. Install the drive belt tensioner spring as oriented below (Fig. 069).

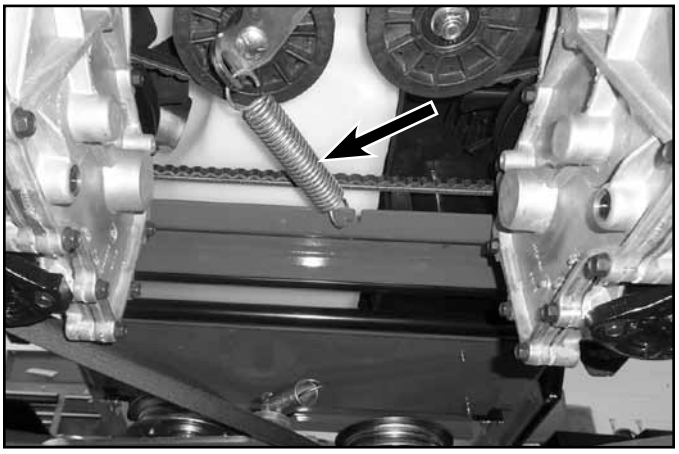


Fig. 069 PICT-3034

5. Apply Loctite® 242 to the PTO clutch bolt threads.

6. Install the PTO clutch. Be sure the PTO clutch stop bracket is properly engaged into the clutch slot (Fig. 070).

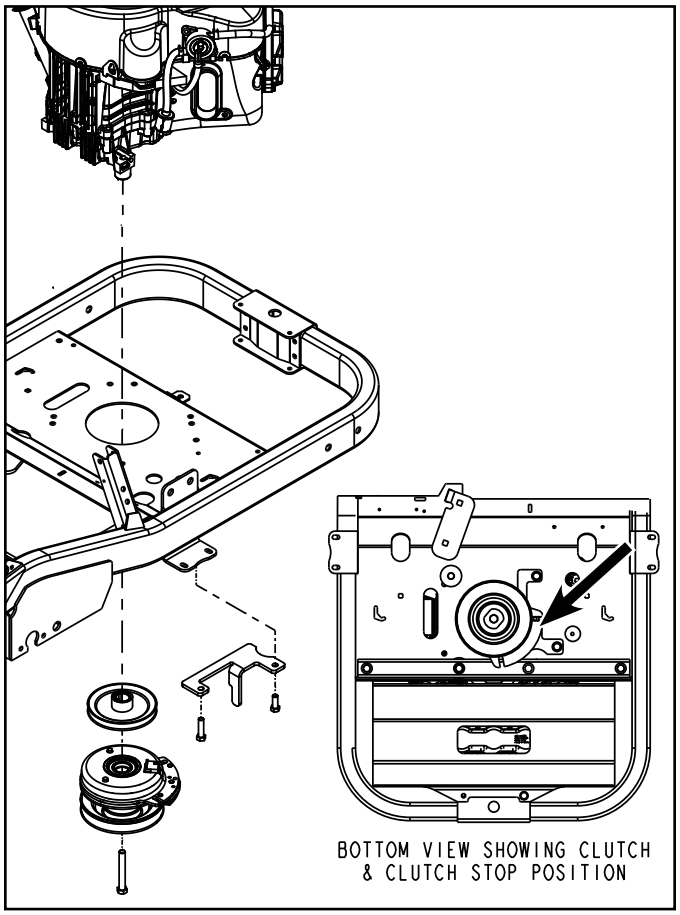


Fig. 070 PICT-3036

7. Torque the clutch bolt to specification - 55 ft-lbs. (75 Nm).

8. Install the PTO belt around the PTO clutch pulley.

9. Verify proper PTO belt routing and then install the PTO belt tensioner spring to the deck. See “PTO Belt Replacement and Belt Routing” on page 6-4.

10. Safely lower unit and verify proper drive system function.

Transaxle Replacement

Transaxle Removal – RH Side Shown

1. Disconnect the battery terminals.
2. Safely raise and support rear of unit so rear wheels are off the ground.
3. Remove the rear wheels.
4. Remove the parking brake return spring (A) from the rod and spring plate.
5. Remove the retaining pin (B) from the brake linkage then remove the brake rod from the hydro arm.
6. Remove the hydro bypass rod (C), retaining clip, and washer then remove the rod from the unit.
7. Remove the hydro control rod nut and bolt (D) (Fig. 071).

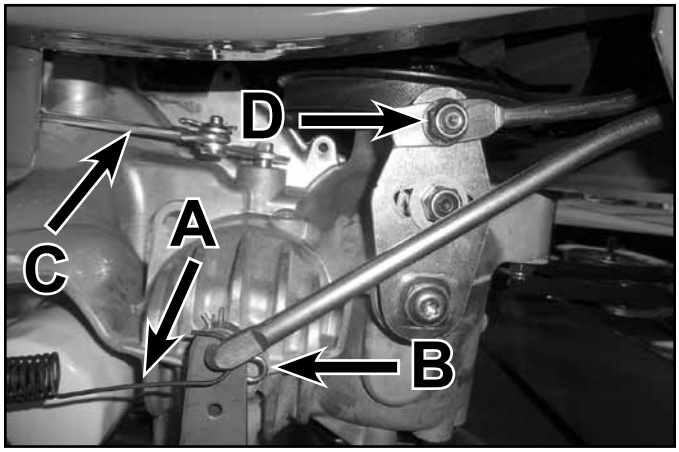


Fig. 071 PICT-3030

8. Remove the drive belt tensioner spring (Fig. 072).

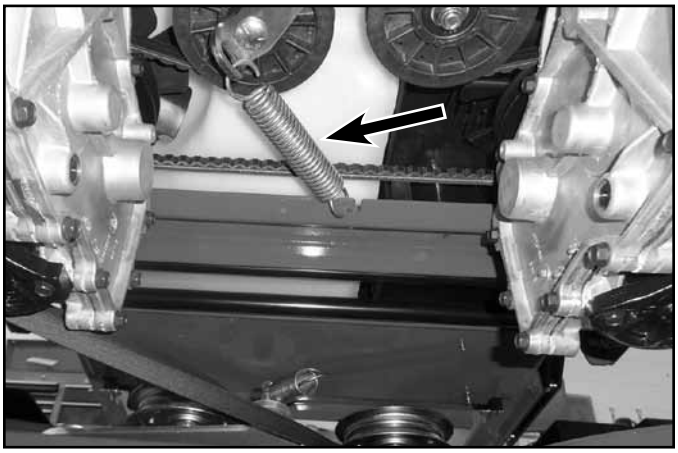


Fig. 072 PICT-3034

9. Slip the drive belt off the idler / tensioner pulleys, then off the appropriate hydro input pulley.
10. Disconnect and plug the hydro reservoir hoses at the hydro fitting. Be sure to capture and dispose of fluid and shop towels properly (Fig. 073).

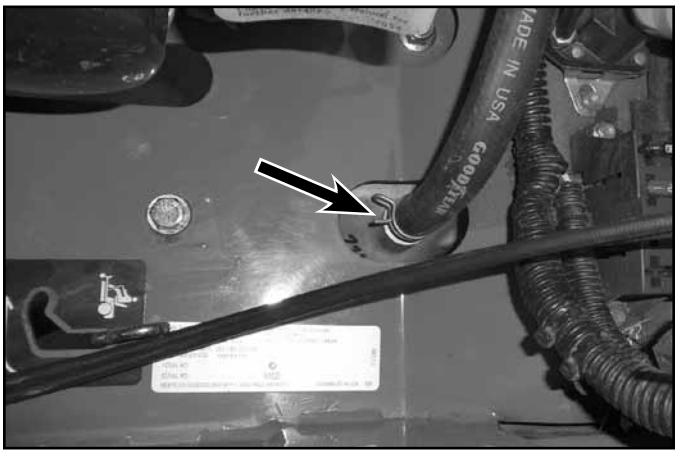


Fig. 073 PICT-2047

11. Remove the (2) bolts that secure hydro center support. Remove support from the unit (Fig. 074).

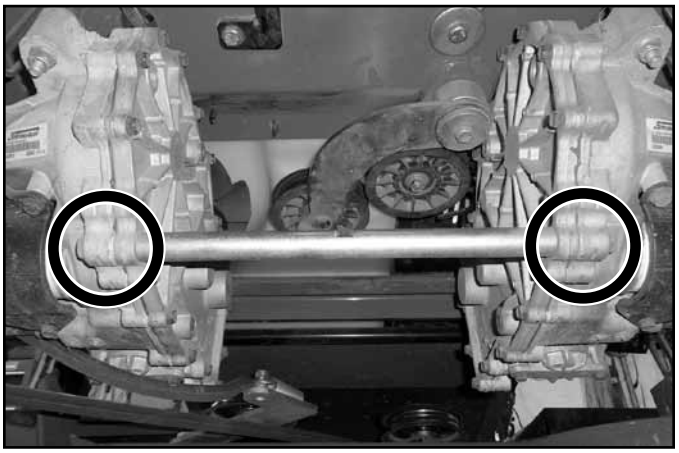


Fig. 074 PICT-2048

12. Safely support hydro assembly in current position using a hydraulic floor jack. Remove the (2) outer hydro mounting fasteners (Fig. 075).

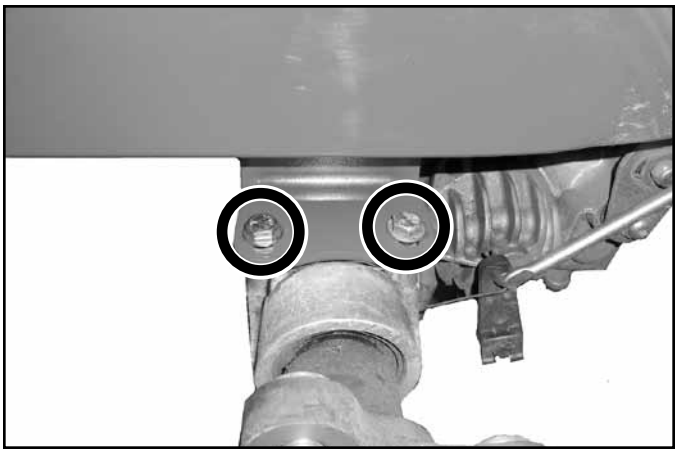


Fig. 075 PICT-2049

13. Remove the (1) front hydro mount fastener (Fig. 076).

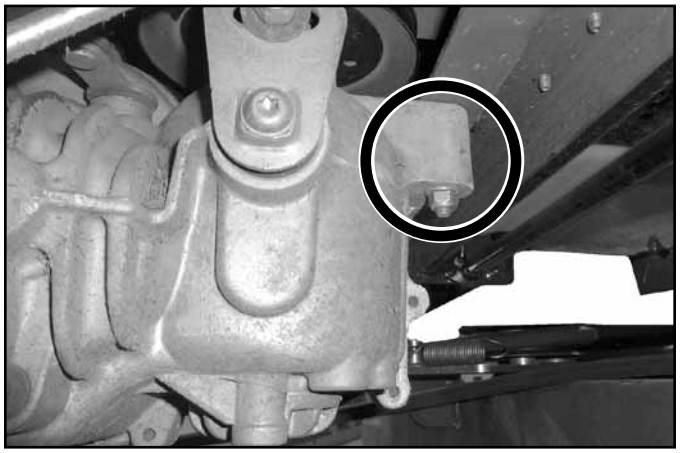


Fig. 076 PICT-2050

14. Remove the (1) rear hydro mounting fastener (Fig. 077).

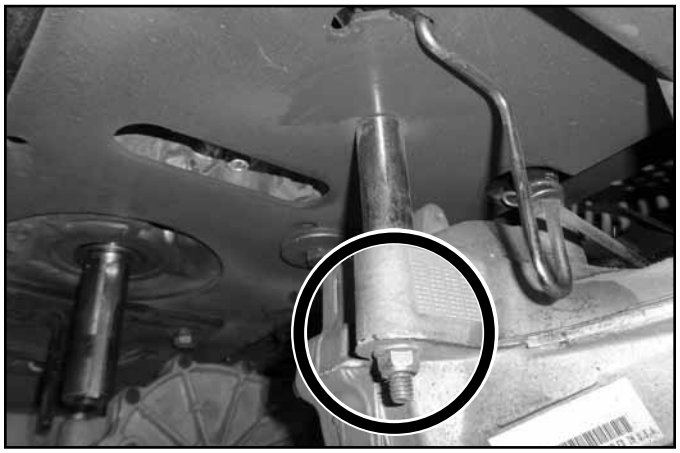


Fig. 077 PICT-2051

15. Lower the hydro assembly then remove it from the frame.

Transaxle Installation

1. Position the hydro assembly up into the unit frame and align mounting points.

2. Apply Loctite® 242 to the (2) hydro center support bolts.

3. Loosely install **ALL** hydro mounting spacers, fasteners and center support bolts. Do not fully tighten at this time.

4. Torque hydro mounting fasteners in sequence to specification and shown:

   1st – Apply Loctite 242 to the hydro center support bolts. Torque bolts to specification – 17 ft-lbs. (23 Nm) (Fig. 078).

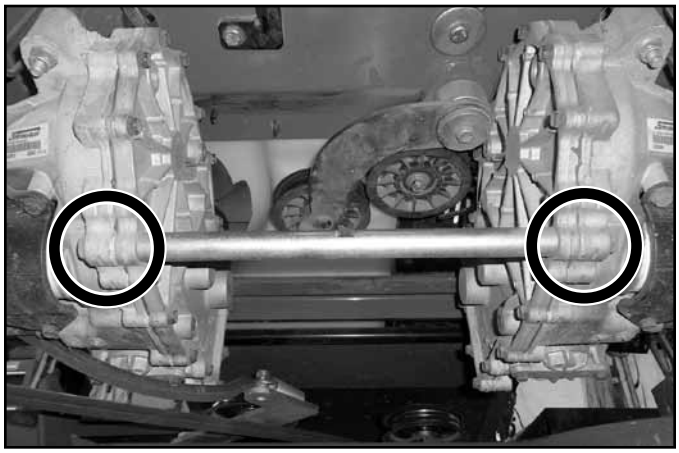


Fig. 078 PICT-2048

2nd - Torque the (1) front hydro mount fastener to specification – 17 ft-lbs. (23 Nm) (Fig. 079).

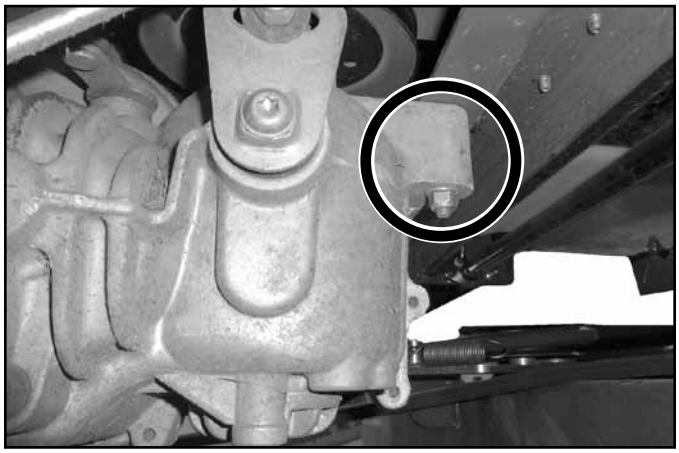


Fig. 079 PICT-2050

3rd – Torque the (1) rear hydro mount fastener to specification – 17 ft-lbs. (23 Nm) (Fig. 080).

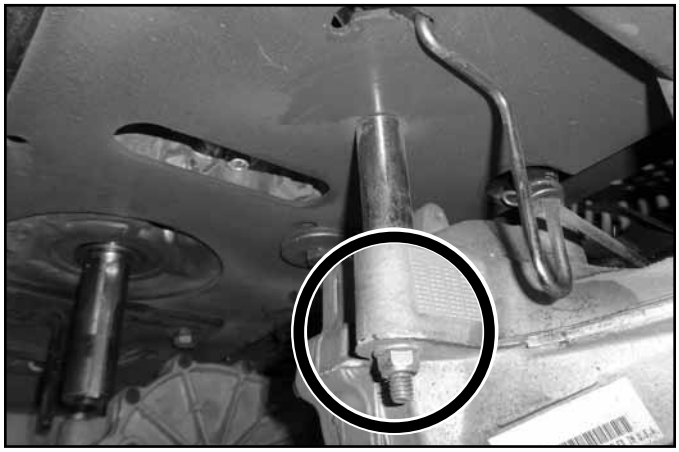


Fig. 080 PICT-2051

4th – Torque the (2) outside hydro mount fasteners to specification – 17 ft-lbs. (23 Nm) (Fig. 081).

