TWISTER UTILITY VEHICLE 1400/1600 SERVICE MANUAL

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TORO

Consumer Products

TWISTER®
UTILITY VEHICLE
1400/1600
SERVICE MANUAL

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Twister™ .

This manual was written with the service technician in mind. We hope that you find this manual a valuable addition to your service shop. If you have questions or comments regarding this manual, please contact us at the address below.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE, AND ADJUSTMENT INSTRUCTIONS. Replacement Operator's Manuals are available by sending complete Model and Serial Number to:

The Toro Company
8111 Lyndale Avenue South
Bloomington, MN 55420–1196

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

This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

Note: A **Note** will give general information about the correct operation, maintenance, service, testing, or repair of the machine.

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.

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Chapter 6 - Chassis, Wheels, and Brakes

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Chapter 1

Safety

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Safety Instructions

Before Operating

1. Operate machine only after reading and understanding the contents of this manual.

2. **Never** allow children to operate the vehicle. **Never** allow adults to operate it without proper instructions. Only trained and authorized persons should operate this vehicle. Make sure all operators are physically and mentally capable of operating the vehicle. Anyone who operates the vehicle should have a motor vehicle license.

3. This vehicle is designed to carry the **operator** and **one passenger** in the seat provided by the manufacturer. **Never** carry more than one passenger on the vehicle.

4. **Never** operate vehicle when under the influence of drugs or alcohol.

5. Become familiar with the controls and know how to stop the engine quickly.

6. Keep all shields, safety devices, and decals in place. Repair or replace any shield, safety device, or decal if it is malfunctioning, illegible, or damaged before operating the machine.

7. Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing or jewelry which could get caught in moving parts and cause personal injury.

8. Wearing safety glasses, safety shoes, long pants and a helmet is advisable, and may be required by some local safety and insurance regulations.

9. Keep everyone, especially children and pets, away from the areas of operation.

10. Before operating the vehicle, always check vehicle and any attachments for damage. If something is wrong, **stop using the vehicle**. Make sure problem is corrected before the vehicle or attachment is operated again.

11. Since gasoline is highly flammable, handle it carefully.

A. Use an approved gasoline container.

B. Do not remove cap from the fuel tank when the engine is hot or running.

C. Do not smoke while handling gasoline.

D. Fill fuel tank outdoors to about one inch below the top of tank (bottom of filler neck). Do not overfill.

E. Wipe up any spilled gasoline.

While Operating

WARNING

POTENTIAL HAZARD

- **Engine exhaust contains carbon monoxide, which is odorless, colorless, poisonous, and deadly.**

WHAT CAN HAPPEN

- **Carbon monoxide can cause death. It is known by the State of California to cause birth defects.**

HOW TO AVOID THE HAZARD

- **Do not run engine indoors or in an enclosed area.**

1. Operator and passenger should remain seated whenever the vehicle is in motion. Operator should keep both hands on the steering wheel. Whenever possible, the passenger should use the hand holds provided. Keep arms and legs within the vehicle body at all times. Never carry passengers in the box or on any attachments. Remember your passenger may not be expecting you to brake or turn.

2. Never overload your vehicle. The name plate (located under the dash and on the center column) shows load limits for the vehicle. The load rating is for level surfaces only. Never overload attachments or exceed the vehicle maximum gross vehicle weight (GVW).

3. Operating the vehicle demands attention. Failure to operate the vehicle safely may result in an accident, tip over of vehicle, and/or serious injury or death. Drive carefully. To prevent tipping or loss of control:

A. Use extreme caution, reduce speed, and maintain a safe distance around sand traps, ditches, creeks, ramps, unfamiliar areas, or any areas that have abrupt changes in ground conditions or elevation.

WARNING

Operating the vehicle on a hill may cause tipping or rolling of the vehicle, or the engine may stall and you could lose headway on a hill. This could result in personal injury.

- **Do not exceed slopes greater than 12 degrees.**
- **If the engine stalls or you lose headway on a hill, never attempt to turn the vehicle around.**
- **Never drive across a steep hill; always drive straight up or down or go around the hill.**
- **Avoid turning on a hill.**
- **Do not accelerate quickly or slam on the brakes.**
- **Reduce your load and the speed of the vehicle.**
- **Avoid stopping on hills, especially with a load.**

B. Use caution when operating vehicle on a slope. Normally travel straight up and down slopes. Reduce speed when making sharp turns or when turning on hillsides. Avoid turning on hillsides whenever possible. If the engine stalls or you begin to lose headway while climbing a hill, gradually apply the brakes and slowly back straight down the hill.

C. Watch for holes or other hidden hazards.

D. Use extra caution when operating the vehicle on wet surfaces, at higher speeds, or with a full load. Stopping distance will increase with a full load. Slow down before starting up or down a hill.

E. When loading the box, distribute load evenly. Use extra caution if the load exceeds the dimensions of the box. Operate vehicle with extra caution when handling loads that cannot be centered. Keep loads balanced and secure to prevent them from shifting.

F. Avoid sudden stops and starts. Do not go from reverse to forward, or forward to reverse, without first coming to a complete stop.

G. Do not attempt sharp turns, abrupt maneuvers, or other unsafe driving actions that may cause a loss of vehicle control.

WARNING

The weight of the box may be heavy and could crush hands or other body parts.

- **Keep hands and other body parts clear when lowering the box.**
- **Do not dump materials on bystanders.**

H. When dumping, do not let anyone stand behind the vehicle. Do not dump the load on anyone's feet. Release tailgate latches from the side of the box, not from behind the box.

I. Only operate/drive vehicle when the cargo box is down and latched.

J. Before backing up, look to the rear of the vehicle. Make sure no one is behind it. Back up slowly.

K. Watch out for traffic when near or crossing roads. Always yield the right of way to pedestrians and other vehicles. This vehicle is **not** designed for use on streets or highways. Always signal your turns or stop early enough so other persons know what you plan to do. Obey all traffic rules and regulations.

L. Never operate vehicle in or near an area where there is dust or fumes in the air which are explosive. The electrical and exhaust systems of the vehicle can produce sparks capable of igniting explosive materials.

M. Always watch out for and avoid low overhangs such as tree limbs, door jambs, over head walkways, etc. Make sure there is enough room over head to easily clear the vehicle and your head.

N. If ever unsure about safe operation, **stop vehicle** and ask your supervisor.

WARNING

Sudden changes in terrain may cause abrupt steering wheel movement, possibly resulting in hand and arm injuries.

- **Reduce your speed and the load when operating on rough terrain and near curbs.**
- **Grip the steering wheel loosely around the perimeter. Keep your hands clear of the steering wheel spokes.**

O. When operating the vehicle over rough terrain or near curbs, reduce your speed and grip the outside of the steering wheel. Keep your hands and fingers away from the steering wheel spokes.

4. Do not touch engine or muffler while the engine is running or soon after it has stopped. These components may be hot enough to cause burns.

5. If the machine ever vibrates abnormally, stop immediately. Wait for all motion to stop. Inspect vehicle for damage. Repair all damage before commencing operation.

6. Before getting off the seat:

A. Stop movement of the machine.

B. Set parking brake.

C. Turn ignition key to OFF.

D. Remove key from ignition switch.

CAUTION

If vehicle is parked on an incline, chock wheels after getting off of the vehicle.

Maintenance and Service

1. Only qualified and authorized personnel should maintain, repair, adjust, or inspect the vehicle.

2. Before servicing or making adjustments to the machine, stop engine, set parking brake, and remove key from the ignition switch to prevent someone from accidentally starting the engine.

3. Make sure entire machine is in good condition. Keep all nuts, bolts, and screws properly tightened.

4. Reduce potential fire hazards. Keep engine area free of excessive grease, grass, leaves, and accumulation of dirt.

5. Never use an open flame to check level or leakage of fuel or battery electrolyte.

6. If the engine must be running to perform a maintenance adjustment, keep hands, feet, clothing, and any parts of the body away from the engine and any moving parts. Keep everyone away.

7. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.

8. **Do not alter** engine speed governor. To assure safety and accuracy, have a Toro Authorized Vehicle Dealer check the engine governor speed.

9. If major repairs are needed or assistance is required, contact a Toro Authorized Vehicle Dealer.

10. Make sure of optimum performance and safety. Always use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers could cause damage and be dangerous. Altering this vehicle in any manner may affect its operation, performance, and/or durability. Alterations may result in injury or death. Such use could void the product warranty of The Toro Company.

Sound Pressure Level

This unit has an equivalent continuous A-weighted sound pressure at the operator's ear of 80 dB(A), which is based on measurements of identical machines per SAE J1174-MAR 85 procedures.

Vibration Level

This unit does not exceed a vibration level of 2.5 m/s^2 at the hands, which is based on measurements of identical machines per ISO 5349 procedures.

This unit does not exceed a vibration level of 0.5 m/s^2 at the posterior, which is based on measurements of identical machines per ISO 2631 procedures.

Jacking and Other Instructions

Jack Vehicle

DANGER

POTENTIAL HAZARD
- **A vehicle that is not properly supported may become unstable.**

WHAT CAN HAPPEN
- **The vehicle may move or fall. Personal injury or damage to the machine may result.**

HOW TO AVOID THE HAZARD
- **Make sure vehicle is parked on a solid level surface, such as a concrete floor.**
- **Make sure engine is off and key is removed from the ignition switch before getting off the vehicle.**
- **Before raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle.**
- **Always chock or block wheels to prevent the vehicle from rolling.**
- **Do not start vehicle while it is on jack stands or blocks without transaxle locked in neutral.**
- **Make sure proper hoists, solid wooden blocks, and jack stands are used to raise and support the vehicle.**

WARNING

Whenever the engine is run for testing that requires the rear wheels to spin, rear wheels should be at least 1 inch (25 mm) off the ground with the axle supported on jack stands.

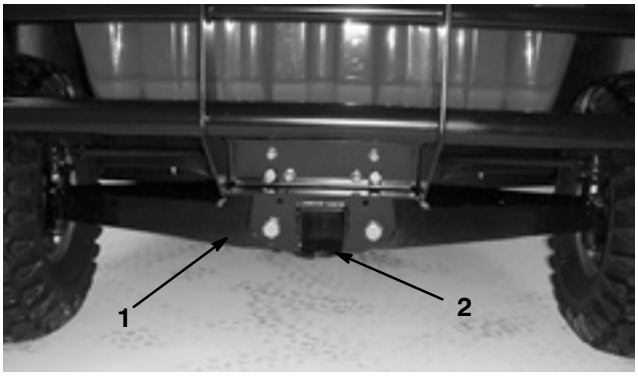

Figure 1

1. Front frame
2. Towing tongue

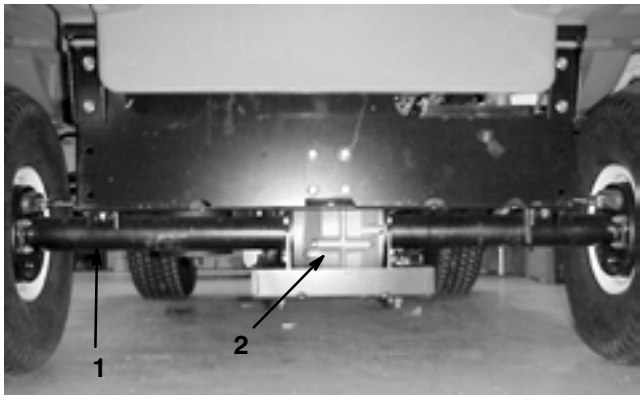

Figure 2

1. Axle tube
2. Transaxle case

Locations

1. Jack front of the vehicle on the front of the frame and behind the towing tongue (Fig. 1).

2. Jack rear of the vehicle under each rear axle tube. Do not jack vehicle below the transaxle case (Fig. 2).

Transport Vehicle

When moving the vehicle long distances, use a trailer or flatbed truck. Make sure vehicle is secured to the trailer properly.

1. Secure front of the vehicle to trailer at the towing tongue (Fig. 1).

2. Secure rear of the vehicle to the trailer at each rear axle tube (Fig. 2).

WARNING

POTENTIAL HAZARD
- **Seats may become loose and fall off the vehicle and trailer when transporting.**

WHAT CAN HAPPEN
- **Seats falling off the trailer may hit another vehicle or become a road hazard.**

HOW TO AVOID THE HAZARD
- **Remove or secure seats with cord or strap.**

Tow Vehicle

In case of emergency, the vehicle can be towed for a short distance. However, Toro does not recommend this as a standard procedure.

WARNING

POTENTIAL HAZARD

- **Towing at excessive speeds could cause the vehicle to lose control.**

WHAT CAN HAPPEN

- **Loss of control could result in personnel injury and/or damage to the vehicle.**

HOW TO AVOID THE HAZARD

- **Never tow vehicle more than 5 mph (8 KPH).**

Towing the vehicle is a two person job. If the vehicle must be moved a considerable distance, transport it on a truck or trailer (see Transport Vehicle).

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove drive belt from drive and driven clutches (see Service Drive Belt).

3. Secure a chain or tow line to tongue on front frame member (Fig. 1).

4. Put vehicle in neutral (see Set Neutral Lock Assembly) and release parking brake.

Transaxle Neutral Position

When performing routine maintenance and/or engine testing, the transaxle must be shifted into the neutral position.

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. On vehicles equipped with a neutral position on the shift lever (Fig. 3):

   A. Move shift lever to the neutral position.

   B. Make sure transaxle is locked in neutral by rotating the driven clutch (Fig.4). The tires should not rotate. If tire rotation does occur, see Adjust Shift Cables – Chapter 4, Drive Train.

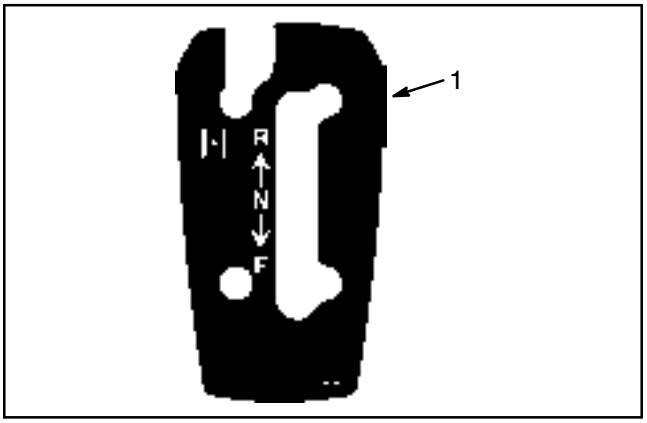

Figure 3

1. Shift lever w/neutral

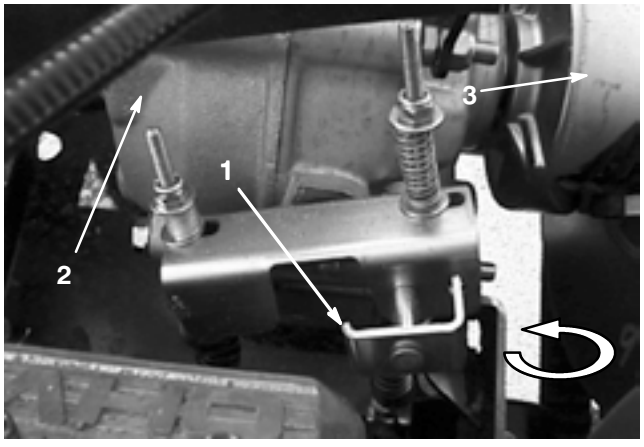

Figure 4

1. Locking pin (if equipped)
2. Transaxle case
3. Driven clutch

Chapter 2

Maintenance and Specifications

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Maintenance

Note: Determine the left and right sides of the machine from the normal operating position.

Recommended Maintenance Schedule

Maintenance Service Interval	Maintenance Procedure
After first 8 hours	• Change the engine oil. • Check the drive belt tension.
Every 8 hours	• Check the engine oil. • Check the tire pressure.
After first 20 hours	• Check the front wheel toe-in at the proper ride height.
Every 50 hours	• Check the battery fluid level. • Check the battery cable connections. • Change the engine oil (includes synthetic oil).[1]
Every 100 hours	• Lubricate all grease fittings. • Clean the engine rotating screen.[2] • Inspect the air cleaner filter.[2] • Replace the engine oil filter. • Inspect the brake and parking brake. • Inspect the condition and wear of the tires. • Torque the wheel lug nuts. • Check the front suspension toe-in and ride height.
Every 200 hours	• Replace the air cleaner filter. • Check the brake cable adjustments. • Inspect the drive belt.
Every 400 hours or yearly	• Inspect the fuel lines.
Every 800 hours or yearly	• Replace the fuel filter. • Change the transaxle oil. • Replace the spark plugs. • Drain and flush the fuel tank.

[1]More often when operating under heavy load or high temperatures.

[2]More often in dusty, dirty conditions.

IMPORTANT: Refer to your engine operator's manual for additional maintenance procedures.

CAUTION

If you leave the key in the ignition switch, someone could accidently start the engine and seriously injure you or other bystanders.

Remove the key from the ignition and disconnect the wire(s) from the spark plug(s) before you do any maintenance. Set the wire(s) aside so that it does not accidentally contact the spark plug(s).

Specifications

Note: Specifications and design are subject to change without notice.

General Specifications

Base weight	Dry 1000 lbs. (454 kg)
Rated capacity (on level ground)	1400 lb. (635 kg) total, including 200 lb. (91 kg) operator and 200 lb. (91 kg) passenger, load, trailer tongue weight, gross trailer weight, accessories, and attachments
Maximum gross vehicle weight (GVW) (on level ground)	2400 lb. (1089 kg) total, including all of the weights listed above
Maximum cargo capacity (on level ground)	1000 lb. (454 kg) total, including trailer tongue weight and gross trailer weight
Tow capacity:	
Standard Hitch	Tongue weight 50 lbs. (23 kg) Maximum trailer weight 400 lbs. (182 kg)
Heavy Duty Hitch	Tongue weight 100 lbs. (45 kg) Maximum trailer weight 800 lbs. (363 kg)
Overall width	60 in. (152.4 cm)
Overall length	117 in. (297.2 cm)
Ground clearance	9-1/4 in. (23.5 cm) at the front with no load or operator 6-1/2 in. (19.7 cm) at the rear with no load or operator
Wheel base	79 in. (200.7 cm)
Wheel tread (center line to center line)	49 in. (124.5 cm) in the front 48-1/4 in. (122.6 cm) in the rear
Cargo box length	46 in. (116.8 cm) inside 51 in. (129.5 cm) outside
Cargo box width	49 in. (124.5 cm) inside 54 in. (137.2 cm) outside
Cargo box height	10 in. (25.4 cm) inside

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	0.397	33/64	0.515625	13.097
1/32	0.03125	0.794	17/32	0.53125	13.494
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	0.0938	2.381	19/32	0.5938	15.081
7/64	0.109375	2.778	39/64	0.609375	15.478
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	0.1563	3.969	21/32	0.6563	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	0.2188	5.556	23/32	0.7188	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	0.2813	7.144	25/32	0.7813	19.844
19/64	0.296875	7.541	51/64	0.796875	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.328125	8.334	53/64	0.828125	21.034
11/32	0.3438	8.731	27/32	0.8438	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	0.4688	11.906	31/32	0.9688	24.606
31/64	0.484375	12.303	63/64	0.984375	25.003
1/2	0.5000	12.700	1	1.000	25.400

1 mm = 0.03937 in. | 0.001 in. = 0.0254 mm

U.S to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp)	Grams	28.3495
Pressure	Pounds Sq. In.	Kilopascal	6.895
	Pounds Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1382
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32° 2. Multiply by 5/9

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 this 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 this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener's head, or similar condition which affects the installation.

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

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

Fastener Identification

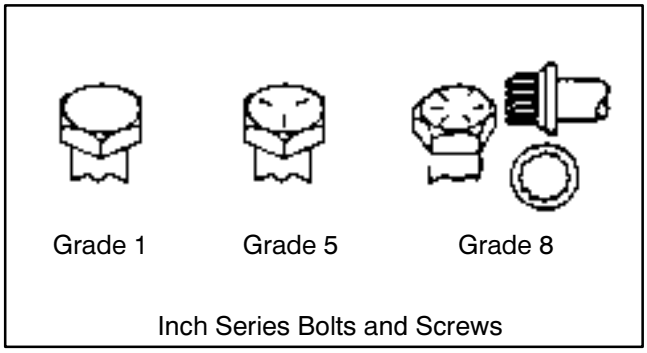

Figure 1

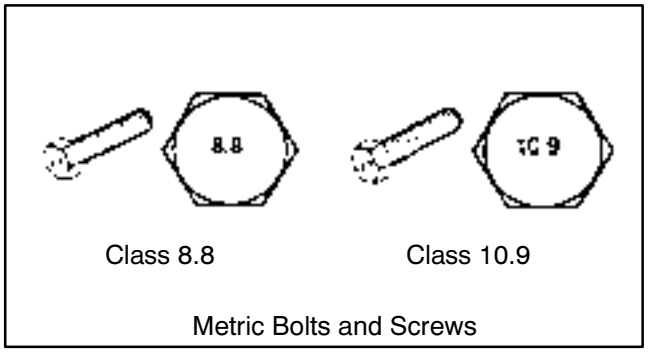

Figure 2

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 5 or Stronger Nuts)	
	in-lb	**in-lb**	**N-cm**	**in-lb**	**N-cm**	**in-lb**	**N-cm**
# 6 - 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 - 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 - 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 - 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 - 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 - 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 - 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 - 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 - 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 - 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft-lb	**ft-lb**	**N-m**	**ft-lb**	**N-m**	**ft-lb**	**N-m**
3/8 - 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 - 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 - 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 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	375 ± 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 Plated, and Steel Fasteners (Metric Fasteners)

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

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

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

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

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 & finish must be considered when determining specific torque values. All torque values are based on non-lubricated fasteners.

Conversion Factors

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

N-cm X 0.08851 = in-lb
N-m X 0.7376 = ft-lb

Lubrication

Note: Perform this maintenance procedure at the interval specified in the TWISTER™ Maintenance Schedule. Lubricate more frequently when using this vehicle for heavy duty operations and after each washing.

Grease Fitting Locations

1. Each tie rod has a grease fitting on each ball joint, the one that secures the tie rod to the Pitman arm (Fig. 3) and the joint that secures the tie rod to the front wheel spindle (Fig. 4).

2. The A-arm has a grease fitting for the king pin (Fig. 4).

3. The throttle and brake pedal pivots each have one grease fitting. **Note:** These fittings are not greased at the factory. Grease them only when and if the pedals begin to stick (Fig. 5).

Greasing

IMPORTANT: Use No. 2 general purpose lithium base grease.

1. Wipe grease fitting clean so foreign matter cannot be forced into the bearing or bushing.

2. Pump grease into the bearing or bushing.

3. Wipe off excess grease.

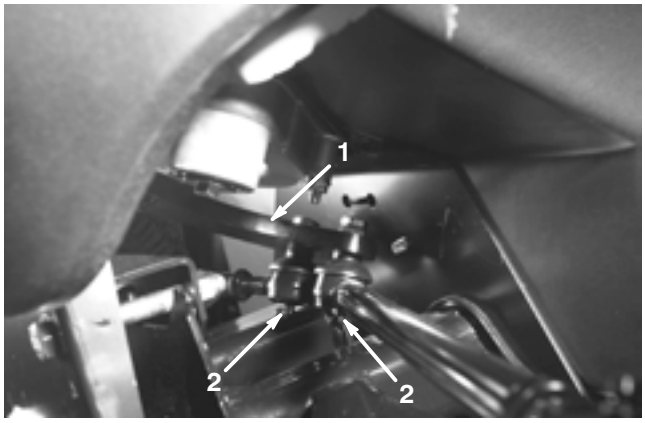

Figure 3

1. Pitman arm
2. Grease fitting

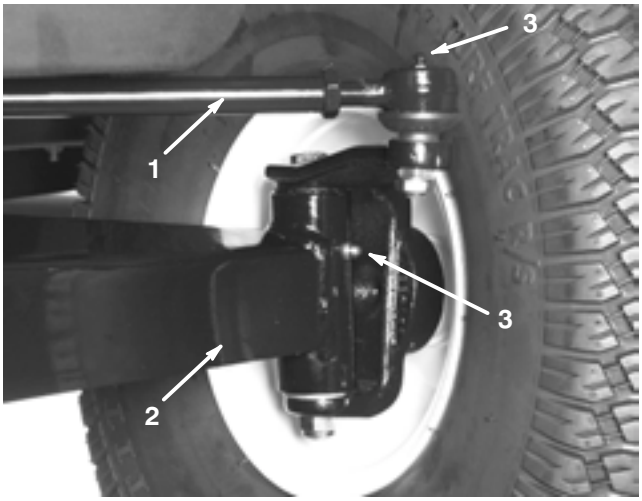

Figure 4

1. Tie rod
2. A-arm
3. Grease fitting

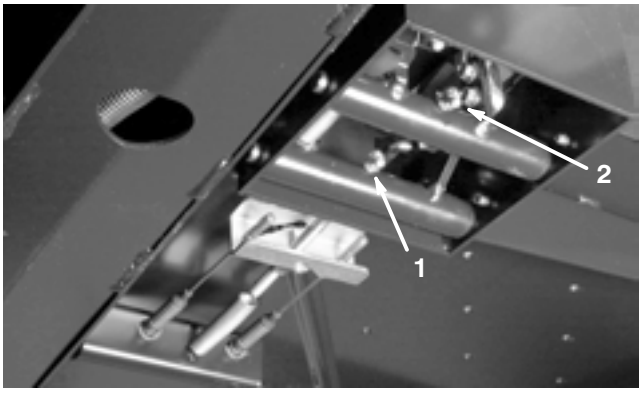

Figure 5

1. Grease fitting (brake)
2. Grease fitting (throttle)

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Chapter 3

Briggs & Stratton Gasoline Engine

Table of Contents

Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the V-twin cylinder, gasoline engine used in the TWISTER™.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton Repair Manual for 4-Cycle, V-Twin Cylinder, OHV Head Engines. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Briggs & Stratton engines are supplied through your local Briggs & Stratton dealer. If no parts list is available, be sure to provide your dealer with the engine model and type number.

Specifications

Item	Description
Make / Designation	Briggs and Stratton, 4-cycle, V-Twin Cylinder, OHV, Air Cooled, Gasoline Engine - Model 303440
Horsepower	16 HP @ 3600 RPM
Torque kg-m (ft-lb)	4.76 (34.5) @ 2300 RPM
Bore x Stroke mm (in.)	66 x 68 (2.68 x 2.60)
Total Displacement cc (cu. in.)	480 (29.3)
Dry Weight (approximate) kg (lb.)	32.4 (72)
Fuel	Unleaded regular grade gasoline
Fuel Capacity liters (gallons)	26.5 (7.0)
Fuel Pump	Pulsating Crankcase Vacuum
Carburetor	Float Feed, Single Barrel
Engine Oil	See Change Engine Oil in Service and Repairs section
Oil Pump	Gear Driven Geroter Type
Crankcase Oil Capacity liters (U.S. qt.)	1.66 (1.75) with new filter
Spark Plugs	Champion RC 12YC (or equivalent)
Spark Plug Gap mm (inch)	0.76 (0.030)
Idle speed - no load	1025 ± 50 RPM
High speed - no load	3600 ± 100 RPM

Fill Fuel Tank and Fuel Safety Precautions

The Toro Company strongly recommends the use of fresh, clean, UNLEADED regular grade gasoline in Toro gasoline powered products. Unleaded gasoline burns cleaner, extends engine life, and promotes good starting by reducing the build-up of combustion chamber deposits. Minimum Octane rating of 85.

IMPORTANT: Never use gasoline containing METHANOL, gasoline containing more than 10% ethanol, gasoline additives, or white gas. Damage could result to the engine fuel system.

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Clean area around fuel tank cap.

3. Remove fuel tank cap.

4. Fill tank to about one inch below the top of tank, (bottom of filler neck). This space in the tank allows gasoline to expand. **Do not overfill.**

5. Install fuel tank cap securely. Wipe up any fuel that may have spilled.

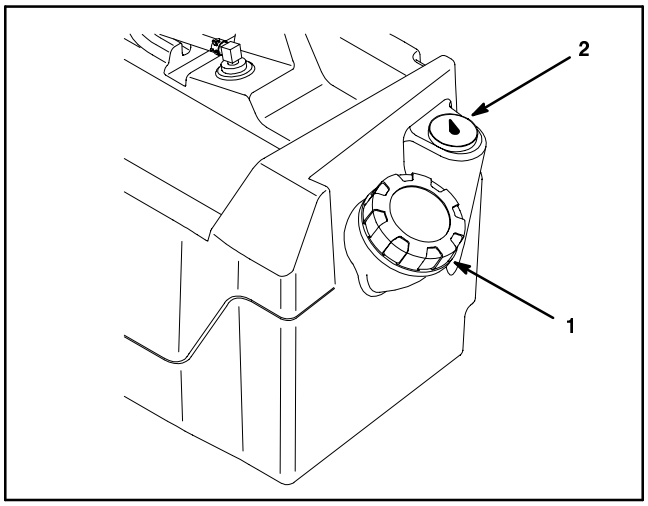

Figure 1

1. Fuel tank cap
2. Fuel gauge

DANGER

POTENTIAL HAZARD

- **Gasoline is extremely flammable and highly explosive under certain conditions.**

WHAT CAN HAPPEN

- **A fire or explosion from gasoline can burn you, others, and cause property damage.**

HOW TO AVOID THE HAZARD

- **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is cold. Wipe up any gasoline that spills.**
- **Do not fill the fuel tank completely full. Add gasoline to the fuel tank until the level is no higher than 1 inch (25 mm) below the bottom of the filler neck. This empty space in the tank allows gasoline to expand.**
- **Never smoke when handling gasoline, and stay away from an open flame or where gasoline fumes may be ignited by a spark.**
- **Store gasoline in an approved container and keep it out of the reach of children. Never buy more than a 30-day supply of gasoline.**
- **Always place gasoline containers on the ground away from your vehicle before filling.**
- **Do not fill gasoline containers inside a vehicle or on a truck or trailer bed because interior carpets or plastic truck bed liners may insulate the container and slow the loss of any static charge.**
- **When practical, remove gas-powered equipment from the truck or trailer and refuel the equipment with its wheels on the ground.**
- **If this is not possible, then refuel such equipment on a truck or trailer from a portable container, rather than from a gasoline dispenser nozzle.**
- **If a gasoline dispenser nozzle must be used, keep the nozzle in contact with the rim of the fuel tank or container opening at all times until fueling is complete.**

Check Engine Oil

Procedure (Fig. 2)

The engine is shipped with oil in the crankcase; however, level of oil must be checked before and after the engine is first started.

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Remove dipstick and wipe it with a clean rag. Insert dipstick into tube and make sure it is seated fully. Remove dipstick and check level of oil.

3. If oil level is low, remove filler cap from valve cover. Pour oil with proper type and viscosity into the opening until the oil level is up to the "FULL" mark on the dipstick. Add oil slowly, and check the level often during this process. **Do not overfill.**

4. Install dipstick firmly in place.

Oil Type and Viscosity (Fig. 3)

Oil Type: Detergent oil (API service SF, SG, SH, SJ, or higher).

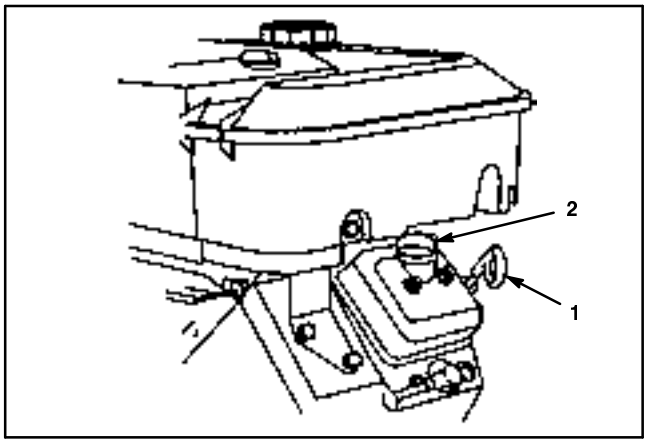

Figure 2

1. Dipstick
2. Filler cap

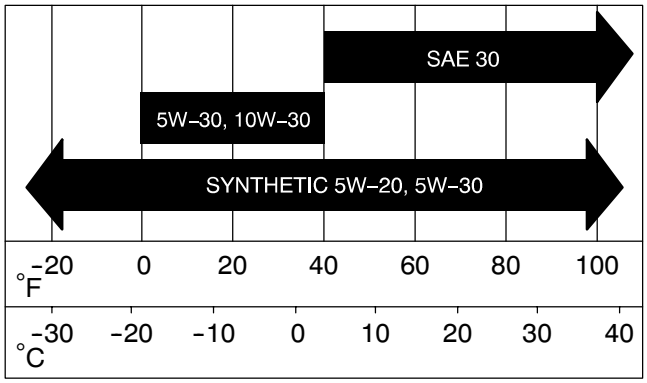

Figure 3

Change Engine Oil

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

1. Start vehicle and let it run for a few minutes to warm the oil.

2. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

3. Raise bed and secure it with the prop rod.

4. Disconnect spark plug wires.

5. Remove drain plug and let the oil flow into a drain pan. When the oil stops, reinstall the drain plug (Fig.4).

Note: Dispose of the used oil at a certified recycling center.

Note: See Check Engine Oil for the proper type and viscosity of oil to add to the engine.

6. Pour oil into fill opening until the oil level is up to the "**FULL**" mark on the dipstick. Add oil slowly and check level often during this process. **Do not overfill (Fig. 5).**

7. Install filler cap and dipstick firmly in place (Fig. 5).

8. Connect spark plug wires.

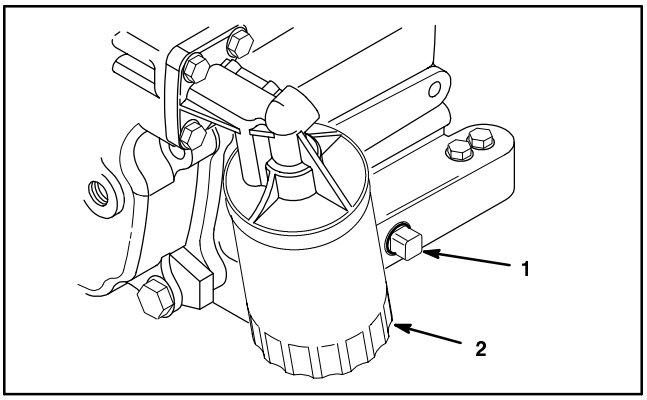

Figure 4

1. Drain plug 2. Oil filter

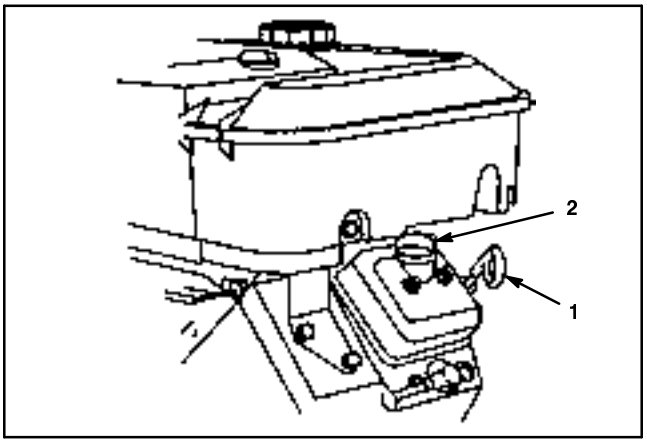

Figure 5

1. Dipstick 2. Filler cap

Change Engine Oil Filter

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

1. Drain oil from the engine (see Change Engine Oil).

2. Remove existing oil filter (Fig.4). Apply light coat of clean oil to the new filter gasket.

3. Screw filter on until gasket contacts mounting plate, then tighten filter an additional 1/2 to 3/4 turn further. **Do not overtighten.**

Note: See Check Engine Oil for the proper type and viscosity of oil to add to the engine.