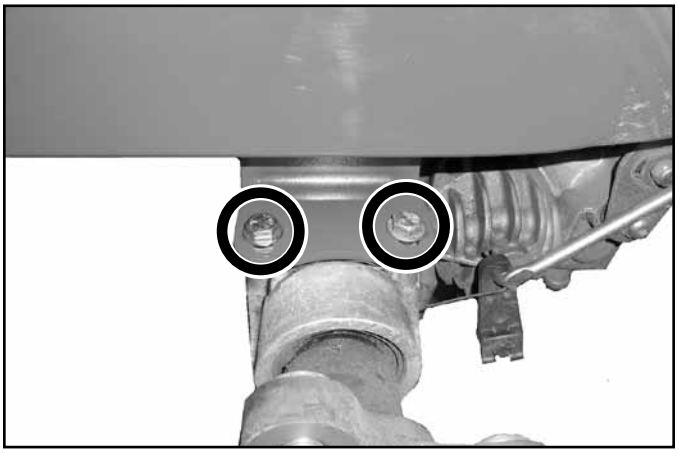


Fig. 081 PICT-2049

5. Connect the hydro reservoir hoses at the hydro fitting (Fig. 082).

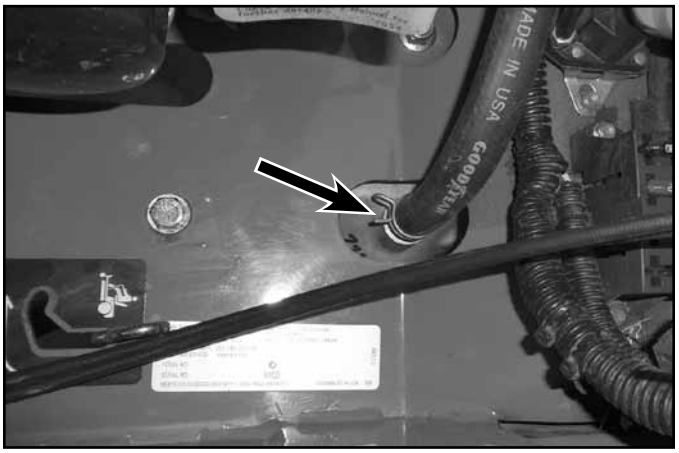


Fig. 082 PICT-2047

6. Install the hydro drive belt and verify proper routing (Fig. 083).

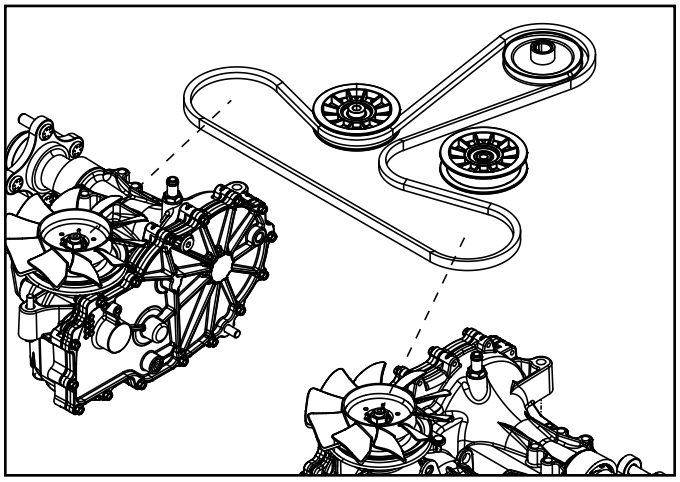


Fig. 083 PICT-2043

7. Install and orient the drive belt tensioner spring as shown (Fig. 084).

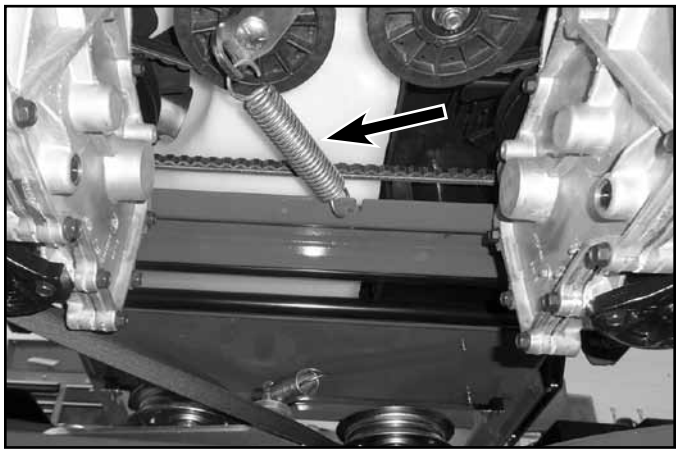


Fig. 084 PICT-3034

8. Install the parking brake return spring (A).

9. Install the brake rod into the hydro arm and insert the retaining pin (B).

10. Install the hydro bypass rod, washer and retaining clip (C).

11. Install the hydro control rod nut and bolt (D) and torque to specification - 17 ft-lbs. (23 Nm) (Fig. 085).

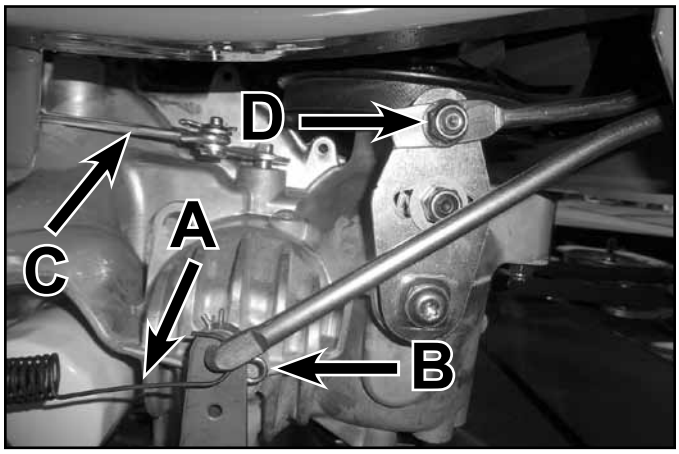


Fig. 085 PICT-3030

12. Install the rear wheels and torque lug nuts to specification – 80 ft-lbs. (108 Nm).

13. Connect battery terminals.

14. Safely lower unit.

15. Add 20w50 engine oil or Toro HYPR-OIL® 500 to the hydro reservoir FULL COLD mark.

16. Perform the purging procedure as shown in this chapter.

17. Perform the neutral and tracking adjustment procedures as shown in this chapter.

18. Verify proper unit oil levels and function.

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Mower Deck Exploded Views

48 Inch Deck

(Fig. 086)

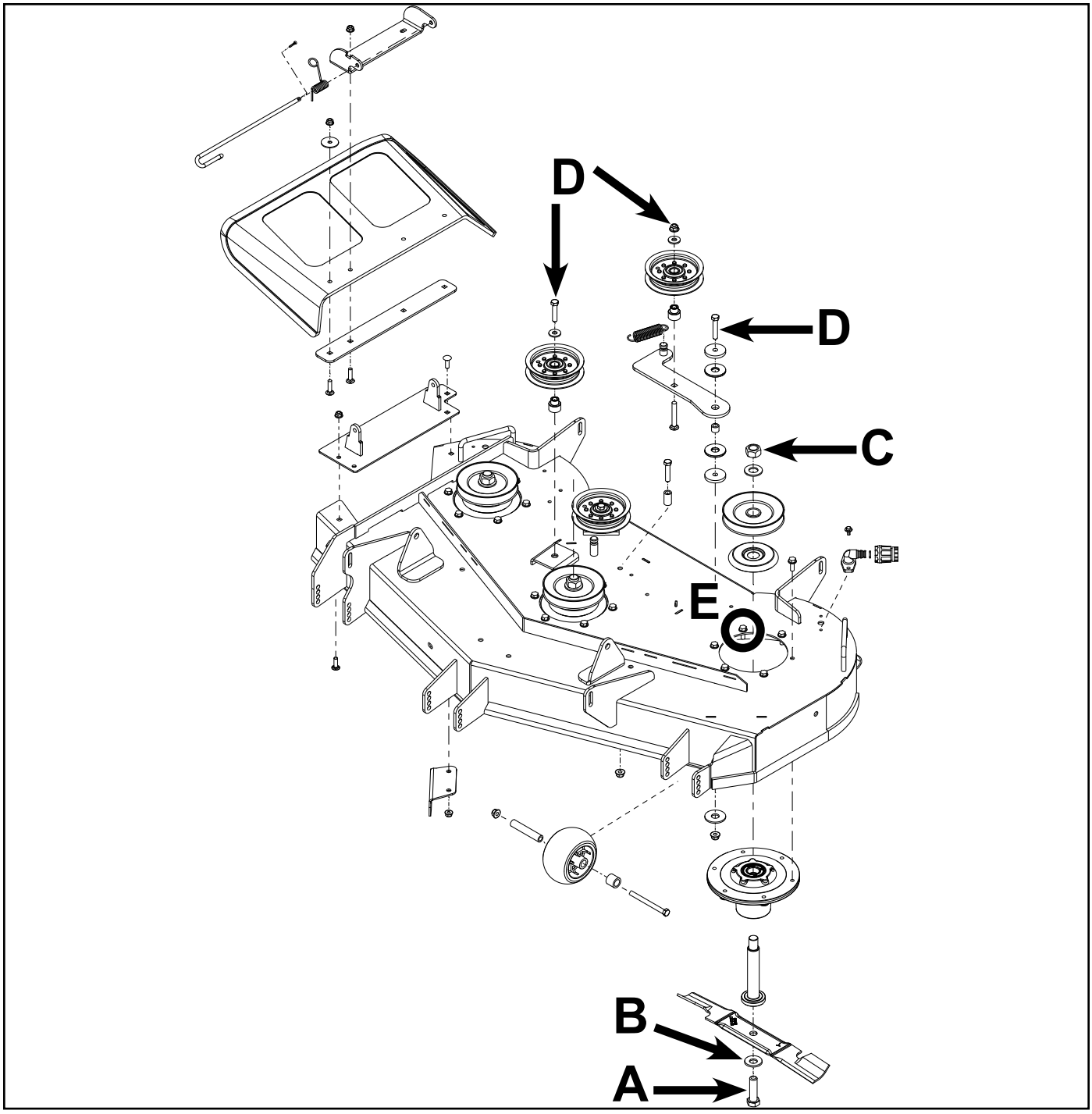

Fig. 086 PICT-3040

A. Blade bolt - 105 ft-lbs. (143 Nm)
B. Washer - concave side towards blade
C. Pulley Nut - 105 ft-lbs. (143 Nm)
D. 30 ft-lbs. (40 Nm)
E. Spindle housing-to-deck bolts - 14 ft-lbs. (19 Nm)

54 Inch Deck
(Fig. 087)

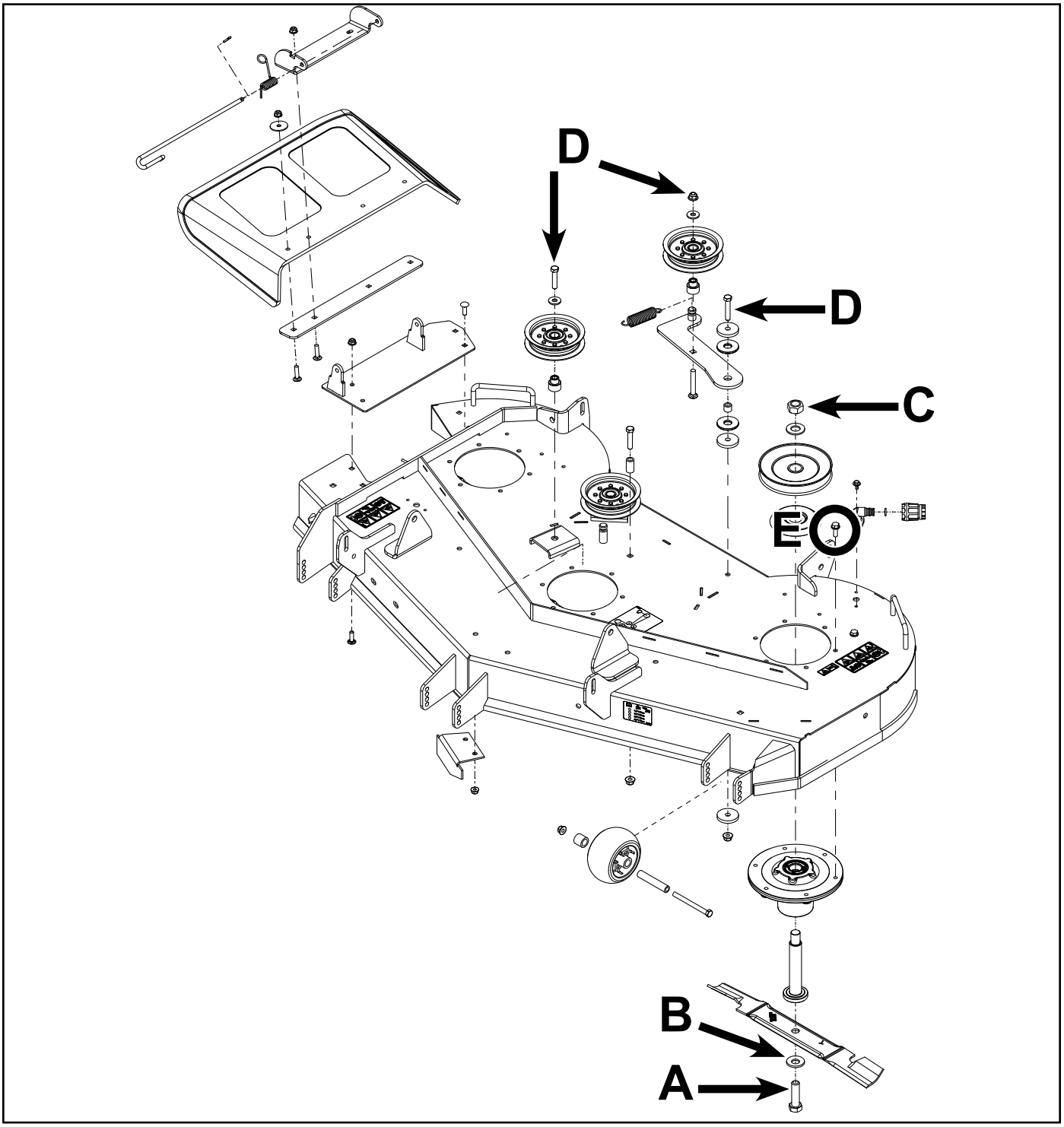

Fig. 087 PICT-3041

A. Blade bolt - 105 ft-lbs. (143 Nm)
B. Washer - concave side towards blade
C. Pulley Nut - 105 ft-lbs. (143 Nm)
D. 30 ft-lbs. (40 Nm)
E. Spindle housing-to-deck bolts - 14 ft-lbs. (19 Nm)

60 Inch Deck
(Fig. 088)

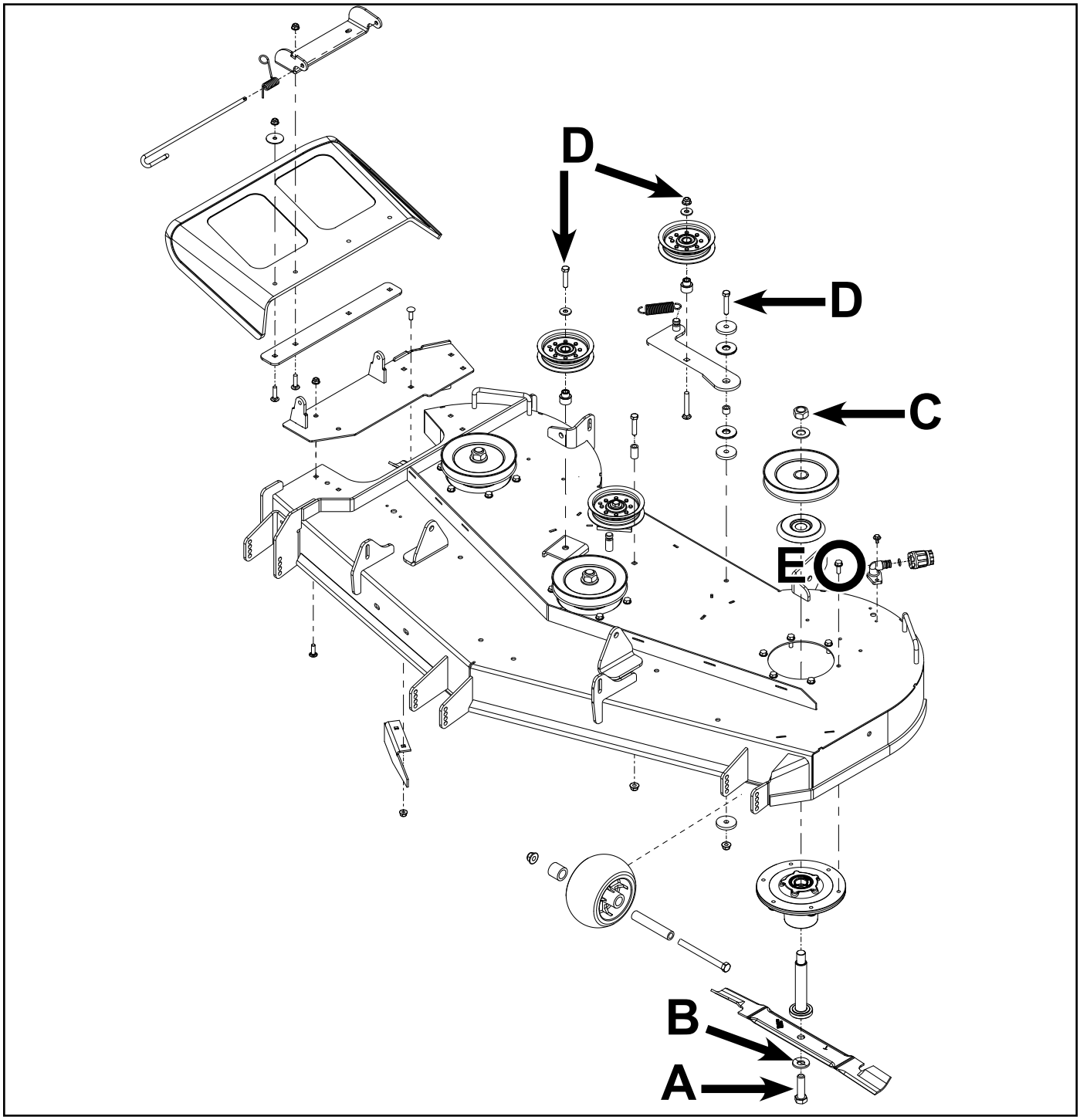

Fig. 088 PICT-3042

A. Blade bolt - 105 ft-lbs. (143 Nm)
B. Washer - concave side towards blade
C. Pulley Nut - 105 ft-lbs. (143 Nm)
D. 30 ft-lbs. (40 Nm)
E. Spindle housing-to-deck bolts - 14 ft-lbs. (19 Nm)

PTO Belt Replacement and Belt Routing

48, 54 & 60 Inch Deck

(Fig. 089)

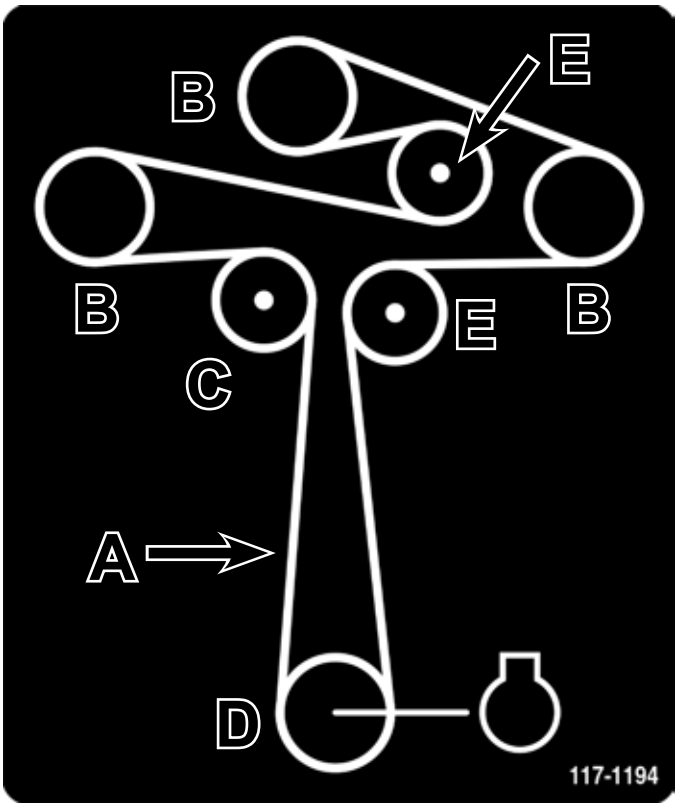

Fig. 089 PICT-2030

A. PTO belt
B. Spindle pulley
C. PTO belt tensioner
D. PTO clutch pulley
E. Stationary idler pulley

Inspecting the Belts

Service Interval: Every 25 hours – Check the belts for wear.

Check the belts for cracks, frayed edges, burn marks or any other damage. Replace damaged belts.

PTO Belt Replacement - 48, 54 & 60 Inch Deck

Squealing when the belt is rotating, blades slipping when cutting grass, frayed belt edges, burn marks and cracks are signs of a worn mower belt. Replace the mower belt if any of these conditions are evident.

1. Disengage the blade control switch (PTO), move the motion control levers to the neutral locked position and set the parking brake.

2. Stop the engine, remove the key, and wait for all moving parts to stop before leaving the operating position.

3. Lower the mower to the 3 inch (76mm) height-of-cut position.

4. Remove the (2) belt covers from the deck.

WARNING

The spring is under tension when installed and can cause personal injury.

Be careful when removing the belt.

5. Lift the floor pan upward into service position to gain access to the belt tensioner / idler pulley. Using a spring tool, (Toro part no. 92-5771), remove the PTO belt tensioner / idler spring from the deck post to remove tension on the idler pulley (Fig. 090).

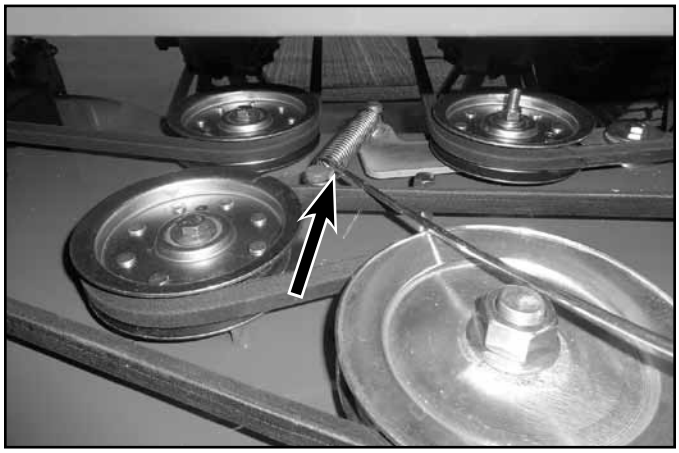

Fig. 090 PICT-3035

6. Lower the mower to the lowest height-of-cut.

7. Remove the belt from the deck and PTO pulleys. Remove the existing belt from the unit.

8. Properly route new belt around the deck pulleys and PTO pulley (Fig. 091).

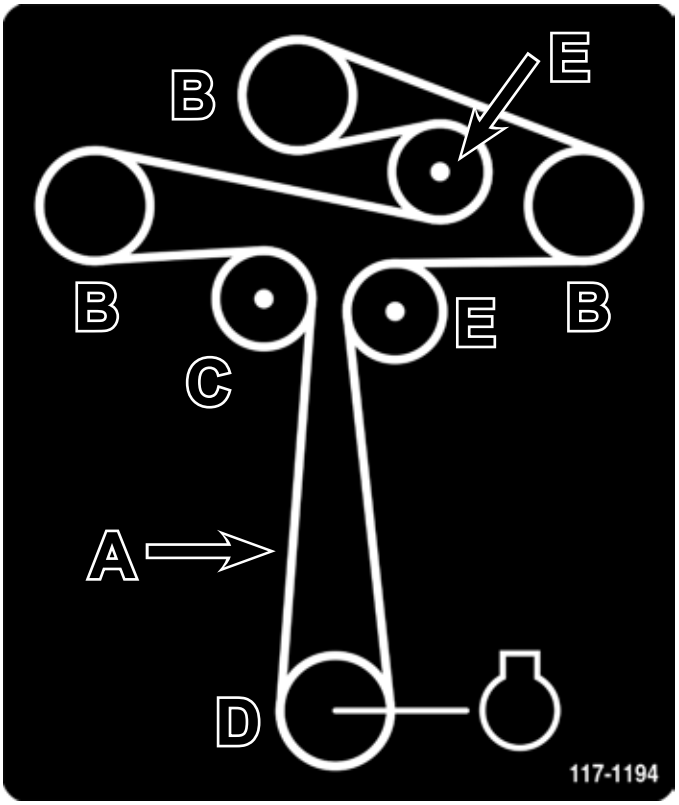

Fig. 091 PICT-2030

A. PTO belt
B. Spindle pulley
C. PTO belt tensioner
D. PTO clutch pulley
E. Stationary idler pulley

9. Using a spring tool, (Toro part no. 92-5771), install the tensioner / idler spring over the deck post to place tension on the idler pulley and mower belt (Fig. 092).

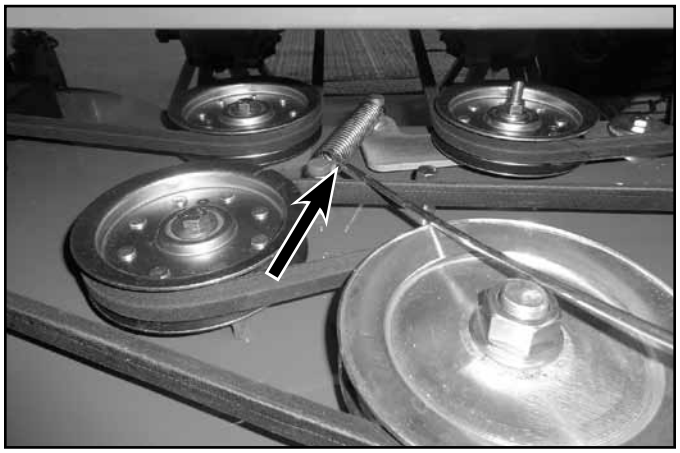

Fig. 092 PICT-3035

10. Ensure that the belt is properly seated in all pulleys.
11. Install the belt covers.
12. Verify proper PTO operation.

Mower Deck Replacement

Mower Deck Removal - 48, 54 & 60 Inch Deck

1. Park the machine on a level surface and disengage PTO switch.
2. Move the motion control levers outward to the neutral position and engage parking brake.
3. Stop the engine, remove the key, and wait for all moving parts to stop before leaving the operating position.
4. Lower the mower to the 3 inch (76mm) height-of-cut position.
5. Remove PTO belt as shown in this chapter.
6. Lower the mower to the lowest height-of-cut.
7. Remove the (2) cotter pins and (2) washer securing the front pivot pin to the deck. Remove the pivot pin from the deck (Fig. 093).

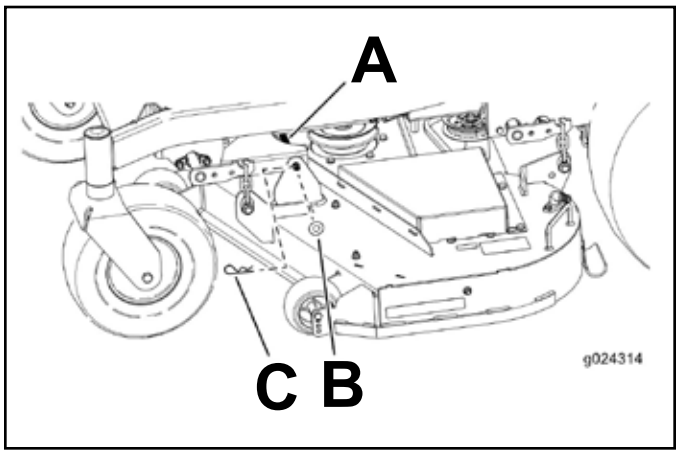

Fig. 093 fig. 65 G024314

A. Link pin
B. Washer
C. Hair pin cotter

8. Safely lift upward on the mower deck to relieve tension from the chain links.
9. Carefully maneuver the top chain link up and off the lift rod hooks. Repeat for the three remaining chain lift points (Fig. 094).

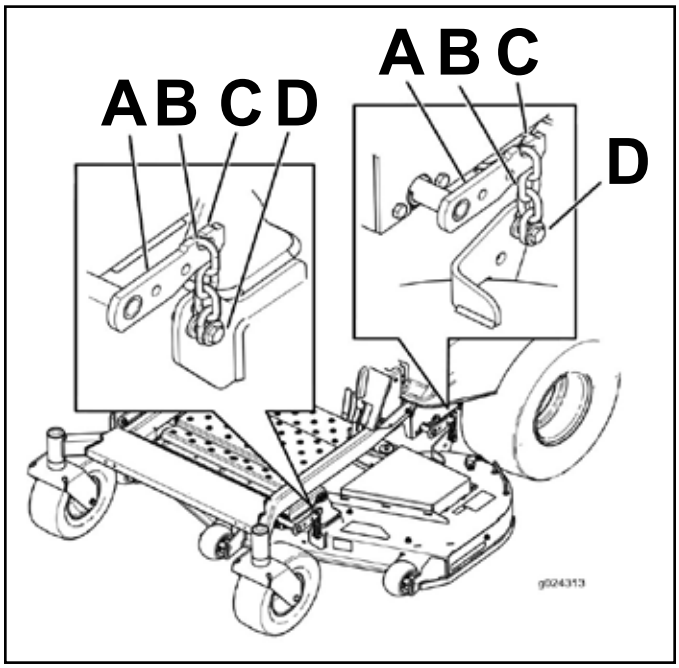

Fig. 094 fig. 66 G024313

A. Deck lift arm
B. Chain
C. Hook
D. Adjustment bolt

10. Raise the height-of-cut to the transport position.
11. Slide the mower out from underneath the machine.

Mower Deck Installation - 48, 54 & 60 Inch Deck

1. Park the machine on a level surface and disengage the PTO switch.
2. Move the motion control levers outward to the neutral lock position, stop the engine, remove the key, and wait for all moving parts to stop before leaving the operating position.
3. Slide deck assembly under the machine.
4. Lower the height-of-cut lever to the lowest position.
5. Safely lift the mower deck and attach the top chain link to the lift arm hooks on all four lift points.
6. Install the front pivot pin, (2) washers and (2) cotter pins.
7. Properly route and install the PTO belt and tensioner spring and shown in this chapter.
8. Level deck if needed as shown in this chapter.
9. Verify proper function.

Spindle Service

Spindle Removal

1. If necessary, remove deck from chassis as outlined in this chapter.
2. Remove belt cover(s) from deck.
3. Remove the PTO belt tensioner spring and disengage the PTO belt from the spindle pulley(s).
4. Safely hold the blade in position and remove the spindle pulley nut (A). Inspect the pulley, bearing shield (B) and spindle shaft for excessive wear and replace if necessary.
5. Remove the (6) fasteners (C) that secure spindle housing to deck shell.
6. Remove spindle assembly from deck.
7. Remove blade bolt (D) and washer.
8. Remove blade.

Spindle Installation

1. Install blade and washer onto spindle shaft. Install and torque blade bolt (D) to specification - 105 ft-lbs. (143 Nm).

Note: Install blade washer so concave surface is towards blade.

2. Install spindle assembly onto the deck shell and torque fasteners (C) to specification - 14 ft-lbs. (19 Nm).
3. Safely hold blade in position.
4. Install the bearing shield (B) and spindle pulley onto the spindle shaft and torque pulley nut (A) to specification - 105 ft-lbs. (143 Nm).
5. If necessary, install deck onto the chassis.
6. Properly route PTO belt, then install the PTO belt tensioner spring.
7. Install belt cover(s) onto deck and sufficiently tighten mounting bolts.
8. Safely verify proper function.

(Fig. 095)

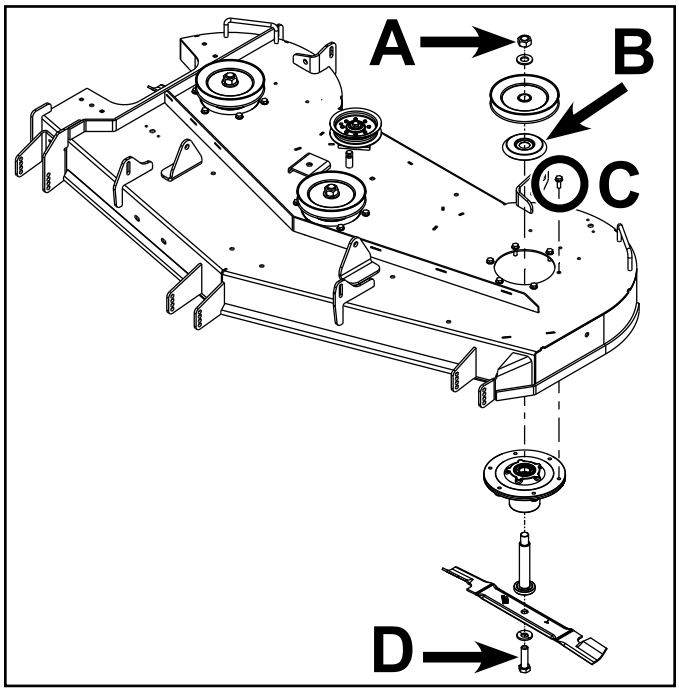

Fig. 095 PICT-3043

A. Pulley nut - 105 ft-lbs. (143 Nm)
B. Bearing Shield
C. Spindle housing-to-deck bolts 14 ft-lbs. (19 Nm)
D. Blade bolt - 105 ft-lbs. (143 Nm)

Spindle Exploded Views

Spindle Assembly - 48, 54 & 60 Inch Deck
(Fig. 096)

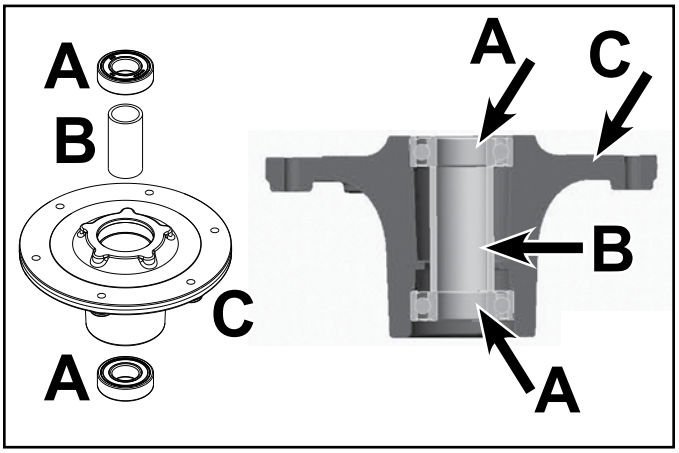

Fig. 096 PICT-2033

A. Bearing
B. Bearing spacer
C. Spindle housing

Spindle Disassembly

1. If necessary, remove deck from the frame as shown in this chapter.
2. Remove mower blade and spindle assembly from deck as outlined in this chapter.
3. Remove spindle shaft (D) from spindle assembly. Inspect for excessive wear and replace if necessary.
4. Use an appropriate punch or bearing extractor to remove the (2) bearings (A) from the spindle housing.
5. Inspect bearing spacer (B) for wear and replace if necessary.
6. Clean and inspect spindle housing (C) bearing bores for excessive wear and replace if necessary.

(Fig. 097)

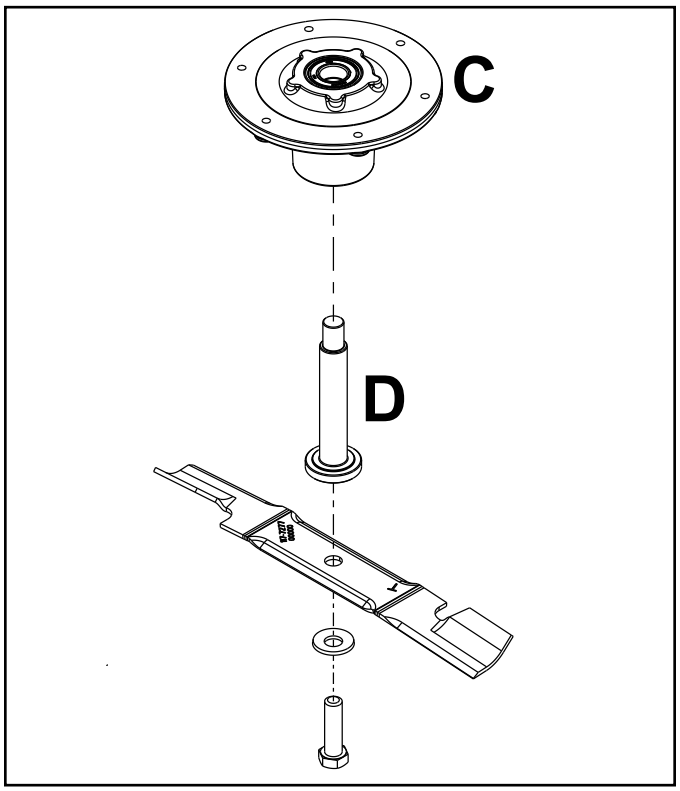

Fig. 097 PICT-2035

Spindle Assembly

1. Fully seat a new UPPER bearing (pulley side) into spindle housing until it contacts the bearing bore shoulder. Be sure to press equally on inner and outer race while installing bearing.

2. Turn spindle housing over.

3. Install the bearing spacer (B) into spindle housing (C).

4. Install a new LOWER bearing (blade side) into spindle housing until it contacts bearing spacer and bore shoulder. Be sure to press equally on the inner and outer race while installing bearing.

Note: While installing lower bearing, align center bore of the bearing spacer(s) with center bore of the bearings.