4. Pour oil into fill opening until the oil level is up to the "**FULL**" mark on the dipstick. Add oil slowly and check level often during this process. **Do not overfill (Fig. 5).**

5. Start and run engine to check for leaks.

6. Stop engine and recheck the oil level. Add oil if necessary.

Service Air Cleaner

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Raise bed and secure with prop.

3. Check air cleaner body and hoses for damage which could possibly cause an air leak. Replace air cleaner body if damaged.

4. Release latches securing the air cleaner cover to the air cleaner body. Separate cover from the body. Clean inside of air cleaner cover.

5. Gently slide filter out of the air cleaner body to reduce the amount of dust dislodged. Avoid knocking filter against the air cleaner body.

IMPORTANT: Do not wash or reuse a damaged filter.

6. Inspect filter. Discard filter if damaged.

7. Clean filter element using either of the following two methods:

Washing Method

A. Prepare a solution of filter cleaner and water. Soak filter element for about 15 minutes. Refer to directions on the filter cleaner carton for complete information.

IMPORTANT: Maximum water pressure must not exceed 40 psi to prevent damage to the filter element.

B. After soaking the filter for 15 minutes, rinse it with clear water. Rinse filter from the clean side to the dirty side.

IMPORTANT: Do not use a light bulb to dry the filter element because damage could result.

C. Dry filter element using warm, flowing air that does not to exceed 160°F (71°C), or allow element to air-dry.

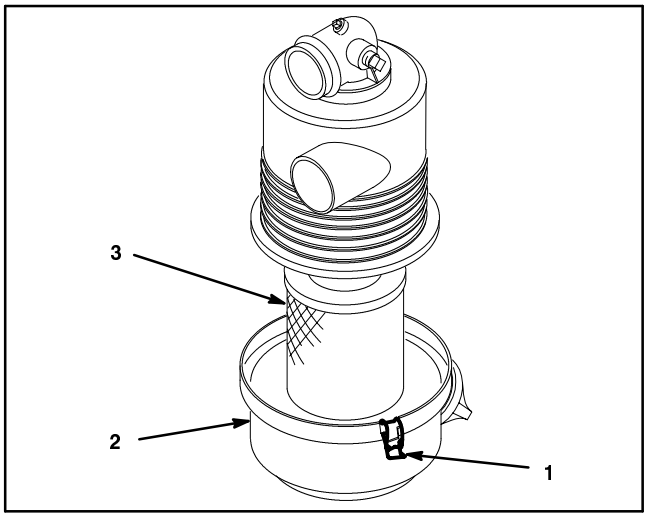

Figure 6

1. Air cleaner latches
2. Cover
3. Filter element

Compressed Air Method

CAUTION

Use eye protection such as goggles when using compressed air.

IMPORTANT: Maximum air pressure must not exceed 100 psi to prevent damage to the element.

A. Blow compressed air from the inside to the outside of the dry filter element.

B. Keep air hose nozzle at least 2 inches (5 cm) from the filter. Move nozzle up and down while rotating the filter element. Inspect for holes and tears by looking through the filter toward a bright light.

8. If filter element is being replaced, inspect new filter for shipping damage. Check sealing end of the filter. Do not install a damaged filter.

9. Insert new (or cleaned) filter correctly into the air cleaner body. Make sure filter is sealed properly by applying pressure to the outer rim of the filter when installing. Do not press on the flexible center of the filter.

10. Reinstall cover and secure latches.

Service Drive Belt

Inspection

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Raise bed and secure with prop rod.

3. Put vehicle transmission in neutral (see Set Neutral Lock Assembly in Chapter 1 – Safety).

4. Rotate and inspect belt for excessive wear or damage. Replace as necessary.

Replacement

1. Rotate and route belt over the driven clutch.

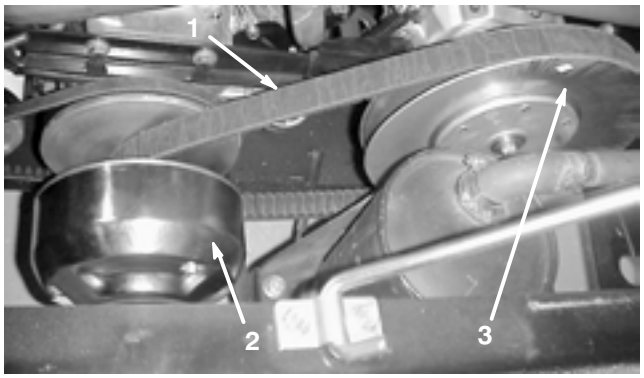

Figure 7

1. Drive belt
2. Drive clutch
3. Driven clutch

2. Remove belt from the drive clutch.

3. Place new belt around drive clutch.

4. Rotate driven clutch while routing the belt on.

Replace Fuel Filter

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

WARNING

Use caution when working with fuel system components (see Fill Fuel Tank and Fuel Safety Precautions).

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Raise bed and support with prop rod.

3. Place a clean container under fuel filter.

4. Remove clamps securing fuel filter to fuel lines.

5. Remove fuel lines from fuel filter.

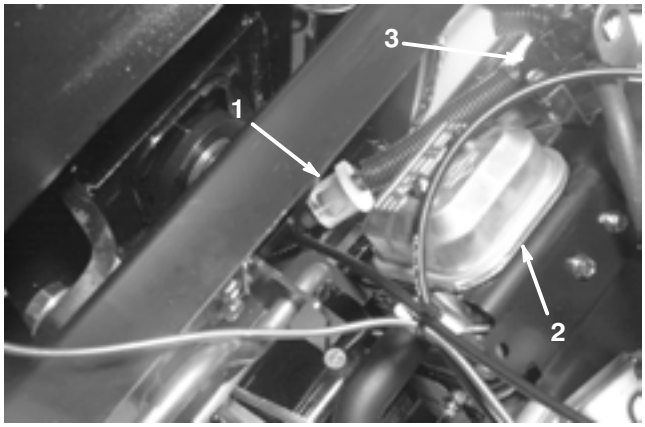

Figure 8

1. Fuel filter
2. Rear cylinder head
3. Fuel pump

IMPORTANT: Mount filter so the arrow points in the direction of fuel flow to the fuel pump.

6. Install new fuel filter to fuel lines with clamps previously removed.

Spark Plugs

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

Type: Champion RC 12YC (or equivalent)
Air Gap: 0.030 inch (0.76 mm)

Note: A spark plug usually lasts a long time; however, the plug should be removed and checked whenever the engine malfunctions.

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Clean area around spark plugs so foreign matter cannot fall into cylinder when spark plug is removed.

3. Pull spark plug wires off spark plugs and remove plugs from cylinder head.

IMPORTANT: Replace cracked, fouled, dirty, or malfunctioning spark plugs. Do not clean plugs. Grit from the plug may damage the engine.

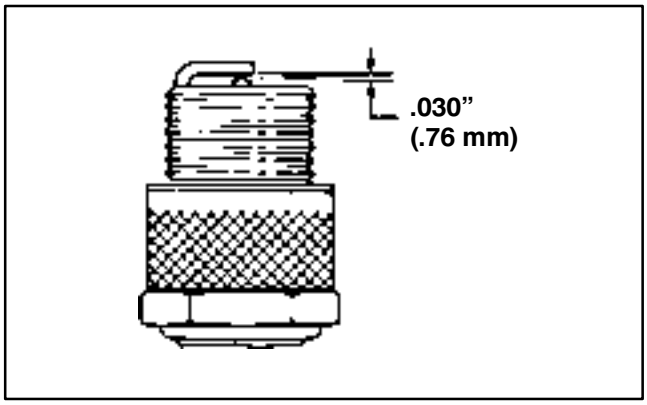

Figure 9

4. Check condition of side electrode, center electrode, and center electrode insulator for damage.

5. Set air gap between center and side electrodes at 0.030" (0.76 mm). Install correctly gapped spark plug and tighten plug to 180 in-lb (20 N–m).

6. Install spark plug wires.

Clean Debris from Engine

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual.

IMPORTANT: This engine is air-cooled. Operating the engine with dirty or plugged cooling fins, a blocked rotating screen, or plugged or dirty blower housing will result in overheating and engine damage.

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

IMPORTANT: Never clean engine with pressurized water. Water could enter and contaminate the fuel system.

2. Clean cooling fins on both cylinder heads (Fig.10).

3. Clean rotating screen and blower housing of dirt and debris. Remove screen and housing if necessary (Fig.11).

IMPORTANT: Never operate engine without the blower housing installed. Overheating and engine damage will result.

4. Make sure rotating screen and blower housing are reinstalled to the engine if removed.

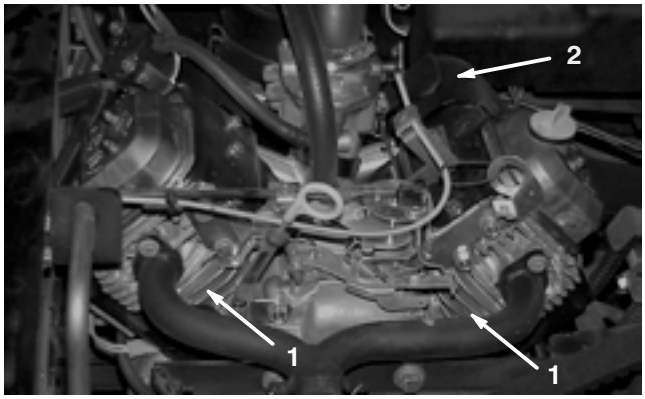

Figure 10

1. Cylinder head 2. Blower housing

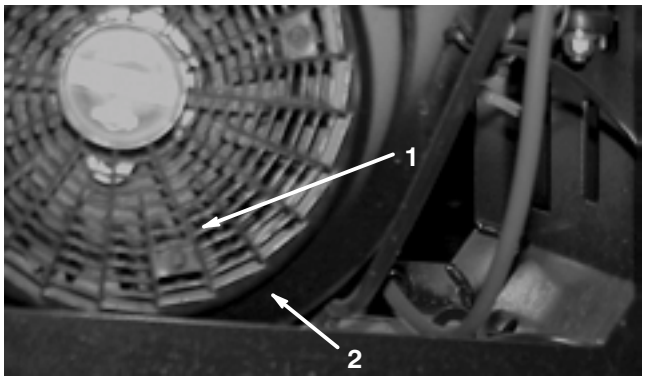

Figure 11

1. Rotating screen 2. Blower housing

Muffler

Removal

1. Park machine on a level surface, stop the engine, engage parking brake, and remove key from the ignition switch.

CAUTION

The muffler and exhaust pipe may be hot. To avoid possible burns, allow engine and exhaust system to cool before working on the muffler.

2. Remove the 4 coupler springs located between the engine manifold and the muffler.

3. Remove the two bolts and nuts securing the engine muffler to the frame.

4. Separate the muffler carefully from the exhaust coupler and the engine manifold.

Installation

1. Make sure engine is off.

2. Position muffler to the frame and carefully install the exhaust coupler between the muffler and the engine exhaust manifold.

3. Install the 4 coupler springs located between the engine manifold and the muffler.

4. Tighten all fasteners.

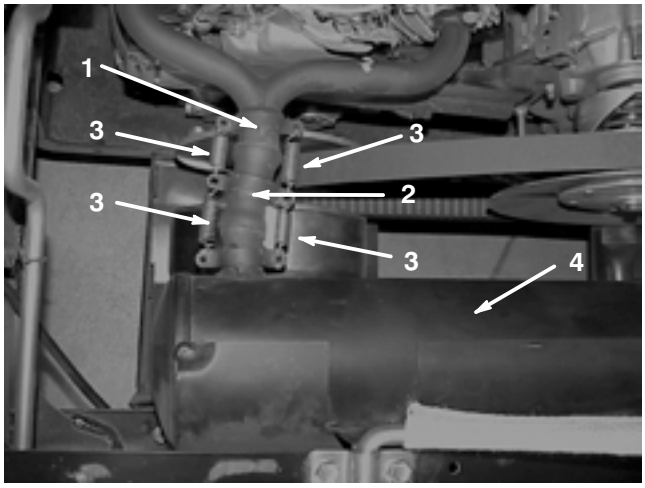

Figure 12

1. Engine manifold
2. Exhaust coupler
3. Coupler spring
4. Muffler

Fuel Tank and Seat Base

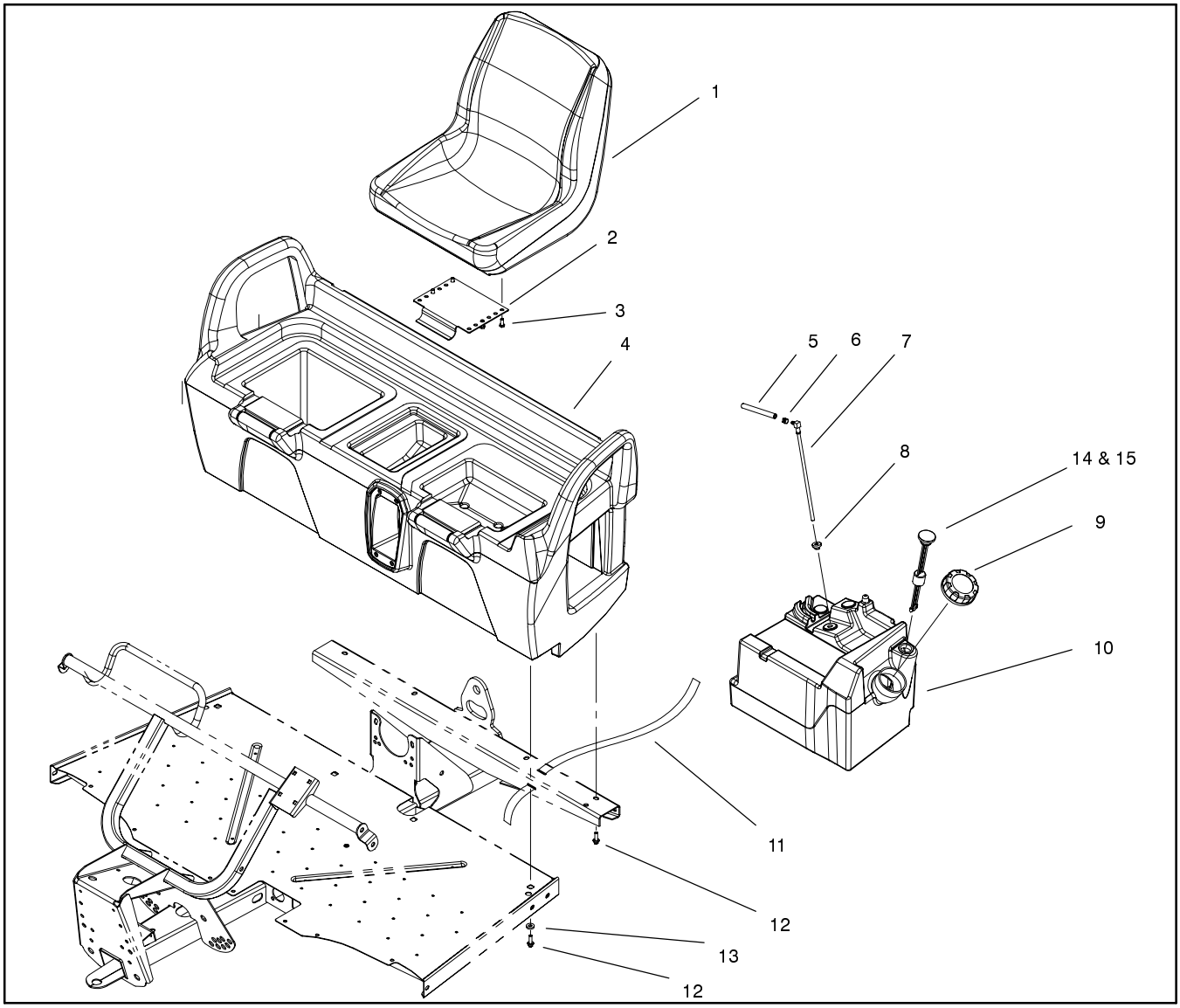

Figure 13

1. Seat
2. Seat bracket
3. Cap screw
4. Seat base
5. Fuel hose (to filter)
6. Clamp
7. Stand pipe
8. Bushing
9. Gas cap
10. Fuel tank
11. Web strapping (48 inch)
12. Hex head flange screw
13. Flat washer
14. Fuel gauge
15. Grommet

Seat Base Removal (Fig. 13)

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Flip both seats forward, and remove them from the seat base.

3. Unscrew knob from the shift lever. Remove four short cap screws securing the shift plate to the shift bracket (not shown) (Fig. 14).

4. Remove four long cap screws securing the shift plate to the seat base. Separate shift bracket from the choke cable and seat base (Fig. 14).

5. Remove four hex head flange screws and flat washers securing the front of the seat base to the frame. Remove four hex head flange screws securing the back of the seat base to the frame.

IMPORTANT:Make sure shift bracket, shift cables, choke cable, and fuel tank do not catch on the seat base during removal.

6. Lift seat base carefully from the machine.

Seat Base Installation

IMPORTANT: Make sure shift bracket, shift cables, choke cable, and fuel tank do not catch on the seat base during installation.

1. Position seat base carefully to the frame.

Note: Do not tighten fasteners securing the seat base to the frame until all of them are installed.

2. Install four hex head flange screws and flat washers through the frame and to the front of the seat base. Install four hex head flange screws through the frame and into the back of the seat base. Tighten all fasteners.

3. Place shift bracket, shift cables, and choke cable through the opening at the front of the seat base.

4. Secure shift plate to the shift bracket (not shown) with four short cap screws. Screw knob to the shift lever (Fig. 14).

5. Position choke cable and shift plate with shift bracket to the seat base. Secure shift plate to seat base with 4 long cap screws (Fig. 14).

Fuel Tank Removal (Fig. 15)

WARNING

Use caution when working with fuel system components (see Fill Fuel Tank and Fuel Safety Precautions).

1. Remove seat base from the frame (see Seat Base Removal).

2. Loosen hose clamp and disconnect fuel hose from the tank.

3. Release tank strap from fuel tank. Do not remove strap from floor plate and frame cross member. Remove tank from frame.

Fuel Tank Installation (Fig. 15)

1. Position fuel tank to frame. Secure tank to frame and cross member with tank strap.

2. Connect fuel hose to the tank and secure with hose clamp.

3. Install seat base to the frame (see Seat Base Installation).

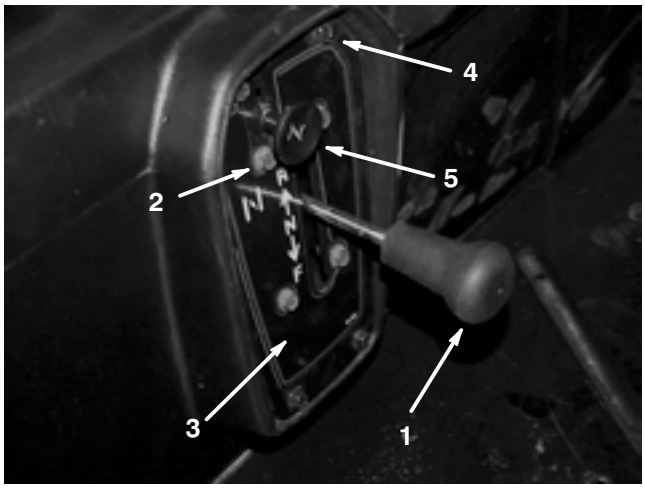

Figure 14

1. Shift lever
2. Cap screw (short)
3. Shift plate
4. Cap screw (long)
5. Choke cable

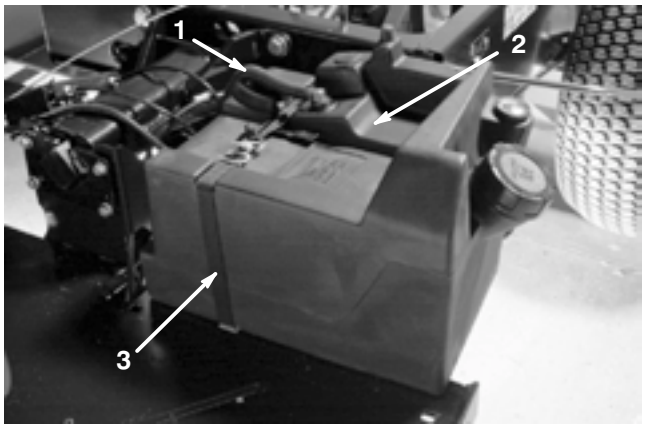

Figure 15

1. Fuel hose
2. Fuel tank
3. Tank strap

Engine

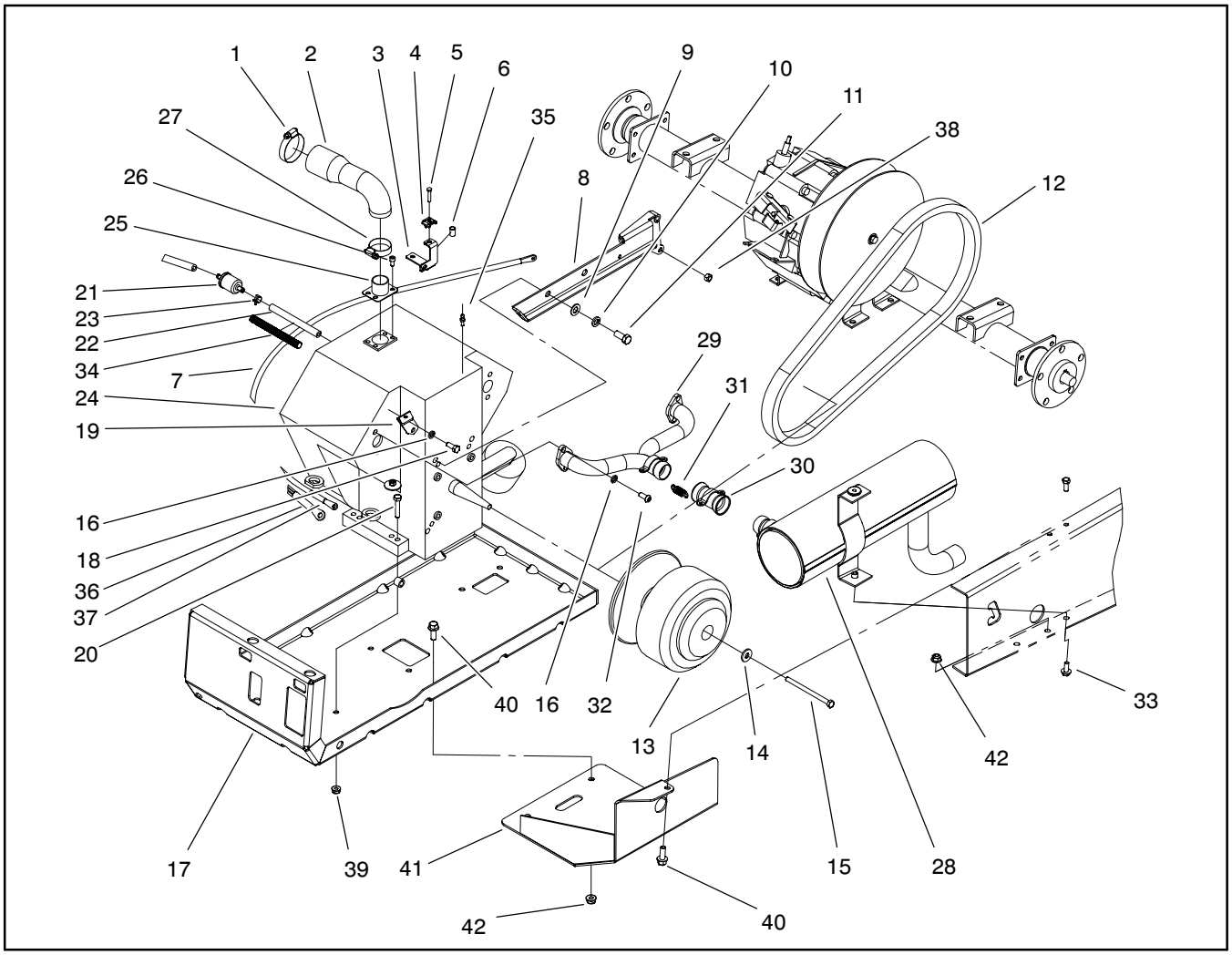

Figure 16

1. Clamp-Hose
2. Hose-Intake
3. Bracket-Cable
4. Clamp-Cable
5. Screw-HH
6. Threaded-Insert
7. Cable-Throttle
8. Arm-Torque
9. Washer-Flat
10. Washer-Lock
11. Screw-HH
12. Belt-Drive
13. Clutch-Drive
14. Washer
15. Screw-HH
16. Washer-Lock
17. Mount-Engine, 16hp
18. Screw-Cap
19. Bracket-Cable Tie
20. Screw-HH
21. Filter-Fuel
22. Hose-Fuel, Filter
23. Clamp
24. Engine-B&S, 303447-1314-E1
25. Bracket-Intake
26. Screw
27. Clamp-Hose
28. Muffler-Engine
29. Manifold-Engine
30. Coupler-Exhaust, 16hp
31. Spring-Coupler, Exhaust
32. Screw
33. Screw
34. Conduit-Line, Fuel
35. Ball-Stud
36. Harness-Wire, Engine
37. Positive Red Wire ASM
38. Nut-Lock
39. Nut-Flange, NI
40. Screw-HHF
41. Clutch-Guard
42. Nut-Flange, NI

Engine Removal (Fig. 16)

1. Park machine on a level surface, stop engine, engage parking brake, and remove key from the ignition switch.

2. Remove cargo bed to gain access to the engine.

3. Disconnect ground (black) cable from the battery. Then, disconnect positive (red) cable from the battery.

IMPORTANT: Make sure all hoses and engine openings are plugged after disconnecting. Prevent contaminants from entering the engine and fuel system and damaging the engine.

4. Disconnect the following components (Fig. 17).

   A. Choke and throttle cables from the carburetor and cable bracket.

   B. Air intake hose from the carburetor.

   C. Breather hose from the crankcase

CAUTION

Read safety precautions for handling gasoline before working on the fuel system (see Fill Fuel Tank and Fuel Safety Precautions).

5. Disconnect fuel hose from the fuel pump. Remove cable tie securing the choke, throttle, and shift cables to the bracket on the front cylinder head. (Fig. 18).

6. Remove muffler and exhaust pipe from the cylinder heads (see Muffler Removal).

7. Remove drive belt (see Service Drive Belt).

8. Remove torque arm from the engine and transaxle.

9. Disconnect engine harness connector from the main harness.

10. Remove four flange lock nuts and cap screws securing the engine to the engine mount.

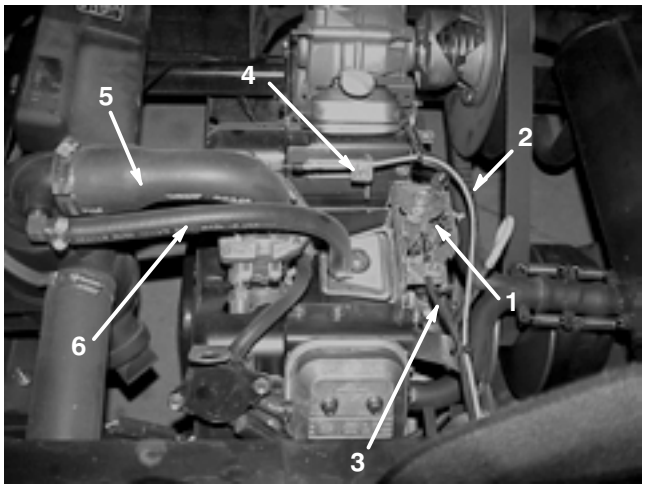

Figure 17

1. Carburetor
2. Choke cable
3. Throttle cable
4. Cable bracket
5. Air intake hose
6. Breather hose

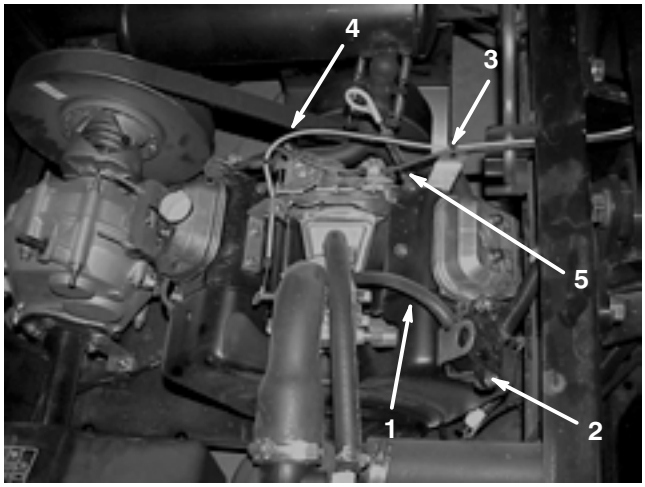

Figure 18

1. Fuel hose
2. Fuel pump
3. Cable tie
4. Choke cable
5. Throttle cable

CAUTION

One person should operate the chain fall or hoist while the other person guides the engine out of the frame.

11. Remove engine from the engine mount.

A. Attach a short section of chain between both engine lift tabs (Fig. 19).

B. Connect hoist or chain fall to center of chain.

IMPORTANT: Make sure not to damage the engine, fuel hoses, electrical harness, or other parts while removing the engine.

C. Slowly remove engine and mounts from the machine.

12. Remove engine parts and attachments as necessary to repair the engine.

Engine Installation (Fig. 16)

1. If removed, install engine parts and attachments to the engine.

CAUTION

One person should operate the chain fall or hoist while the other person guides the engine into the frame.

2. Install engine to the frame.

A. Attach a short section of chain between both engine lift tabs (Fig. 19).

B. Connect a hoist or chain fall at the center of the short section of chain.

IMPORTANT: Make sure not to damage engine, fuel lines, electrical harness, or other parts while installing the engine.

C. Lower engine into the engine mount.

3. Secure engine to the engine mount with flange lock nuts and cap screws.

4. Connect engine harness connector to the main harness connector.

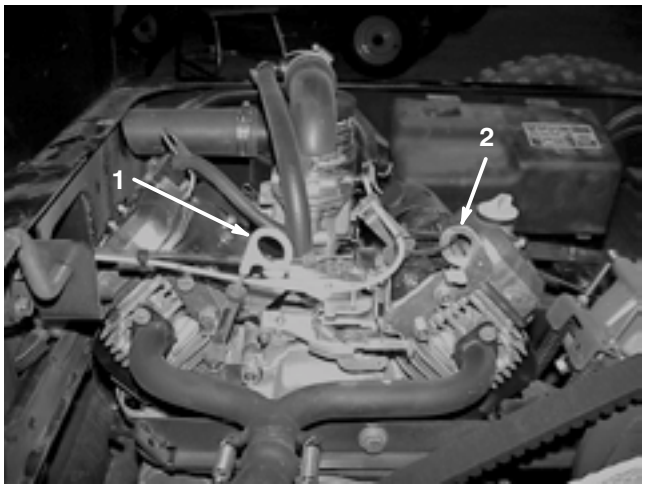

Figure 19

1. Front lift tab
2. Rear lift tab

5. Install torque arm to the engine and transaxle.

6. Install drive belt (see Service Drive Belt).

7. Install muffler and exhaust pipe to the cylinder heads (see Muffler Removal).

8. Connect fuel hose to the fuel pump (Fig. 18).

9. Connect the following components (Fig. 17):

IMPORTANT: Make sure all hoses and engine opening plugs are removed.

A. Choke and throttle cables to the carburetor and cable bracket.

B. Air intake hose to the carburetor.

C. Breather hose to the crankcase.

10. Secure choke, throttle, and shift cables to the bracket on the front cylinder head with cable tie (Fig. 18).

11. Connect positive (red) cable to the battery. Then, connect ground (black) cable to the battery.

12. Install cargo bed to the frame.

13. Make sure engine oil level is correct (see Check Engine Oil).

14. When starting a new or repaired engine, observe the following:

A. After starting a cold engine, let it warm up for about 15 seconds before applying any load to it.

B. Check engine oil level regularly. Be alert for conditions of overheating.

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Chapter 4

Drive Train

Table of Contents

Specifications

Item	Description
Transaxle Transaxle Fluid Capacity Transaxle Fluid	Mechanical differential with neutral lock 1.5 quarts (1.5 liters) 10W–30 Motor Oil
Clutch System Drive Clutch Driven Clutch	Continuously variable transmission type, torque convertor Speed sensing with mechanical fly weights Torque sensing with spring loaded cam

Special Tools

Service Tools, SPX Corporation supplies special tools for servicing Toro Products. To order, contact:

Service Tools, SPX Corporation
Attn: Order Dept.
28635 Mound Road
Warren, MI 48092-9923

1-800-533-0492
Visa, Mastercard, Company Check, or C.O.D. orders are accepted.

Some tools may have been supplied with your vehicle or available as TORO parts. Some tools may also be available from a local supplier.

Clutch Removal Tool - TOR4094

This tool is required to remove the drive clutch from the tapered drive shaft of the engine. It is placed in the threaded hole of the fixed clutch sheave after the clutch holding cap screw is removed.

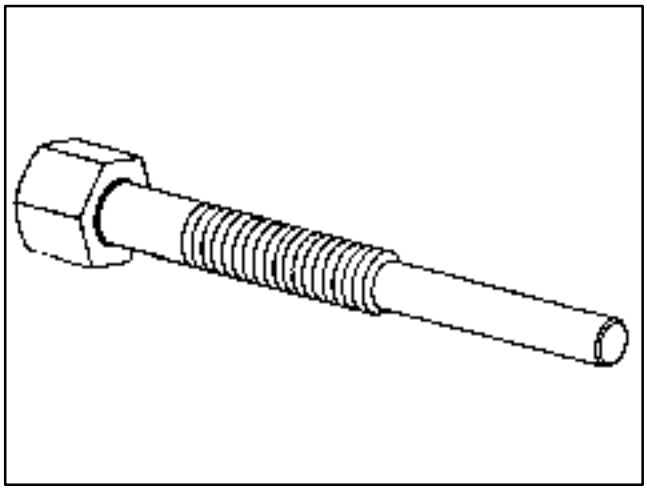

Figure 1

Spider Removal Tool Kit (Drive Clutch)- TOR4098

This kit is required to remove the drive clutch spider from the post of the fixed sheave. Kit includes spanner and clutch holding bar.

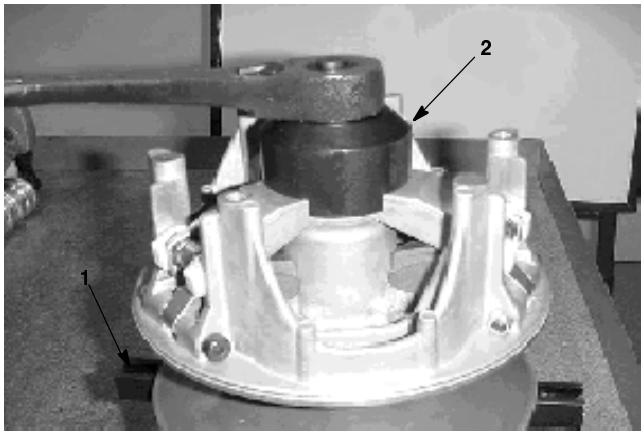

Figure 2

1. Holding bar
2. Spanner

Adjustments

Adjust Shift Cables

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch. Raise and latch cargo bed.

2. On vehicles with a shift lever neutral position (Fig. 3):

   A. Set the shift lever into the Neutral position.

   B. The transaxle select lever assembly should be in a level position.

   C. Tighten the locknut on one of the shift cables just enough to take up any cable slack. Note: the locknut below the bracket must be held to allow adjustment.