5. Install spindle shaft (D) into spindle housing.

6. Install spindle assembly to the deck as outlined in this chapter.

7. If necessary, install the deck onto the frame. (Fig. 098)

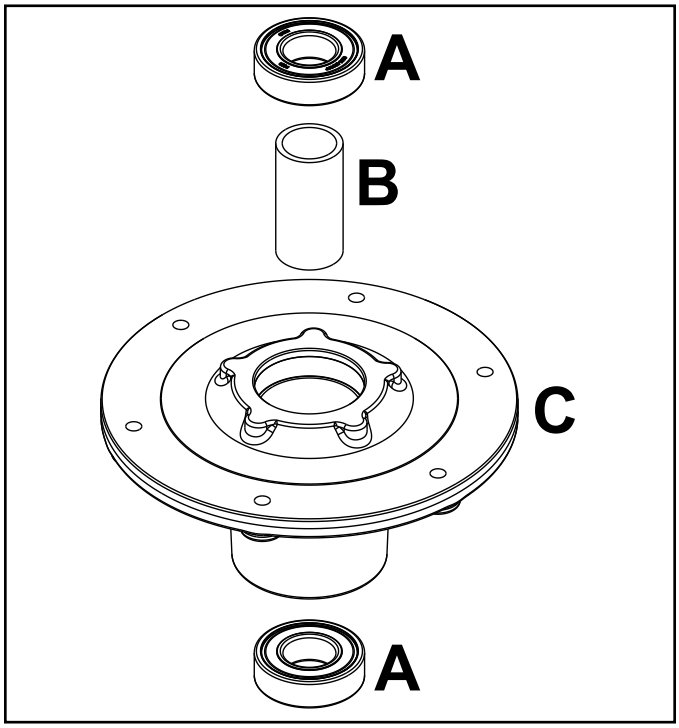

Fig. 098 PICT-2063

A. Bearing
B. Bearing spacer
C. Spindle housing

6

Idler Arm / Deck Belt Tensioner Service

Idler Arm / Tensioner Exploded View - 48, 54 & 60 Inch Deck

(Fig. 099)

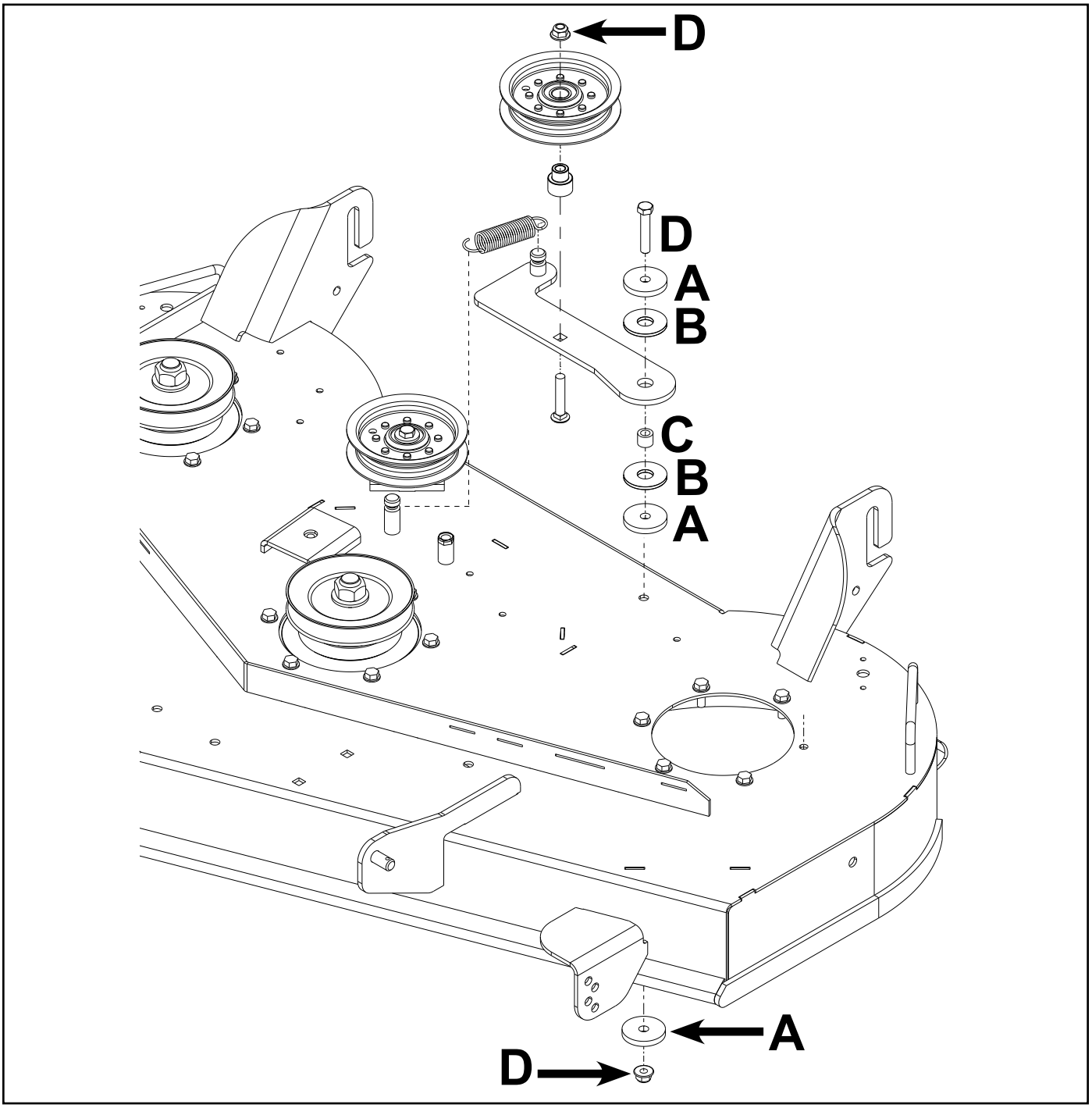

Fig. 099 PICT-2037

A. Standard washer
B. Friction washer (composite)
C. Spacer
D. 30 ft-lbs. (40 Nm)

Idler Arm Inspection

1. Remove deck belt as shown in this chapter.
2. Remove deck if necessary, as outlined in this chapter.
3. Rotate idler arm by hand. The idler arm should not pivot freely, it should take some force to rotate the idler arm.
   - If the idler arm rotates easily and / or rocks excessively side-to-side, replace mounting hardware, spacers and all washers.
4. Inspect idler arm pulley bearing and replace if necessary.

Idler Arm Removal

1. Remove deck belt as shown in this chapter.
2. Remove deck if necessary.
3. Remove idler arm/tensioner spring from idler arm. Inspect spring and replace if necessary.
4. Remove the (1) fastener that secures idler arm assembly to deck.
5. Inspect pivot bolt, friction washers, standard washers, spacers and replace if necessary.
6. Remove the fastener that secures idler pulley to the idler bracket. Inspect pulley bearing and replace if necessary.

Idler Arm Installation

1. Install idler pulley to the idler arm and torque mounting bolt to specification - 30 ft-lbs. (40 Nm).
2. Assemble the idler arm pivot washers, spacers and bolts. Verify proper component order according the exploded views.
3. Install idler arm assembly and pivot bolt onto the deck and torque to specification - 30 ft-lbs. (40 Nm).
4. Install deck to the frame if it was removed.
5. Fully install deck belt and tensioner spring to idler arm.
6. Safely operate unit and check for proper function.

Checking for Bent Blades

Note: The machine must be on a level surface for the following procedure.

1. Raise deck to the highest height-of-cut position.

2. While wearing thickly padded gloves or other adequate hand protection slowly rotate blade to be measured into a position that allows effective measurement of the distance between the cutting edge and the level surface the unit is on (Fig. 100).

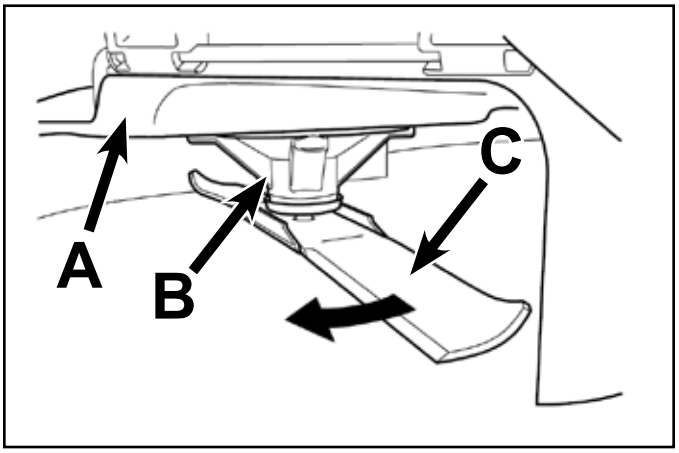

Fig. 100 fig. 39 G009679

A. Deck
B. Spindle housing
C. Blade

3. Measure from the tip of the blade to the level surface (Fig. 101).

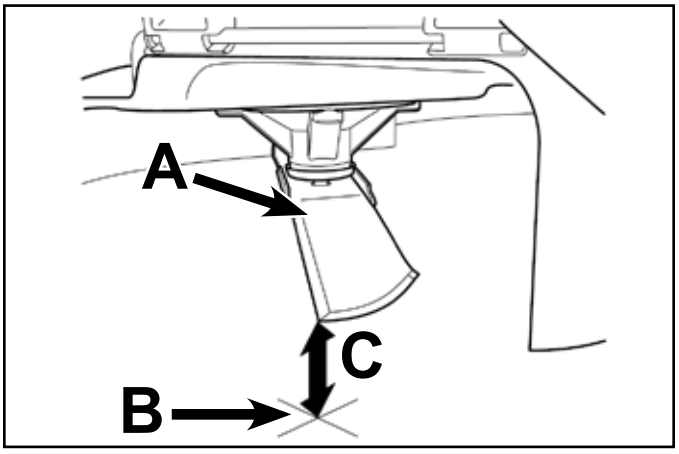

Fig. 101 fig. 40 G009680

A. Blade, in position for measuring
B. Level surface
C. Measure from blade tip to level surface

4. Rotate the same blade 180 degrees so that the opposing cutting edge is now in the same position (Fig. 102).

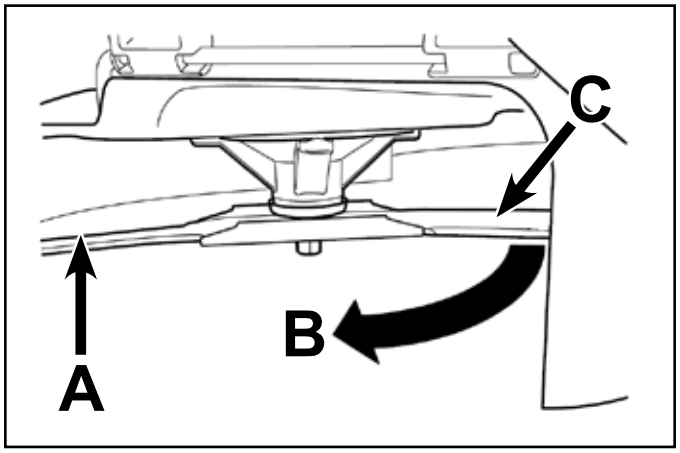

Fig. 102 fig. 41 G009681

A. Blade, side previously measured
B. Measurement position used previously
C. Opposing side of blade being moved into measurement position

5. Measure from the tip of the blade to the level surface. The variance should be no more than 1/8” (3mm) (Fig. 101).

A blade that is bent or damaged could break apart and could seriously injure or kill you or bystanders.

- Always replace bent or damaged blades with a new blade
- Never file or create sharp notches in the edges or surfaces of blade

a. If the difference between A and B is greater than 1/8” (3mm) replace the blade with a new blade as outlined in this chapter.

- Recheck, starting at step 1.

Note: If a bent blade is replaced with a new one and the dimension obtained continues to exceed 1/8” (3mm), the blade spindle shaft could be bent.

b. If the variance is within constraints, move to the next blade.

Repeat this procedure on each blade.

Mower Deck Leveling

Check to ensure the mower deck is level any time you install the mower or when you see an uneven cut on your lawn.

The mower deck must be checked for bent blades prior to leveling; any bent blades must be removed and replaced; refer to “Checking for Bent Blades” as shown in this chapter.

The mower deck must be leveled side-to-side first then the front to rear slope can be adjusted.

Requirements:

- The machine must be on a flat level surface.
- All four tires must be properly inflated.

Checking Side-to-Side Level

The mower blades must be level from side to side. Check the side-to-side level any time you install the mower deck or when you see an uneven cut on your lawn.

1. Park the machine on a level surface and disengage the blade control switch.
2. Move the motion control levers outward to the neutral lock position, stop the engine, remove the key, set the parking brake and wait for all moving parts to stop before leaving the operating position.
3. Carefully rotate the blades side to side.
4. Measure between the outside cutting edges and the flat surface (Fig. 103).

Note: If both measurements are not within 3/16 inch (5mm), an adjustment is required; continue to the "Leveling the Mower Deck" as shown in this chapter.

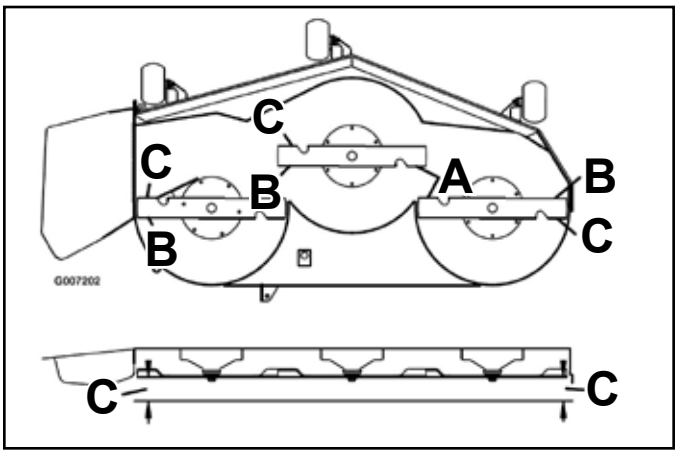

Fig. 103 fig. 58 G007202

A. Blades side-to-side
B. Outside cutting edges
C. Measure from the tip of the blade to the flat surface here

Checking the Front-to-Rear Blade Slope

Check the front-to-rear blade level any time you install the mower.

1. Park the machine on a level surface and disengage the blade control switch.
2. Move the motion control levers outward to the neutral position, engage the parking brake, stop the engine, remove the key, and wait for all moving parts to stop before leaving the operating position.
3. Carefully rotate the blades so they are facing front to rear (Fig. 104).
4. Measure from the tip of the front blade to the flat surface and the tip of the rear blade to the flat surface (Fig. 104).

Note: If the front blade tip is not 1/16-5/16 inch (1.6-7.9mm) lower than the rear blade tip, continue to the "Leveling the Mower Deck" as shown in this chapter.

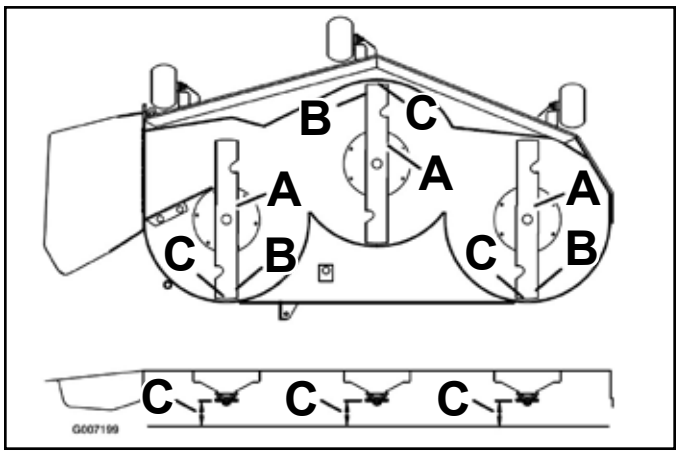

Fig. 104 fig. 59 G007199

A. Blades front-to-rear
B. Outside cutting edges
C. Measure from the tip of the blade to the flat surface here

Leveling the Mower Deck

1. Set anti-scalp rollers to top holes or remove completely for this procedure.

2. Set the height-of-cut lever to the 3 inch (76mm) position.

3. Place two 2-5/8” (6.66cm) blocks under each side of the front edge of the deck, but not under the anti-scalp roller brackets (Fig. 105).

4. Place two 2-7/8” (7.30cm) thick blocks under the rear edge of the cutting deck skirt; one on each side of the cutting deck (Fig. 105).

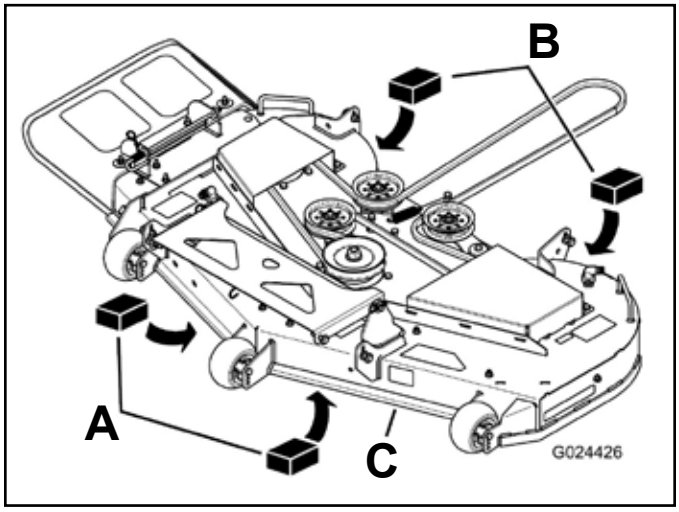

Fig. 105 fig. 60 G024426

A. Wood block, 2-5/8” (6.66cm) thick
B. Wood block, 2-7/8” (7.30cm) thick
C. Front edge

5. Loosen the adjustment bolts on all four corners so that the deck is sitting securely on all four blocks (Fig. 106).

6. Ensure there is tension on all four chains (Fig.106).

7. Tighten the four adjustment bolts (Fig. 106).

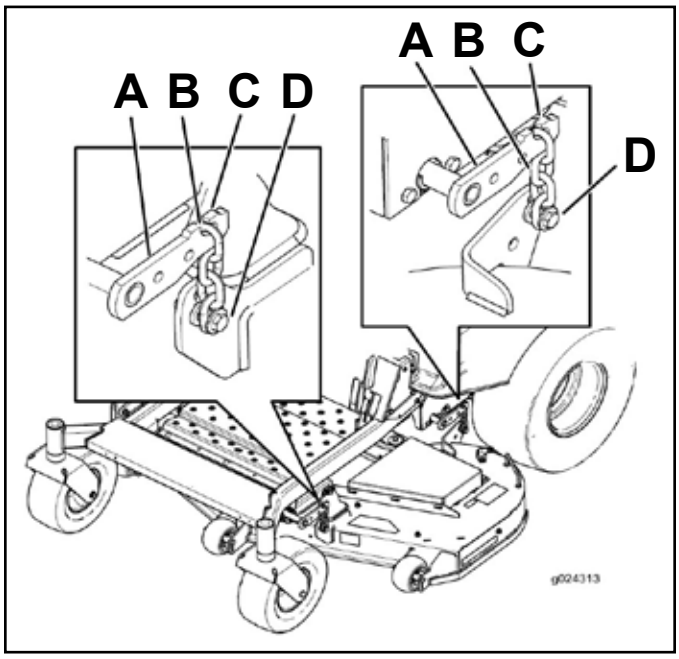

Fig. 106 fig. 61 G024313

A. Deck lift arm
B. Chain
C. Hook
D. Adjustment bolt

8. Check that blocks fit just snugly under the deck skirt. Make sure all bolts are tight.

9. Verify that the deck is level by checking the side-to-side level and front-to-rear blade slope; repeat the deck leveling procedure if necessary.

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Chassis Switches

Key/Ignition Switch

Purpose

The ignition switch makes the proper connections for the starter, accessories, and safety circuits.

Location

The ignition switch is located on the control panel, on the right fender (Fig. 107).

Fig. 107 PICT-3019

How It Works

Detents inside the switch give it 3 positions: OFF, RUN, and START. The START position is spring loaded so the key automatically returns to RUN when released (Fig. 108).

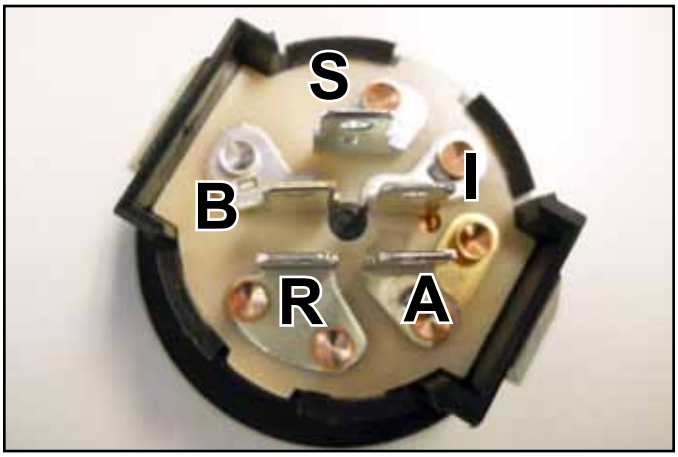

Fig. 108 DSCN-0173a

Ignition Switch Wiring Connections

B - Battery voltage IN
S - Starting Circuit
I - PTO Switch, Safety Interlock Switches, Fuel Solenoid
A - Seat Switch, Safety Interlock Switches
R - Regulator, Charging Circuit

Testing

1. Disconnect switch from wiring harness.
2. Verify that continuity exists between the terminals listed for the switch position.
3. Verify there is NO continuity between terminals not listed for the position.

Key Switch Continuity Table	
OFF	No continuity between any terminals
RUN	Continuity – B R I A only
START	Continuity – B R I S only

PTO Switch

Purpose

The PTO (Power Take Off) switch is 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 control panel, on the right fender (Fig. 109).

Fig. 109 PICT-2001

How It Works

- **PTO Switch ON (Switch Pulled Up)**

The PTO Switch provides battery voltage from the key switch to the PTO clutch.

The PTO Switch provides battery voltage from the key switch to the hour meter.

As a part of the safety interlock system, the PTO switch will prevent the engine from cranking/starting when in the ON position by preventing the starter solenoid from grounding through the kill relay.

Note: The engine will not crank over to start when the PTO switch is ON.

- **PTO Switch OFF (Switch Pushed Down)**

The PTO Switch will not supply battery voltage to the PTO clutch.

The PTO Switch provides battery voltage from the key switch to the parking brake switch and neutral switches as a part of the Safety Interlock System to allow the unit to crank / start (Fig. 110).

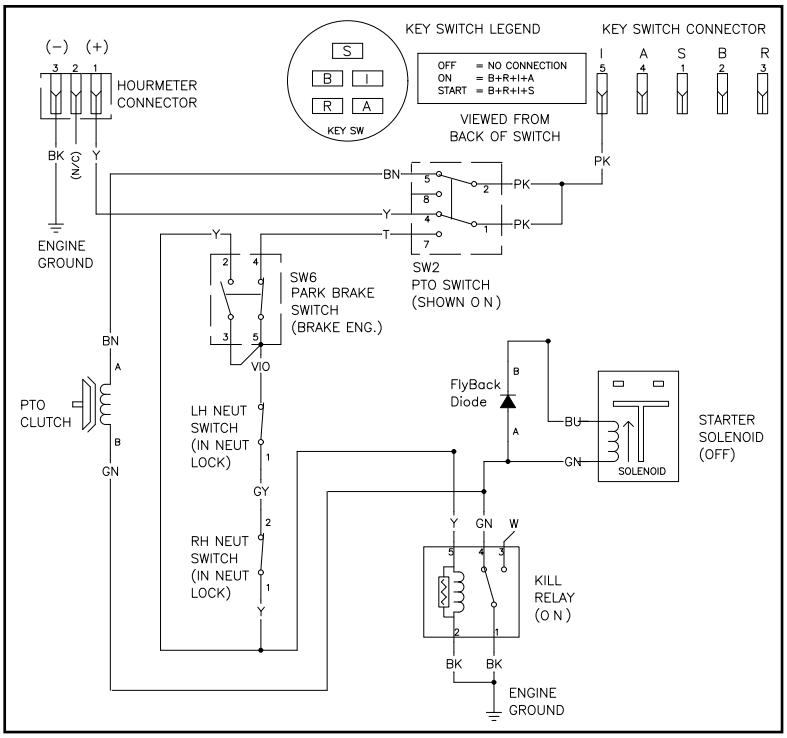

Fig. 110 PICT-2002

Continuity Testing

Terminals viewed from the back of the switch.

With the Switch “ON” (Button pulled OUT):
- Pin 2 and 5 should have continuity (closed - circled below)
- Pin 1 and 4 should have continuity (closed - circled below)
- Pin 1 and 7 should not have continuity (open)
- Pin 2 and 8 should not have continutiy (open)

(Fig. 111 and Fig. 112)

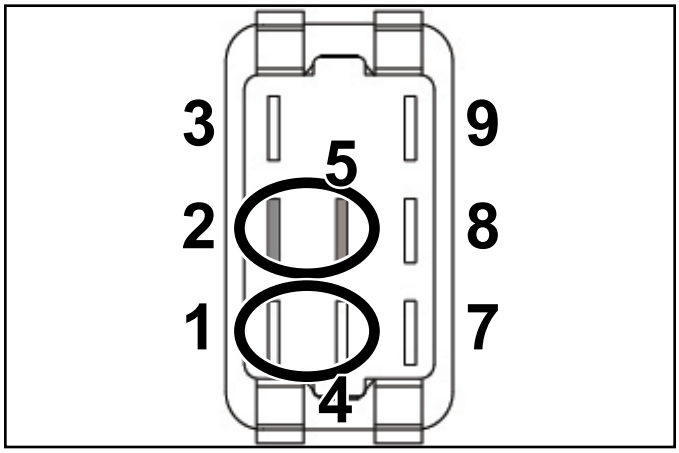

Fig. 111 PICT-1005

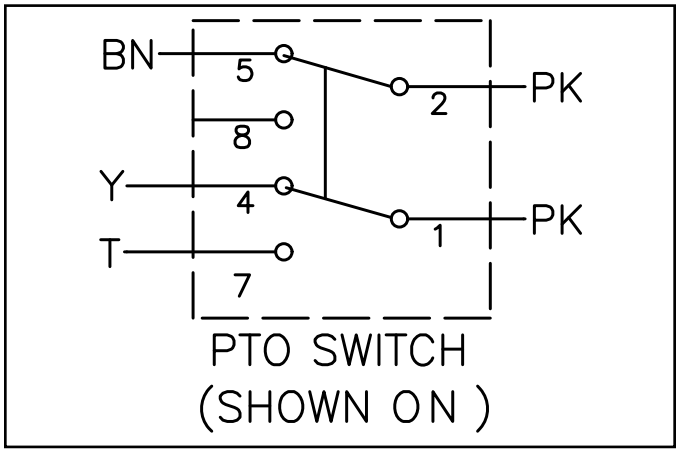

Fig. 112 PICT-2004

With the Switch “OFF” (Button pushed IN):
- Pin 1 and 7 should have continuity (closed - circled below)
- Pin 2 and 8 should have continuity (closed - circled below)
- Pin 2 and 5 should not have continuity (open)
- Pin 1 and 4 should not have continuity (open)

(Fig. 113 and Fig. 114)

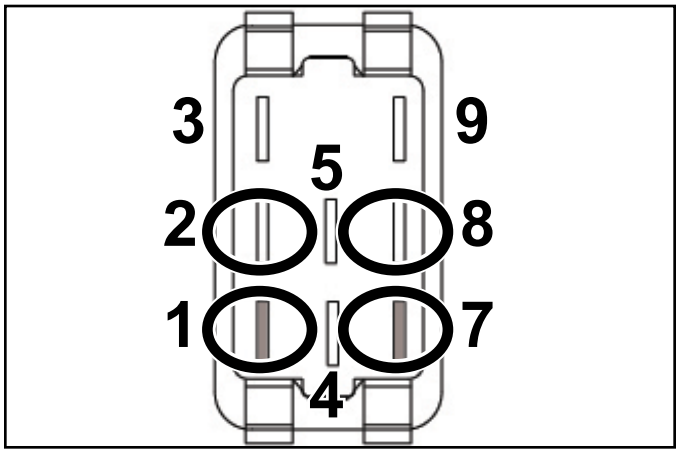

Fig. 113 PICT-1006

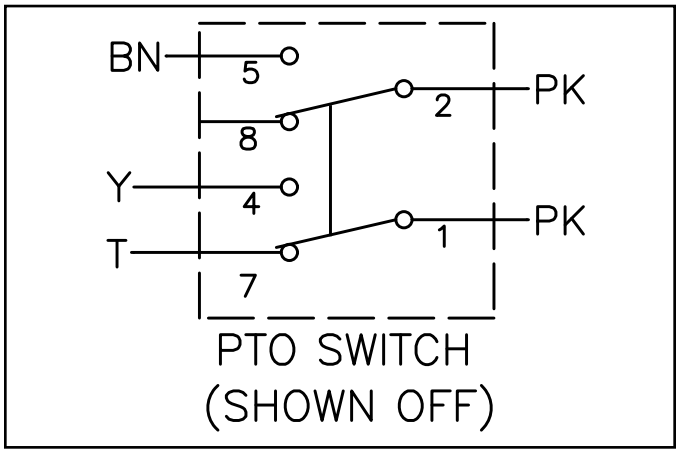

Fig. 114 PICT-2003

Note: Switch pins 3 and 9 are not used.

Seat Switch

Purpose

The seat switch is a part of the safety interlock system. If the engine is running and the operator vacates the seat with the PTO engaged and/or the handles pulled IN, the engine will shut off.

Location

The seat switch is attached to the seat base, accessible by flipping the seat up into the service position.

ZX Seat Switch (Fig. 115)

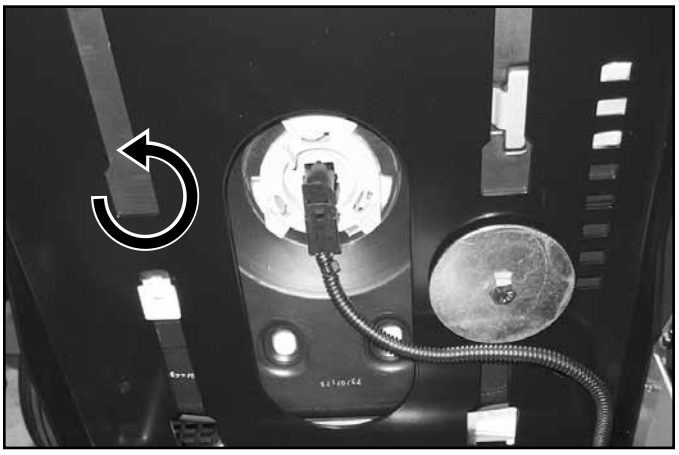

Fig. 115 PICT-1009

MX Seat Switch (Fig. 116)

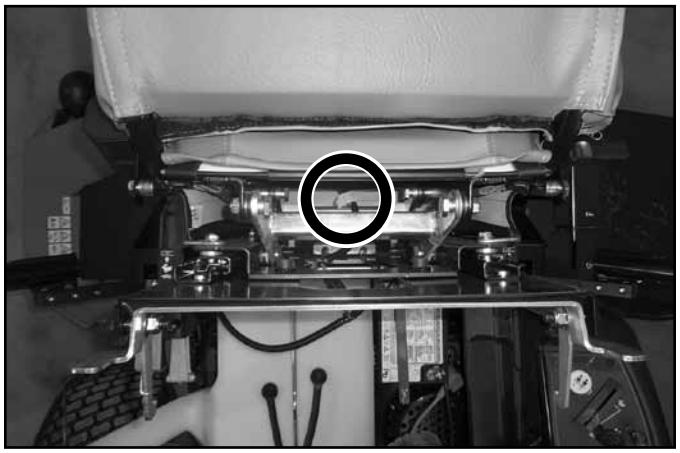

Fig. 116 PICT-3031

How It Works

With the ignition switch ON, and the seat switch closed, it supplies battery voltage to the neutral switches.

Testing

1. Disconnect the harness connection from the seat switch.

2. With a multimeter set to the Ohm or Continuity setting, check the continuity between the two switch terminals:

   - When the seat is vacated, the switch should be OPEN and there should be NO continuity between the two switch terminals.

   - When the seat is occupied, the switch CLOSES and there should be continuity between the two switch terminals.

(Fig. 117)

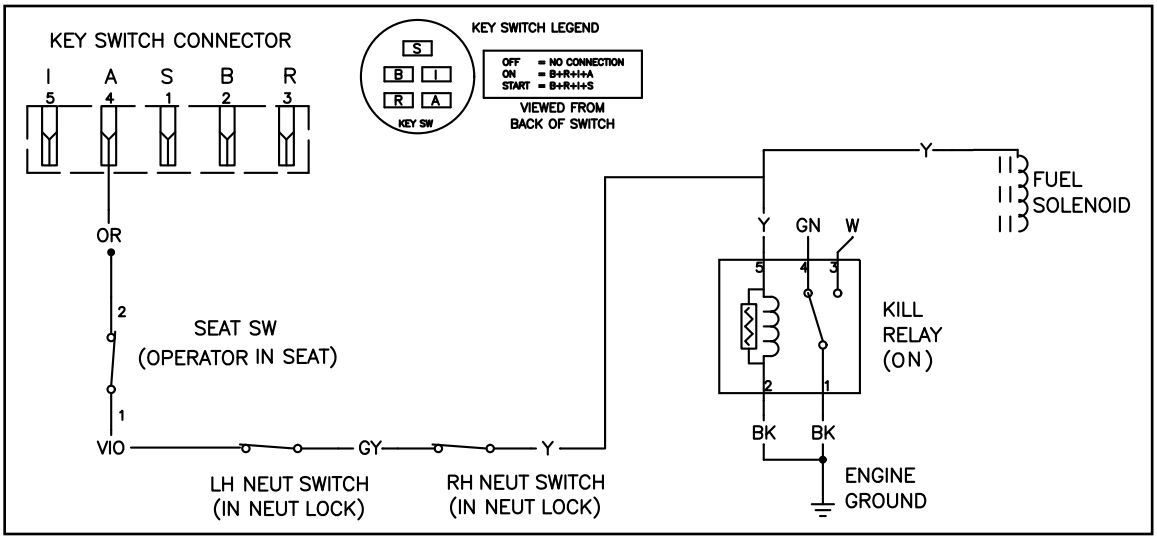

Fig. 117 PICT-2005

7

RH and LH Neutral Switch

Purpose

Used to ensure the motion control handles are in neutral to start the unit. It is activated by moving the motion control handles to the neutral position (handles outward).

Location

The RH and LH Neutral Switches are located in the fender/control arm pivot area. The RH and LH switches are serviceable by removing the control cover fastener and the control cover (A) (Fig. 118 and Fig. 119).

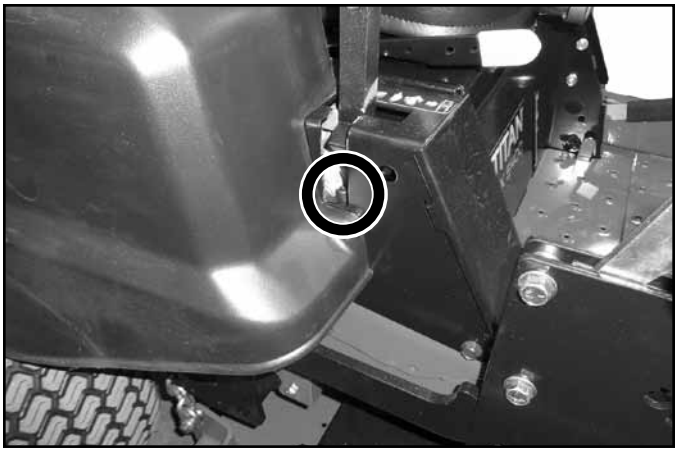

Fig. 118 PICT-3032

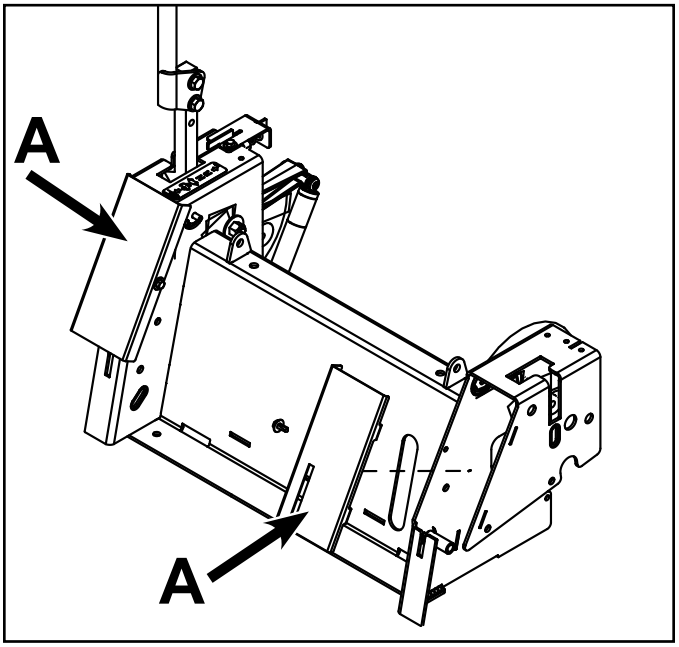

Fig. 119 PICT-2010

How it Works

This single pole plunger (normally open) type switch has two terminals. When the motion control handles are in the neutral position (handles in the OUT position), it pushes on the plunger, closing the contact and connecting the terminals (Fig. 120).

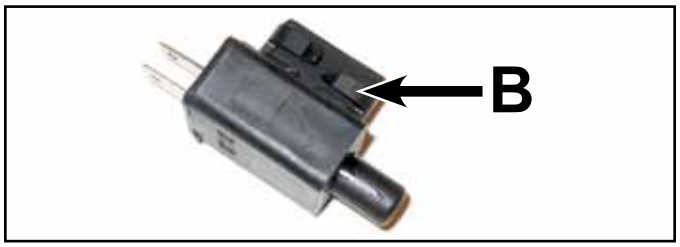

Fig. 120 DSCN-0150a

When the key is ON, the RH and LH Neutral Switches get battery voltage from the Parking Brake Switch and/or the Seat Switch.