   D. Repeat process for other shift cable.

   E. Start engine and check operation in forward, reverse and neutral. Readjust if needed for correct operation.

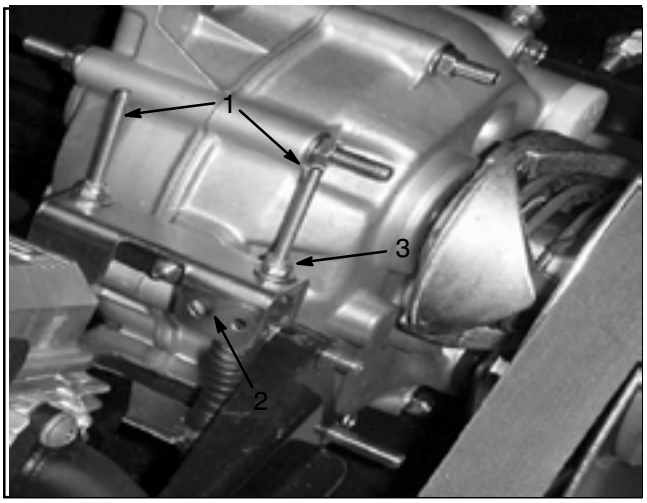

Figure 3

1. Shift cable
2. Select lever assembly
3. Locknut

Clutch System Operation

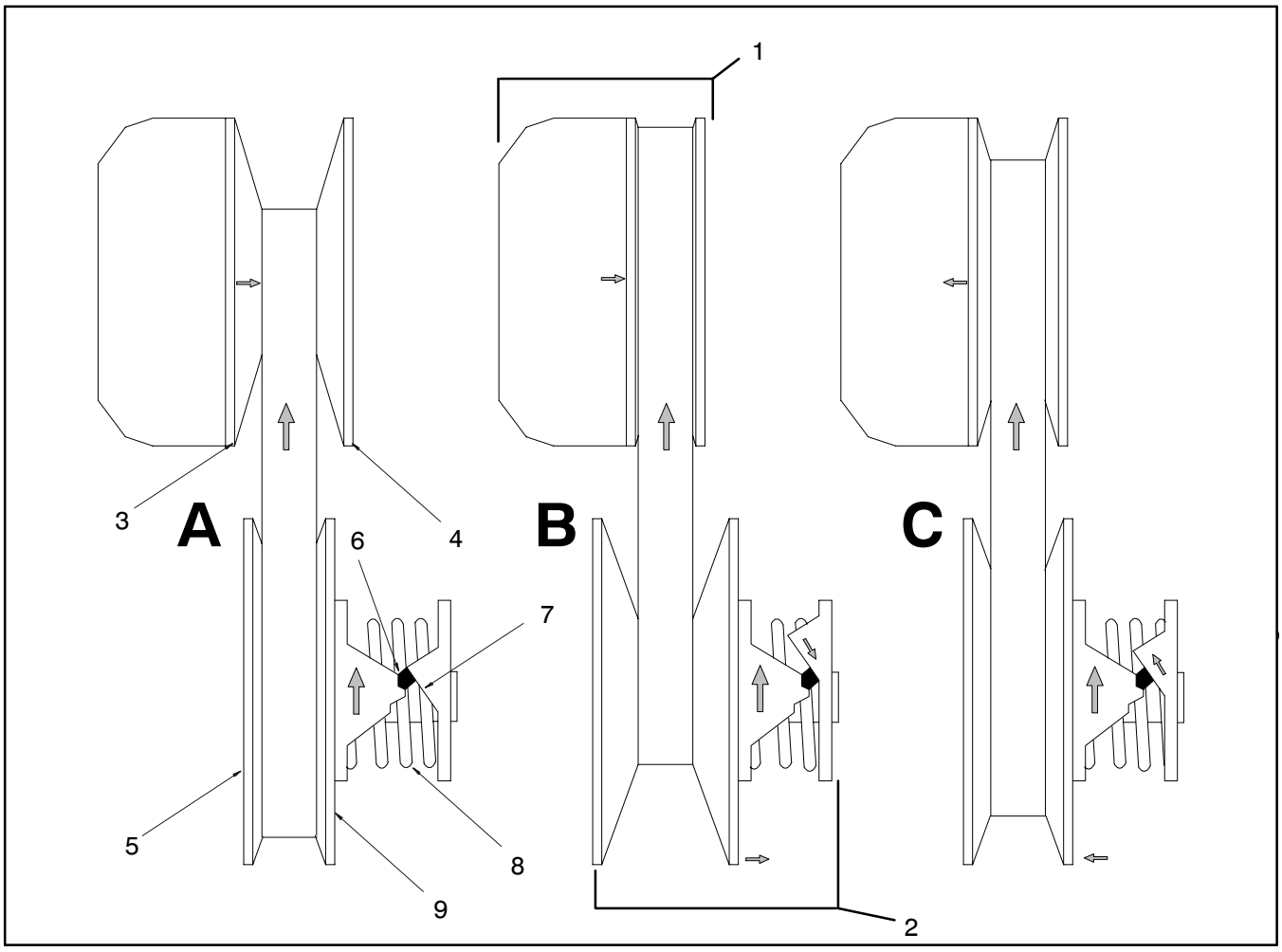

Figure 4

1. Drive clutch
2. Driven clutch
3. Moveable sheave (drive clutch)
4. Fixed sheave (drive clutch)
5. Moveable sheave (driven clutch)
6. Button
7. Ramp (fixed cam)
8. Spring
9. Fixed sheave (driven clutch)

Two Clutch System (Fig. 4)

Power is transferred from the engine to the transaxle by a variable clutch system that consists of two clutches connected by a drive belt. The drive clutch responds to engine speed, and is mounted to the engine drive shaft. The driven clutch responds to changes in load to the rear axle, and is mounted to the transaxle input shaft.

Both clutches work together as a matched unit. The units automatically up-shift and back-shift with changes in load and speed. This shifting changes the turning ratio between the drive and driven clutches and allows the engine to operate at optimum efficiency.

Drive Clutch

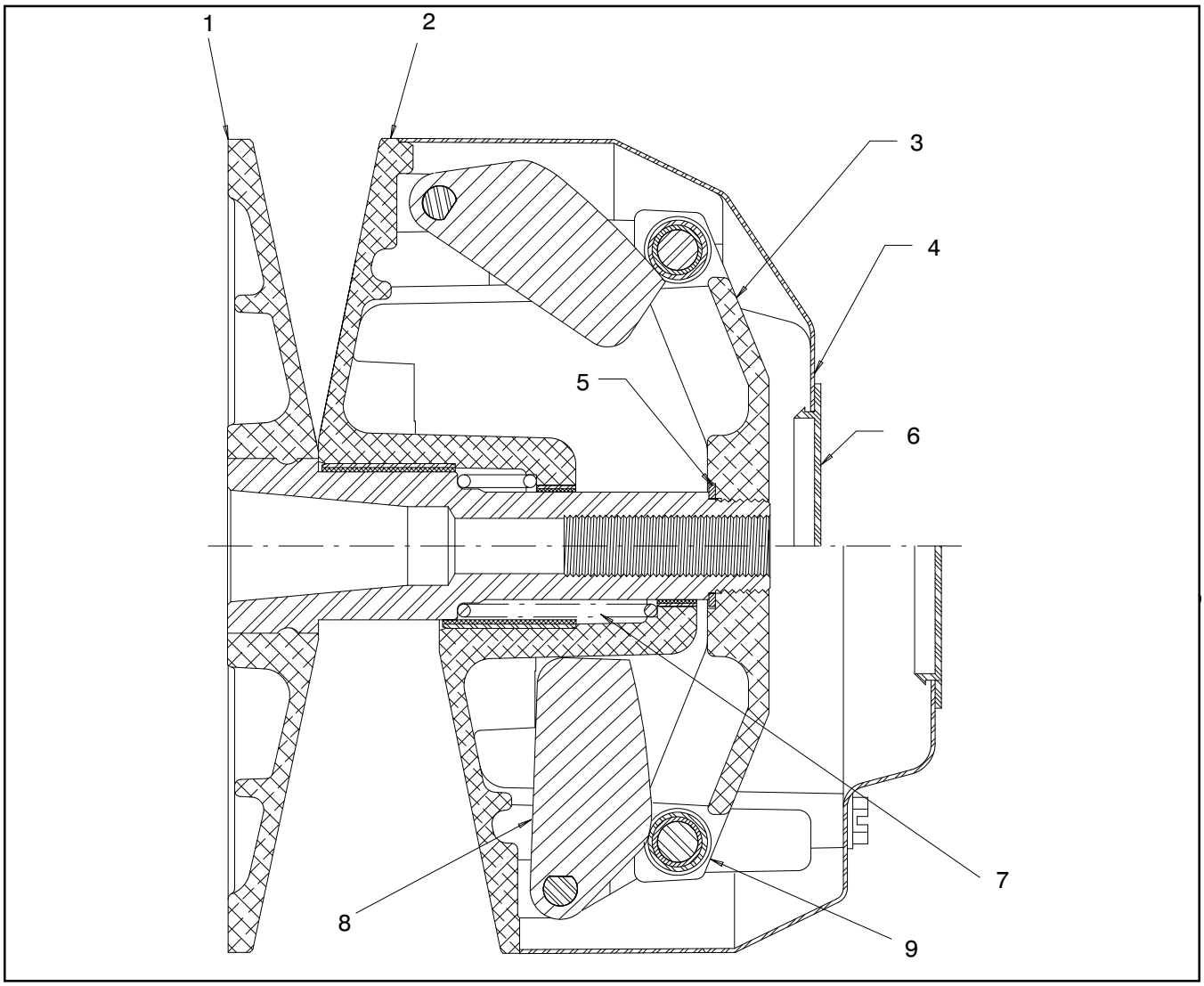

Figure 5

1. Fixed sheave
2. Moveable sheave
3. Spider assembly
4. Cover
5. Washer
6. Plastic cap
7. Spring
8. Cam weight
9. Roller

Principles of Operation (Fig. 5)

The operation of the drive clutch is affected by engine shaft speed. With the engine not turning, the drive belt rests low within the clutch sheaves as the pressure of the spring holds the sheaves apart. As the engine increases in speed, the cams attached to the moveable sheave move outward as they spin about the engine drive shaft. The outward movement of the cams presses against the rollers and overcomes spring pressure through the spider assembly, which forces the moveable sheave closer to the fixed sheave. This inward movement of the sheave engages the drive belt.

With increasing engine speed, the moveable sheave continues to move inward, which forces the drive belt to ride towards the outer diameter of the clutch sheaves.

When engine speed is decreased, the cams exert less force on the rollers and thus the spring. The spring pressure overcomes the force of the cams, and shifts the moveable sheave away from the fixed sheave. The drive belt disengages from the clutch sheaves at a point where the force of the spring is greater than that of the weights.

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove drive belt from the drive clutch (see Service Drive Belt in Engine Chapter).

3. Remove starter/generator V-belt from the engine pulley (see Replace Starter/Generator Belt in Engine Chapter).

4. Remove plastic cap carefully from the drive clutch.

5. Remove cap screw and washer securing the drive clutch to the engine tapered shaft.

IMPORTANT: Grease end of clutch removal tool lightly to prevent wear. Prevent damage to clutch threads; thread tool only enough to remove the clutch.

6. Use clutch removal tool (see Special Tools) to remove drive clutch from the engine tapered shaft.

7. If necessary, the engine pulley can be removed from the drive clutch. Remove four cap screws and lock washers securing the pulley and starter spacer to the clutch.

Installation

1. Install engine pulley to the drive clutch as follows:

   A. Insert four cap screws through lock washers pulley, and spacer.

   B. Apply Loctite Blue #242 or equivalent to the threads of the cap screws.

   C. Secure pulley and starter spacer to the clutch with cap screws.

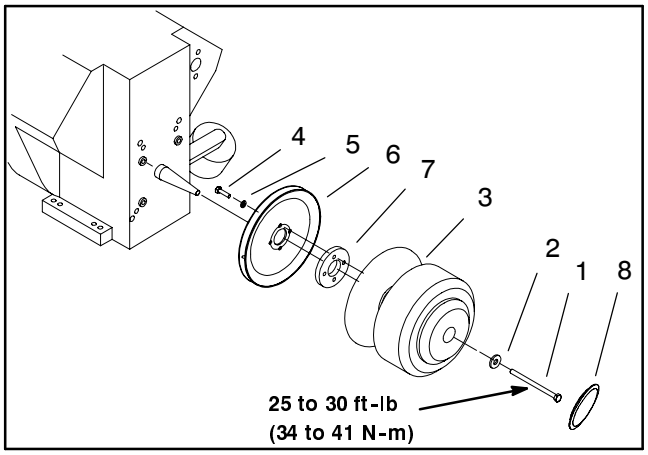

Figure 6

1. Cap screw
2. Washer
3. Drive clutch
4. Cap screw
5. Lock washer
6. Engine pulley
7. Starter spacer
8. Plastic cap

2. Slide drive clutch onto the tapered engine shaft.

   A. Apply Loctite Blue #242 or equivalent to the threads of the cap screw.

   B. Secure clutch to shaft with cap screw and washer.

   C. Torque cap screw from 25 to 30 ft-lb (34 to 41 N-m).

3. Install plastic cap carefully to the drive clutch.

4. Install starter/generator V-belt to the engine and starter pulley and adjust (see Install Starter/Generator Belt and Adjust Starter/Generator Belt in Engine Chapter).

5. Install drive belt to the drive clutch (see Service Drive Belt in Engine Chapter).

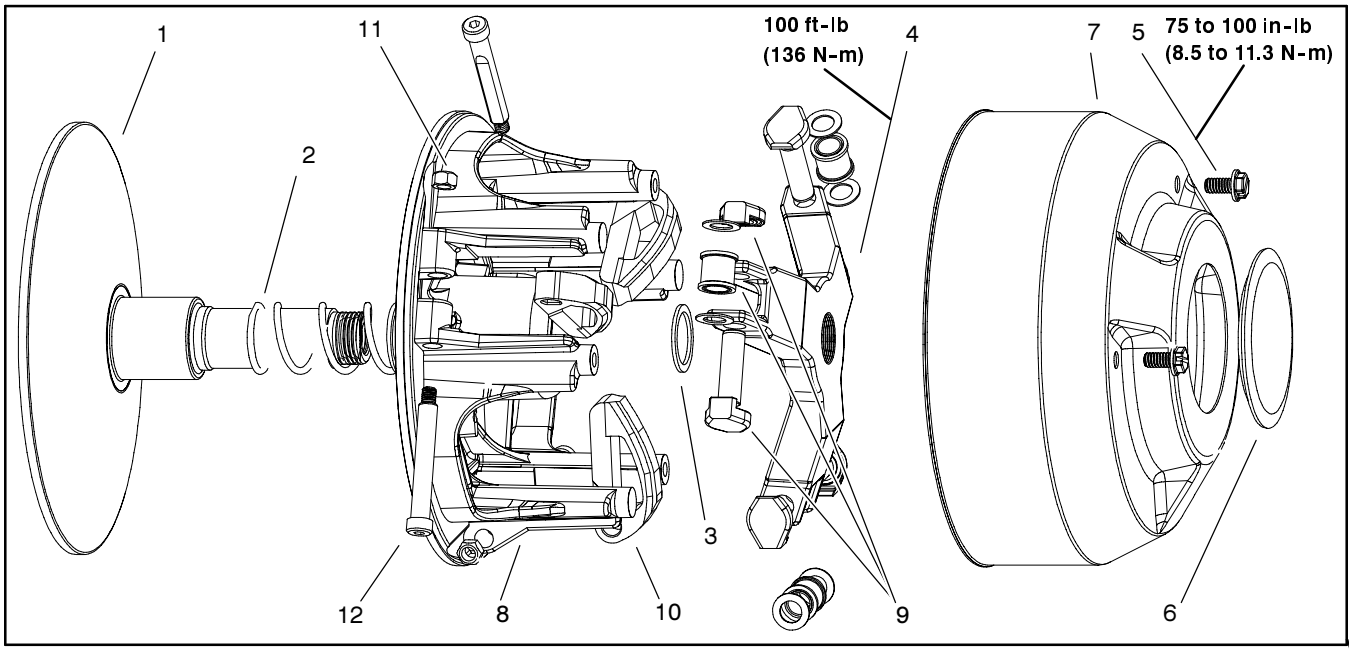

Figure 7

1. Fixed sheave
2. Spring
3. Washer
4. Spider assembly
5. Cap screw
6. Plastic cap
7. Cover
8. Moveable sheave
9. Roller kit
10. Cam weight
11. Nut
12. Pilot bolt

Disassembly (Fig. 7)

IMPORTANT: Do not pry off cover, damage may result. Cover should pop off.

1. Remove cap screws securing the cover to the movable sheave. Pull cover from clutch.

2. Remove the engine pulley from the drive clutch. Remove four cap screws and lock washers securing the pulley and starter spacer to the clutch.

3. Use two 1/4-20 X 1" cap screws to secure the spider removal holding bar (TOR4098: see Special Tools) to drive clutch (Fig. 8).

4. Place clutch with attached spider removal holding bar into vise.

5. Matchmark position of spider and moveable sheave for reassembly.

IMPORTANT: Use spider removal tool kit to remove spider. Unequal pressure on the cam towers may damage them.

CAUTION

Remove spider from fixed sheave slowly. The moveable sheave is under pressure from the spring.

6. Using spider removal spanner tool (TOR4098: see Special Tools), remove spider from the fixed sheave post (Fig. 8).

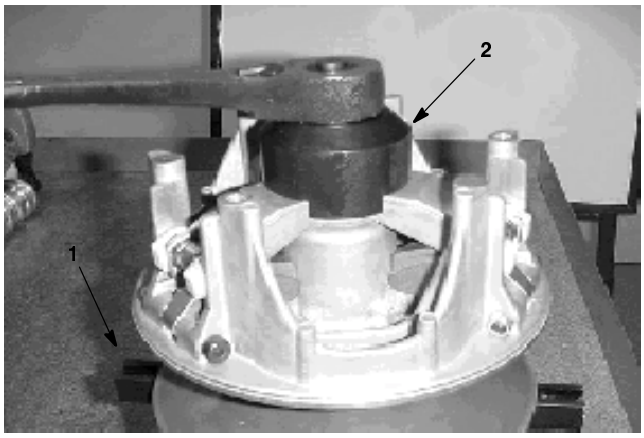

Figure 8

1. Holding bar
2. Spanner

Inspection

1. Inspect the tapered ends of the crankshaft and primary fixed sheave for scratches. If either is severely scratched, replace component. If scratches are minor, burnish the component with emery cloth.

2. Check the surface of the cam weights. If worn, replace all cam weights as a set (Fig. 9).

3. Check the rollers. If binding or uneven wear is found, replace all rollers as a set (Fig. 10).

4. Clean pilot bolts and roller pins with 800 - 1000 grit abrasive paper. If the chrome-plated surface of the bolts or pins is scaled off, replace the damaged components.

5. Check the contact surface of the movable sheave for wear and/or fraying. If surface is worn/frayed, replace component.

6. Inspect the clutch spring and replace if damaged or fatigued.

Assembly (Fig. 7)

1. If removed, install rollers, washers, and roller pins to spider. Roller pins should be lubricated with Comet Clutch Lube GP-730 A or equivalent.

2. Lubricate cam weights with spray lubricant P/N 104-7011, Comet Clutch Lube GP-730-A, or equivalent. Make sure lubricant penetrates to pilot bolts by rotating and sliding the weights side to side, or remove weights if needed to lubricate properly. Assemble cam weights to moveable sheave as follows:

   A. Make sure the threads of the pilot bolts are clean and dry. Apply Loctite 271 or equivalent to the threads of each bolt.

IMPORTANT: To maintain the balance of the clutch, all pilot bolts must be installed with their threads pointing in a clockwise direction (Fig. 11).

   B. Immediately install new self locking nuts on the pilot bolts. Tighten nuts until they just touch the sheave casting. Never reuse self-locking nuts.

3. Apply Loctite 271 or equivalent to the threads of the fixed sheave post.

4. Install spider to the fixed sheave post using spider removal tool kit (see Special Tools). Make sure to align matchmark.

5. Torque spider to 100 ft-lb (136 N-m).

6. Position cover to clutch. Secure cover to the movable sheave with cap screws. Torque cap screws from 75 to 100 in-lb (8.5 to 11.3 N-m).

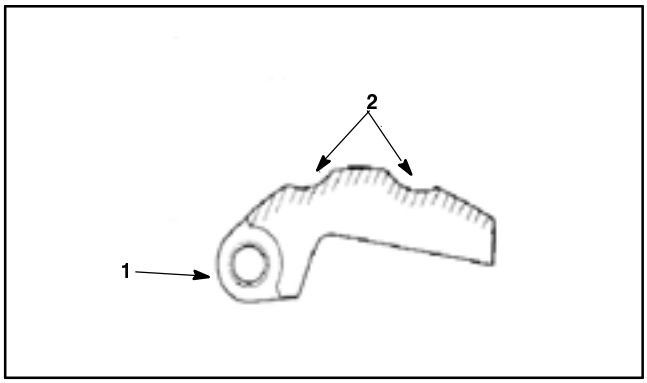

Figure 9

1. Cam weight
2. Worn contact surface

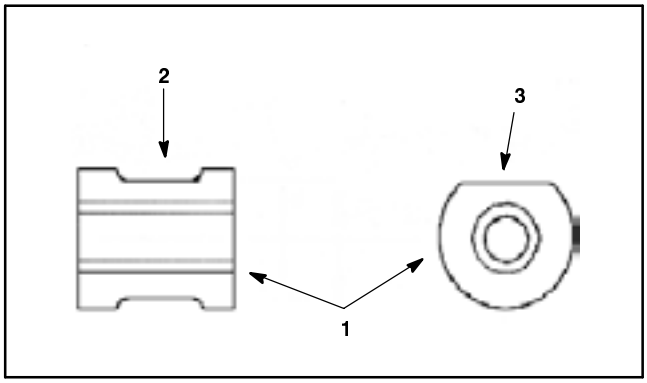

Figure 10

1. Roller
2. Weight contact surface
3. Roller uneven wear

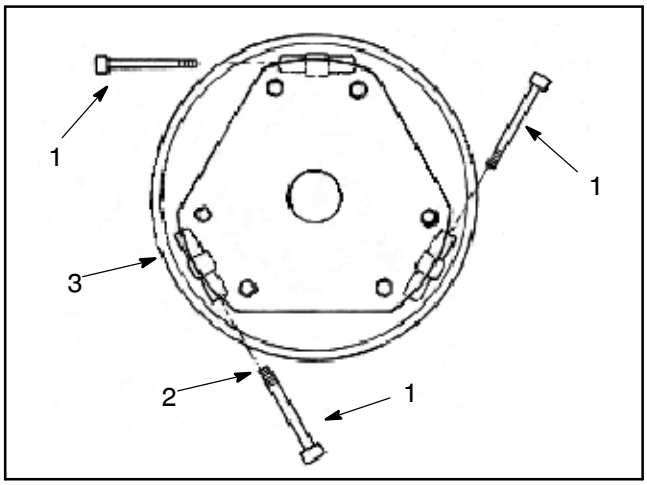

Figure 11

1. Pilot bolt
2. Pilot bolt threads
3. Moveable sheave

Driven Clutch

Principles of Operation (Fig. 12)

The operation of the driven clutch is affected by transaxle load. When the vehicle is stopped, the drive belt is held at the outer diameter of the clutch sheaves from the pressure of the spring pushing the moveable sheave against the fixed sheave and away from the fixed cam. Three sets of buttons on the moveable sheave provide a low friction surface on which the sheave can slide on the ramp of the fixed cam.

Once the drive belt starts rotating, the drive clutch also starts to rotate. With increasing speed of the drive clutch, the drive belt begins to climb to the outer diameter of its sheaves. This increases the tension on the drive belt, and forces the moveable sheave to move away from the fixed sheave against the pressure of the spring. As the belt tightens and the sheaves open up, the drive belt rides lower in the clutch sheaves.

With increased load to the transaxle, the cam resists forward movement relative to the moveable sheave and drive belt. Torque from the drive belt and spring pressure moves the movable sheave up the ramp of the fixed cam. The drive belt becomes positioned closer to the outer diameter of the clutch sheaves.

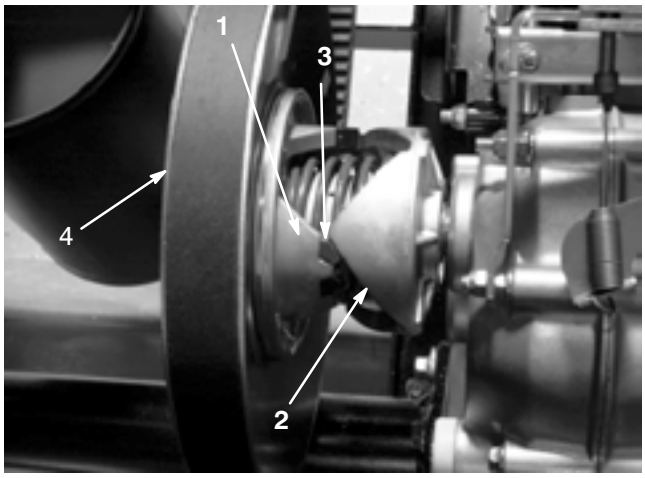

Figure 12

1. Moveable sheave
2. Ramp (fixed cam)
3. Button
4. Fixed sheave

Removal (Fig. 13)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove muffler from the engine and engine mount (see Muffler Removal in Engine Chapter).

3. Remove drive belt from the driven clutch (see Service Drive Belt).

4. Remove cap screw, washer, and spacer securing the driven clutch to the input shaft of the transaxle.

5. Pull driven clutch from the input shaft.

Installation (Fig. 13)

1. Coat input shaft of the transaxle with never seize lubricant.

2. Position driven clutch to the input shaft. Make sure pulley side of the clutch faces away from the transaxle case.

3. Apply Loctite Blue #242 or equivalent to the cap screw threads.

   A. Secure driven clutch to the input shaft with cap screw, washer, and spacer.

   B. Torque cap screw from 25 to 30 ft-lb (34 to 41 N-m).

4. Install drive belt to the driven clutch (see Service Drive Belt).

5. Install muffler to the engine and engine mount (see Muffler Removal in Engine Chapter).

Ramp Button Replacement (Fig. 14)

1. Park vehicle on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove drive belt from the driven clutch (see Service Drive Belt in Engine Chapter).

3. Turn fixed and moveable sheaves in opposite directions so button is separated sufficiently enough from the ramp to allow removal.

4. Place small block of wood between the outer ramps to keep the ramps apart.

CAUTION

To prevent burns, hold allen wrench with locking pliers.

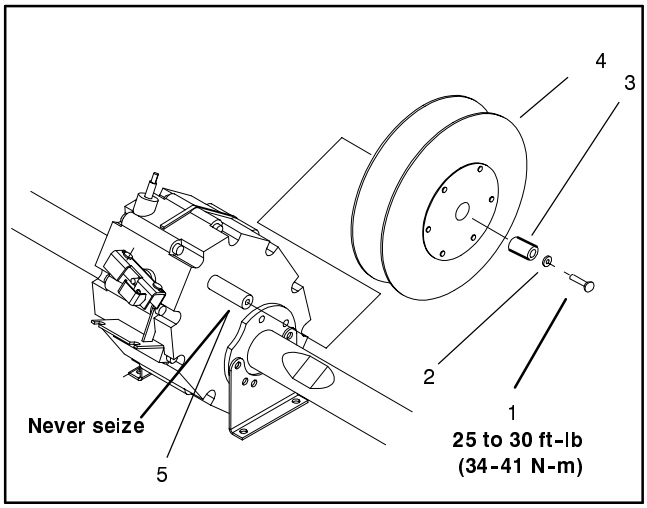

Figure 13

1. Cap screw
2. Washer
3. Spacer
4. Driven clutch
5. Input shaft (transaxle)

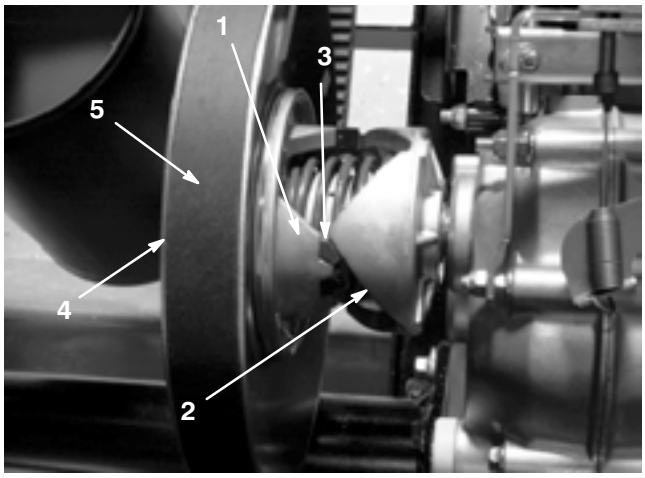

Figure 14

1. Moveable sheave
2. Ramp (fixed cam)
3. Button
4. Fixed sheave
5. Drive belt

5. Clamp long end of a 2 mm allen wrench with locking pliers. Heat short end of the allen wrench until it is red hot.

6. Insert hot end of the allen wrench into the button so it melts around the end of the wrench. Hold wrench in place until the button hardens.

7. Pull and twist on the allen wrench to remove the button from the ramp.

Note: If the new button is difficult to install, sand its mounting tab as necessary. If the button is loose, apply Loctite (blue) #242 or equivalent on its mounting tab.

8. Install new button to ramp. Push button in straight with a screw driver by prying against the ramp.

9. Remove and install remaining buttons.

Check Driven Clutch Spring Torsion

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Place transaxle in gear to prevent the fixed sheave from moving.

3. Remove drive belt from the driven clutch (see Service Drive Belt in Engine Chapter).

IMPORTANT: Use protective strips of soft metal when clamping the moveable sheave with locking pliers to prevent damage.

4. Clamp moveable sheave with locking pliers.

5. Measure spring torsion.

   A. Pull scale tangentially to the outer diameter of the moveable sheave.

   B. When the button on the ramp of the moveable sheave is 0.125 inch (3.18 mm) from the ramp of the fixed sheave, read the scale.

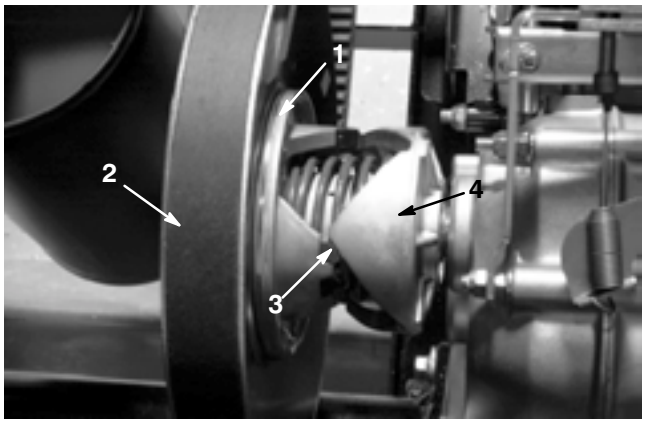

Figure 15

1. Moveable sheave
2. Drive belt
3. Button
4. Ramp (fixed sheave)

   C. The reading should be 16 to 20 lbf (71 to 89 N).

6. If the above specification is not met, replace the driven clutch.

Change Transaxle Fluid

Note: Perform this maintenance procedure at the interval specified in the Operator's Manual or Chapter 2 – Maintenance and Specifications.

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove drain plug from the right side of the transaxle case. (Fig. 16) Let fluid flow into a drain pan.

3. When fluid stops draining, reinstall and tighten drain plug (Fig. 16). Torque plug from 15.2 to 18.8 ft-lb (20.6 to 25.5 N-m).

4. Use 10W-30 motor oil to fill the transaxle case.

   A. Fill case with about 1.5 quarts (1.5 liters) of motor oil (Fig. 17).

   B. Or, fill case until oil level is at the bottom level of the indicator hole with the plug removed (Fig. 16).

5. Reinstall level indicating plug and fill cap. Tighten plugs that were removed (Fig. 16 and 17).

6. Start engine and operate vehicle to allow the transaxle to fill. Recheck oil level. Replenish oil if required.

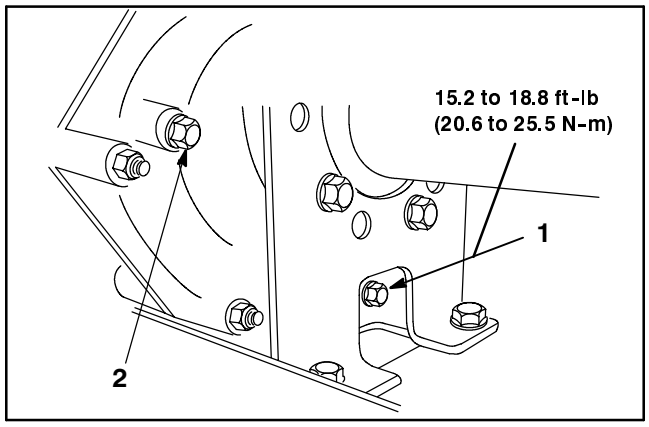

Figure 16

1. Drain plug
2. Level indicating plug

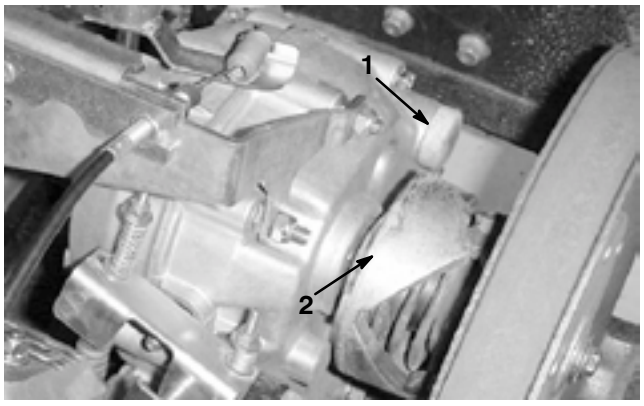

Figure 17

1. Fill cap
2. Driven clutch

Transaxle

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove cargo box from the frame (see Cargo Box Removal in Chapter 6 – Chassis, Wheels, and Brakes).

3. Remove drive belt from the driven clutch (see Service Drive Belt in Engine Chapter).

4. Remove tie wraps securing both battery cables to the passenger side axle tube.

5. Remove lock nut securing the select lever assembly to the selector shaft. Loosen jam nuts securing both shift cables to the cable bracket. Separate select lever assembly and shift cables from the transaxle (Fig. 18).

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

6. Jack up both sides of the frame (at the jacking point indicated) enough to remove rear wheels (Fig. 19).

   A. Chock the front and rear of both front tires to prevent the vehicle from moving.

   B. Support both sides of the frame with jackstands positioned just in front of the axle tubes. This will allow the transaxle to be removed from the rear of the vehicle.

7. Remove both wheels and brake assemblies from the transaxle (see Rear Wheel and Brake Removal in Chapter 6 – Chassis, Wheels, and Brakes).

8. Attach hoist or chain fall to the engine mount to lower the engine and transaxle. Make sure lifting device is attached to hold the full weight of the engine and mount.