When both of the Neutral Switches are CLOSED, battery voltage is provided to the Kill Relay and the Fuel Solenoid (Fig. 121).

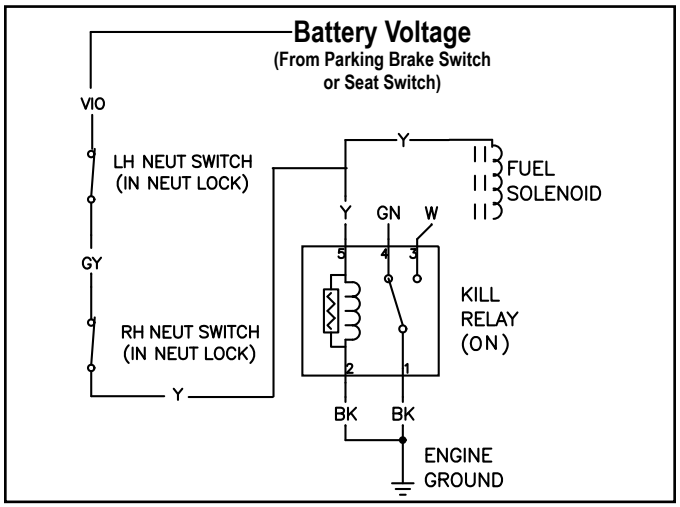

Fig. 121 PICT-2007

Testing

1. Disconnect the switch from the wiring harness.
2. With a multimeter set to the Ohm or Continuity setting, check the continuity between the two switch terminals.
3. With the plunger pushed in, there should be continuity between the terminals. With the plunger pulled out, there should not be continuity between the terminals.

Parking Brake Switch

Purpose

The Parking Brake Switch is part of the safety interlock system.

The parking brake switch circuit can:

- Prevent the engine from cranking if parking brake is not engaged.
- Prevent the engine from cranking if a control handle is not in the neutral position.
- Turn the engine OFF if a control handle is moved out of neutral with the brake engaged.

Location

The Parking Brake Switch is located in the control box assembly, near the parking brake lever. Remove LH control cover (A) for better access (Fig. 122 and Fig. 123).

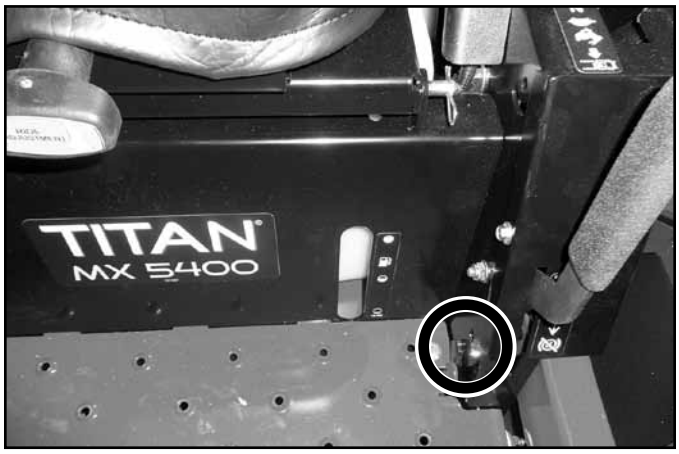

Fig. 122 PICT-3033

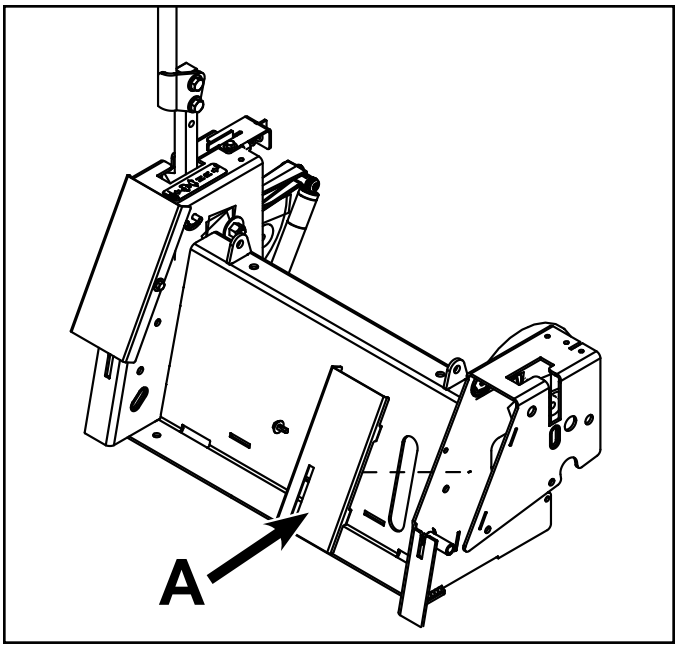

Fig. 123 PICT-2010

How it Works

This double pole plunger type switch has four terminals. For engine START, it is used to ensure the park brake is in the ON position. At the same time it allows battery voltage to flow through the safety circuit.

When the park brake is released, it bypasses both the neutral switches, as long as the operator is sitting in the seat to maintain current for the safety circuit.

Park Brake ON:

- Normally Open contacts are closed – Battery voltage to kill relay coil and fuel solenoid, through motion control neutral switches.
- Operator must be in seat.

Park Brake OFF (engine running):

- Normally closed contacts are closed – Battery voltage directly to kill relay coil and fuel solenoid, neutral switches NOT in circuit.
- Operator must be in seat.

Testing

1. Remove the LH control cover (A).
2. Press inward on the locking taps and push the switch out of the mounting slot.
3. Pull the switch and harness downward, in-between the frame and deck assembly.
4. Disconnect the harness connection to switch and remove the switch from the unit.
5. Use a ohm meter to test the switch continuity as shown below:

View From Back of Switch (Fig. 124)

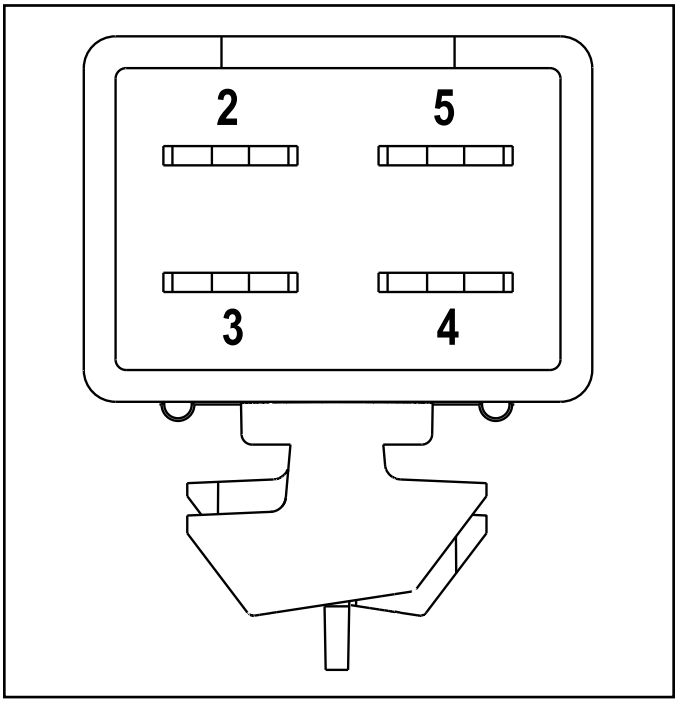

Fig. 124 PICT-2012

Switch Plunger NOT Depressed:
Pin 2 and 3 – CLOSED, continuity between the pins
Pin 4 and 5 – OPEN, NO continuity between the pins

Switch Plunger Depressed:
Pin 2 and 3 – OPEN, NO continuity between the pins
Pin 4 and 5 – CLOSED, continuity between the pins

Parking Brake Circuit

(Fig. 125)

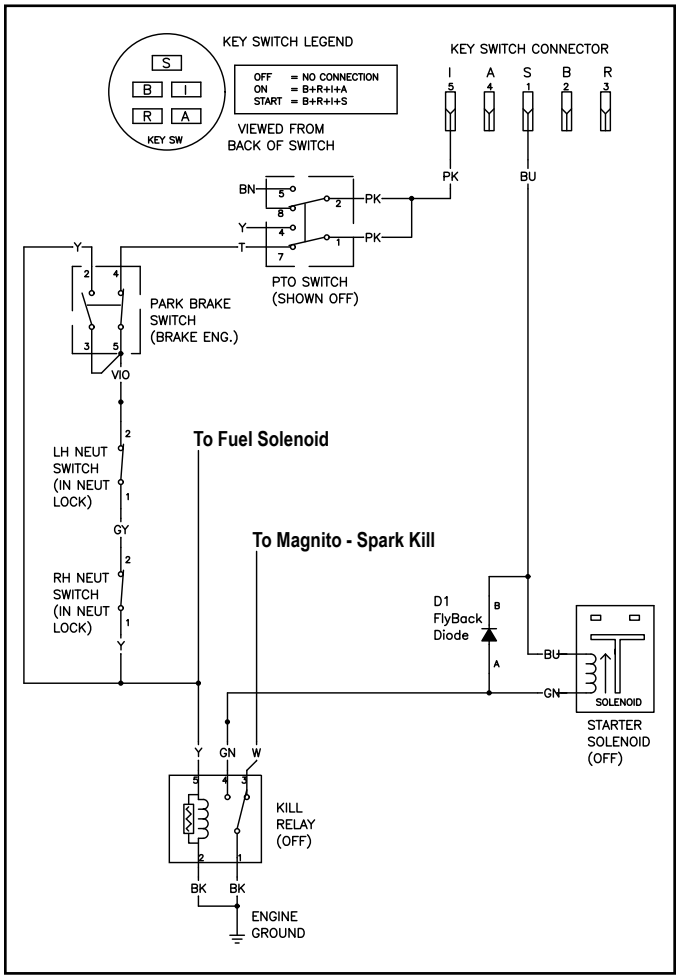

Fig. 125 PICT-2011

Starter Solenoid & Starting System

Purpose

The solenoid's purpose is a remote switch to connect the battery to the starter motor on the engine 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 starter solenoid is located behind the operator's seat, near the fuse block (Fig. 126).

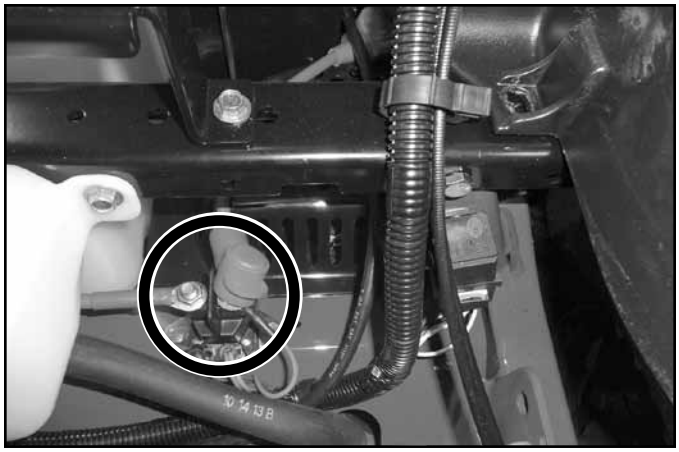

Fig. 126 PICT-3023

How It Works (solenoid only)

The solenoid has two primary parts. One, a coil of wire is 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 of the engine.

When 12 volts is applied to the coil, it becomes an electromagnet. This quickly pulls the contact bar toward the 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.

Starter Solenoid Testing (solenoid only)

1. Disconnect solenoid from the wiring harness.
2. With a multimeter (ohms setting), check to ensure that terminals "c" and "d" are open (no continuity).
3. Apply +12 VDC to terminal "a" and ground terminal "b". Terminals "c" and "d" should now be closed (continuity) (Fig. 127).

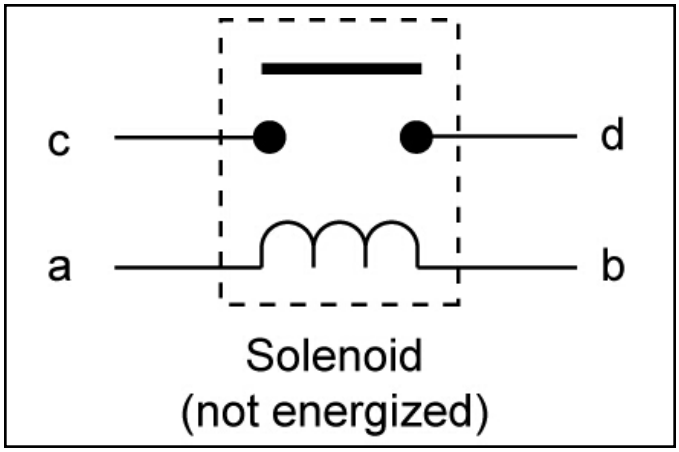

Fig. 127 xl solenoid

7

Starter Solenoid Circuit & Operation

The starter solenoid B+ (battery positive) input is controlled by the ignition switch when in the START position. The starter solenoid B- (battery negative) is controlled by the Kill Relay.

The Kill Relay will only ground and activate the starter solenoid and allow the engine to start when:

- The key is in the start position.
- Proper battery voltage is present at the key switch, kill relay, and starter solenoid
- Proper ground is present at the battery, chassis, and kill relay.
- The PTO switch is OFF, supplying battery voltage to the Park Brake Switch.
- Both handles are in the neutral position and both neutral switches are CLOSED, supplying battery voltage to the control side of the kill relay.

Note: The engine will not crank over to start when the PTO switch is ON.

(Fig. 128)

Starting System Schematic

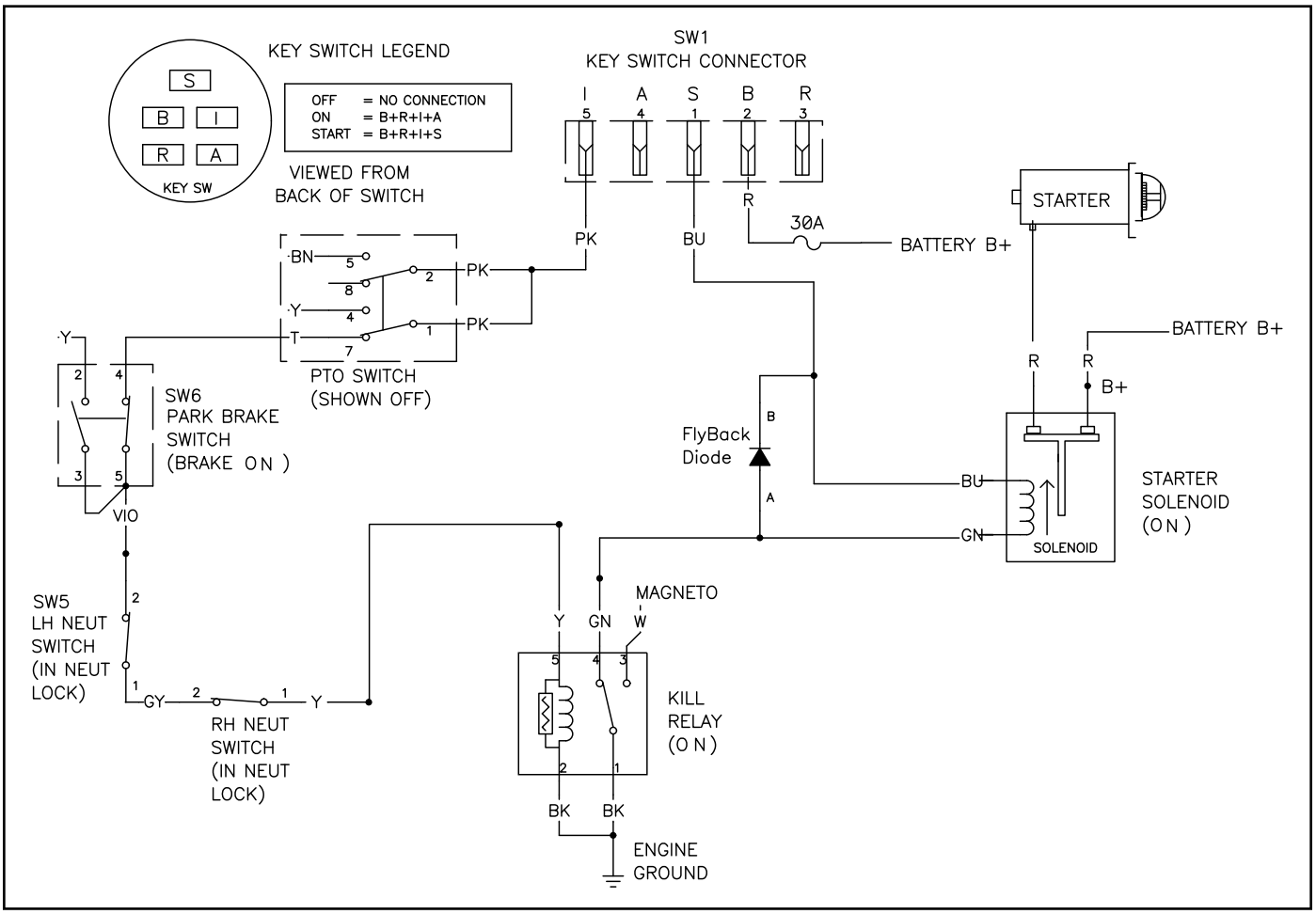

Fig. 128 PICT-2014

Electric PTO Clutch

Purpose

The clutch electrically controls the engagement and disengagement of the PTO pulley.

Location

The electric clutch is located on the PTO end of the engine crankshaft.

How It works

The PTO clutch is composed of three major components; the field, clutch plate, and 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 switch, turn ignition off and remove key.
2. Disconnect clutch wire connector.
3. Set the multimeter to check resistance (ohms).
4. Connect the meter lead wires to the terminals in the clutch connector (Fig. 129).

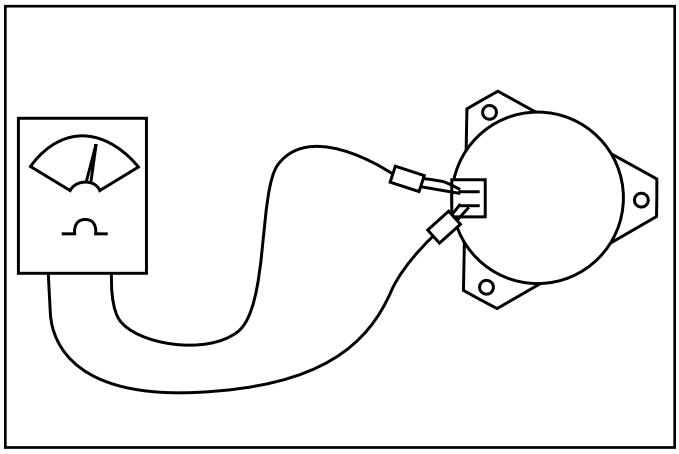

Fig. 129 coil resist msmt_v2

5. See the PTO Clutch Electrical Specifications chart.

PTO Clutch Electrical Specifications

Ohms Specification	Amp Draw Specification	Continuity to Ground
3.05 ± 10%	3.93 ± 10%	OPEN

PTO Clutch Continuity to Ground Check

1. Disengage PTO switch, turn ignition off and remove key.
2. Disconnect clutch wire connector.
3. Set the multimeter to check resistance (ohms).
4. Connect one meter lead to the engine, chassis or battery ground. Connect the other meter lead to each of the PTO clutch terminals.
5. The two PTO terminals should never have continuity to ground and should be OPEN at all times. If continuity is found between the clutch wires and ground, the clutch and PTO switch must be replaced.

Measuring Clutch Current Draw

Note: Do not measure current draw if clutch has shorted to ground or if the resistance measurement is out of specification.

1. Disengage PTO switch, turn ignition off and remove key.
2. Disconnect clutch wire connector.
3. Set the multimeter to check amps (10 amp scale).
4. Connect the positive meter lead to the chassis harness terminal A (brown wire) (Fig. 130).
5. Connect the negative meter lead to the corresponding wire terminal B (Fig. 130).
6. Connect a short jumper lead from terminal C to terminal D (Fig. 130).
7. Turn the ignition key in the switch to “RUN” position and the PTO switch to the “ON” position.
8. See the PTO Clutch Electrical Specifications chart.

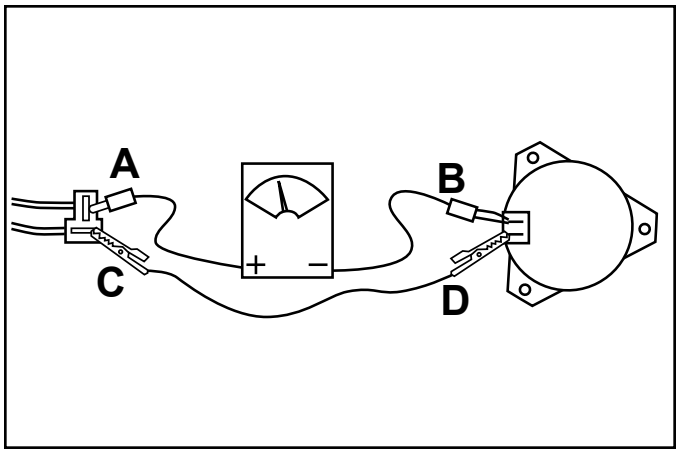

Fig. 130 clutch current msmt_v2

PTO Clutch Electrical Specifications

Ohms Specification	Amp Draw Specification	Continuity to Ground
3.05 ± 10%	3.93 ± 10%	OPEN

PTO Circuit & Operation

The The PTO clutch is powered by the PTO Switch and grounded through the kill relay.

The PTO Clutch will only ground and engage when:

- The ignition switch is in the ON position.
- The PTO switch is in the ON position.
- Proper battery voltage is present at the key switch kill relay.
- Proper ground is present at the battery, chassis and kill relay.
- An operator is in the seat.
- The parking brake is ON and the handles are in the outward neutral position.
- The parking brake is OFF and the handles in any position.

Note: The engine will not crank over to start when the PTO switch is ON.

(Fig. 131, next page)

PTO Circuit Schematic

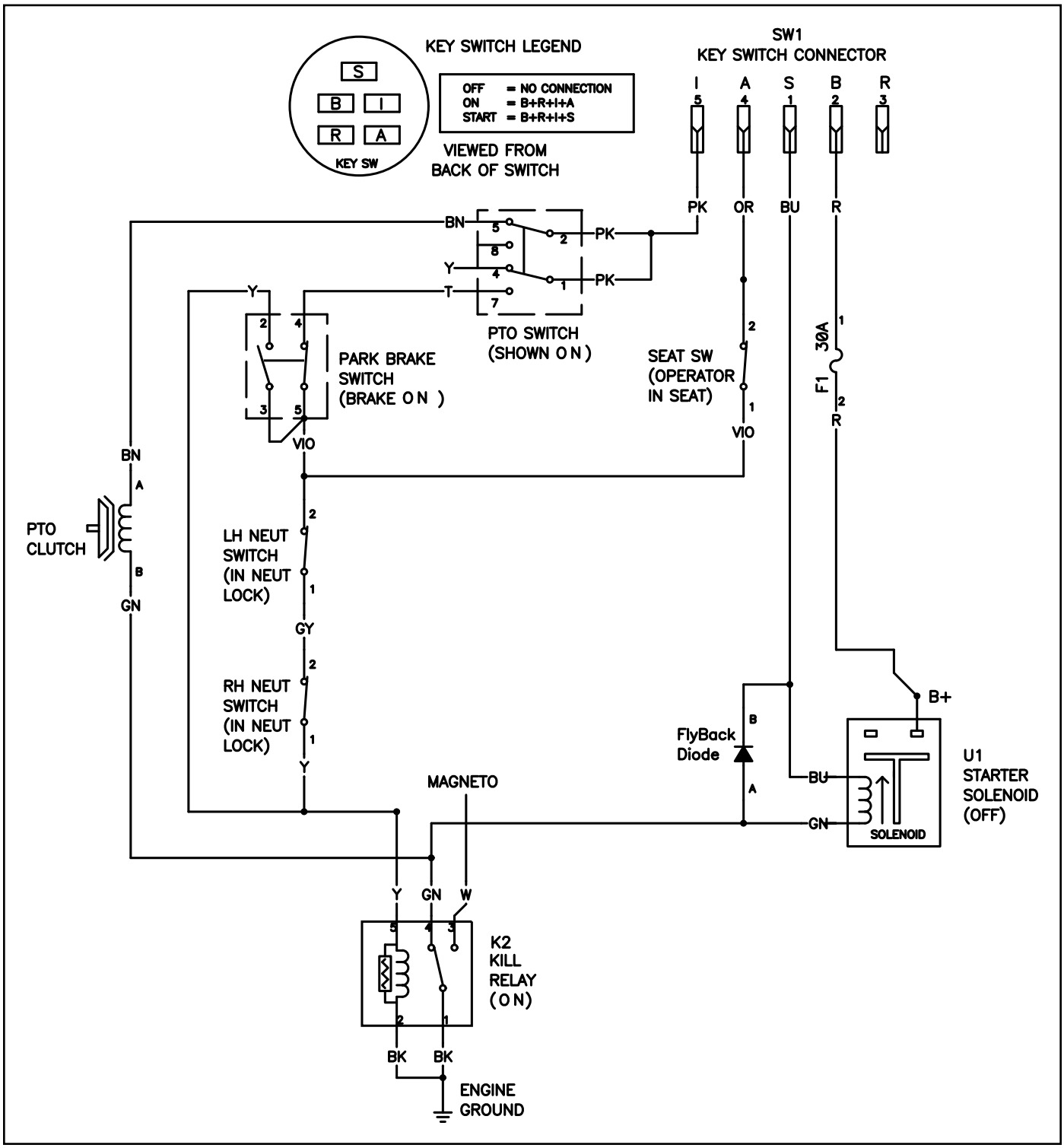

Fig. 131 PICT-2015

PTO Clutch Replacement

PTO Clutch Removal

1. Remove the PTO belt tensioner spring from the deck, then remove the PTO belt from the PTO clutch.
2. If necessary, safely raise and support unit.
3. Disconnect harness connection to PTO clutch.
4. Remove the PTO clutch bolt (A).
5. Remove PTO clutch (B) from the engine crankshaft.

PTO Clutch Installation

1. Clean engine crankshaft.
2. Apply anti-seize to engine crankshaft.
3. Install PTO clutch onto engine crankshaft. Be sure anti-rotation bracket (C) is properly aligned.
4. Apply Loctite® 242 to PTO clutch bolt.
5. Torque the PTO clutch mounting bolt to 55 ft-lbs. (75 Nm).
6. Connect harness connection to PTO clutch.
7. Install PTO belt, then tensioner spring and verify proper PTO belt routing.
8. Safely lower unit.
9. Verify proper function.

(Fig. 132)

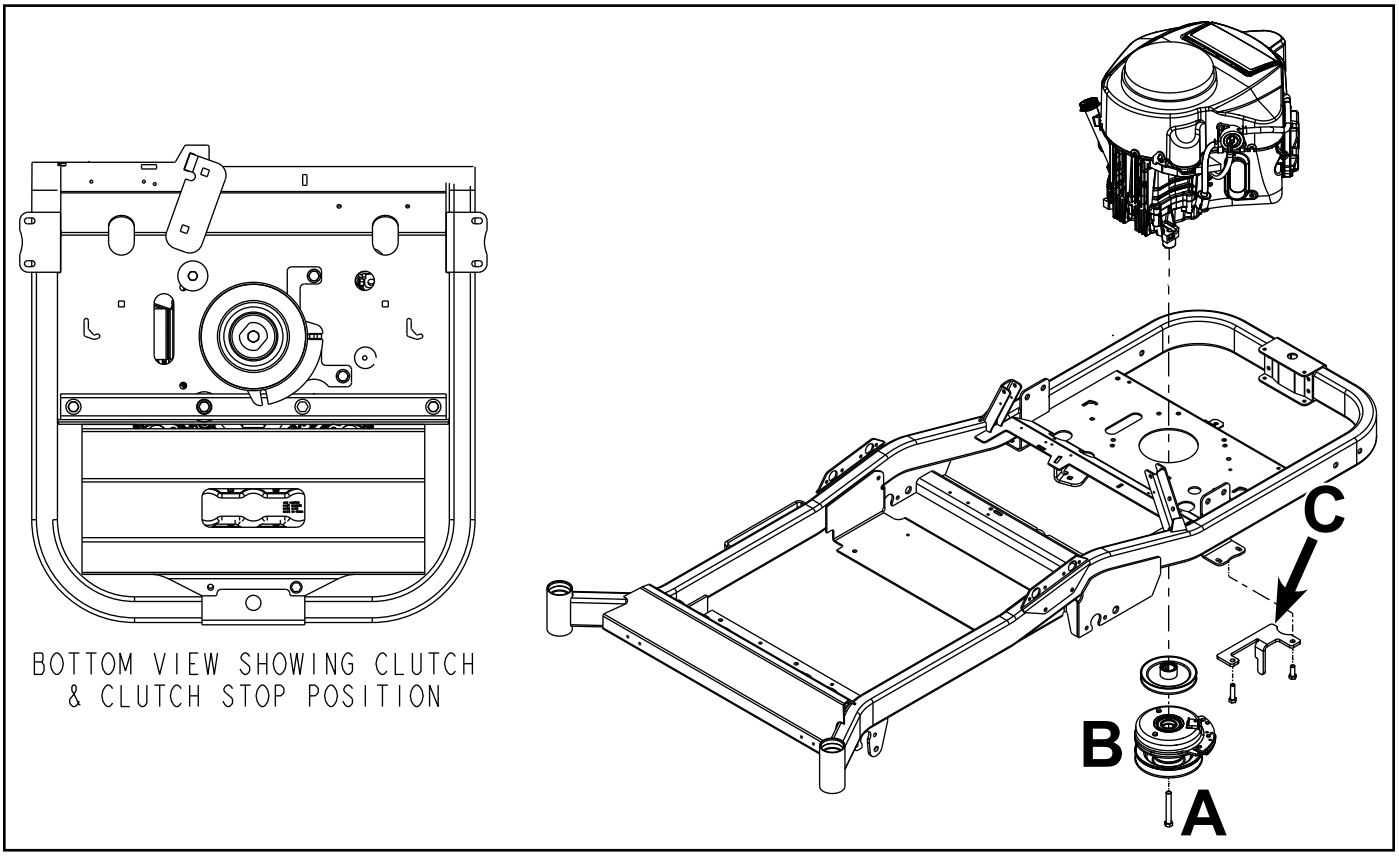

Fig. 132 PICT-3024

Hour Meter

Purpose

The hour meter records hours of operation only when:

- The Ignition key is ON
- The PTO switch is ON

Location

The hour meter is located on the RH control panel (Fig. 133).

Fig. 133 PICT-3019

How It Works

When they key is ON, a closed PTO switch supplies battery voltage to the hour meter.

The electric/LCD style hour meter has an internal battery the keeps the hour meter display illuminated at all times.

Testing

With the key ON and PTO switch CLOSED, verify battery voltage and ground are present at the hour meter (Fig. 134).

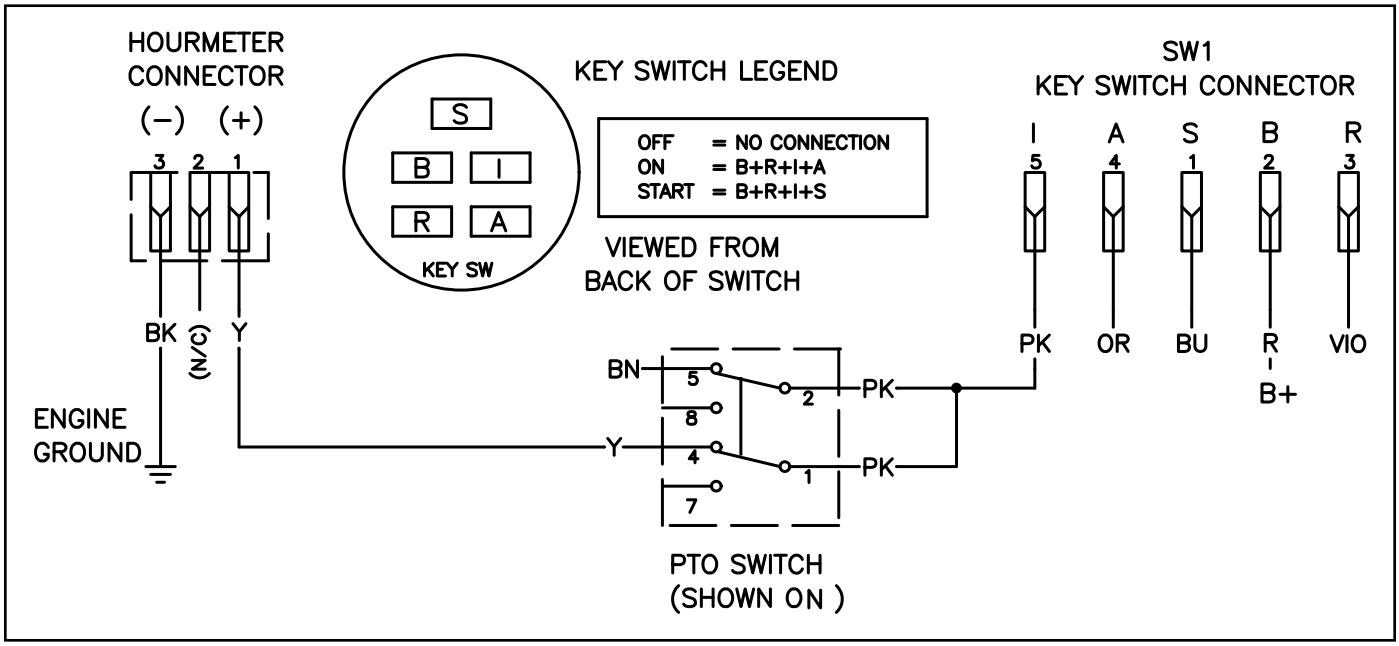

Fig. 134 PICT-2016

7

Fuses

Location

- The main 30 Amp fuse (A) is located near the starter solenoid and kill relay.
- The charging system 25 Amp fuse (B) is located under the RH control panel.
- The optional accessory 15 Amp fuse (C) is located under the RH control panel.

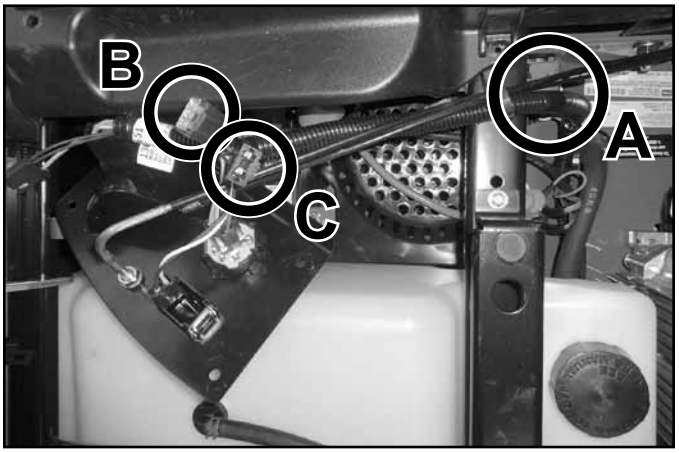

Fig. 135 PICT-3044

Testing

- With a multimeter set to OHM of continuity setting, check the continuity between the fuse blades. If the fuse is OPEN, replace it and test the circuit.
- The fuses used in this application can also be visually inspected. A failed fuse can be identified by the broken/melted element inside the fuse cover or a damaged spade (Fig. 136 and Fig. 137).

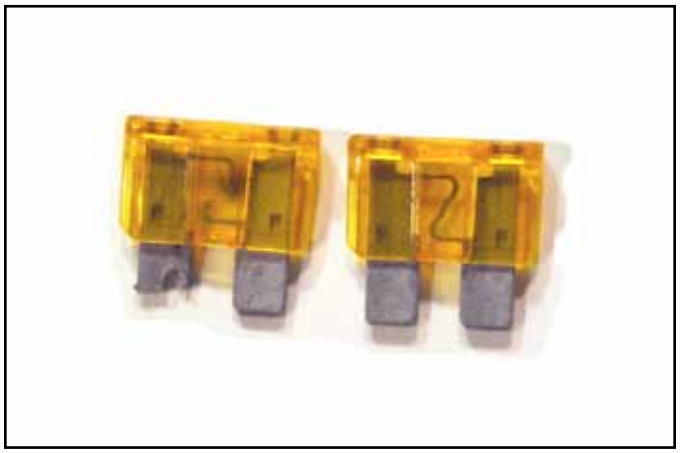

Fig. 136 IMG-1214a

How It Works

The fuses protect the electrical system from electrical surges.