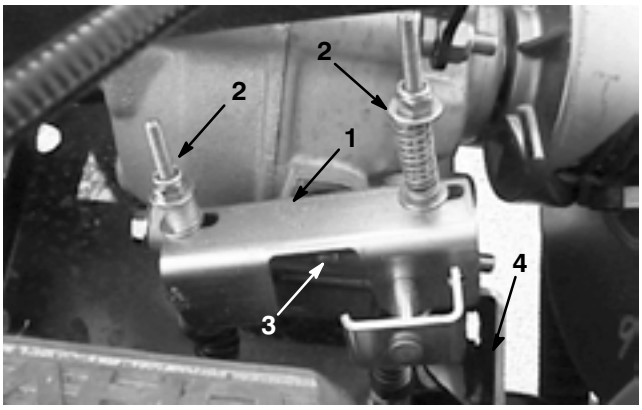

Figure 18

1. Select lever assembly
2. Shift cable
3. Lock nut
4. Cable bracket

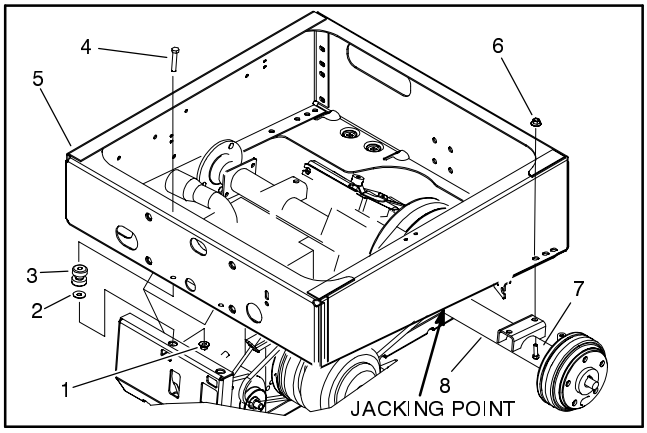

Figure 19

1. Flange lock nut
2. Flat washer
3. Isolation mount
4. Cap screw
5. Rear frame
6. Flange lock nut
7. Hex head flange screw
8. Transaxle

9. Remove both flange lock nuts, flat washers, isolation mounts, and cap screws securing the engine mount to the rear frame (Fig. 19).

10. Remove four flange lock nuts and hex head flange screws securing the transaxle to the engine mount (Fig. 20).

11. Lower engine mount enough to allow the transaxle and driven clutch to be removed from the rear of the vehicle.

12. Remove four flange lock nuts and hex head flange screws securing the transaxle to the rear frame. Remove transaxle from the rear of the vehicle (Fig. 19).

Installation

1. Position transaxle and driven clutch to the rear frame. Secure transaxle to the rear frame with four hex head flange screws and flange lock nuts (Fig. 19).

2. Raise engine mount.

3. Secure transaxle to the engine mount with four hex head flange screws and flange lock nuts. Make sure R-clamp with both shift cables is secured to the engine mount with screw (Fig. 20).

4. Secure engine mount to the rear frame as follows (Fig. 19 and 21):

   A. Attach both isolation mounts to the engine mount.

   B. Align engine mount to rear frame. Insert cap screw through rear frame channel, isolation mounts, and engine mount.

   C. Secure cap screw with flat washer and flange lock nut.

5. Position select lever assembly and shift cables to the transaxle. Secure select lever assembly to the selector shaft with lock nut. Secure both shift cables to the cable bracket with jam nuts (Fig. 18).

6. Secure both battery cables to the passenger side axle tube with tie wraps.

7. Install drive belt to the driven clutch (see Service Drive Belt in Engine Chapter).

8. Install both brake assemblies and wheels to the transaxle (see Rear Wheel and Brake Installation in Chapter 6 – Chassis, Wheels, and Brakes).

9. Install cargo box to the frame (see Cargo Box Installation in Chapter 6 – Chassis, Wheels, and Brakes).

10. Check brakes for proper adjustment (see Adjust Brakes in Chapter 6 – Chassis, Wheels, and Brakes).

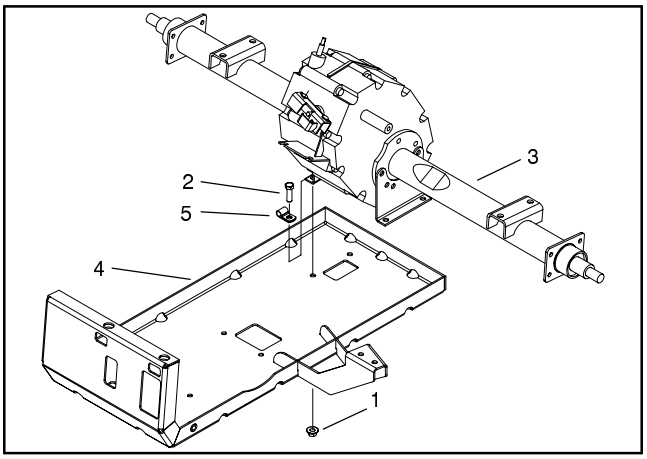

Figure 20

1. Flange lock nut
2. Hex head flange screw
3. Transaxle
4. Engine mount
5. R-clamp

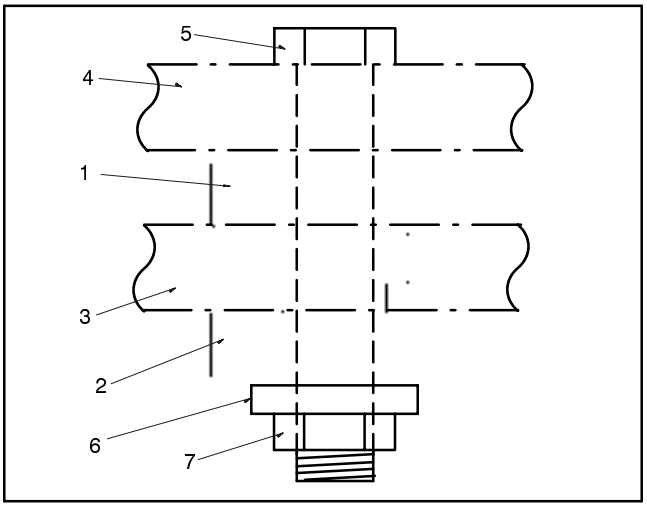

Figure 21

1. Iso mount (top)
2. Iso mount (bottom)
3. Engine mount
4. Rear frame channel
5. Cap screw
6. Flat washer
7. Flange lock nut

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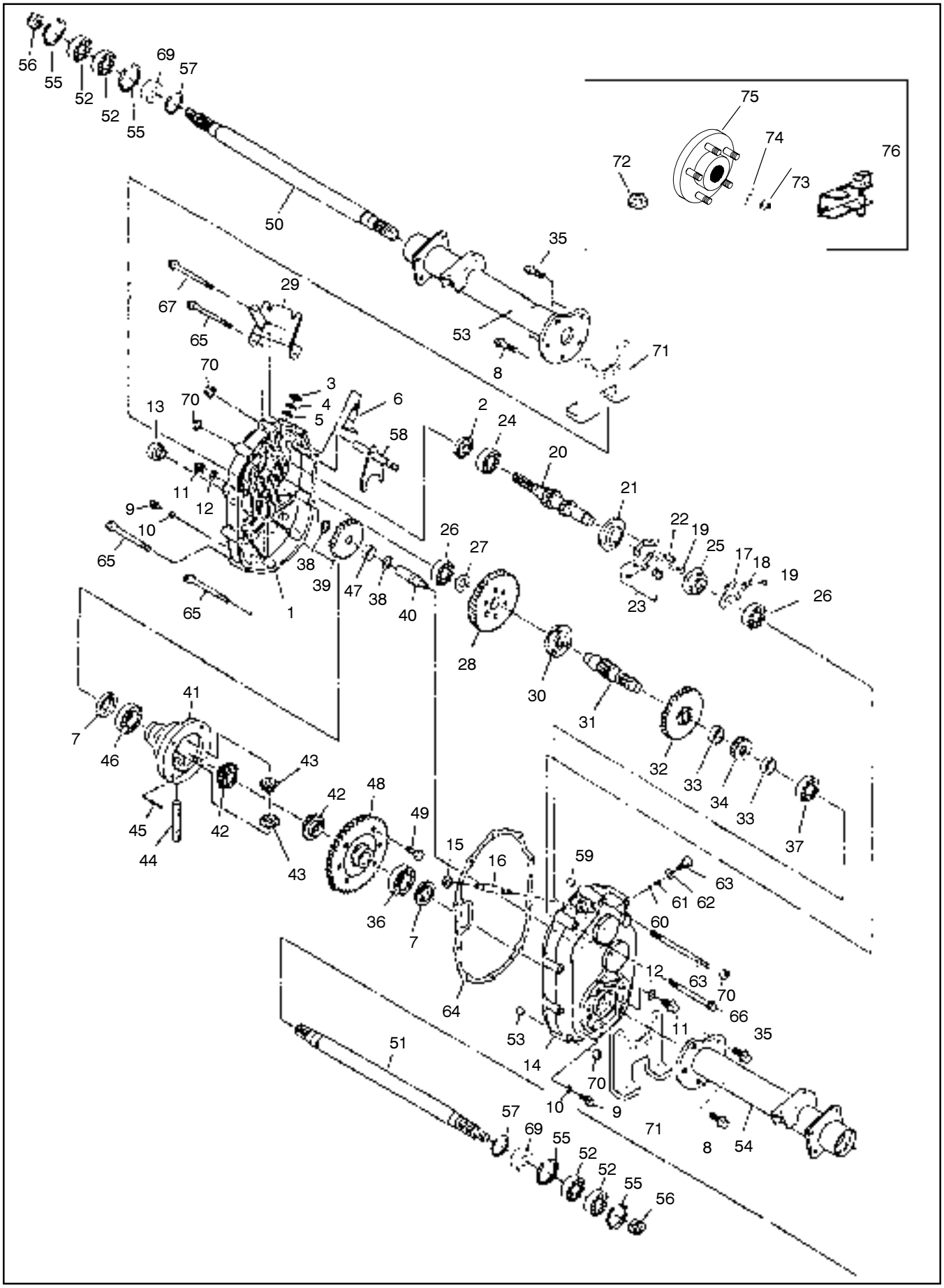
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Figure 22

Figure 22 (Continued)

1. Case (LH)
2. Oil seal
3. Oil seal
4. Snap ring
5. Spacer
6. Selector shaft
7. Oil seal
8. Flange bolt
9. Oil check plug
10. Gasket
11. Oil drain plug
12. Gasket
13. Oil filler plug
14. Case (RH)
15. Oil seal
16. Governor shaft
17. Governor fork
18. Stopper
19. Screw and washer
20. Input shaft
21. Governor base
22. Lock pin
23. Governor plate unit
24. Ball bearing
25. Governor sleeve
26. Ball bearing
27. Spacer
28. Gear 55
29. Cable bracket
30. Pin clutch
31. Center shaft
32. Gear 47
33. Collar
34. Gear
35. Flange bolt
36. Ball bearing
37. Ball bearing
38. Spacer
39. Gear 34
40. Counter shaft
41. Differential case
42. Side gear
43. Pinion gear
44. Pinion shaft
45. Spring pin
46. Ball bearing
47. Needle bearing
48. Gear 62
49. Bolt
50. Axle shaft (LH)
51. Axle shaft (RH)
52. Ball bearing
53. Axle case (LH)
54. Axle case (RH)
55. Snap ring
56. Castle nut
57. Snap ring
58. Shift shaft
59. Pipe knock
60. Steel ball
61. Spring
62. Gasket
63. Bolt
64. Gasket
65. Flange bolt
66. Flange bolt
67. Flange bolt
68. Bolt
69. Collar
70. Flange bolt
71. Axle bracket
72. Lock nut
73. Spring washer
74. Washer
75. Hub complete
76. Select lever

Disassembly and Inspection

1. Disassemble case (LH and RH)

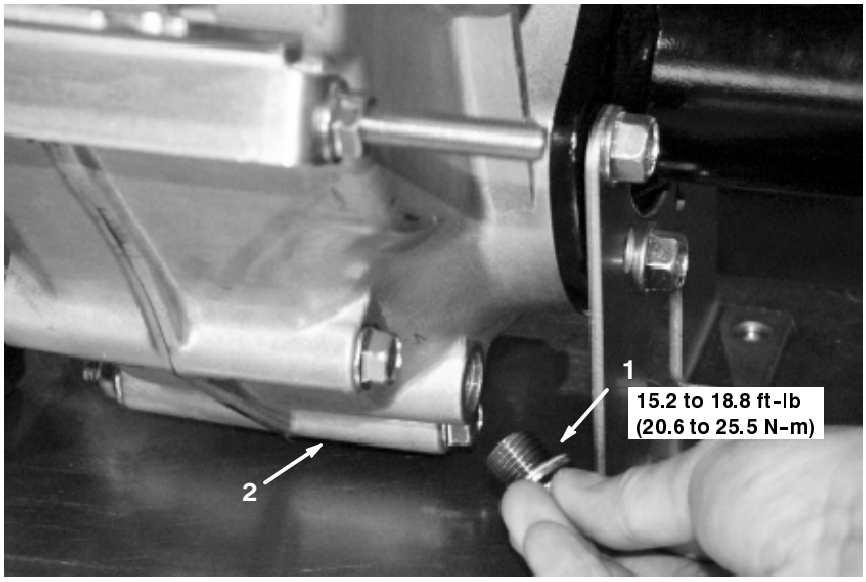


Figure 23

1. Drain plug & gasket
2. Case (LH)

CAUTION

Make sure transaxle case is not hot prior to draining oil to prevent getting burned.

A. Remove drain plug. Drain oil completely from transaxle. Replace drain plug gasket if damaged.

B. Reinstall drain plug to transaxle case. Torque plug from 15.2 to 18.8 ft-lb (20.6 to 25.5 N-m).

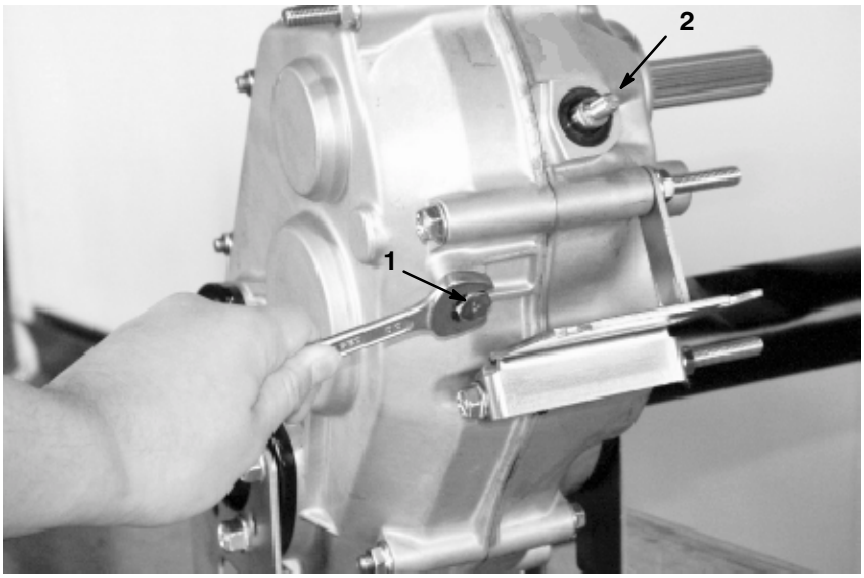


Figure 24

1. Bolt (steel ball, spring & gasket)
2. Selector shaft

C. Remove bolt near the selector shaft. Remove spring and steel ball. Replace gasket if damaged.

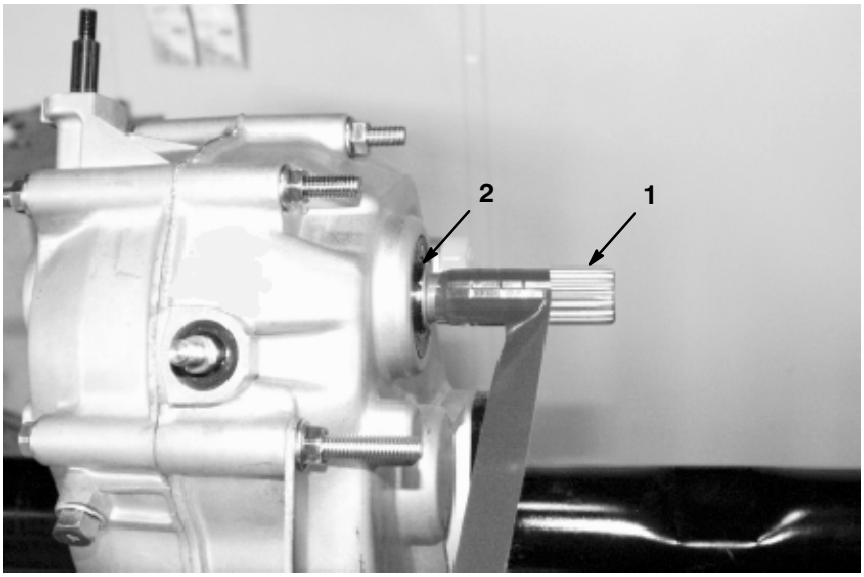


Figure 25

1. Input shaft
2. Oil seal

D. Wrap vinyl tape around the splined portion of the input shaft. This should protect the oil seal from being damaged.

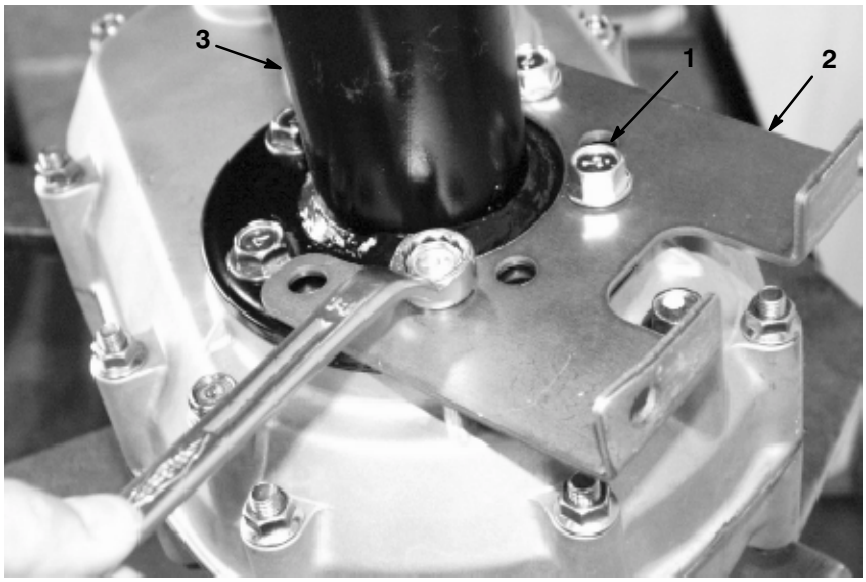


Figure 26

1. Flange bolts
2. Axle bracket
3. Axle case

E. Remove three flange bolts securing the axle bracket and axle case to each case. Separate bracket from each axle case.

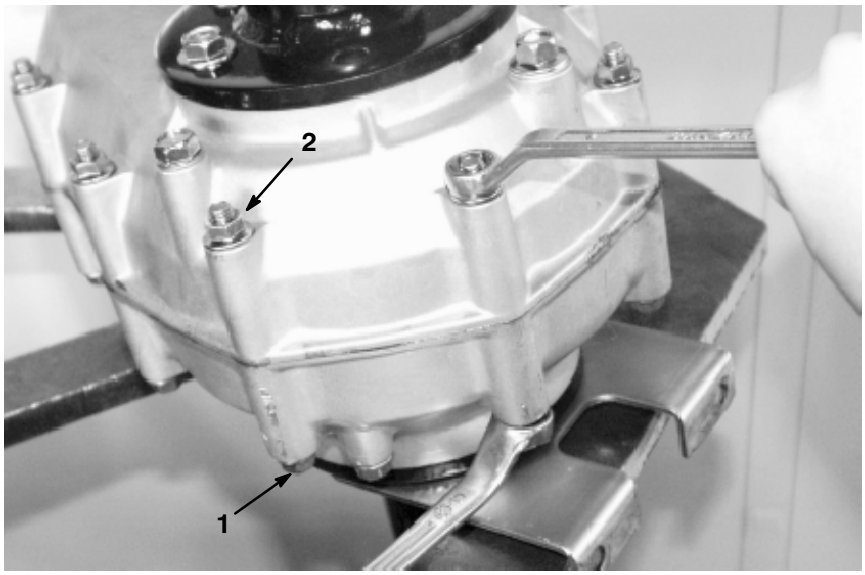


Figure 27

1. Flange bolt
2. Flange nut

F. With the input shaft side down, loosen and remove flange bolts and nuts securing the case (RH) and case (LH) together.

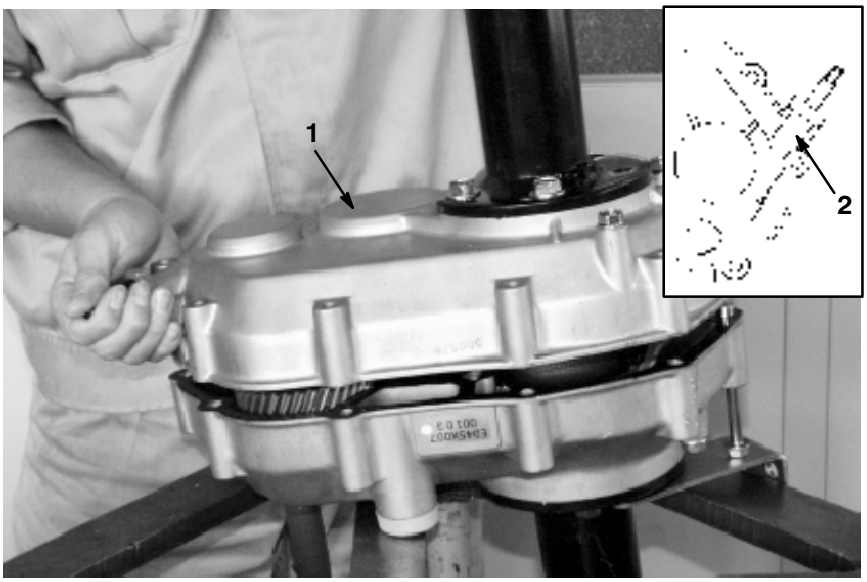


Figure 28

1. Case (RH)
2. Governor boss

IMPORTANT: Make sure not to hit the governor boss too hard when separating the cases, the boss may get damaged. Do not pry open the two cases with a screw driver, damage may result to the sealing surfaces.

G. Hold the case (RH) and lift up while lightly tapping the governor boss with a plastic hammer.

Note: The Governor Assembly (Fig. 28) is not used on the Twister Vehicle. These parts remain in the transmission even though they are not used in this application.

2. Remove input shaft, center shaft, and differential assemblies.

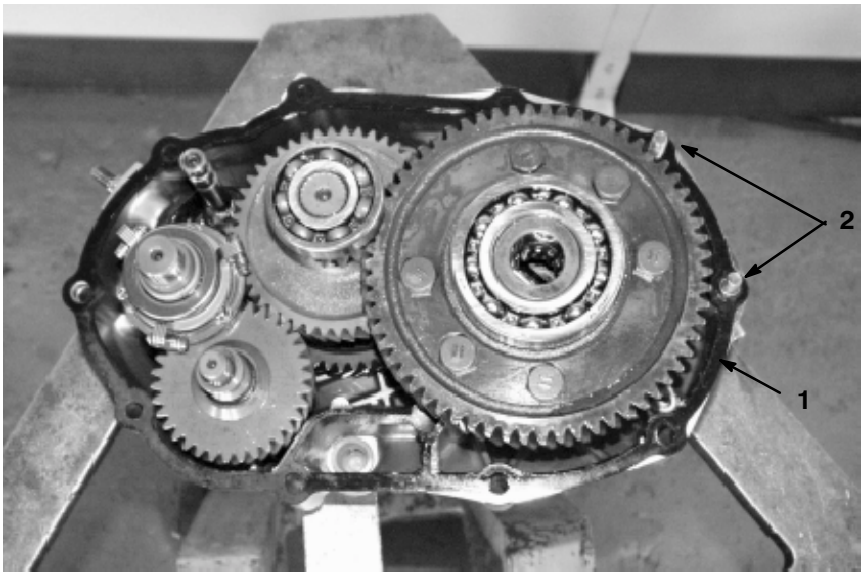


Figure 29

1. Gasket
2. Pipe knock

A. Remove gasket and pipe knocks.

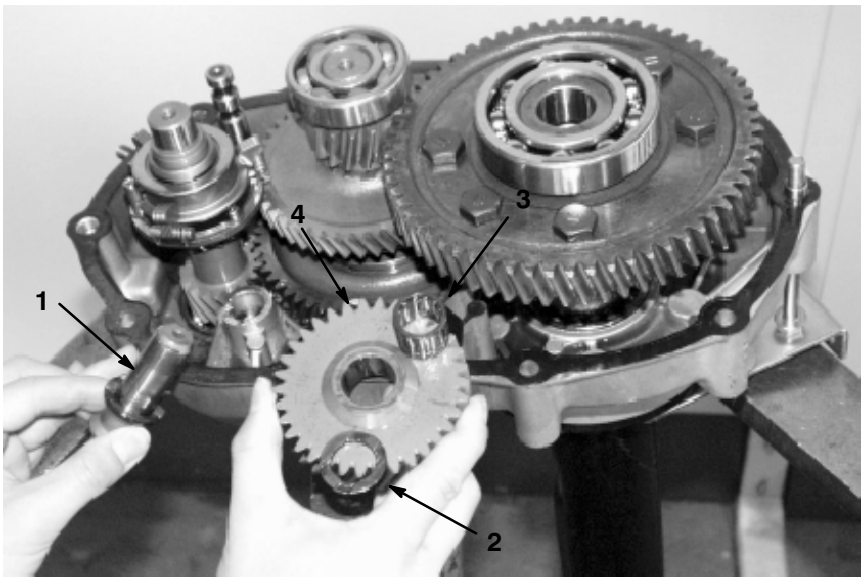


Figure 30

1. Counter shaft
2. Spacer
3. Needle bearing
4. Gear 34

B. Pull out counter shaft. Remove spacer, needle bearing, gear 34, and spacer.

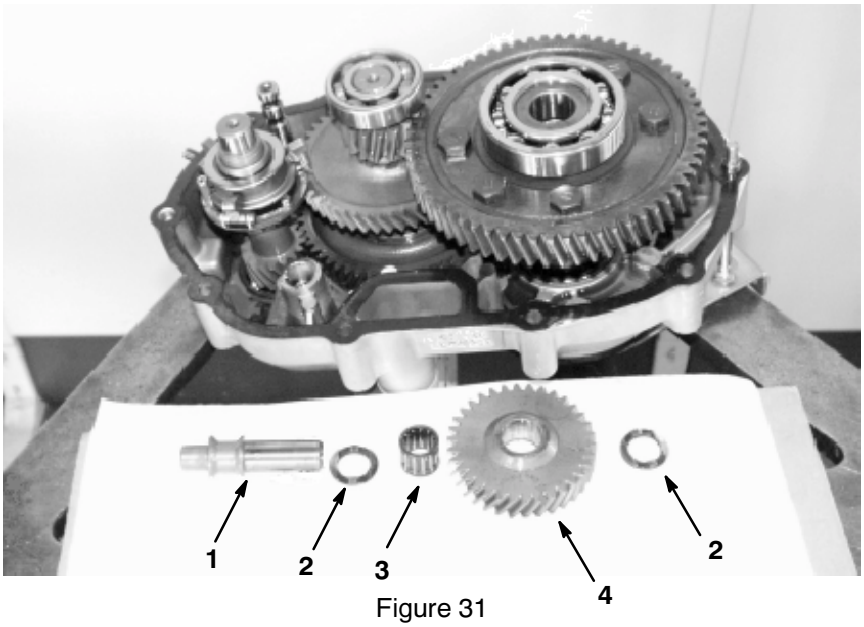


Figure 31

1. Counter shaft
2. Spacer
3. Needle bearing
4. Gear 34

C. Replace counter shaft if it has abnormal wear, cracks, or damage.

D. Replace spacer if either one is cracked or bent.

E. Replace needle bearing if needles are bent, do not rotate freely, or do not remain in the bearing cage.

F. Replace gear 34 if worn or damaged. Cracked, broken, missing, or chipped gear teeth are not acceptable.

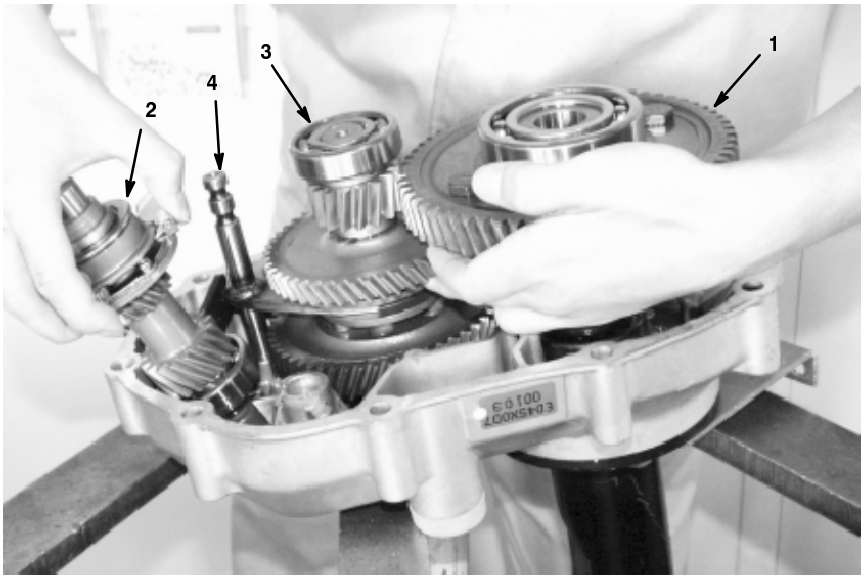


Figure 32

1. Differential assembly
2. Input shaft assembly
3. Center shaft assembly
4. Shift shaft

IMPORTANT: Make sure not to damage the oil seal when removing the input shaft.

Note: If any of the assemblies can not be pulled out by hand, hold the assembly while gently tapping the case with a plastic hammer. Make sure to tap equally around the case.

G. Lift up differential assembly, center shaft assembly, and input shaft assembly at the same time. First, remove input shaft assembly. Then, remove center shaft assembly with the shift shaft and differential assembly.

3. Remove axle case from case (RH and LH).

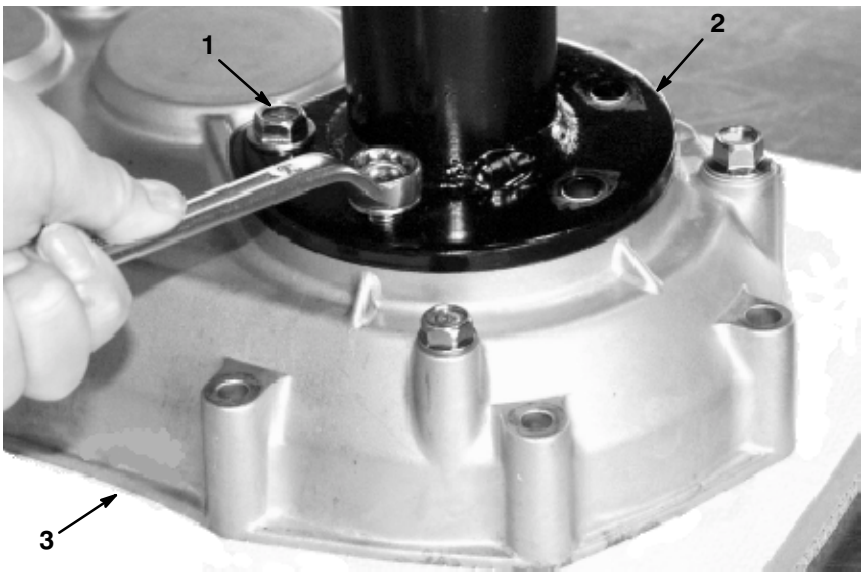


Figure 33

1. Flange bolt
2. Axle case
3. Case

A. Remove flange bolts securing each axle case to the case. Remove axle case from the case.

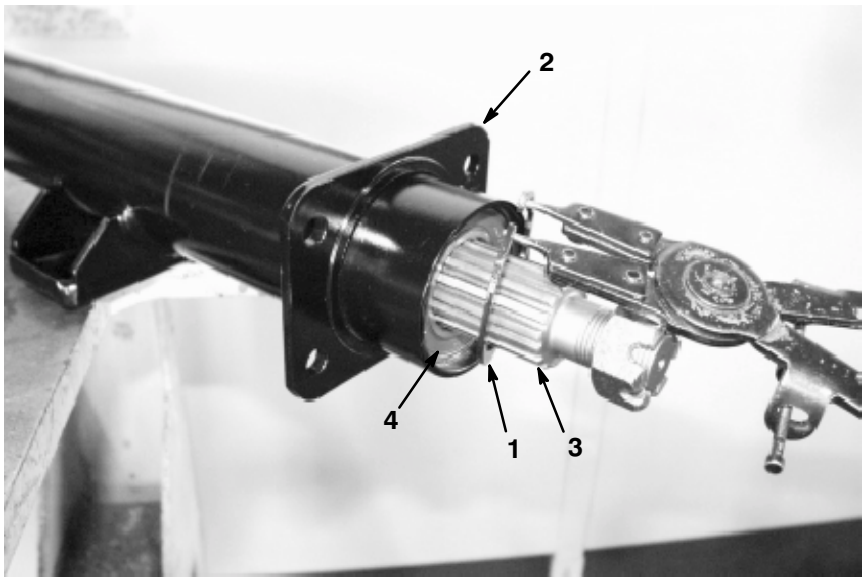


Figure 34

1. Snap ring
2. Axle case
3. Axle shaft
4. Ball bearing

IMPORTANT: Do not reuse snap ring. Discard and replace ring with new one.

B. Remove snap ring from the axle case. Remove axle shaft from case.

IMPORTANT: When replacing ball bearings, both ball bearings must be replaced as a set.

4. Disassemble input shaft assembly.

C. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

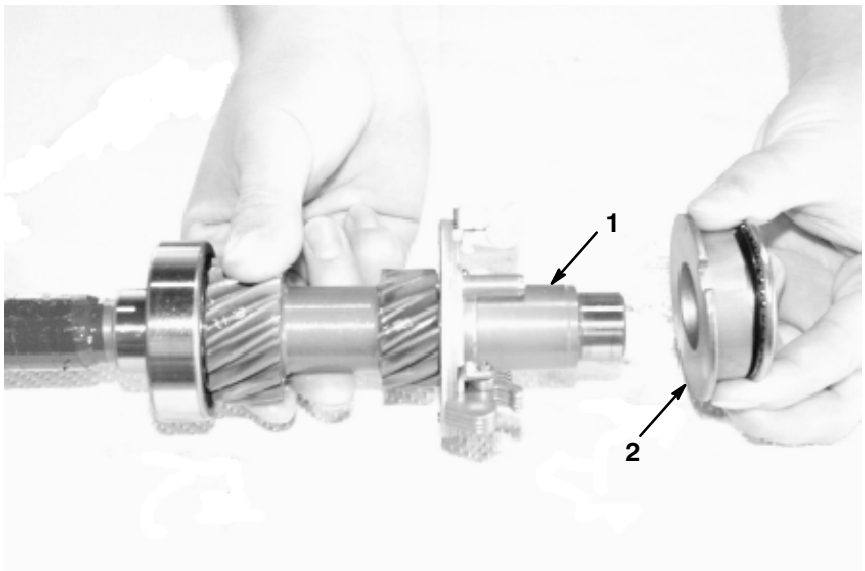


Figure 35

1. Input shaft
2. Governor sleeve

A. Remove governor sleeve from the input shaft.

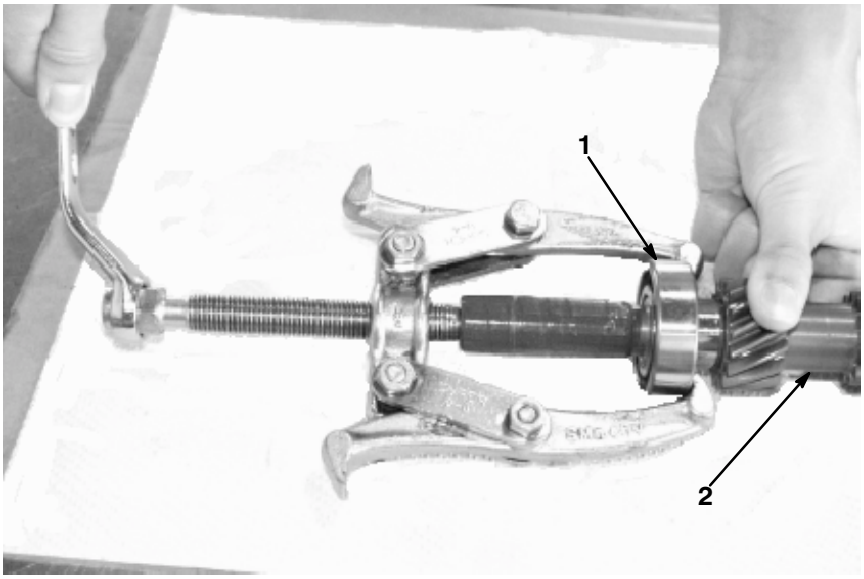


Figure 36

1. Ball bearing
2. Input shaft

IMPORTANT: Do not reuse ball bearings that have been removed.