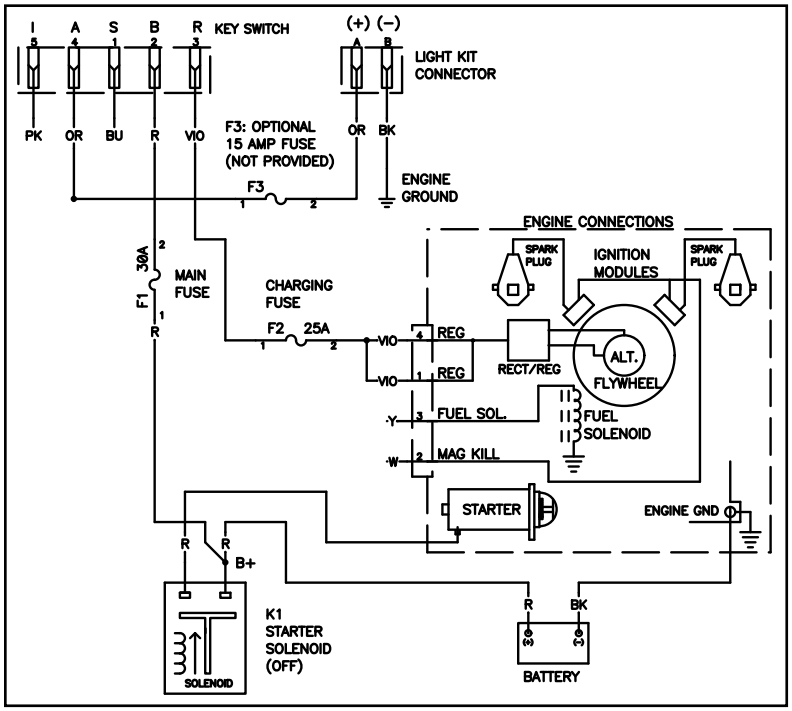

Fig. 137 PICT-3045

FlyBack Diode

Purpose

The flyback diode protects the electrical system from current surges caused by PTO engagement and disengagement (Fig. 138).

Fig. 138 DSCN-0149a

Location

The flyback diode is located just in front of the engine, near the hydro expansion tank. The diode is cable tied to the main wire harness (Fig. 139 and Fig 140).

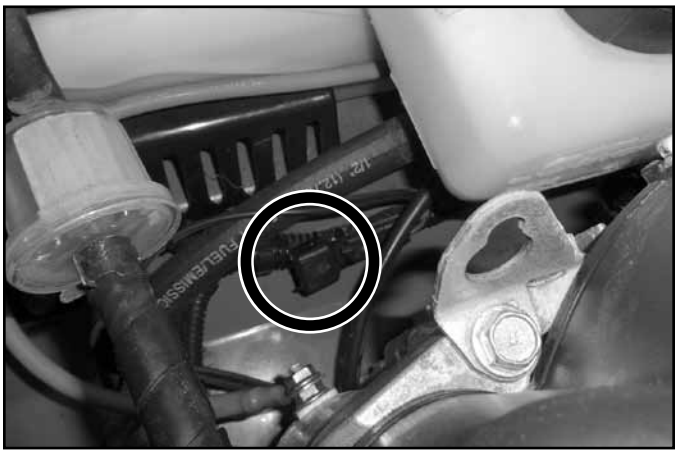

Fig. 139 PICT-2021

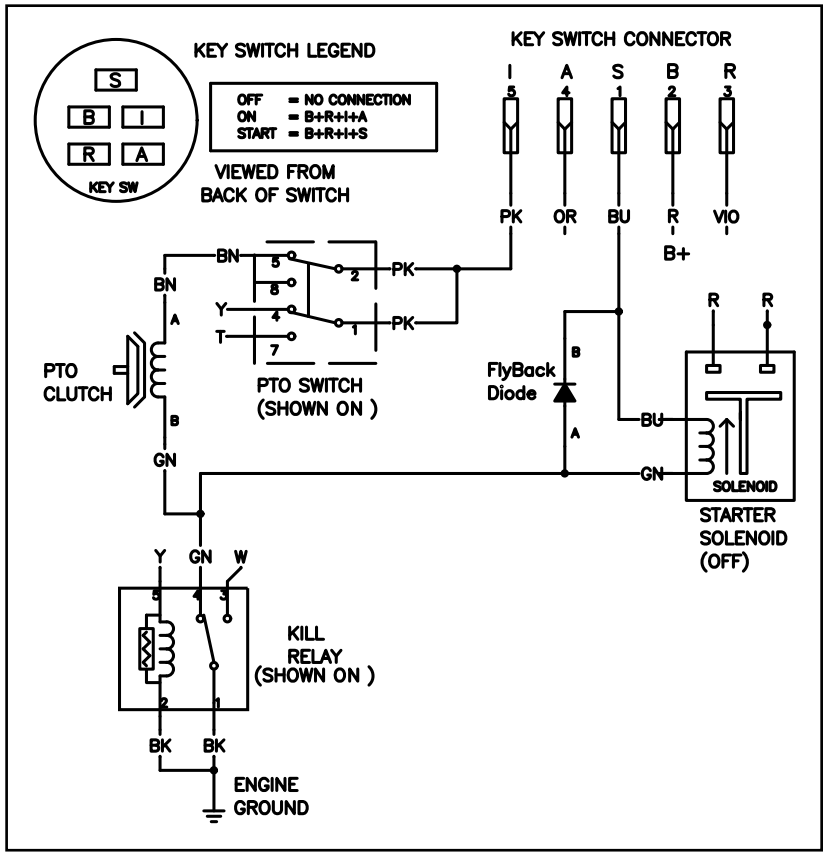

Fig. 140 PICT-2024

7

Testing

1. Remove the diode from the harness connection.
2. Use a volt / ohm meter set to the ohm or diode setting to test the diode.
3. Measure the diode resistance, record the value.
4. Reverse the ohm meter leads on the diode terminals and measure the diode resistance again, record this value.
   - If the resistance value is the same in steps 3 and 4, the diode is shorted or open – replace the diode.

Note: If the flyback diode tests shorted or open, also test the PTO clutch as shown in this chapter.

- A properly functioning diode will be open in one direction and have an ohms resistance value when the meter leads are reversed as shown:

(Fig. 141 and Fig. 142)

Fig. 141 PICT-2022

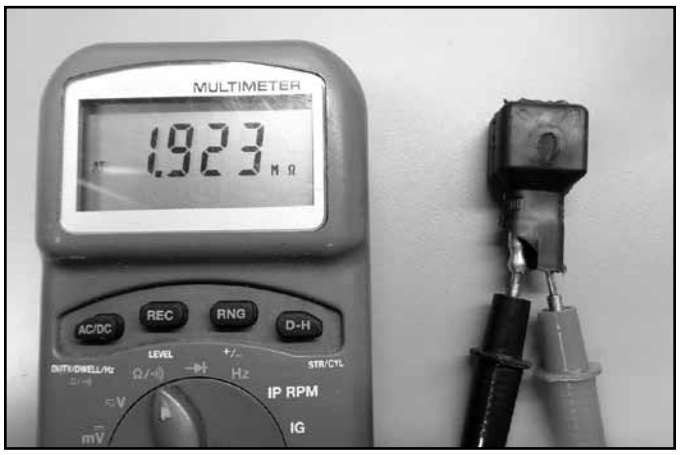

Fig. 142 PICT-2023

7

Wire Harness View 1 of 3

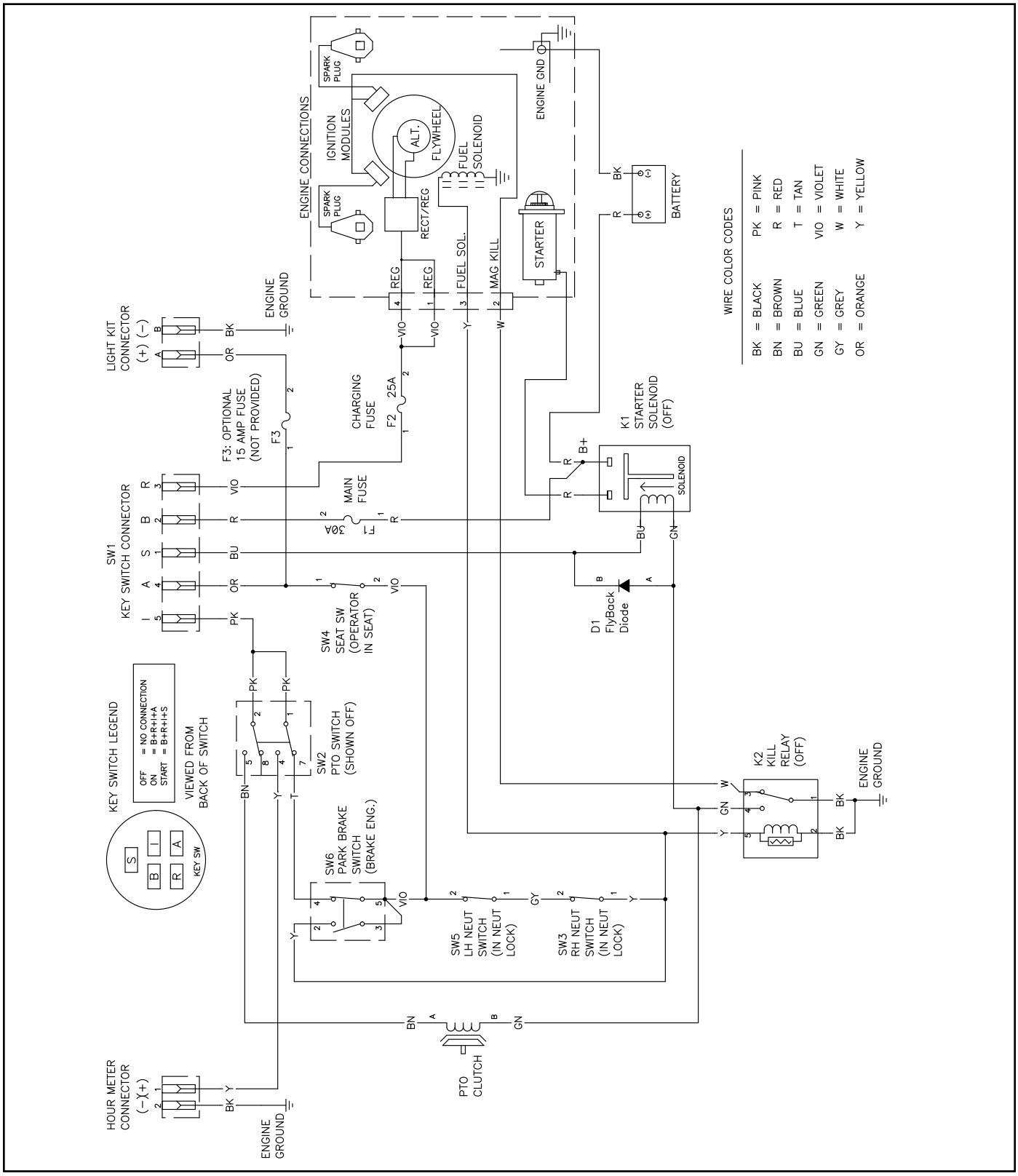

Fig. 143 PICT-3020

Wire Harness View 2 of 3

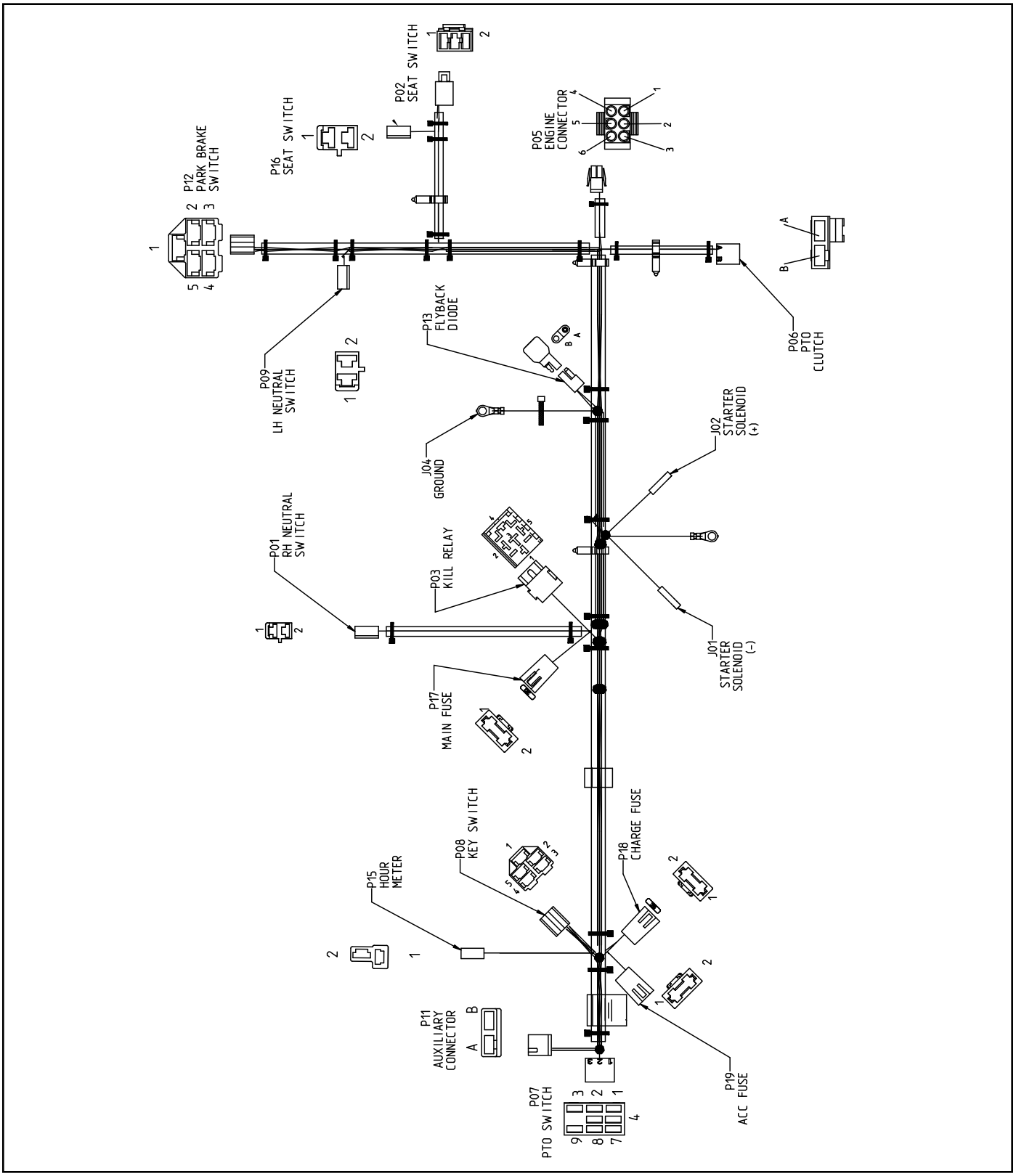

Fig. 144 PICT-3021

Wire Harness View 3 of 3

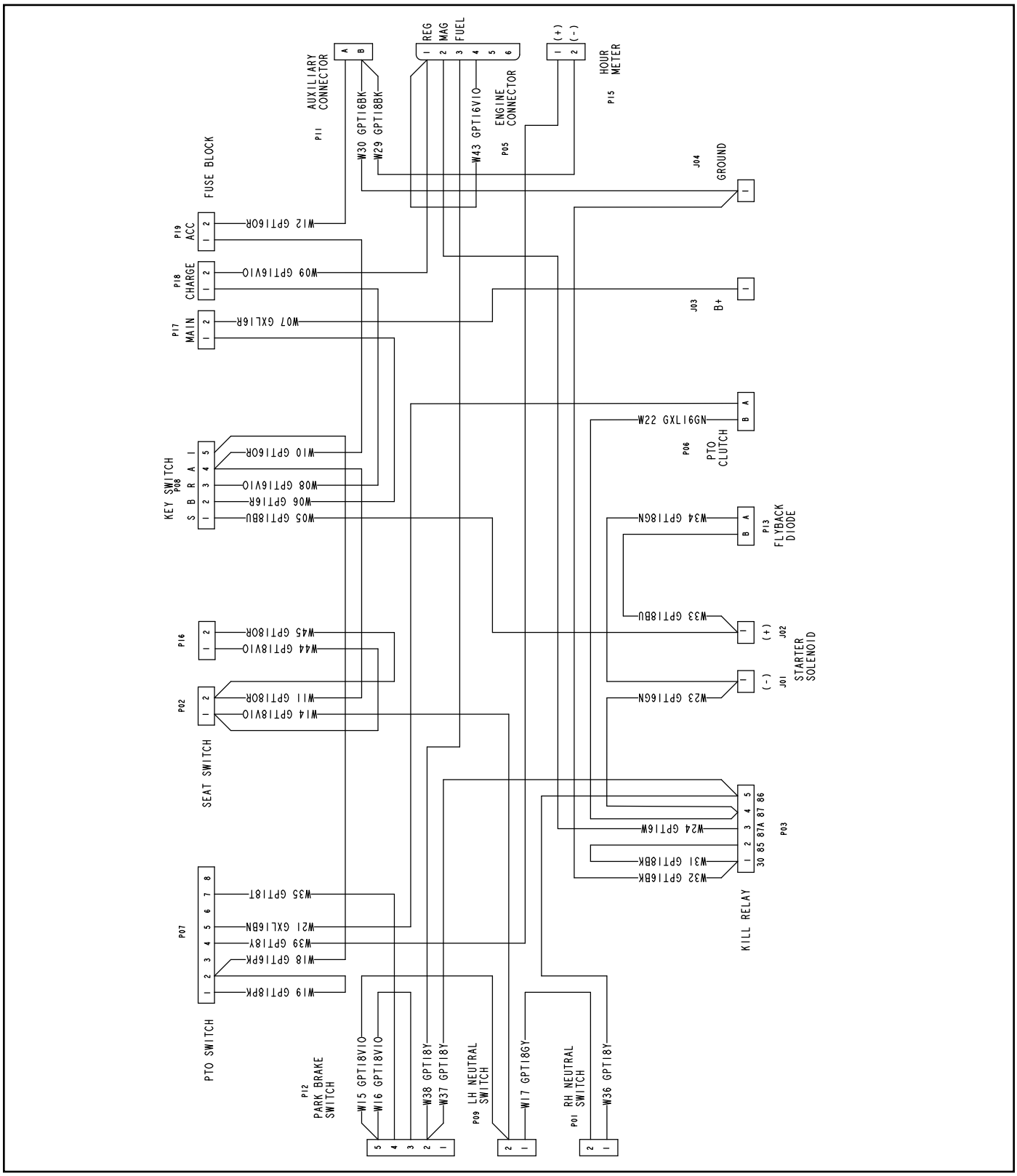

Fig. 145 PICT-3022

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Service Manual

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