B. Remove ball bearing from the input shaft with a bearing puller.

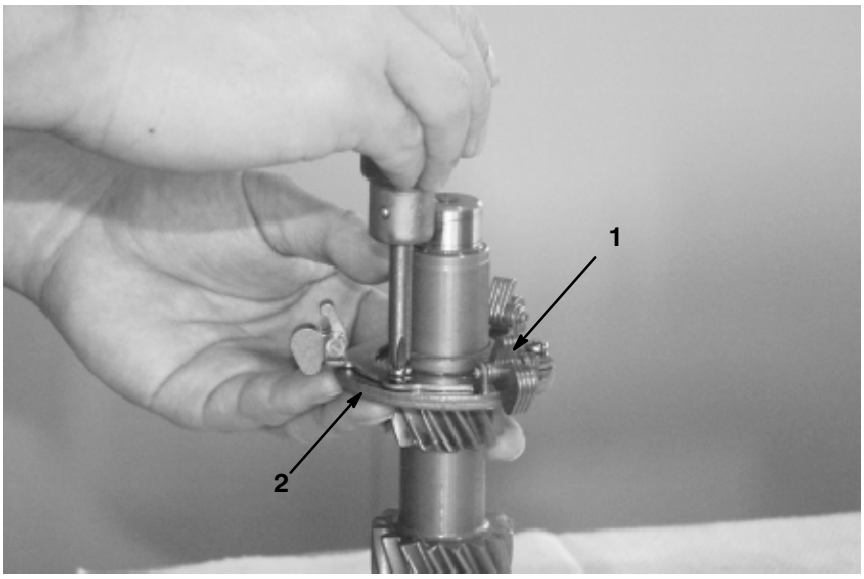


Figure 37

1. Governor plate assembly
2. Governor base

IMPORTANT: Make sure not to damage the screw heads when removing screws. Each screw is secured with an adhesive.

C. Remove screws securing the governor plate assembly to the governor base.

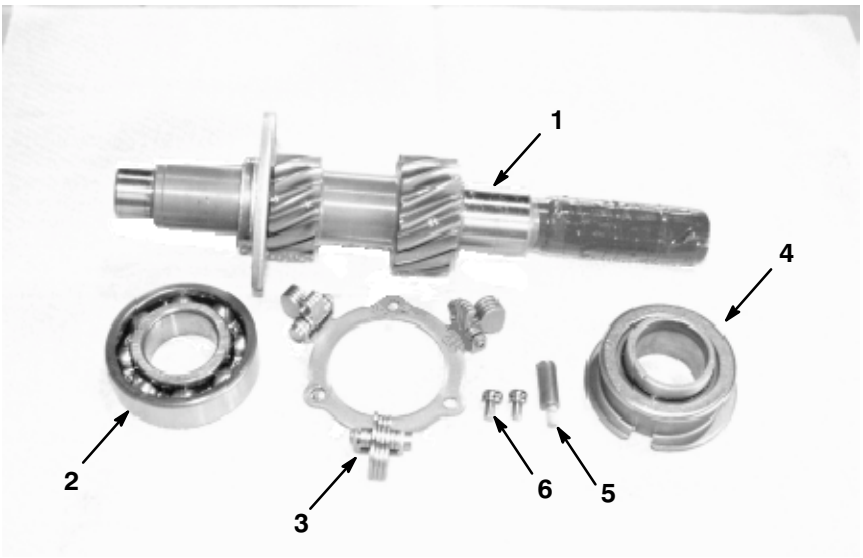


Figure 38

1. Input shaft
2. Ball bearing
3. Governor plate (weight)
4. Governor sleeve
5. Lock pin
6. Screw

D. Replace input shaft if worn or damaged. Gear teeth that are cracked, broken, chipped or missing are not acceptable.

E. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

F. Replace governor plate if cracked, bent, or any weight is missing. Weights must swing freely.

G. Replace governor sleeve if cracked or worn.

5. Disassemble center shaft assembly.

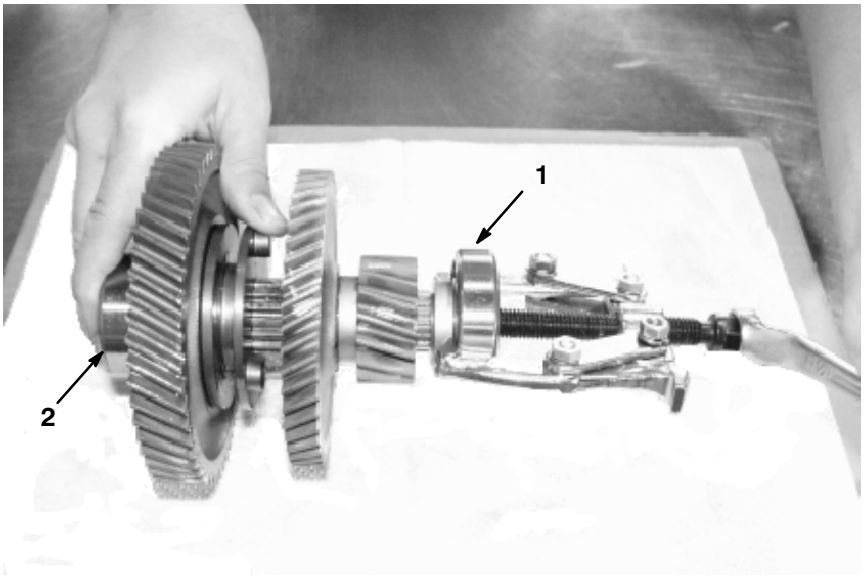


Figure 39

1. Ball bearing
2. Ball bearing

IMPORTANT: Do not reuse ball bearings that have been removed.

A. Remove ball bearings from the center shaft assembly.

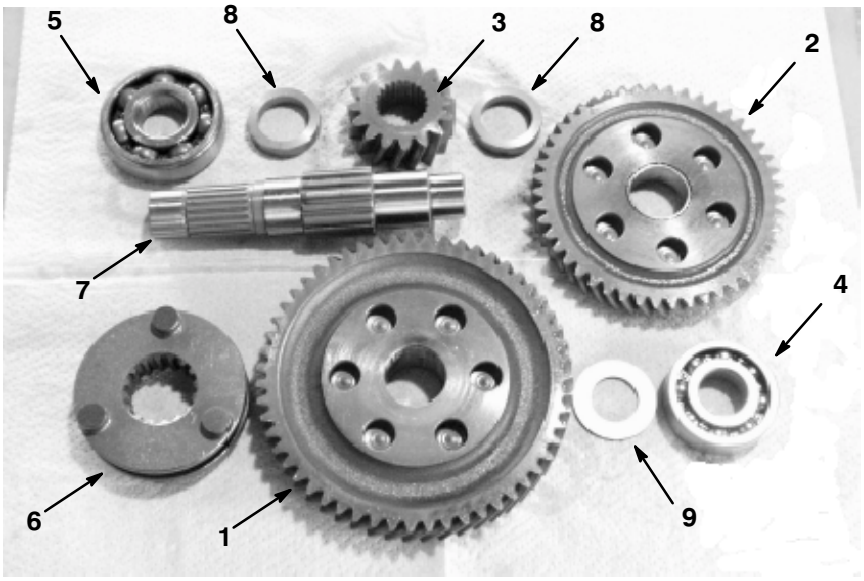


Figure 40

1. Gear 55
2. Gear 47
3. Gear (small)
4. Ball bearing
5. Ball bearing
6. Pin clutch
7. Center shaft
8. Collar
9. Spacer

B. Remove gears, pin clutch, collars, and spacer from the input shaft.

C. Replace gears if worn or damaged. Cracked, broken, missing, or chipped gear teeth are not acceptable.

D. Replace center shaft if worn or damaged. Splines that are cracked, broken, chipped or missing are not acceptable.

E. Replace pin clutch if cracked or bent.

F. Ball bearing roller balls must be free of deformation and scoring. Ball bearings must spin freely and have minimum axial play. Replace ball bearings as necessary.

G. Replace collars or spacer if excessively worn or damaged. Replace both collars as a set.

6. Disassemble differential case assembly.

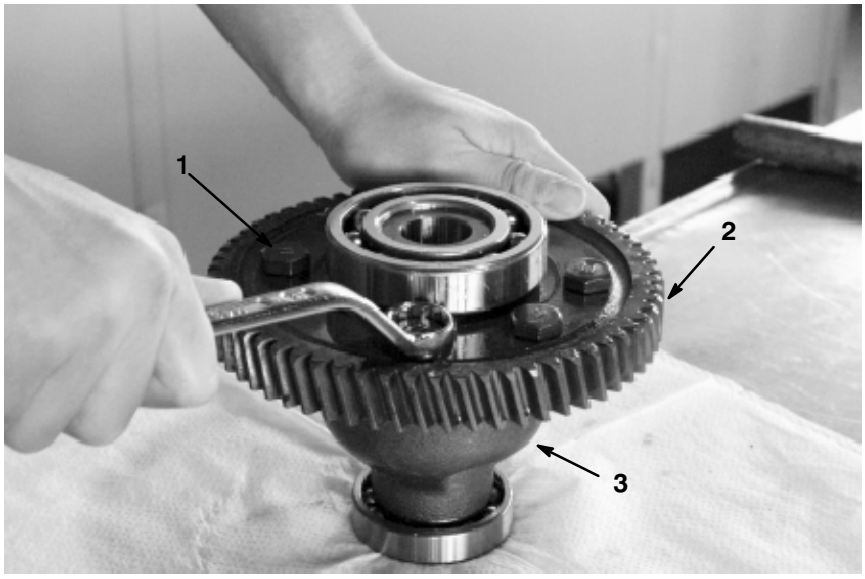


Figure 41

1. Bolt
2. Gear 62
3. Differential case

A. Remove bolts securing gear 62 to the differential case.

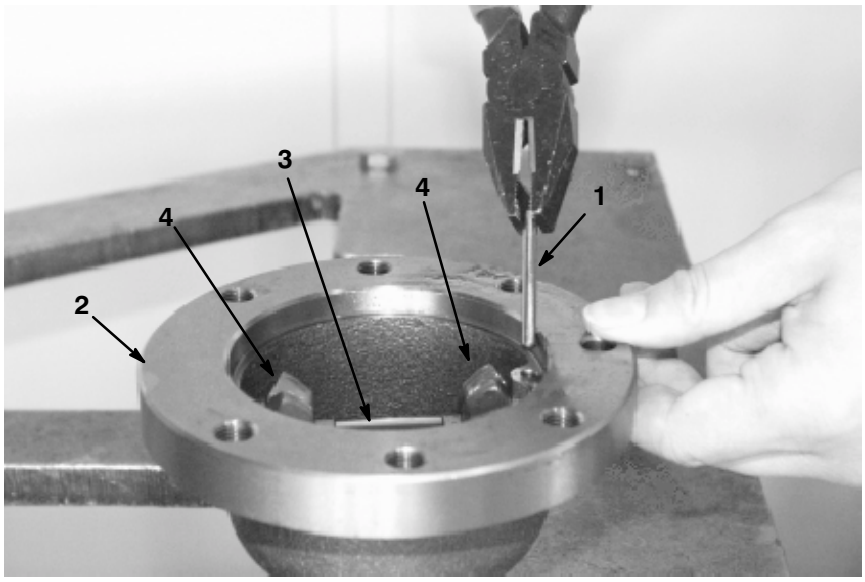


Figure 42

1. Spring pin
2. Differential case
3. Pinion shaft
4. Pinion gear

Note: The spring pin can be punched out from the hole on the opposite side of gear 62.

B. Remove spring pin from the differential case. Discard pin and replace it with new spring pin.

C. Remove pinion shaft and gears from the case. Separate gears from shaft.

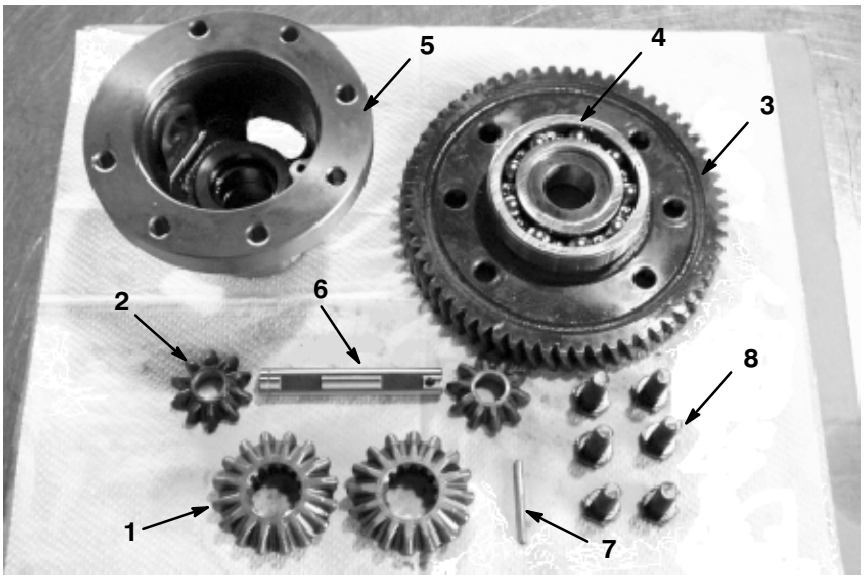


Figure 43

1. Side gear
2. Pinion gear
3. Gear 34
4. Ball bearing
5. Differential case
6. Pinion shaft
7. Spring pin
8. Bolt

D. Replace gears if worn or damaged. Cracked, broken, missing, or chipped gear teeth are not acceptable.

E. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

F. Replace case if machined areas where the side and pinion gears mesh are scored or if the pinion shaft fits loosely in its bore.

G. Replace pinion shaft if cracked or bent.

H. Replace oil seal if cracked, nicked, or distorted such that it would not hold a proper seal.

7. Disassemble governor fork and shaft.

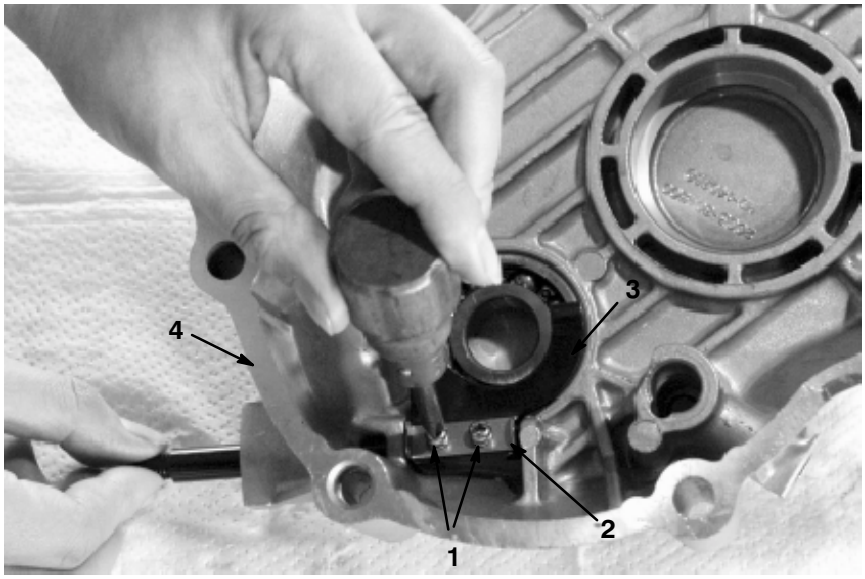


Figure 44

1. Screw
2. Stopper
3. Governor fork
4. Case (RH)

IMPORTANT: Make sure not to damage the screw heads when removing screws. Each screw is secured with an adhesive.

A. Remove both screws and washers securing the stopper and governor fork to the case (RH). Remove stopper and fork from the case.

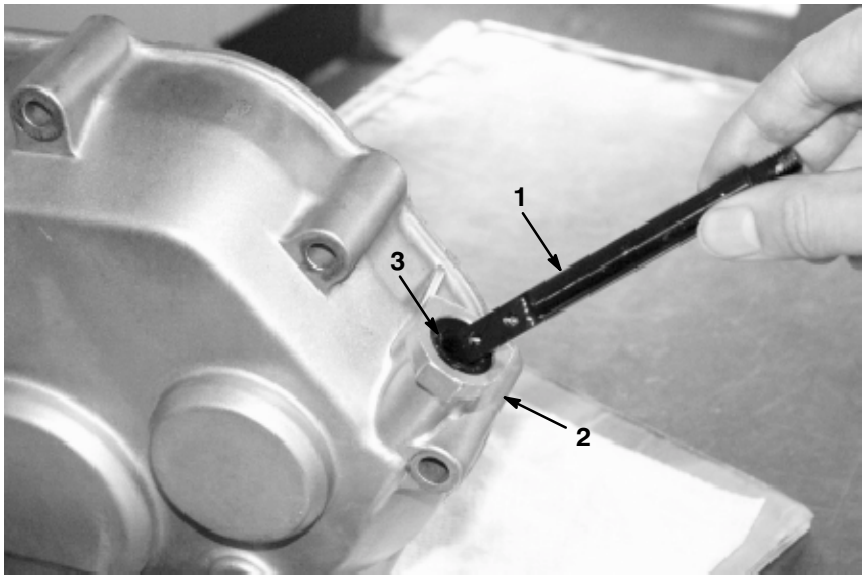


Figure 45

1. Governor shaft
2. Boss
3. Oil seal

IMPORTANT: Make sure not to damage the oil seal when removing the governor shaft from the governor boss.

B. Pull governor shaft from the boss.

C. Replace oil seal if if cracked, nicked, or distorted such that it would not hold a proper seal.

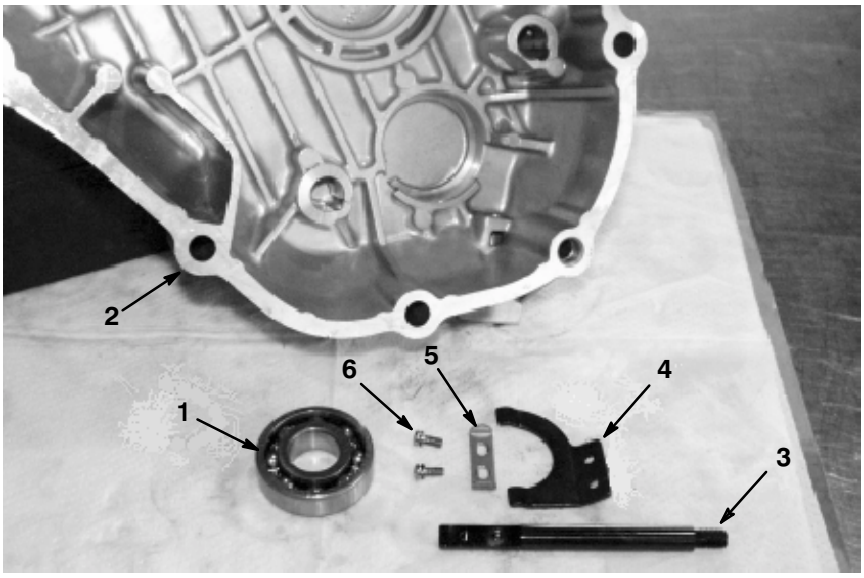


Figure 46

1. Ball bearing
2. Case (RH)
3. Governor shaft
4. Governor fork
5. Stopper
6. Screws

D. Remove ball bearing from the case. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

E. Replace governor shaft if cracked, bent, or excessively worn.

F. Replace governor fork or stopper if bent or deformed.

Assembly

1. Assemble input shaft assembly.

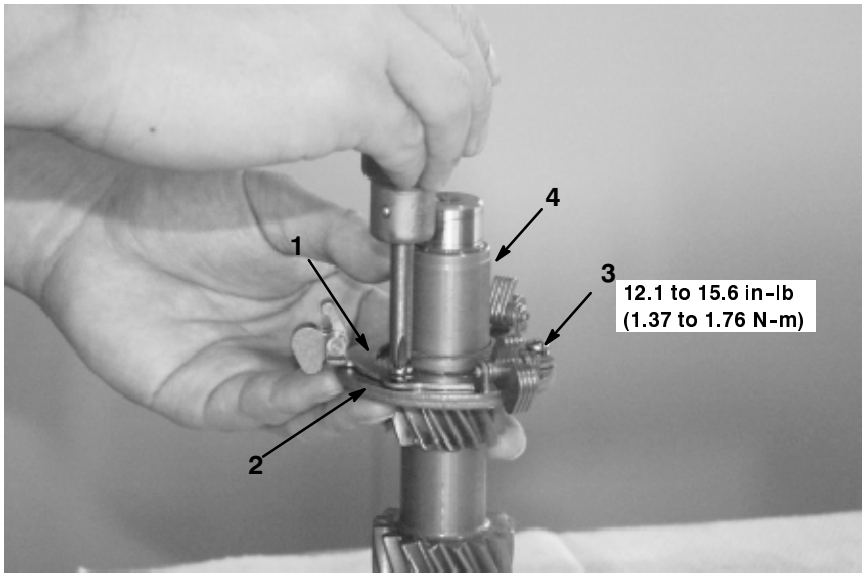


Figure 47

1. Governor plate
2. Governor base
3. Screw
4. Governor sleeve

IMPORTANT: To prevent the screws that secure the governor plate to the governor from loosening, apply Loctite Blue No. 242 or equivalent to the screw threads.

A. Secure governor plate unit to the governor base with screws. Torque screws from 12.1 to 15.6 in-lb (1.37 to 1.76 N-m).

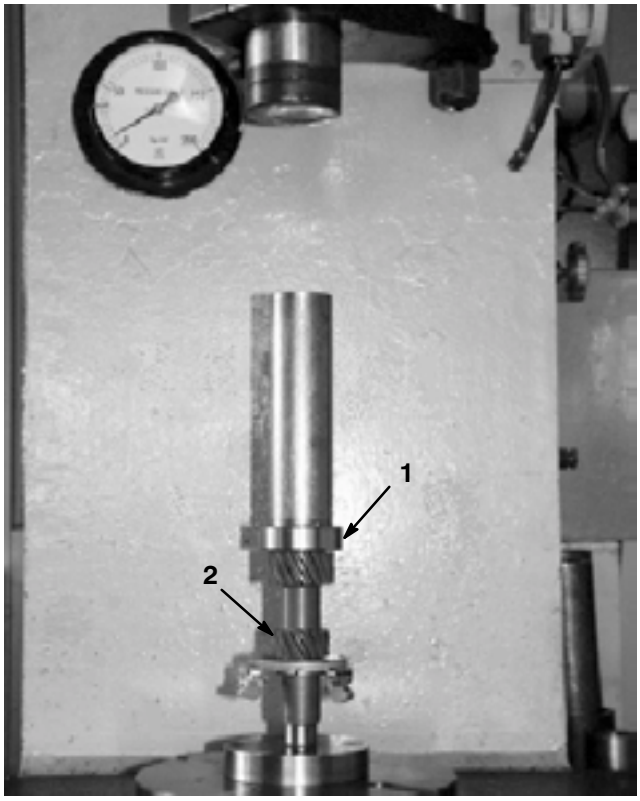


Figure 48

1. Ball bearing
2. Input shaft

IMPORTANT: Make sure to press ball bearing at the inner race to prevent damaging the ball bearing.

B. Press ball bearing onto the input shaft.

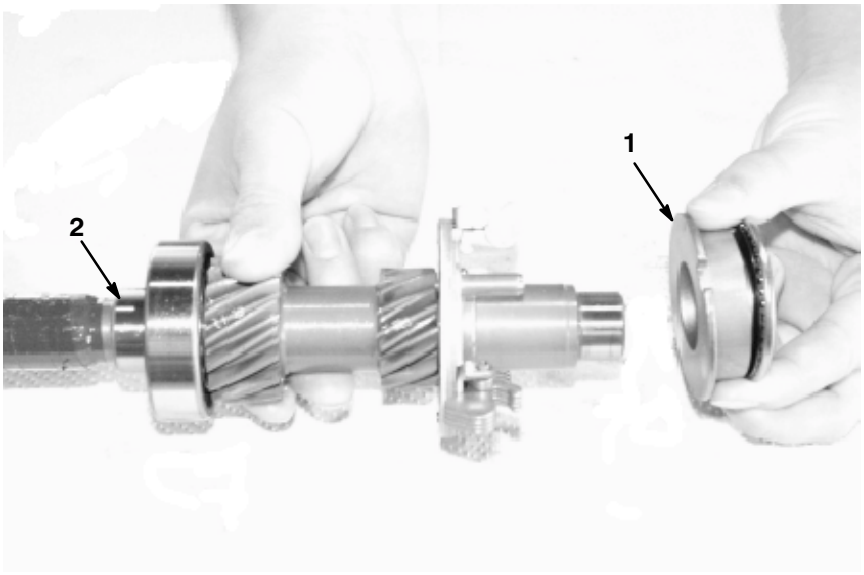


Figure 49

1. Governor sleeve
2. Input shaft

C. Apply molybdenum disulfide grease to the inside of the governor sleeve. Slide sleeve onto the input shaft.

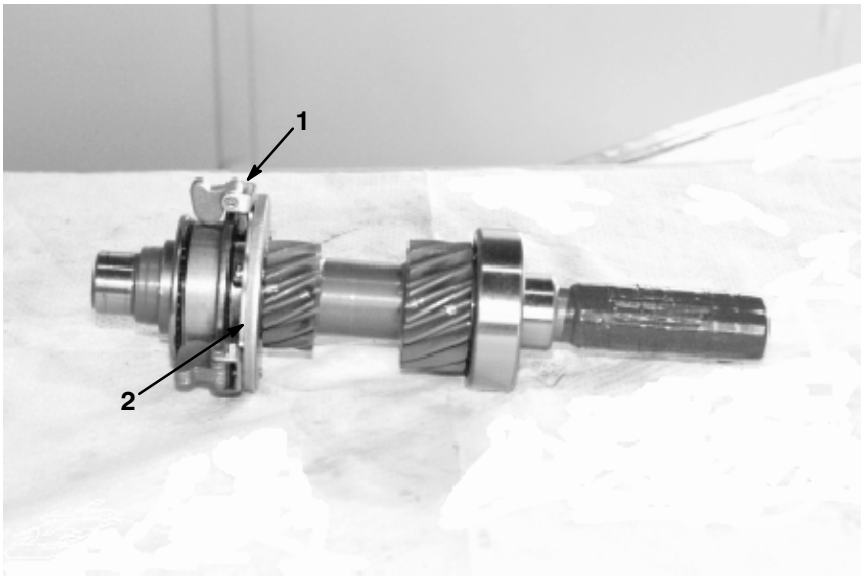


Figure 50

1. Pivot point
2. Governor plate

D. Make sure to apply molybdenum disulfide grease to the pivot points of the weights on the governor plate unit.

2. Assemble the center shaft assembly.

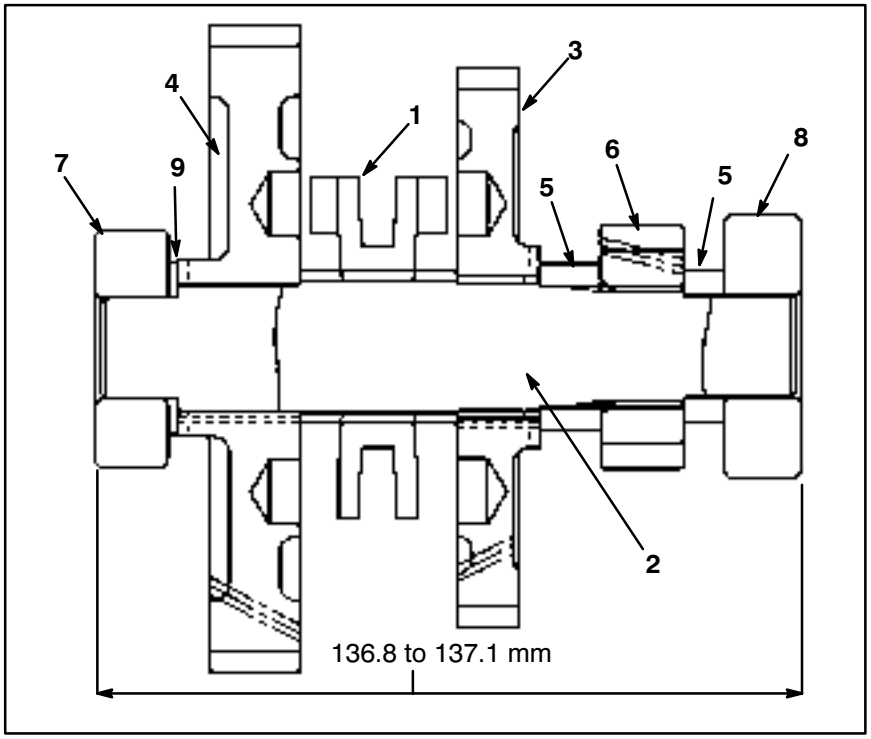


Figure 51

1. Pin clutch
2. Center shaft
3. Gear 47
4. Gear 55
5. Collar
6. Gear (small)
7. Bearing
8. Bearing
9. Spacer

Note: Before assembling, apply molybdenum disulfide grease to the inside of gears 47 and 55.

A. Slide pin clutch onto the centershaft. Install gears 47 and 55 onto shaft noting correct orientation of gears. Slide collars, small gear, and spacer onto the center shaft.

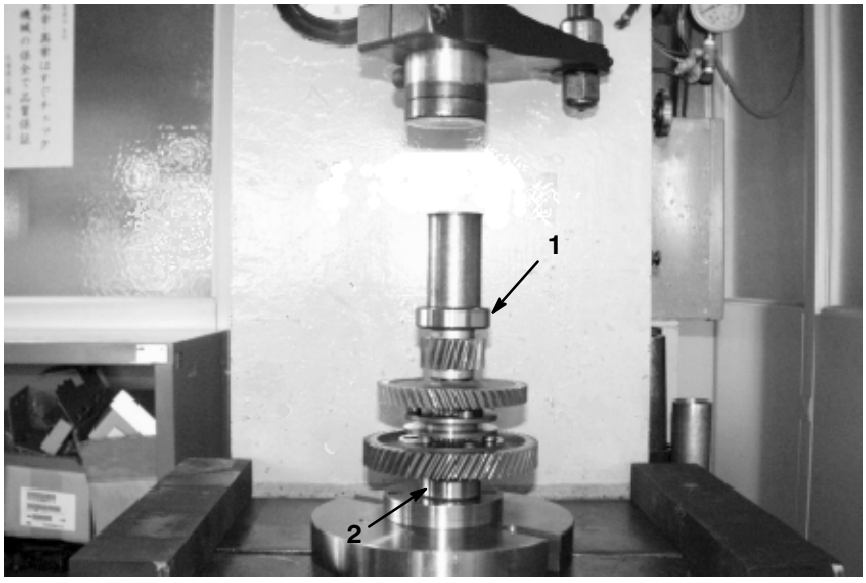


Figure 52

1. Ball bearing
2. Ball bearing

B. Press ball bearings onto the center shaft using a bearing press.

C. Make sure distance from one ball bearing outer edge to the other ball bearing outer edge is 136.8 to 137.1 mm (Fig. 51).

Figure 53

D. The center shaft should appear as above when assembled.

3. Assemble differential assembly.

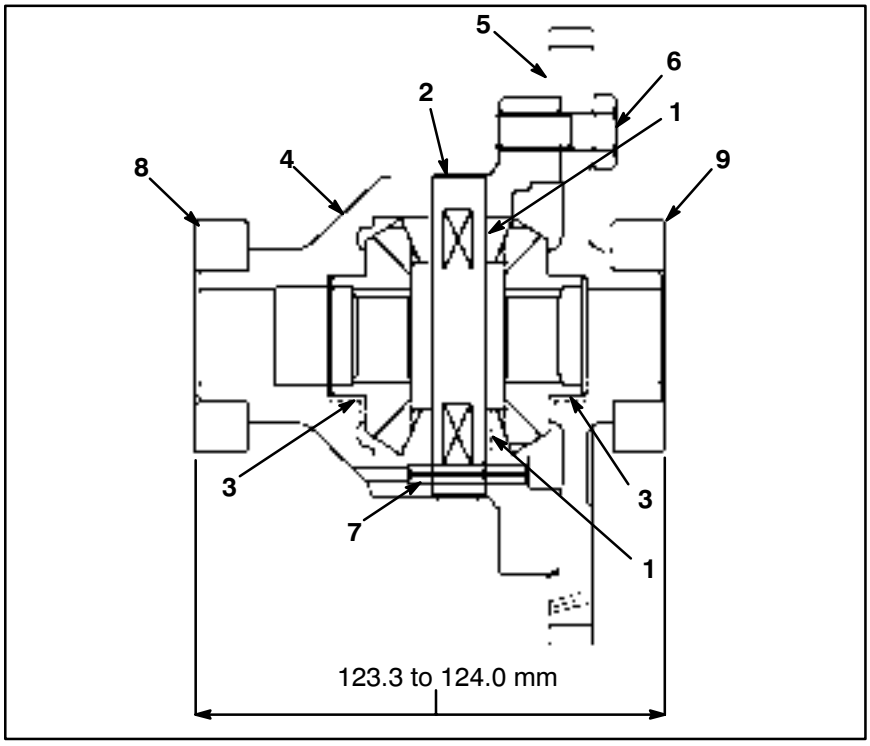


Figure 54

1. Pinion gear (greased surface)
2. Pinion shaft
3. Side gear (greased surface)
4. Differential case
5. Gear 62
6. Bolt
7. Spring pin
8. Ball bearing
9. Ball bearing

A. Apply molybdenum disulfide grease to the inside of both pinion gears where they contact the pinion shaft. Apply molybdenum disulfide grease to the outside of both side gears where they contact the differential case and gear 62.

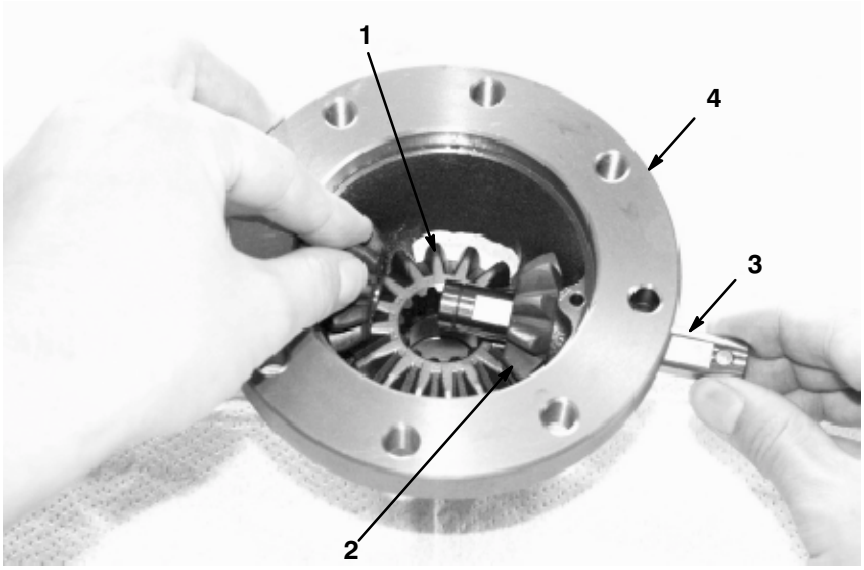


Figure 55

1. Side gear
2. Pinion gear
3. Pinion shaft
4. Differential case

B. Install side gear, both pinion gears, and pinion shaft into the differential case.

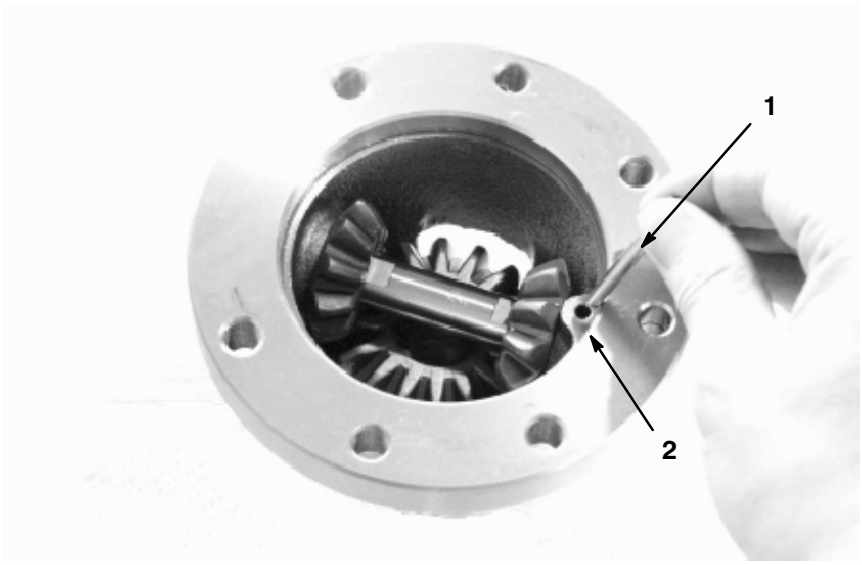


Figure 56

1. Spring pin
2. Differential case

C. Align pinion shaft hole and install new spring pin through the differential case and pinion shaft.

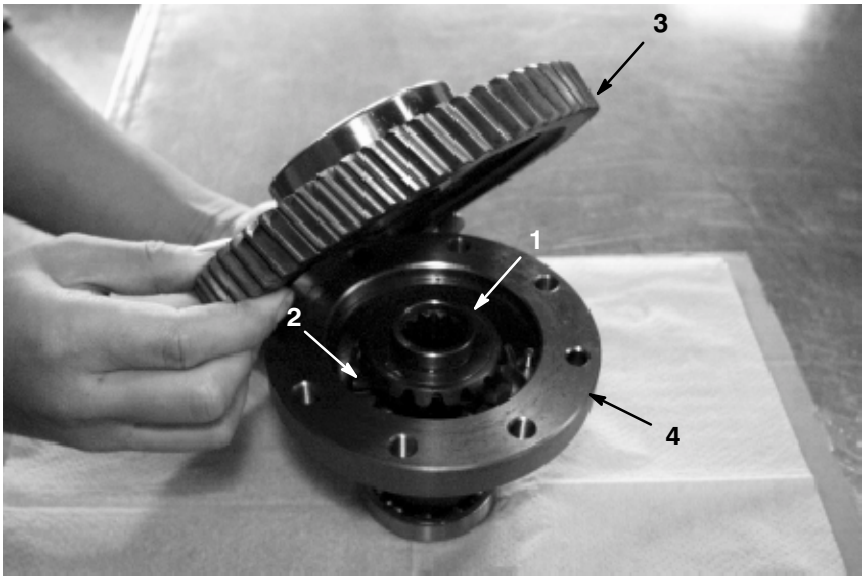


Figure 57

1. Side gear
2. Pinion gear
3. Gear 62
4. Differential case

D. Install remaining side gear to the pinion gears.

E. Secure gear 62 to the differential case with bolts. Torque bolts from 39.8 to 45.5 ft-lb (54.0 to 61.7 N-m) in a criss-cross pattern.

Figure 58

IMPORTANT: The length from the outer most side of each ball bearing must be from 123.3 to 124.0 mm (Fig. 54).

F. If ball bearings were removed, press new ball bearings onto differential case and gear 62.

G. The differential assembly should appear as above when assembled.

4. Assemble governor fork.

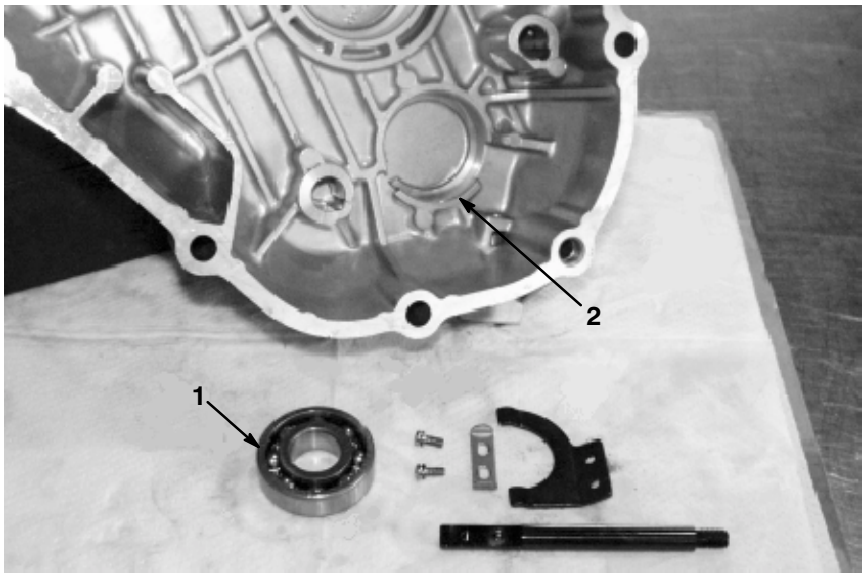


Figure 59

1. Ball bearing
2. Case (bore)

A. Install ball bearing into the bore of the case (RH).

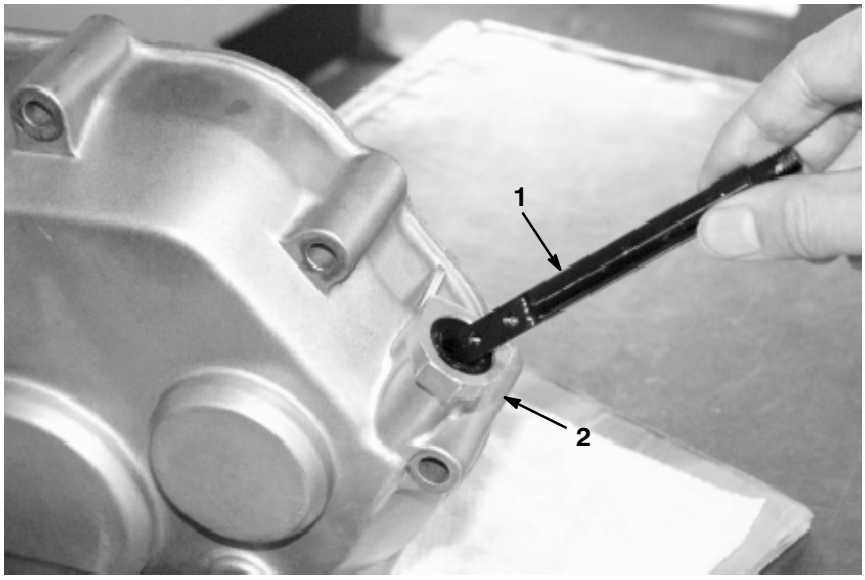


Figure 60

1. Governor shaft
2. Boss

IMPORTANT: Make sure not to damage the oil seal when installing the governor shaft into the governor boss.

B. Lubricate governor shaft with molybdenum disulfide grease before installing.

C. Install governor shaft into the boss.

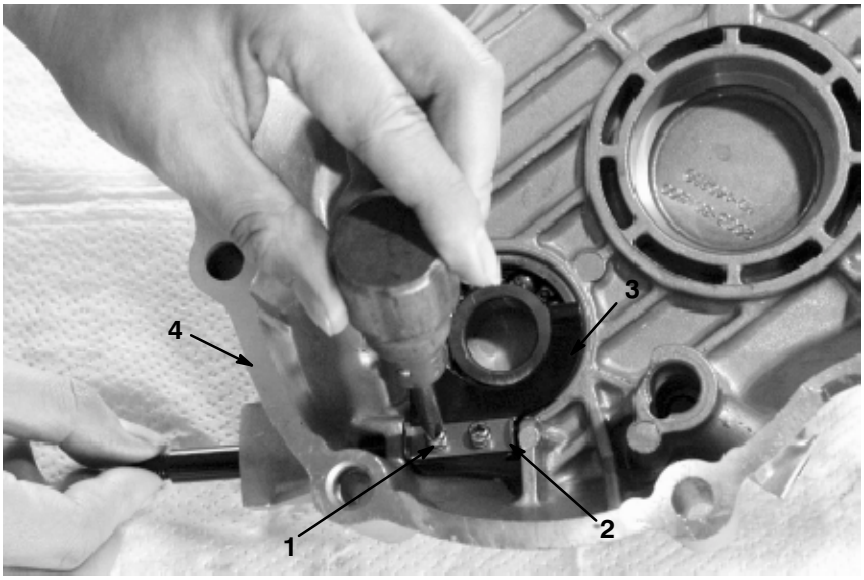


Figure 61

1. Screw
2. Stopper
3. Governor fork
4. Case (RH)

IMPORTANT: To prevent the screws that secure the governor fork and stopper to the governor shaft from loosening, apply Loctite Blue No. 242 or equivalent to the screw threads.

D. Secure stopper and governor fork to the governor shaft with both screws.

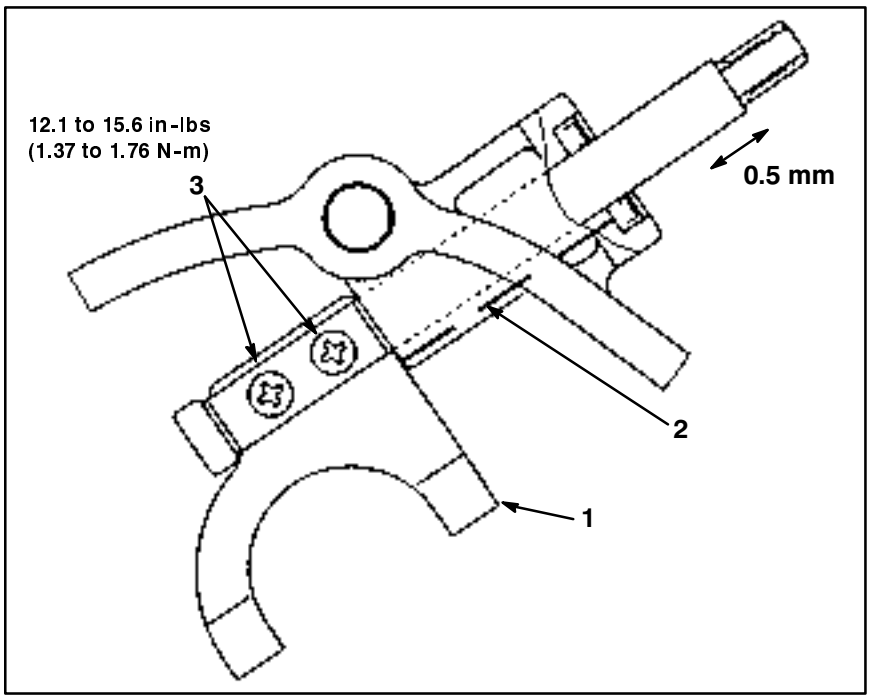


Figure 62

1. Governor fork
2. Governor shaft (greased surface)
3. Screw

E. Adjust governor fork center to the center of the ball bearing hole. Also, adjust thrust clearance of the governor shaft to less than 0.5 mm.

F. Torque screws from 12.1 to 15.6 in-lbs (1.37 to 1.76 N-m).

5. Install axle case to case (RH and LH).

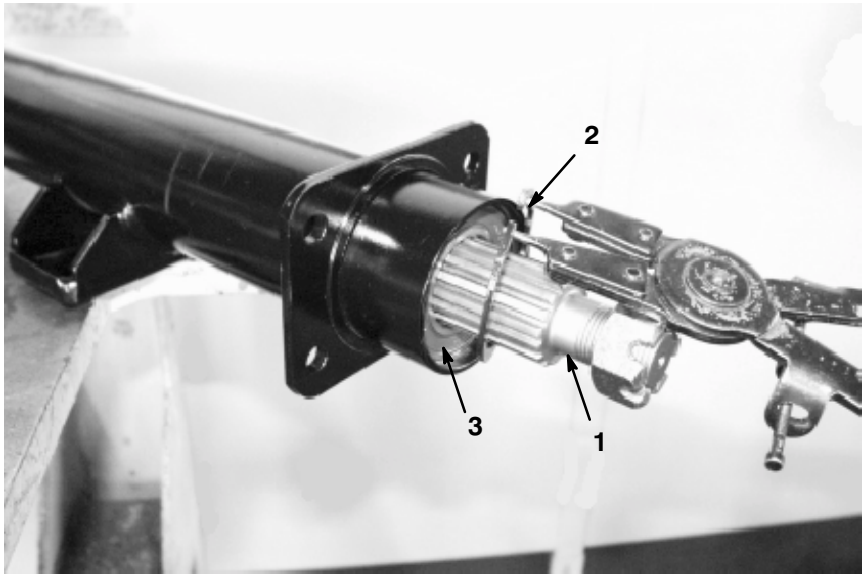


Figure 63

1. Axle shaft
2. Snap ring
3. Ball bearing

IMPORTANT: Do not reuse snap ring. Replace snap ring with new one.

A. Insert axle shaft with snap rings, collar, and ball bearings into the axle case. Install snap ring to the axle case.

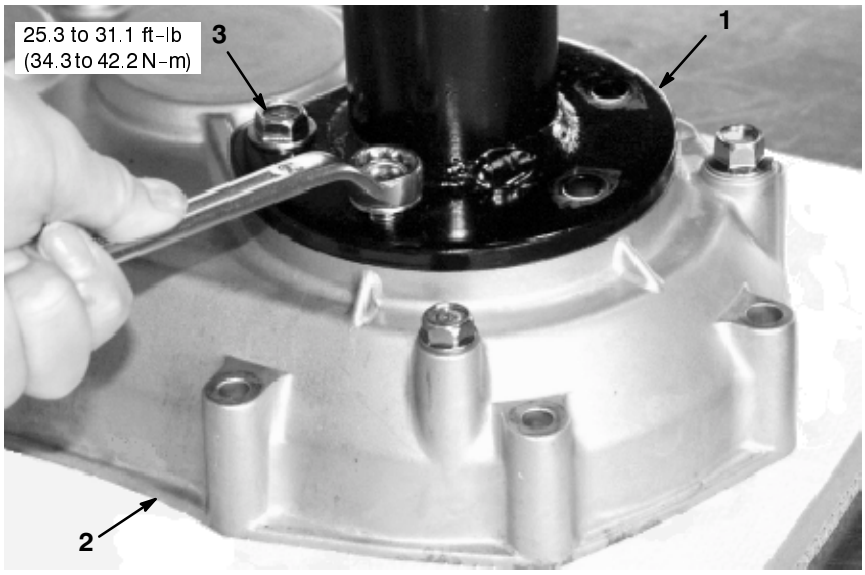


Figure 64

1. Axle case
2. Case
3. Flange bolt

IMPORTANT: Make sure to install the axle case to the proper side of the case. The right side of the case takes the short axle case, and the left side takes the long axle case.

IMPORTANT: Make sure not to damage the oil seal when installing the axle case to the case.

B. Install axle case to the case. Secure each axle case to the case with flange bolts. Torque bolts from 25.3 to 31.1 ft-lb (34.3 to 42.2 N-m).

6. Install input shaft, center shaft, and differential assemblies to the case.

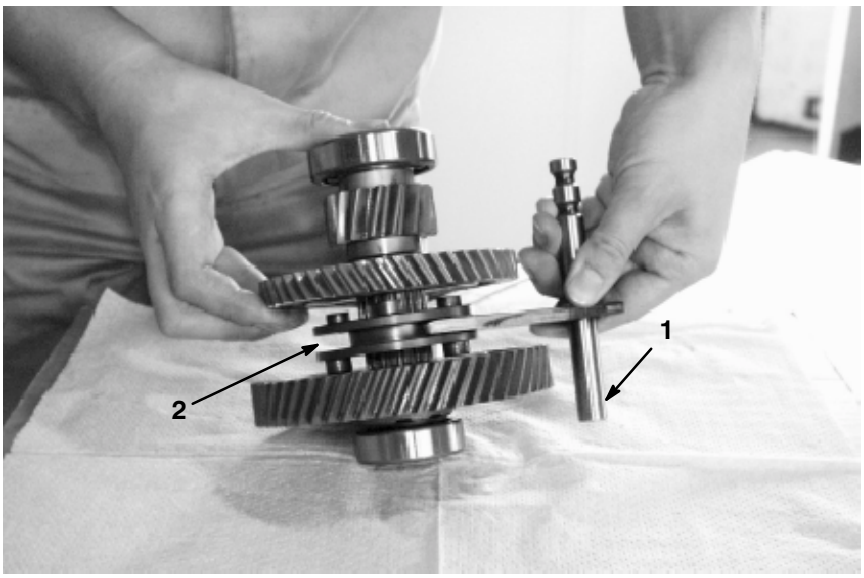


Figure 65

1. Shift shaft
2. Clutch groove

A. Insert fork of the shift shaft to the clutch groove of the center shaft assembly.

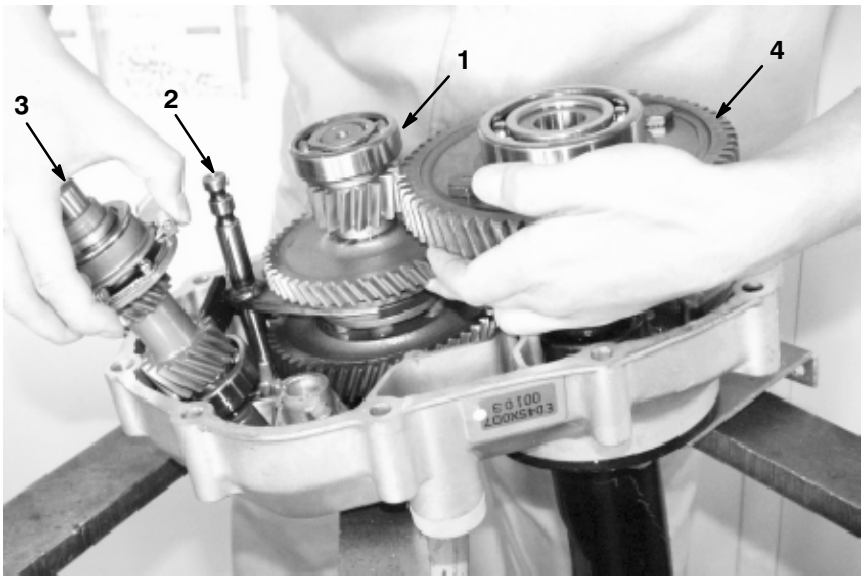


Figure 66

1. Center shaft assembly
2. Shift shaft
3. Input shaft
4. Differential assembly

B. Replace oil seals for the input and selector shafts on the case (LH) if cracked, nicked, or distorted such that they would not hold a proper seal.

IMPORTANT: Make sure not to damage the oil seal when installing the input shaft.

C. Install center shaft assembly with shift shaft and differential assembly. Then, install input shaft assembly. Lower differential assembly, center shaft assembly, and input shaft assembly into the case at the same time.

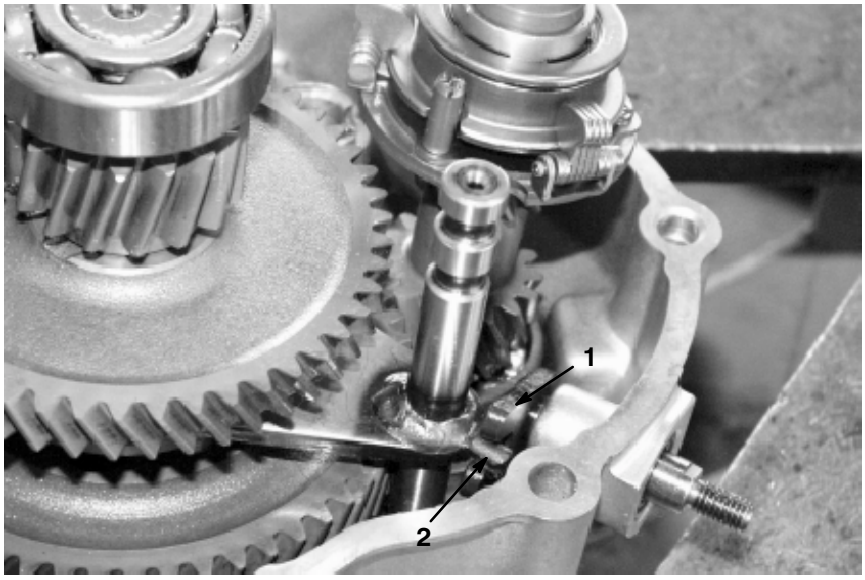


Figure 67

1. Fork (selector shaft)
2. Pin (shift shaft)

D. Make sure the selector shaft fork is contacting the pin on the shift shaft.

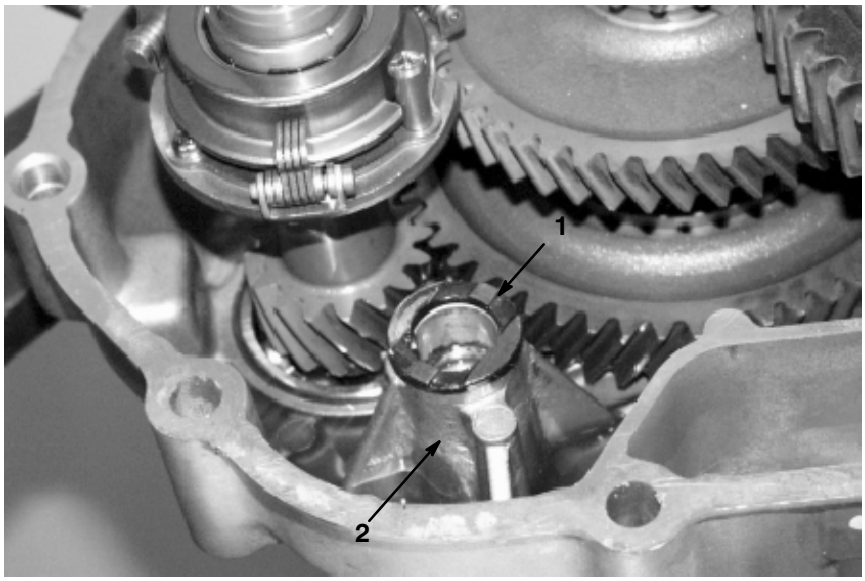


Figure 68

1. Spacer
2. Boss (counter shaft)

E. Place spacer on the counter shaft boss of the case (LH) so the oil groove faces up.

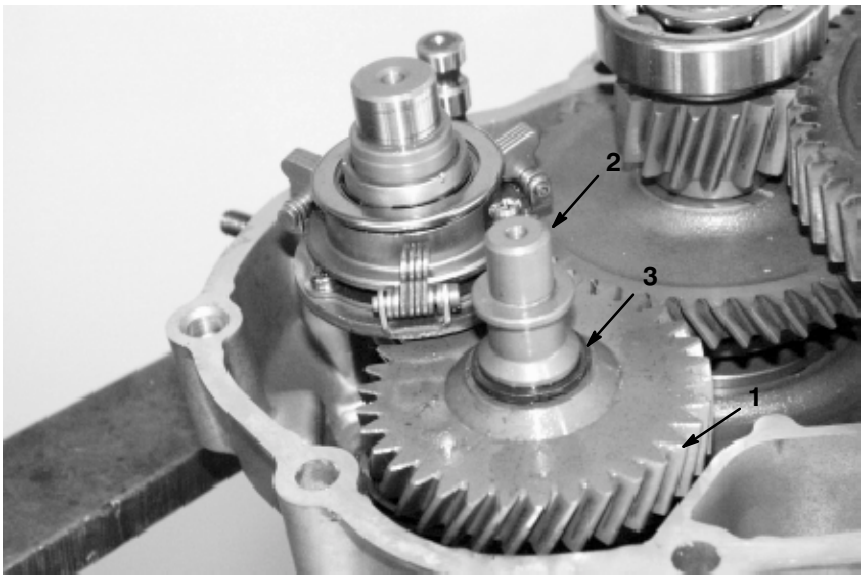


Figure 69

1. Gear 34
2. Counter shaft
3. Spacer

F. Apply molybdenum disulfide grease to the inside of gear 34 and the contact surface between the case and the counter shaft.

G. Place gear 34 onto the spacer. Make sure not to drop the spacer. Insert needle bearing into gear. Insert counter shaft with remaining spacer through the needle bearing, gear 34, and into the spacer and case.

7. Assemble case (LH and RH).

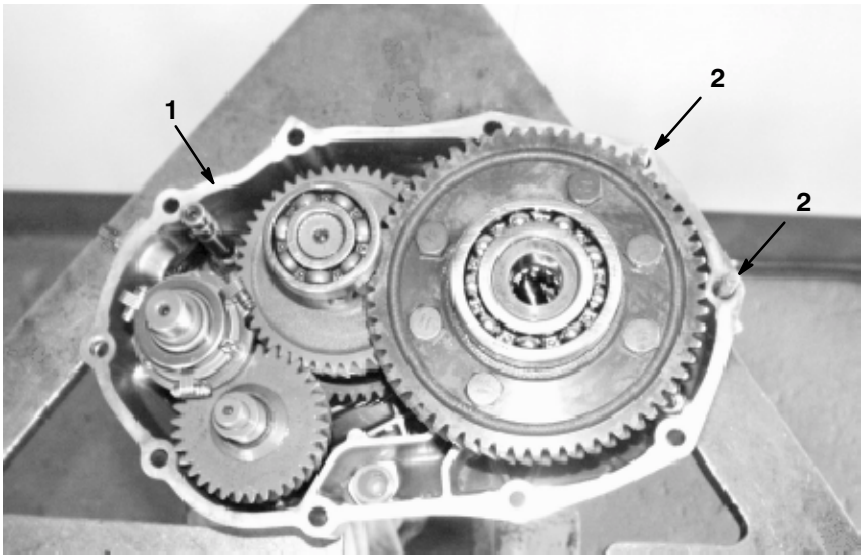


Figure 70

1. Case (sealing surface)
2. Pipe knock

A. Make sure gasket sealing surfaces of both cases are clean. Install gasket to case.

B. Install both pipe knocks to the case (LH).

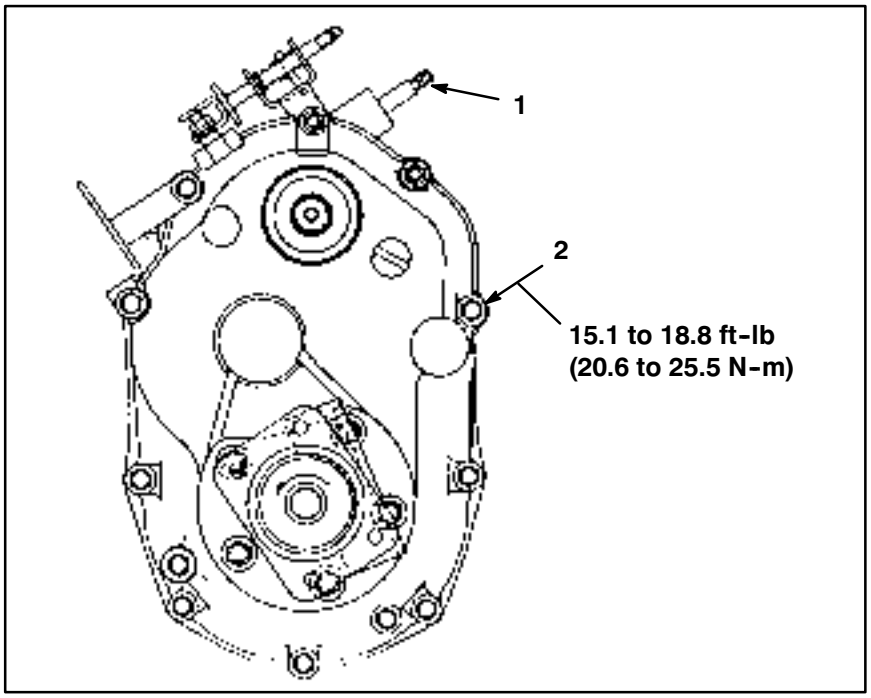


Figure 71

1. Governor shaft
2. Bolts

Note: When installing case (RH) to the case (LH), hold governor shaft so the ball bearing will not drop off. Keep the gasket sealing surfaces of the cases as horizontal to each other as possible. If the sealing surfaces do not join to each other, tap the case lightly with a plastic hammer.

C. Install case (RH) so each shaft fits properly into the case.

D. Secure case (RH) to case (LH) with bolts. Torque bolts from 15.1 to 18.8 ft-lb (20.6 to 25.5 N-m).

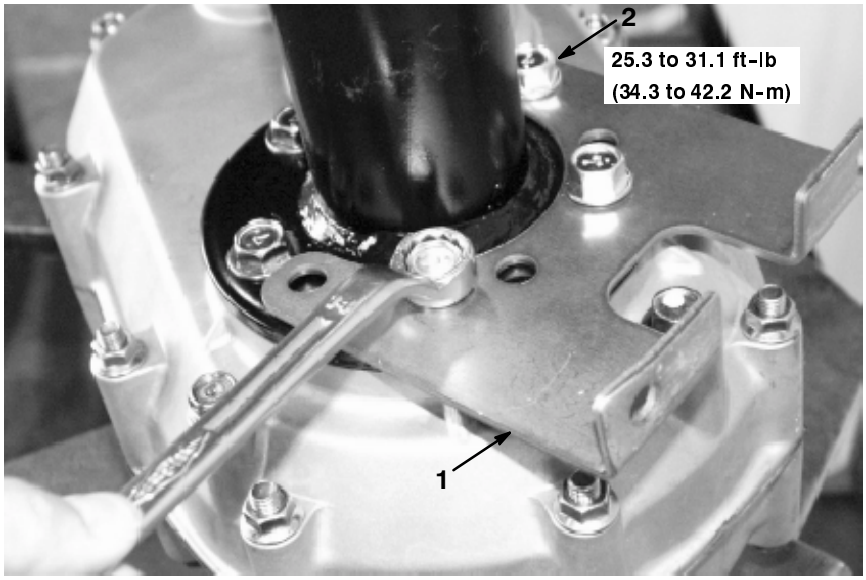


Figure 72

1. Axle bracket
2. Flange bolt

E. Position axle bracket to each axle case. Secure axle bracket to each axle case with flange bolts. Torque bolts from 25.3 to 31.1 ft-lb (34.3 to 42.2 N-m).

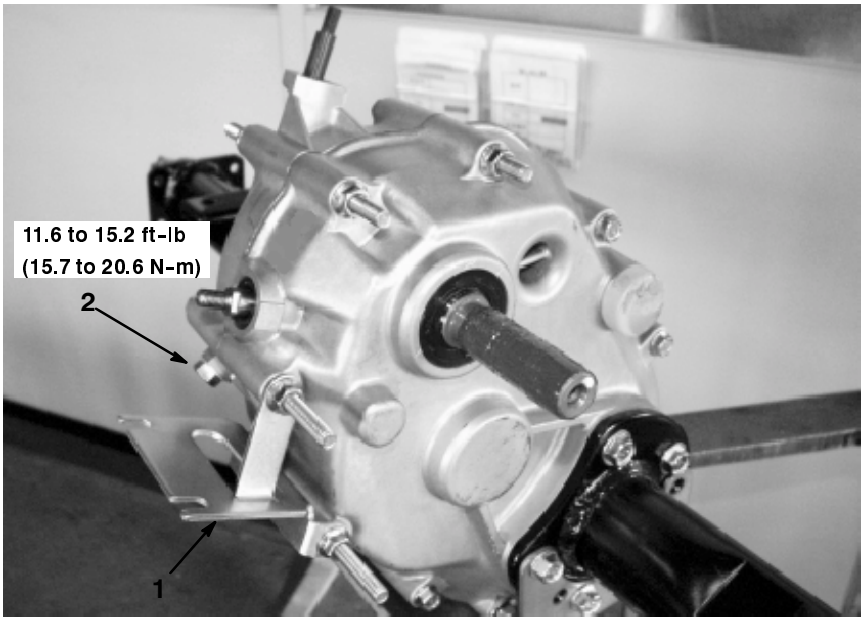


Figure 73

1. Cable bracket
2. Bolt (steel ball, spring, & gasket)

F. Install cable bracket to the transaxle.

G. Install steel ball, spring, gasket, and bolt. Torque bolt from 11.6 to 15.2 ft-lb (15.7 to 20.6 N-m).

H. Fill transaxle with 1.5 quarts (1.4 liters) of new 10W-30 motor oil.

Chapter 5

Electrical System

Table of Contents

Special Tools

Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

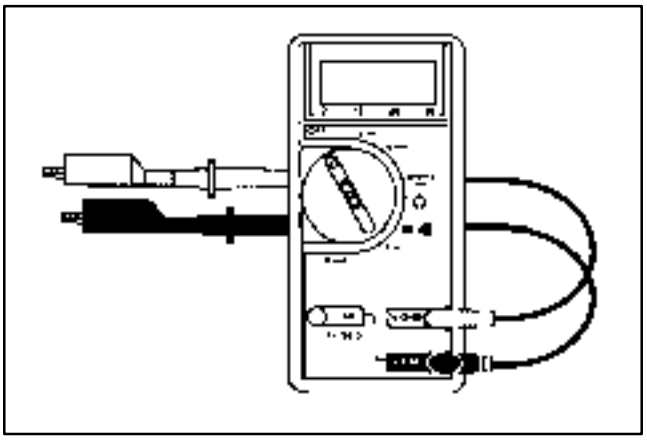


Figure 1

Skin-Over Grease

Special non-conductive grease (Toro Part No. 505-47) which forms a light protective skin which helps waterproof electrical switches and contacts.

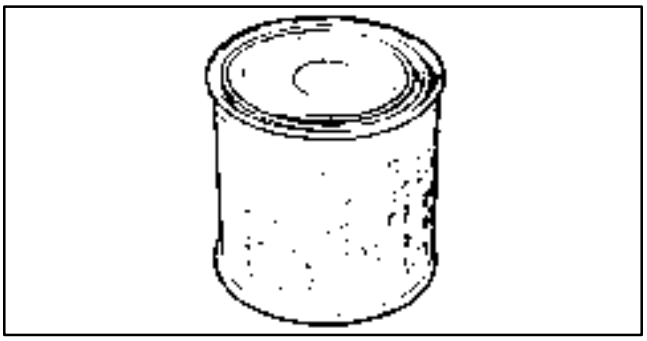


Figure 2

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical trouble-shooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this vehicle (see Wiring Schematic at the end of this chapter).

If the vehicle has any interlock switches by-passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank.	Battery charge is low. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for the solenoid. Starter is faulty and causing an incomplete circuit for the solenoid.
Nothing happens when start attempt is made.	Battery is dead. Wiring to the start circuit (see Wiring Schematic) components is loose, corroded, or damaged. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Fuse block is faulty. 10 ampere fuse to the ignition switch is loose or blown. The ignition switch is faulty. Starter solenoid is faulty.
Engine cranks, but does not start.	Wiring to start circuits (see Wiring Schematic) is loose, corroded, or damaged. Engine or fuel system is malfunctioning (see Engine Chapter). Engine and fuel may be too cold.

General Run Problems

Problem	Possible Causes
Battery does not charge.	Wiring to the charging circuit (see Wiring Schematic) components is loose, corroded, or damaged. Voltage regulator and/or starter/generator is faulty. Battery is dead.
Engine kills during operation.	Wiring to the run circuit (see Wiring Schematic) components became broken or disconnected.

Electrical System Quick Checks

Battery Test

Use a multimeter to measure the voltage between the battery terminals.

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60° to 100° F. The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead the the negative battery post.

Note: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check on the switch).

Note: See the Briggs & Stratton Repair Manual for 4 Cycle, V–Twin Cylinder, OHV Head Engines for additional component testing information.

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

The ignition (key) switch has three positions (Off, Run, and Start). The terminals are marked as shown. The circuitry of the ignition switch is shown in the chart. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

POSITION	CIRCUIT “MAKE”	AMPS
OFF	+M + –M	1
RUN	B + A	15
START	B + A + S	20

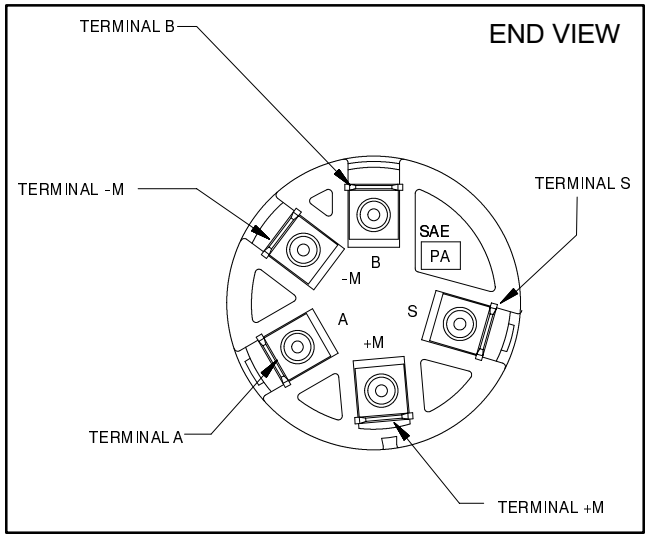


Figure 3

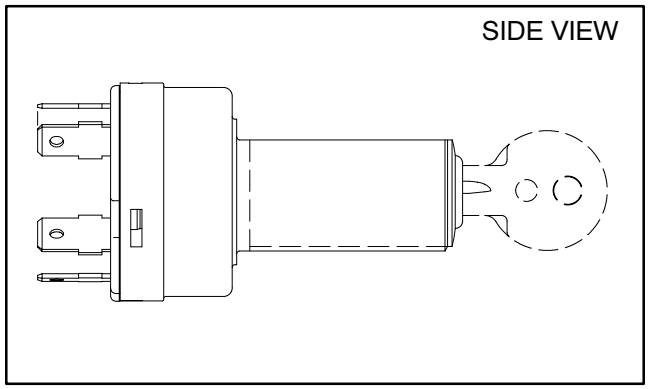


Figure 4

Attachment Relay

1. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting). Resistance should be from 80 to 90 ohms. There should not be any continuity between terminals 30 and 87.

2. To bench test the relay, connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply 12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as 12 VDC is applied and removed from terminal 85. Relay is operating properly.

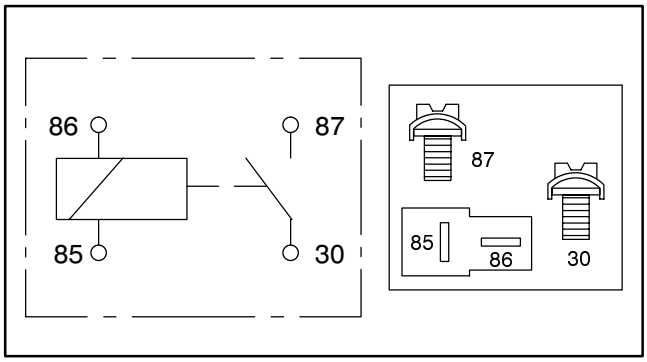


Figure 5

Starter Solenoid

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Make sure engine is off. Disconnect battery. Disconnect solenoid electrical connections.

2. Apply 12 VDC directly across the solenoid coil posts. The solenoid should click. Make sure resistance across the main contact posts is less than **1 ohm**.

3. Remove voltage from solenoid coil posts. The solenoid should click. Make sure resistance across the main contact posts is **infinite ohms**.

4. Resistance across the solenoid coil posts should be **15.5 ohms**.

5. Replace starter solenoid if necessary.

6. Reconnect electrical connections to solenoid: positive battery cable and wire to fuse block on one main contact post and starter/generator cable and wire to regulator on the other main contact post. Reconnect battery.

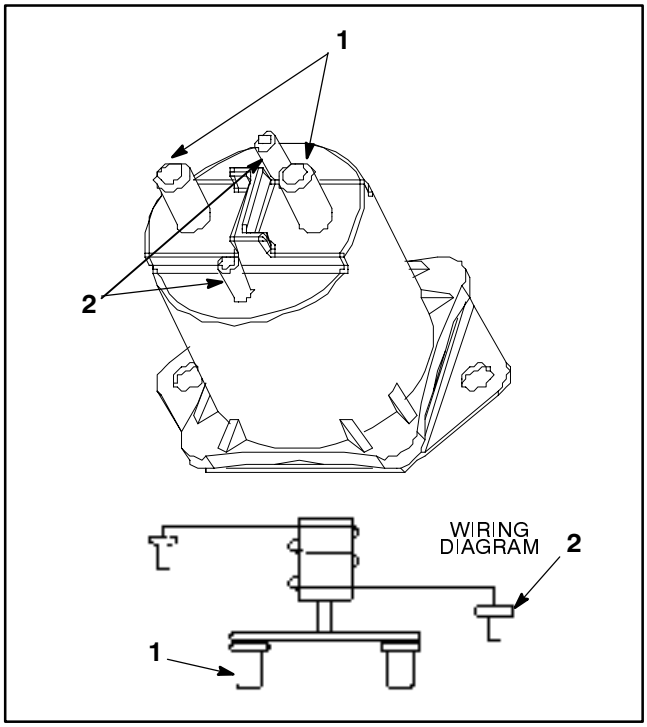


Figure 6

1. Main posts (copper)
2. Solenoid posts (steel)

Hour Meter

IMPORTANT: Make sure to observe polarity on the hour meter label when testing. Damage to the meter may result from an improper connection.

1. Isolate hour meter from the circuit.

2. Connect positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.

3. Connect negative (–) terminal of the voltage source to the other terminal of the hour meter.

4. The hour meter should move 1/10 of an hour in six minutes.

5. Disconnect voltage source from the hour meter. Reconnect hour meter to the circuit.

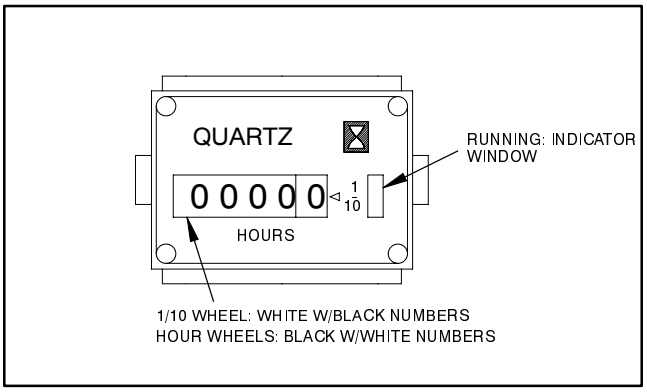


Figure 7

Fuse Block

There are 4 fuses in the vehicle's electrical system. They are located beneath the bed in a box on the right hand side of the frame. Fuses can be removed to check continuity. The test meter should read **less than 1 ohm.**

Fuses supply power to the following (Fig. 8):

1. The top left 25 ampere fuse supplies power to the start/run systems.

2. The top middle 10 ampere fuse supplies power to the headlights.

3. The top right 10 ampere fuse supplies power to the power outlet.

4. The bottom left 10 ampere supplies power to the low oil light and to the hour meter.

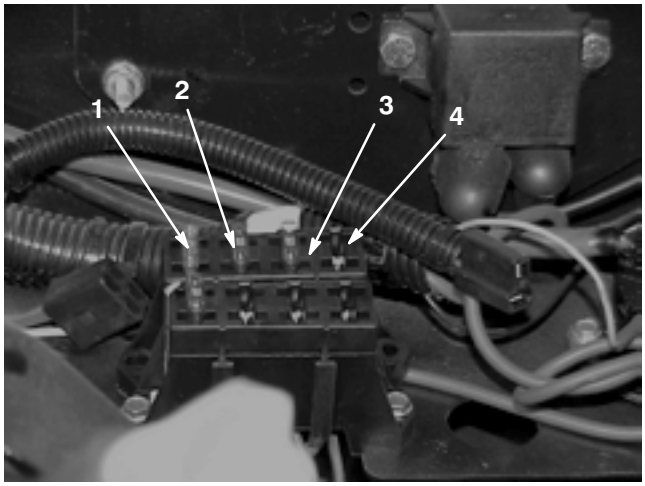


Figure 8

1. **Ignition system**
2. **Headlights**
3. **Power outlet**
4. **Low oil light, hour meter**

Oil Pressure Switch

The switch is located on the mounting adapter for the oil filter. It is a normally closed switch and opens with pressure.

Oil pressure switch testing

1. Turn the ignition switch to ON. The oil indicator light should be on.

2. If the light is not on, disconnect the wire from the oil pressure switch and ground the wire to the engine block.

3. If the light comes on, the oil pressure switch is bad.

4. If the light does not come on after step 2, check the indicating circuit (see Electrical Schematic).

If the lamp comes on with the engine running:

1. Shut off the engine **immediately**.

2. Disconnect the wire from the oil pressure switch.

3. Turn the ignition switch to ON. The oil pressure lamp should go out.

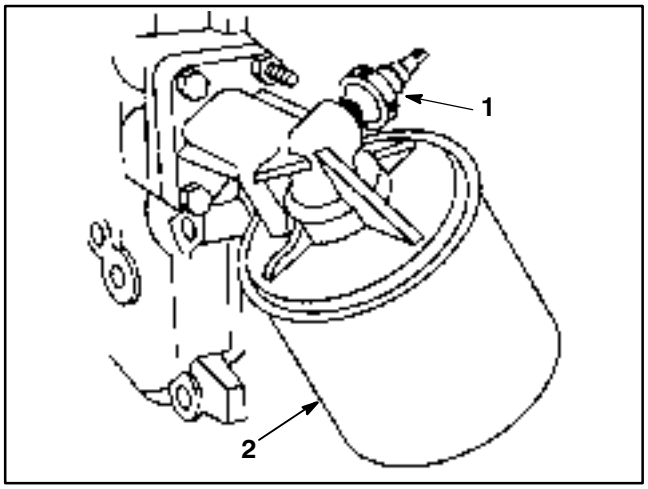


Figure 9

1. Oil pressure switch 2. Oil filter

4. If the light is still on, check for short circuiting in the indicating circuit (see Electrical Schematic).

5. Refer to the Briggs & Stratton Repair Manual for 4 Cycle, V-Twin Cylinder, OHV Head Engines for additional testing information.

Neutral Switch

The neutral switch is located in the shifter assembly.

When the shift lever is in neutral, the switch is closed, allowing voltage to pass through from the ignition switch to the solenoid.

The switch has three terminals which are marked, COM 1, NC2, and NO3. The lever is spring loaded in the "up" position. When the button is pushed down, continuity switches from the COM 1 and NC2 to COM 1 and NO3.

To test the switch

1. Disconnect the switch from the harness.

2. Verify the conditions in the table.

BUTTON	CONDITION
UP	COM 1 + NC2
DOWN	COM 1 + NO3

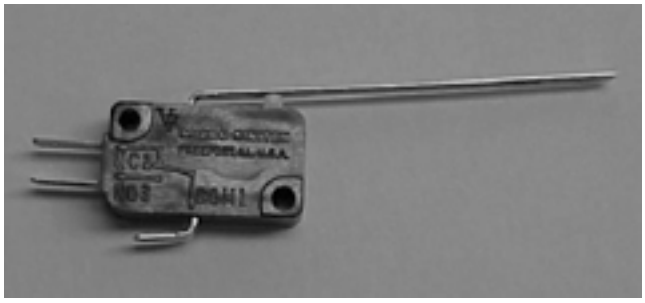


Figure 10

Headlights

1. Set parking brake, turn ignition off, and remove key.

2. Underneath the dash you will see the backside of each headlight.

3. On each side of the headlight assembly there are 2 retainer brackets holding each headlight assembly to the hood assembly.

4. Each retainer bracket has one screw holding the bracket. Loosen each screw until you can turn the retainer bracket. Once both brackets are loosed and turned you will be able to pull the headlight assembly out through the back-side of the hood.

5. To replace the lamp, twist the back socket about a ¼ turn. This will allow you to replace the lamp. To install, simply install new lamp in the socket, turn the socket a ¼ turn to lock and reinstall the headlight assembly in the hood assembly and turn the retainer brackets and tighten the screws.

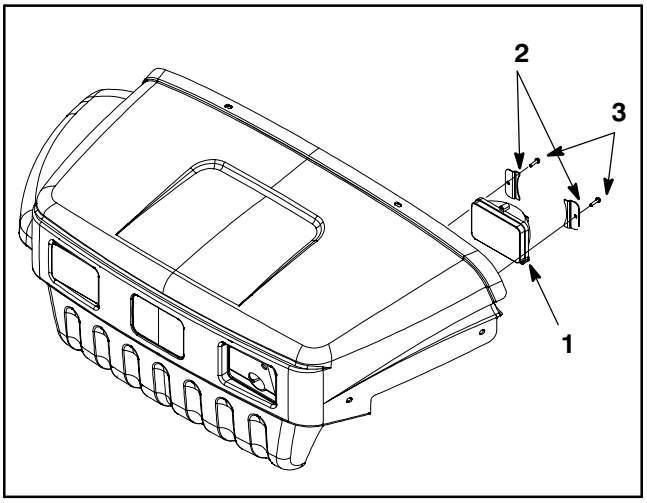


Figure 11

1. Rubber seal
2. Inside notch
3. Outside notch
4. Headlight

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

WARNING

POTENTIAL HAZARD
- **Either the battery terminals or metal tools could short against metal vehicle components.**

WHAT CAN HAPPEN
- **Sparks can cause the battery gasses to explode.**
- **Damaged cables could short against metal vehicle components and cause sparks.**

HOW TO AVOID THE HAZARD
- **When removing or installing the battery, do not allow the battery terminals to touch any metal parts of the vehicle.**
- **Always DISCONNECT the negative (black) battery cable before disconnecting the positive (red) cable.**
- **Always RECONNECT the positive (red) battery cable before reconnecting the negative (black) cable.**
- **Do not allow metal tools to short between the battery terminals and metal parts of the vehicle.**
- **Always keep the battery strap in place to protect and secure the battery.**

Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80°F (26.7°C)
Discharged: less than 1.240

Battery Specifications
BCI Group Size UI:
300 Amp Cranking Performance at 0° F (-17.8°C)
Reserve Capacity at 25 Amps and 80°F (26.7°C) is 34 Minutes

Removal (Fig. 12)

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Position vehicle on a level surface, set parking brake, turn ignition off, and remove key.

2. Raise bed and secure with prop rod. Unhook battery strap.

3. Disconnect black cable (-) first to prevent short circuiting the battery, other components, or operator's hands. Disconnect red (+) cable.

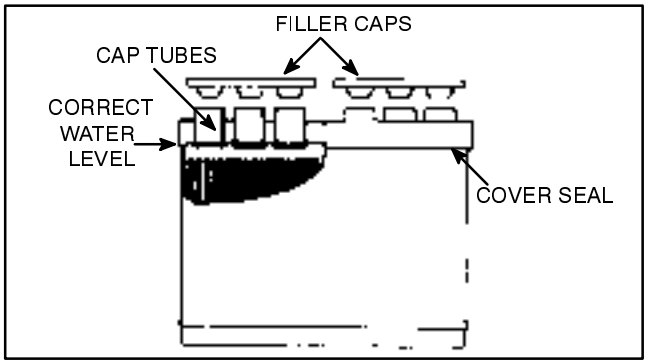


Figure 12

4. Make sure that filler caps are on tightly.

5. Remove battery from chassis to a service area. This will minimize possible battery damage and allow better access for inspection and service.

WARNING

POTENTIAL HAZARD
- **Battery electrolyte contains sulfuric acid which is a deadly poison and it causes severe burns.**

WHAT CAN HAPPEN
- **If you carelessly drink electrolyte you could die or if it gets onto your skin you will be burned.**

HOW TO AVOID THE HAZARD
- **Do not drink electrolyte and avoid contact with skin, eyes or clothing. Wear safety glasses to shield your eyes and rubber gloves to protect your hands.**
- **Fill the battery where clean water is always available for flushing the skin. Always RECONNECT the positive (red) battery cable before reconnecting the negative (black) cable.**
- **Follow all instructions and comply with all safety messages on the electrolyte container.**

Inspection, Maintenance, and Testing

1. Perform the following inspections and maintenance:

A. Check for cracks caused by overly tight or loose hold-down clamp. Replace battery if cracked and leaking.

B. Check battery terminal posts for corrosion. Use a terminal brush or steel wool to clean corrosion from the battery terminal posts.

IMPORTANT: Before cleaning the battery, tape or block the vent holes to the filler caps and make sure the caps are on tightly.

C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post, or overfilling. Also, check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water to the bottom of the cap tubes (or fill line). Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example:	Cell Temperature 100°F	
	Cell Gravity	1.245
	ADD (20° above 80°F)	0.008
	Correction to 80°F	1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the manufacturer's instructions when using a battery tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.0 VDC, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturers' instructions.

C. Make sure the battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturers' instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	21.1°C (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

l. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure the ignition switch and all accessories are off.

2. Make sure the battery base is clean and repainted if necessary.

3. Make sure battery cables, battery connections, and the battery hold down strap are in good condition.

4. Set battery on the battery base with its posts toward the rear of the vehicle. Push the red cable (+) connector onto positive battery post. Do not hammer; this will damage the battery. Tighten bolt and wing nut.

5. Secure battery to the base with rubber strap.

6. Connect a digital multimeter (set to amps) between the negative battery post and the black cable (–) connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

7. Connect black cable (–) connector to the negative battery post. Tighten bolt and wing nut.

8. Apply a light coat of grease on battery posts and cable connectors to reduce corrosion after connections are made.

Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

CAUTION

Follow the manufacturer's instructions when using a battery charger.

Note: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its open specific gravity or circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.

Charge battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive.

Keep open flame and electrical spark away from the battery. Do not smoke. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

Nausea may result if the gases are inhaled.

3. **Follow the manufacturer's instructions.** Connect charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

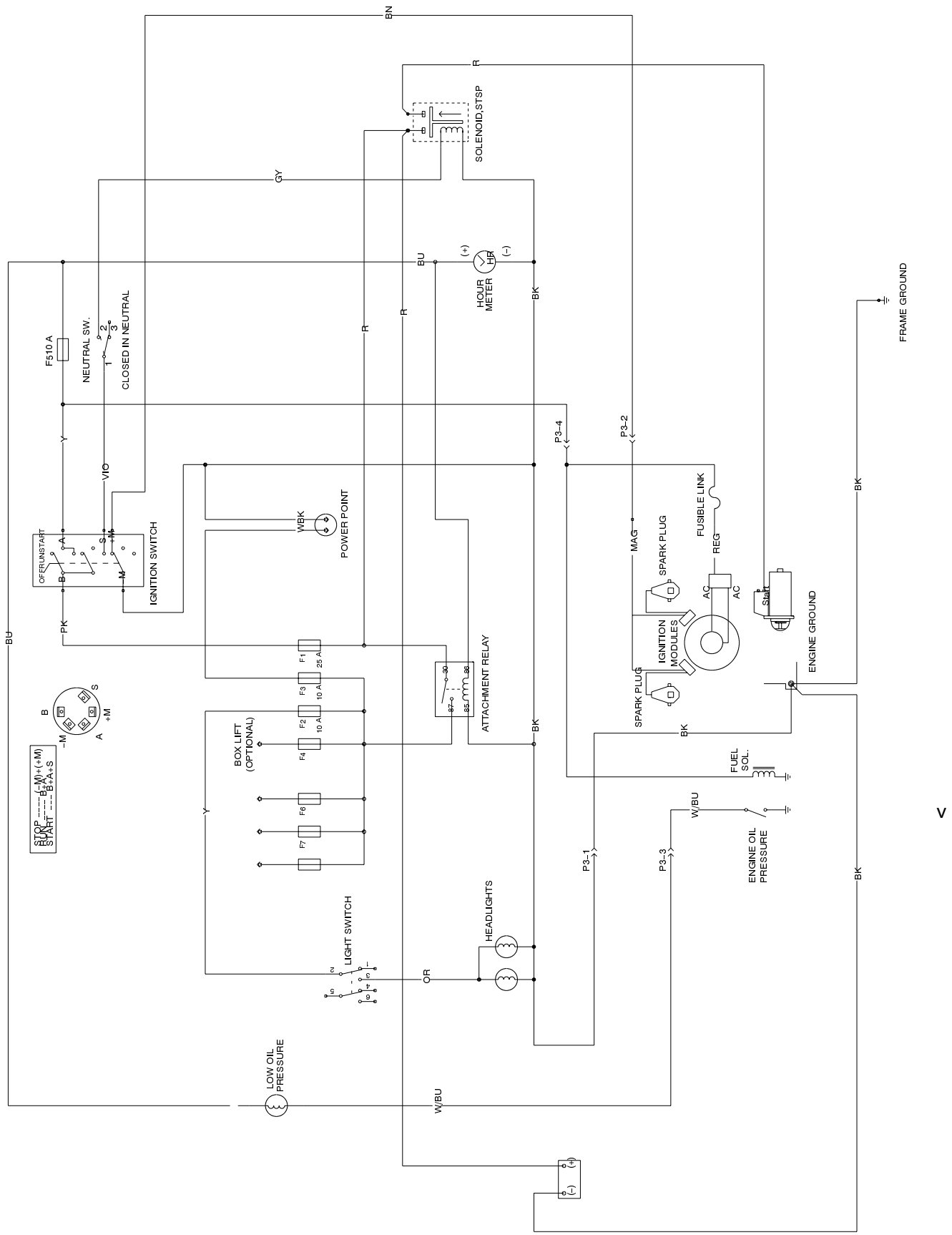
5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

Battery Storage

If the vehicle will be stored for more than 30 days, remove the battery and charge it fully. Either store it on the shelf or on the vehicle. Leave the cables disconnected if it is stored on the vehicle. Store the battery in a cool atmosphere to avoid quick deterioration of the charge in the battery. To prevent the battery from freezing, make sure it is fully charged.

Electrical Schematic



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Chapter 6

Chassis, Wheels, and Brakes

Table of Contents

Specifications

Item	Description
Twister 1400 front tire (20 x 10 - 8, 4 ply) pressure	6 to 12 PSI (0.41 to 0.83 bar)
Twister 1400 rear tire (22.5 x 10 - 8, 4 ply) pressure	8 to 22 PSI (0.55 to 1.52 bar)
Twister 1600 front tire (22 x 9.5 - 10, 4 ply) pressure	8 to 22 PSI (0.55 to 1.52 bar)
Twister 1600 rear tire (24 x 12 - 10, 4 ply) pressure	8 to 22 PSI (0.55 to 1.52 bar)
Front wheel bolt torque	135 to 165 ft-lb (183 to 224 N-m)
Wheel lug nut torque	45 to 65 ft-lb (61 to 88 N-m)

Troubleshooting

Suspension and Steering

Problem	Possible Cause
Front end is noisy.	Front wheel bearings are loose or worn. Front wheel lug nuts are loose. Front end components are loose or worn. Steering gear is loose. Control arm bushings are worn.
Rear end is noisy.	Clutch or transaxle problem (see Chapter 5 – Drive Train). Rear wheel lug nuts are loose.
Excessive steering play.	Front wheel bearings are loose or worn. Front wheel lug nuts are loose. Steering linkage is loose or worn. Tie rod ends are worn. Steering gear is incorrectly adjusted.
Front end shimmies.	Front wheel bearings are loose or worn. Front wheel lug nuts are loose. Steering linkage is loose or worn. Tie rod ends are worn. Front wheel alignment (toe-in) is incorrect. Rubber shock insert in A-arm is worn.
Vehicle is unstable or wanders.	Tire pressure is low or uneven between tires. Front wheel bearings are loose. Wheel lug nuts are loose. Steering column bushings are worn. Rubber shock insert in A-arm is worn. Steering gear is incorrectly adjusted. Front wheel alignment (toe-in) is incorrect.

Suspension and Steering (continued)

Problem	Possible Cause
Steering is hard.	Steering linkage is binding or damaged. Tire pressure is low or uneven between tires. Steering gear is damaged or worn. Front wheel alignment (toe-in) is incorrect.
Vehicle pulls to one side when not braking.	Tire pressure is low or uneven between tires. Front wheel alignment (toe-in) is incorrect. Steering or suspension component may be bent.

Brakes

Problem	Possible Cause
Brake pedal goes to the floor.	Brakes are incorrectly adjusted (Twister 1400). Brake cable is loose or broken (Twister 1400). Rear brake shoes are excessively worn. Front brake pads are excessively worn (Twister 1600). Brake fluid level low (Twister 1600). Brake fluid leak at hose, caliper, or wheel cylinder (Twister 1600). Brake master cylinder faulty (Twister 1600).
Brake pedal is spongy.	Brake drums are excessively worn or cracked (Twister 1400). Brake shoes are not burnished. Brake cable is loose or broken (Twister 1400). Brakes are incorrectly adjusted (Twister 1400). Air in brake lines (Twister 1600). Ground speed is too fast (see Chapter 5 - Drive Train). Engine has excessive run-on when accelerator pedal is released due to carburetor not fully closing (see Engine Chapter).
Brakes pull to either side.	Tire pressure is incorrect or uneven between tires. Brake linings are contaminated. Front wheel alignment (toe-in) is incorrect. Brake cable is loose or broken (Twister 1400). Brake cable is binding (Twister 1400). Brake shoes are distorted. Tires on same axle are unmatched.

Brakes (continued)

Problem	Possible Cause
Brakes squeal.	Brake lining is glazed or saturated. Shoe-to-shoe spring(s) is (are) weak or broken. Brake shoes are distorted. Anchor plate is bent. Brake drums and shoes are dusty. Brake drums are scored or out-of-round.
Brakes drag.	Parking brake is set. Brakes are incorrectly adjusted (Twister 1400). Shoe-to-shoe spring(s) is (are) weak or broken. Brake pedal is binding. Brake cable is binding (Twister 1400). Brake linings are saturated. Brake drums are bent or out-of-round.
Brake pedal is hard to push.	Incorrect brake lining material. Brake pedal linkage is binding. Brake cable is binding (Twister 1400).
Wheels lock-up when braking.	Brake linings are contaminated. Brake linings are loose or damaged. Wheel or transaxle bearings are damaged. Shoe-to-shoe springs are weak. Brake drums are grooved in the contact face with brake shoes.
Brakes fade.	Brake drums are overheated. Brake linings are saturated.
Vehicle surges at slow speeds and chatters at fast speeds.	Brake drums are bent or out-of-round.
Brakes do not self adjust.	Adjuster bolt is seized (Twister 1400). Adjuster lever does not engage star wheel (Twister 1400).

Adjustments

Adjust Brakes (Twister 1400)

CAUTION

Before and after adjusting the brakes, always check the brakes in a wide open area that is flat and free of other persons and obstructions.

1. While driving the machine, depress brake pedal. Both wheels should lock equally.

2. Park machine on a level surface. Make sure engine is off. Remove key from ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

3. Jack front of the vehicle off the ground.

4. Tighten cable adjusting screw, located beneath the floor panel, until the cables are snug in the brake equalizer. Do not overtighten. There should be some free play in the brake pedal before the brake engages. The actuator levers on the brakes should fully return when the brake pedal is released.

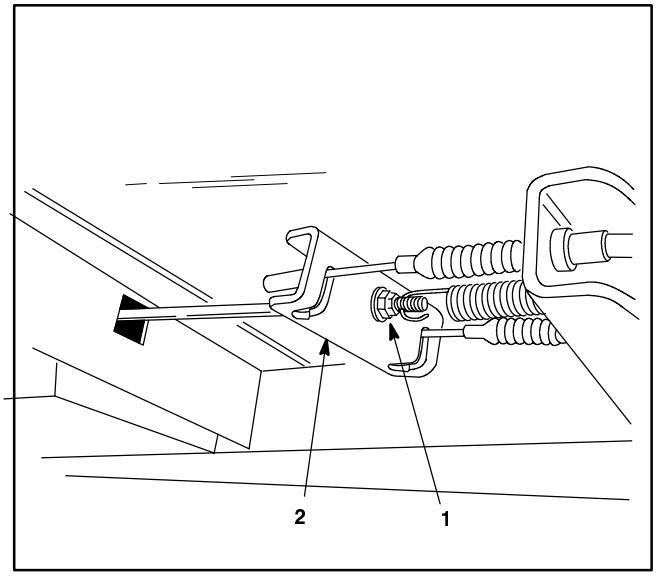

Figure 1

1. Cable adjusting screw
2. Brake equalizer

Adjust Parking Brake (Twister 1600)

1. Pry the rubber cover off of the parking brake.

2. Loosen the set screw securing the knob to the parking brake lever (Fig. 2).

3. Rotate the knob until a force of 30–35 lb. (133–156 N) is required to actuate the lever.

4. Tighten the set screw and install the rubber cover.

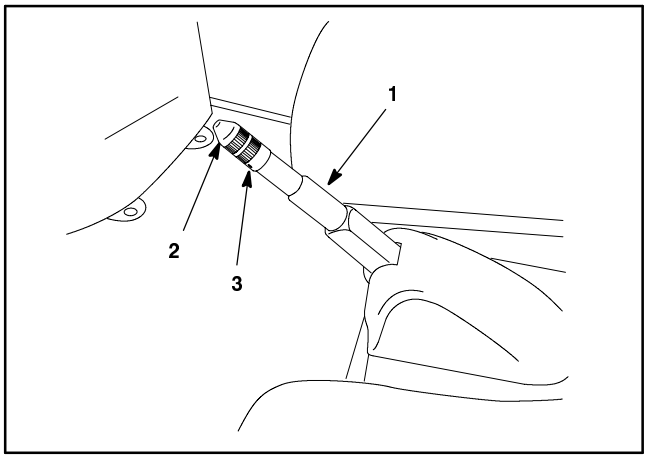

Figure 2

1. Parking brake lever
2. Brake knob
3. Set screw

Check Front Ride Height

1. Adjust tire pressures to 12 psi before checking front ride height.

2. With a 175 to 225 lb (79 to 102 kg) operator in the driver's seat, drive vehicle back and forth a few times on a level surface to relax suspension.

3. Stop vehicle. With operator still in driver's seat and wheels pointed straight ahead, measure the front ride height. The front ride height is the distance from the bottom of the front towing tongue to the ground. Front ride height should be from 8-3/4 to 9-1/2 inches (22.2 to 24.1 cm).

4. If the ride height is incorrect, adjustment needs to be made (see Adjust Front Ride Height).

Figure 3

1. Front towing tongue

Adjust Front Ride Height

1. If front ride height adjustment is needed, park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

2. Jack front end of the vehicle off the ground.

3. Remove travel limiting bolt (Fig. 4).

4. Loosen centering bolts (front and rear) in the A-arm (Fig. 4).

5. Remove ride height adjustment bolt (Fig. 5).

NOTE: The A-arms suspension inserts are made with rubber and have different spring rates. Because of the different spring rates, the A-arms come adjusted from the factory based on that spring rate. Generally, the ride height adjustment bolts will be installed in hole number 2, 3, or 4 (Fig. 6) and it may be different from the left side (driver side) to the right side (passenger side). If the A-arms look like they are sagging, then they should be adjusted to the next higher number (Fig. 6). Each hole equals about 3/4 inch (19 mm) of adjustment at the wheel. Ride height should be adjusted to the next higher position when adding heavy attachments or carrying heavy loads often.

6. Rotate A-arm to the desired position and replace ride height adjustment bolt.

7. Tighten and torque ride height adjustment bolt from 135 to 165 ft-lb (183 to 224 N-m).

NOTE: To reinstall the travel limiting bolt, it may be necessary to lower the machine to the ground.

8. Replace travel limiting bolt (Fig. 4 and 5).

9. Tighten and torque centering bolts from 240 to 290 ft-lb (325 to 393 N-m).

10. Repeat procedure on opposite side of the vehicle.

11. Recheck front ride height.

12. After front ride height is adjusted, check and adjust front wheel toe-in (see Adjust Front Wheel Toe-in).

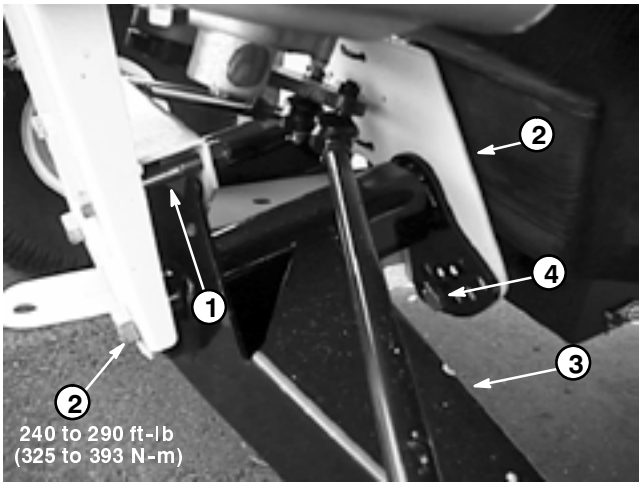

Figure 4

1. Travel limiting bolt
2. Centering bolt
3. A-arm
4. Ride height adj. bolt

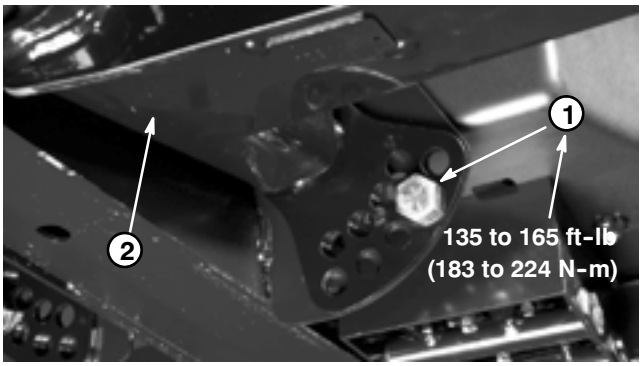

Figure 5

1. Ride height adj. bolt
2. A-arm

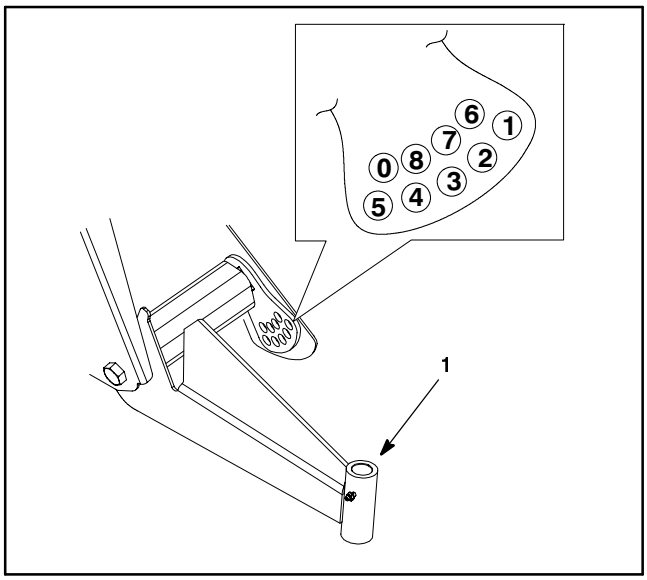

Figure 6

1. Front A-arm (LH shown)

Adjust Front Wheel Toe-in

Note: Adjust front wheel ride height before checking or adjusting front wheel toe-in.

1. Adjust tire pressures to 12 psi before checking front wheel toe-in.

2. With a 175 to 225 lb (79 to 102 kg) operator in the driver's seat, drive vehicle back and forth a few times on a level surface to relax suspension.

3. Stop vehicle. With operator still in driver's seat and wheels pointed straight ahead, measure the front wheel toe-in.

4. Measure distance between the front tires at axle height at both the front and rear of the tires. To obtain an accurate measurement at axle height, a universal alignment gauge (or equivalent) should be used (Fig. 7). Front wheel toe-in should be 1/8 to 5/8 inch (3 to 16 mm).

NOTE: If the vehicle will be run with medium to heavy loads most of the time, adjust the toe-in toward the maximum specification. Conversely, if light loads are carried, adjust toe-in toward the minimum specification.

5. If the front wheel toe-in is incorrect, adjust as follows:

   A. Loosen jam nuts at both ends of tie rods (Fig. 8).

   B. Rotate both tie rods to move front of tire inward or outward.

   C. Tighten tie rod jam nuts when toe-in adjustment is correct.

6. Ensure that there is full steering travel in both directions.

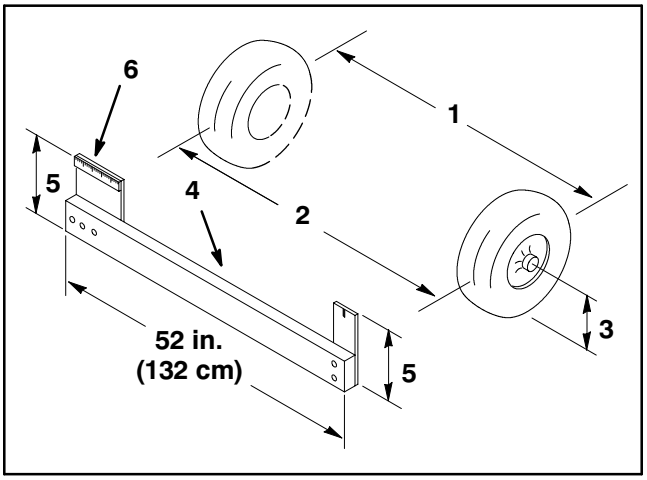

Figure 7

1. Tire center line (back)
2. Tire center line (front)
3. Axle center line
4. Alignment gauge
5. Axle center line height
6. Ruler

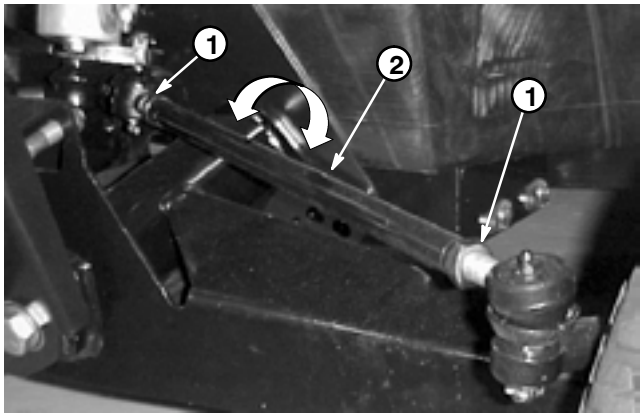

Figure 8

1. Jam nut
2. Tie rod

Check Tire Pressure

See Specifications for tire pressure range for front and rear tires.

The air pressure needed is determined by the payload carried. The **lower** the air pressure, the less the compaction and tire marks are minimized. Lower pressure should not be used for heavy payloads at high speeds.

Higher pressures should be used for heavier payloads at higher speeds. Do not exceed the maximum tire pressure.

Inspect Tires and Wheels

Operating accidents, such as hitting curbs, can damage a tire or rim and also disrupt wheel alignment, so inspect tire condition after an accident.

Check wheels to ensure they are mounted securely. Torque wheel lug nuts to 45 to 65 ft-lb (61 to 88 N-m). The front wheel bolts on Twister 1400 should be torqued from 135 to 165 ft-lb (183 to 224 N-m).

Upper Steering

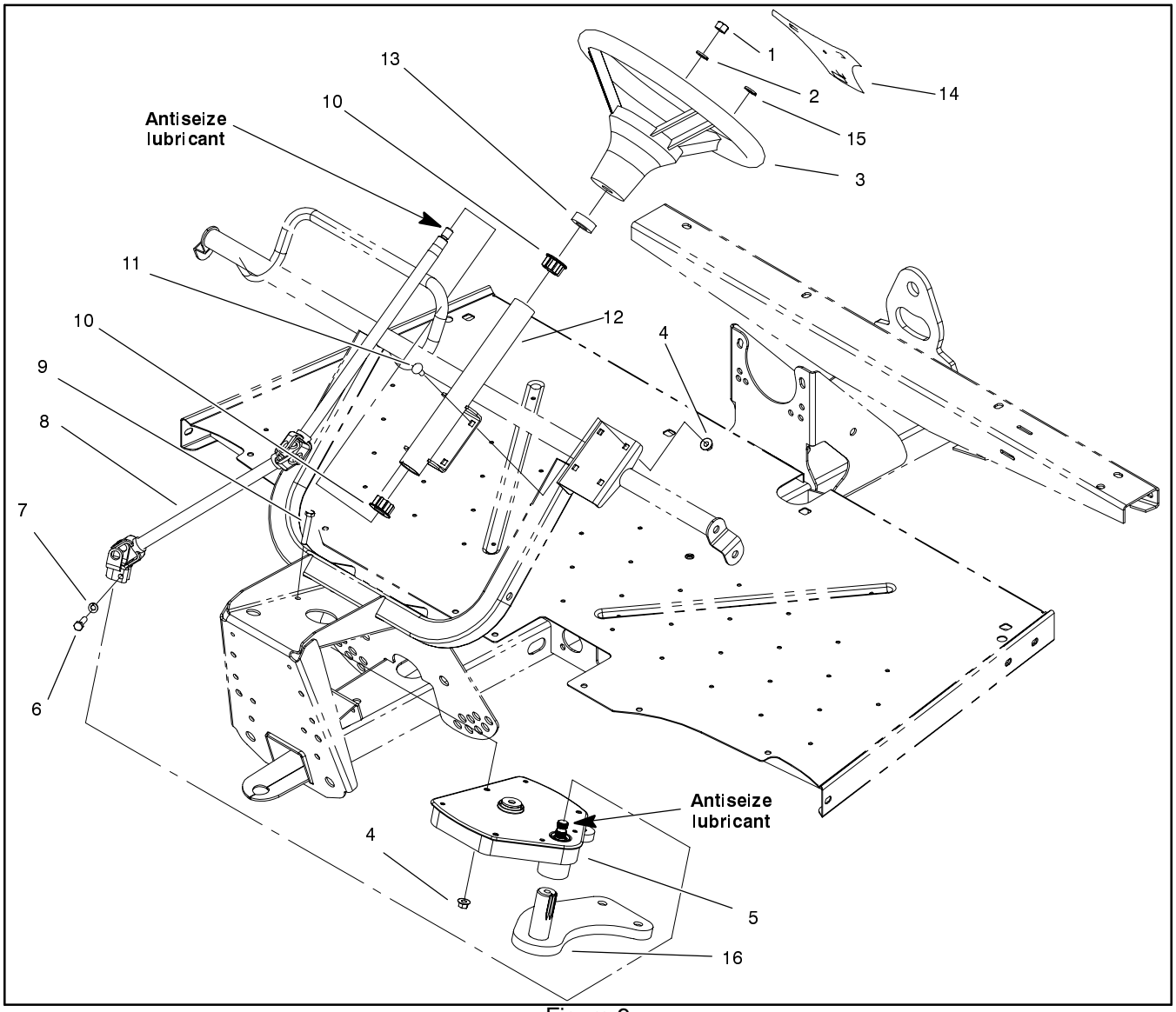

Figure 9

1. Nut
2. Lock washer
3. Steering wheel
4. Flanged lock nut
5. Steering gearbox
6. Cap screw
7. Washer
8. Steering shaft
9. Cap screw
10. Upper steering bushing
11. Carriage screw
12. Steering column
13. Dust cover
14. Steering wheel cover
15. Decal
16. Pitman arm

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove front hood to gain access to the steering mechanism (see Front Hood Removal).

3. Remove steering wheel cover carefully from the steering wheel. Remove nut and lock washer securing the steering wheel to the steering shaft. Pull wheel from the shaft.

4. Remove cap screw and lock washer securing the lower steering shaft knuckle to the steering gearbox shaft. Pull knuckle from the gearbox shaft.

5. Remove four flange lock nuts and carriage screws securing the steering column to the mounting plate on the frame.

6. Remove dust cover from the steering shaft. Replace cover if damaged. Slide steering shaft out of the steering column.

7. Disconnect both tie rods from the Pitman arm on the steering gearbox (see Lower Steering and Front Wheel Removal).

8. Remove flange lock nuts and cap screws securing the steering gearbox to the tower plate on the front frame. Remove gearbox from the tower plate.

Installation

1. Position steering gearbox to the tower plate of the front frame with the Pitman arm facing down and to the rear. The gearbox shaft must be to the left side of the tower.

2. Secure steering gearbox to the tower plate with four cap screws and flange lock nuts.

3. Insert steering shaft up through the steering column. Place dust cover onto the shaft.

4. Secure steering column to the mounting plate on the frame with four carriage screws and flange lock nuts.

NOTE: Apply antiseize lubricant to the steering gearbox shaft before installing to steering shaft knuckle.

5. Position knuckle of the lower steering shaft onto the gearbox shaft. Secure knuckle to the steering gearbox shaft with cap screw and lock washer.

6. Connect both tie rods to the Pitman arm on the steering gearbox (see Lower Steering and Front Wheel Installation).

NOTE: Apply antiseize lubricant to the steering shaft taper before installing the steering wheel.

7. Position front tires straight ahead. Position steering wheel to the steering shaft so that the leg of the "Y" formed by the wheel struts is directed towards the operator platform.

8. Secure steering wheel to shaft with lock washer and nut. Install steering wheel cover to wheel.

9. Install front hood to the frame and fenders (see Front Hood Installation).

10. Check front wheel alignment (see Adjust Front Wheel Toe-in).

Steering Gearbox

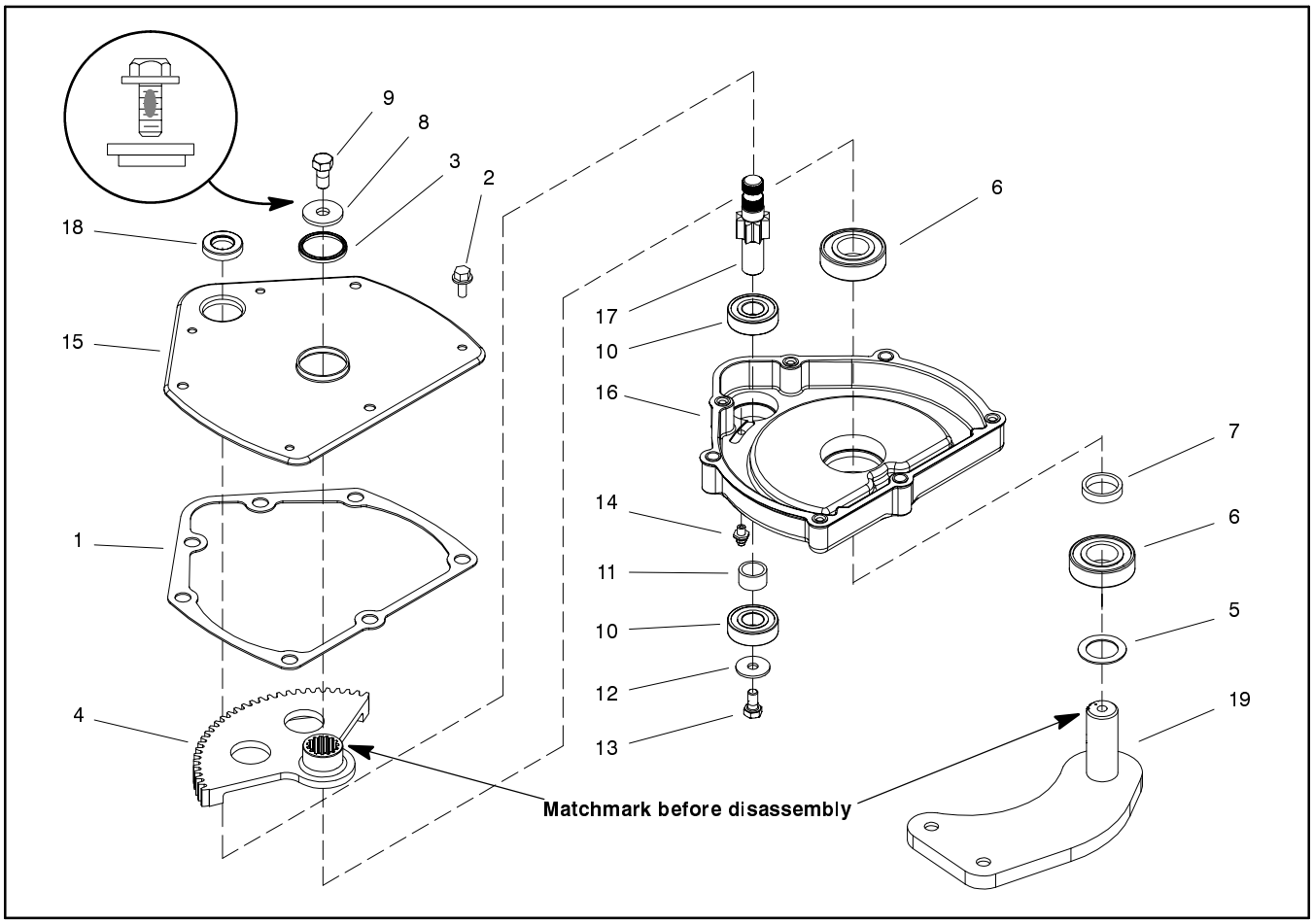

Figure 10

1. Gasket
2. Hex washer head screw
3. Seal
4. Sector gear
5. Flat washer
6. Ball bearing
7. Output shaft spacer
8. Stepped washer
9. Flange head screw with patch lock
10. Ball bearing
11. Input shaft spacer
12. Flat washer
13. Cap screw
14. Lube fitting
15. Steering housing cover
16. Steering housing
17. Pinion gear
18. Oil seal
19. Pitman arm

Disassembly

IMPORTANT: Do not reuse flange head screw with patch lock after it has been removed.

1. Remove flange head screw with patch lock and stepped washer from Pitman arm. Discard flange head screw.

2. Remove cap screw and flat washer from pinion gear shaft.

3. Remove hex washer head screws securing the housing cover and gasket to the steering housing. Remove cover and gasket from the housing. Replace gasket if damaged.

4. Inspect gears. Sector and pinion gear teeth must be free of damage that prevents them of free movement.

5. Remove pinion gear from the housing.

IMPORTANT: Matchmark pitman arm shaft and sector gear. Their position is critical during reassembly.

6. Separate Pitman arm from the sector gear and steering housing and remove from the housing.

7. Inspect bearings. Bearings must spin smoothly and be free of damage. Press bearings and spacer out of housing if necessary.

8. Inspect seals. Seals must be free of rips and tears. Replace seals if necessary.

Assembly

IMPORTANT: Always replace ball bearings as a set.

1. If ball bearings were removed:

   A. Press new bearing into housing from the inside first.

   B. Turn housing over. Insert spacer and press new bearing into housing.

2. If seals were removed, press new seals into housing.

3. Place flat washer onto shaft of the Pitman arm. Insert shaft into steering housing.

IMPORTANT: The position of the Pitman arm and sector gear is critical during reassembly. If either or both of these parts is replaced, make sure their alignment matches the matchmark position of the original gear and arm.

4. Position sector gear onto the spline of the Pitman arm shaft.

IMPORTANT: Make sure sector gear is centered to the pinion gear.

5. Insert pinion gear into the small bearing in the steering housing.

6. Fill steering housing with number 2 general purpose grease. Make sure all gear teeth on the sector and pinion gears are covered.

7. Place gasket and steering housing cover onto the housing. Secure cover to housing with four hex washer head screws.

IMPORTANT: Flange head screw with patch lock should be replaced whenever it is removed.

8. Secure flange head screw with patch lock and step washer to the Pitman arm. Make sure to position step washer as in Figure 10.

9. Secure cap screw and flat washer to the pinion gear shaft.

Lower Steering and Front Wheels (Twister 1400)

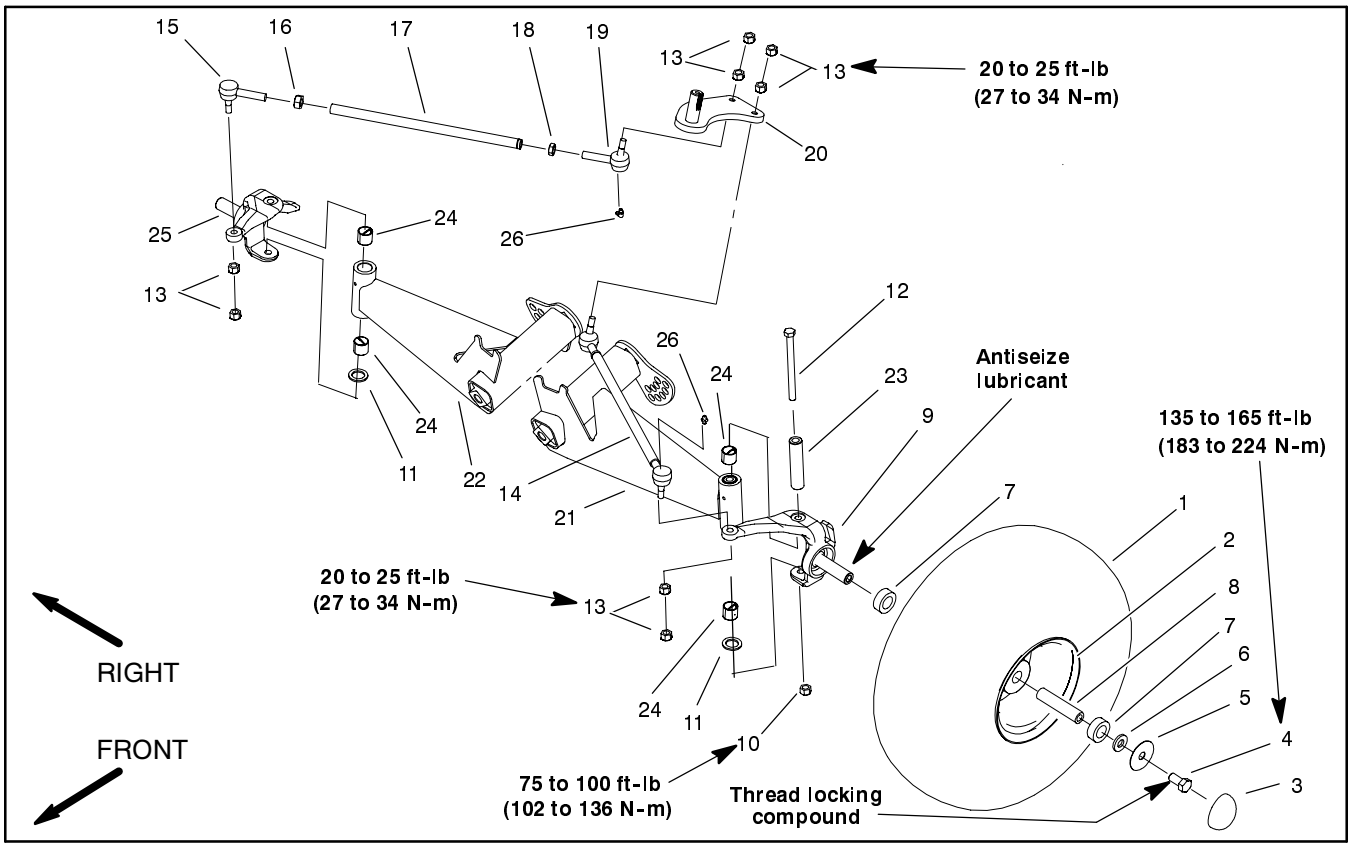

Figure 11

1. Tire
2. Front wheel
3. Plastic dust cap
4. Cap screw
5. Large flat washer
6. Flat washer
7. Bearing
8. Spacer
9. Spindle (LH)
10. Lock nut
11. Thrust washer
12. Cap screw (king pin)
13. Jam nuts
14. Tie rod assembly
15. Ball joint (RH thread)
16. Jam nut (RH thread)
17. Tie rod
18. Jam nut (LH thread)
19. Ball joint (LH thread)
20. Pitman arm
21. A-arm (LH)
22. A-arm (RH)
23. Kingpin sleeve
24. Bushing
25. Spindle (RH)
26. Grease fitting

NOTE: Both front wheels (2) have two bearings (7) and one spacer (8).

NOTE: Both tie rod assemblies (14) consist of the following parts: ball joints (15 and 19), jam nuts (16 and 18), and tie rod (17).

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground, and place blocks beneath the frame.

3. Remove tire and front wheel as follows:

   A. Remove plastic dust cap carefully from the wheel to prevent damage to the cap.

   B. Remove cap screw and washers securing the wheel to the spindle. Slide tire and wheel assembly from the spindle shaft.

4. Remove spindle as follows:

   A. Remove jam nuts securing tie rod ball joint to the spindle. Separate ball joint from the spindle. Remove tie rod from Pitman arm if necessary.

   B. Remove lock nut and cap screw (king pin) securing the spindle to the A-arm. Separate spindle from the A-arm.

Installation

1. Install spindle as follows:

   A. Position king pin sleeve into the pivot hub of the A-arm. Spacer must extend through the bottom of the hub.

   B. Place thrust washer onto the bottom of the king pin sleeve. Then position spindle over the hub, king pin sleeve, and thrust washer.

NOTE: Make sure cap screw (king pin) is inserted down through the spindle and A-arm hub.

   C. Secure spindle to A-arm hub with cap screw (king pin) and lock nut. Torque fasteners from 75 to 100 ft-lb (102 to 136 N-m).

   D. Insert tie rod ball joints down through the spindle and up through the Pitman arm. Secure with jam nuts.

   E. Torque first jam nut from 20 to 25 ft-lb (27 to 34 N-m) to secure ball joint to spindle and Pitman arm. Then torque second jam nut to the same value.

2. Install tire and front wheel as follows:

   A. Place antiseize lubricant on spindle shaft.

   B. Slide tire and wheel assembly onto the shaft with the valve stem facing out.

NOTE: Apply thread locking compound to the threads of the cap screw.

   C. Place large washer and then small washer onto the cap screw. Thread cap screw with washers into the spindle shaft.

   D. Torque cap screw from 135 to 165 ft-lb (183 to 224 N-m).

3. Lower machine to ground.

4. Align steering and toe-in (see Adjust Front Wheel Toe-in).

5. Lubricate tie rod ball joints and king pin (see Lubrication in Chapter 2 - Product Records and Maintenance).

Lower Steering and Front Wheels (Twister 1600)

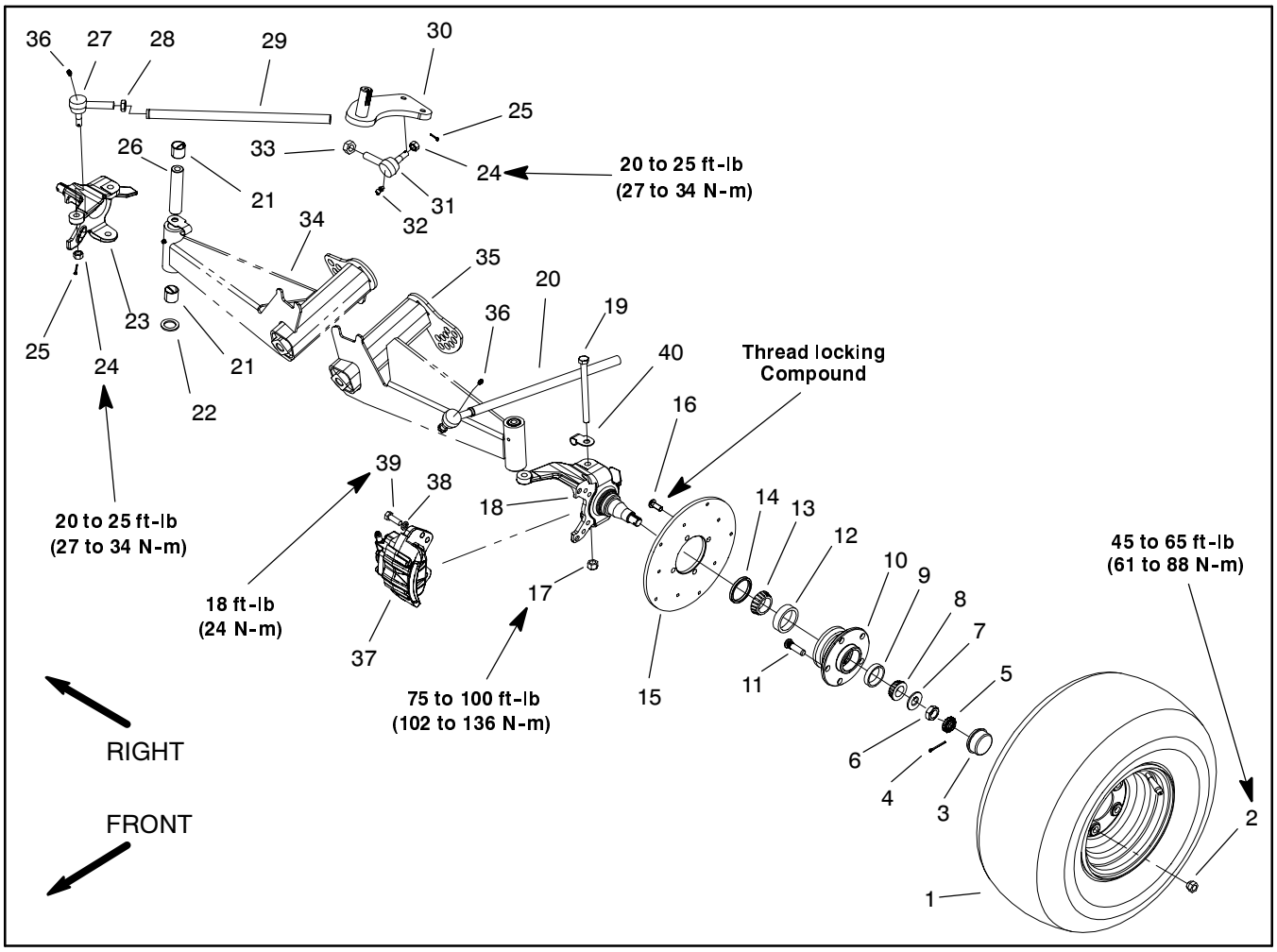

Figure 12

1. Wheel assembly
2. Lug nut
3. Dust cap
4. Cotter pin
5. Nut retainer
6. Jam nut
7. Tab washer
8. Bearing cone
9. Bearing cup
10. Wheel hub
11. Wheel stud
12. Bearing cup
13. Bearing cone
14. Seal
15. Brake rotor
16. Socket head screw
17. Lock nut
18. LH spindle
19. Cap screw
20. Tie rod assembly
21. Bushing
22. Thrust washer
23. RH spindle
24. Castle nut
25. Cotter pin
26. Kingpin sleeve
27. Ball joint (RH thread)
28. Jam nut (RH thread)
29. Tie rod tube
30. Pitman arm
31. Ball joint (LH thread)
32. Grease fitting
33. Jam nut (LH thread)
34. A-arm (RH)
35. A-arm (LH)
36. Grease fitting
37. Brake caliper (LH shown)
38. Lock washer
39. Cap screw
40. Brake hose bracket

NOTE: Both tie rod assemblies (20) consist of the following parts: ball joints (27 and 31), jam nuts (28 and 33), tie rod tube (29) and grease fittings (32 and 36).

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.

3. Remove lug nuts and pull wheel assembly from machine.

4. Remove brake caliper from spindle (see Front Brake Caliper). Position caliper away from wheel hub and spindle.

5. Carefully pry dust cap from wheel hub.

6. Remove cotter pin and nut retainer from spindle.

7. Remove jam nut that secures wheel hub to spindle. Slide wheel hub with bearings and rotor from spindle.

8. Disassemble the wheel hub:

   A. Pull the seal out of the wheel hub.

   B. Remove bearings from both sides of the wheel hub. Clean bearings in solvent. Make sure bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting, or other noticeable damage. Replace worn or damaged parts.

   C. If necessary, remove four socket head screws and brake rotor from wheel hub.

9. Remove spindle:

   A. Remove cotter pin and castle nut securing tie rod ball joint to the spindle. Separate ball joint from the spindle. Remove tie rod from Pitman arm if necessary.

   B. Remove lock nut and cap screw (19) securing the spindle to the A-arm. Separate spindle from A-arm.

   C. Locate and remove thrust washer from bottom of kingpin sleeve in A-arm and brake hose bracket from top of A-arm. Remove kingpin sleeve from A-arm if necessary.

Installation

1. Install spindle as follows:

   A. Position king pin sleeve into the pivot hub of the A-arm. Sleeve must extend through the bottom of the hub.

   B. Place thrust washer onto the bottom of the king pin sleeve. Then position spindle over the hub, king pin sleeve, and thrust washer.

NOTE: Make sure cap screw (19) is inserted down through the spindle and A-arm hub.

   C. Install brake hose bracket onto cap screw (19).Secure spindle to A-arm hub with cap screw (19) and lock nut. Torque fasteners from 75 to 100 ft-lb (102 to 136 N-m).

   D. Insert tie rod ball joints down through the spindle and up through the Pitman arm. Secure with castle nuts.

   E. Torque castle nuts from 20 to 25 ft-lb (27 to 34 N-m) to secure ball joint while aligning castle nut slot with hole in ball joint stud. If necessary to align holes, castle nut torque may be slightly more than specification. Install cotter pin.

2. Assemble wheel hub:

   A. If bearing cups were removed from the wheel hub, press inner and outer cups into the hub until they seat against the hub shoulder.

   B. Pack both bearings with grease. Install inner bearing into the cup on inboard side of the wheel hub.

IMPORTANT: The lip seal must be pressed in so it is flush with the end of the hub. The lip of the seal must be toward the bearing.

   C. Lubricate the inside of the new lip seal and press it into the wheel hub.

   D. If brake rotor was removed, apply thread locking compound to socket head screws and install rotor to hub.

3. Slide wheel hub assembly onto spindle. Install outer bearing, tab washer, and jam nut onto spindle.

4. Rotate the wheel by hand and tighten the jam nut from 75 to 100 in-lb (8.5 to 11.3 N-m) to set the bearings. Then, loosen the nut until the hub has end play.

5. Rotate the wheel by hand and re-tighten the jam nut from 15 to 20 in-lb (1.7 to 2.3 N-m).

6. Position nut retainer over jam nut and install cotter pin through spindle shaft hole. Install dust cap to hub.

7. Install brake caliper to spindle (see Front Brake Caliper).

8. Install wheel assembly with valve stem facing out. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m).

9. Lower machine to ground.

10. Align steering and toe-in (see Adjust Front Wheel Toe-in).

11. Lubricate tie rod ball joints and king pin (see Lubrication in Chapter 2 - Product Records and Maintenance).

A-arm and Frame Pivot Yoke

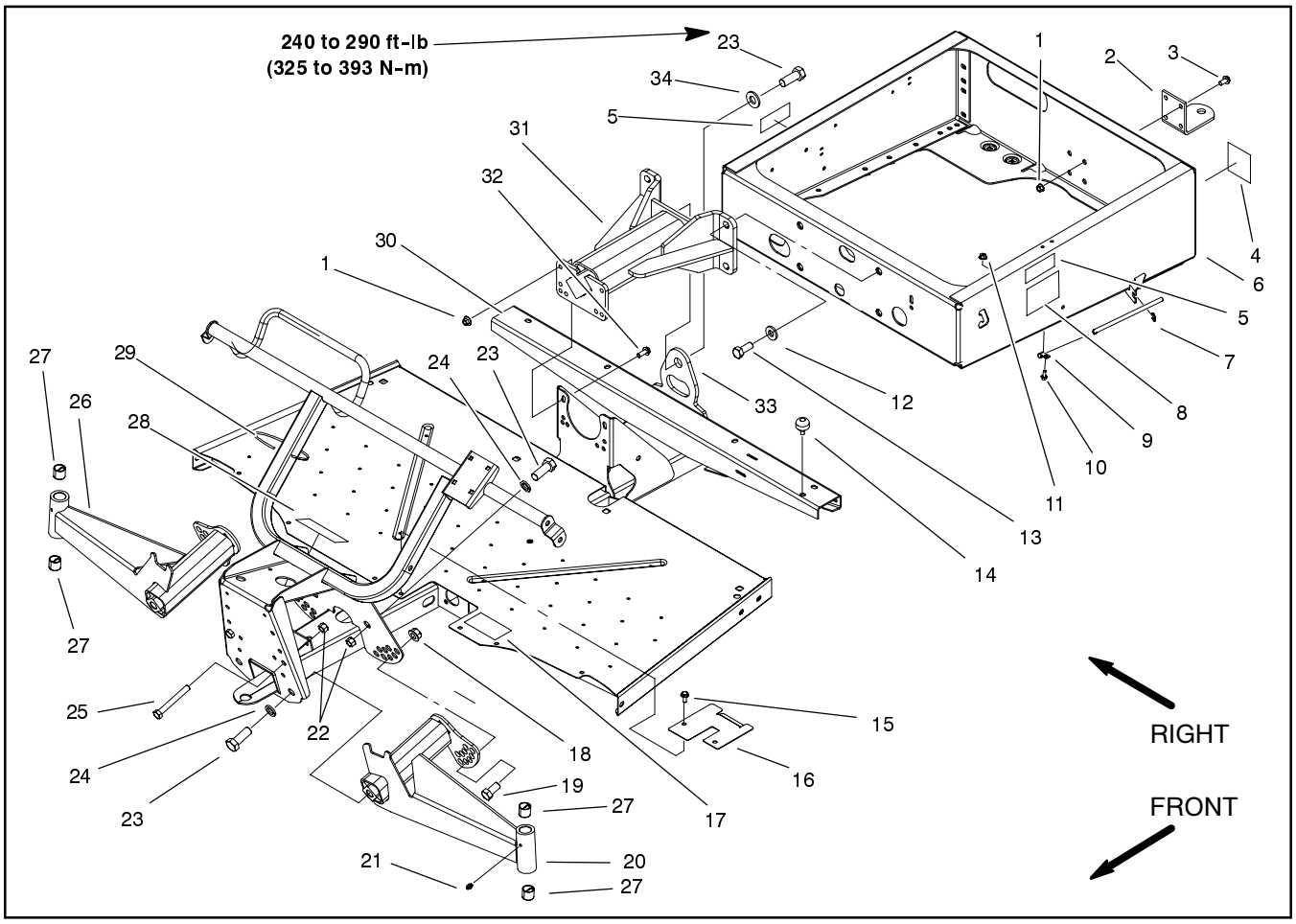

Figure 13

1. Flange lock nut
2. Light duty hitch
3. Flange head screw
4. Decal
5. Decal
6. Rear frame
7. Retaining ring
8. Decal
9. R-clamp
10. Flange head screw
11. Flange nut
12. Flat washer
13. Cap screw
14. Rubber bumper
15. Flange head screw
16. Pedal cover
17. Decal
18. Flange nut
19. Ride height adjustment bolt
20. A-arm (LH)
21. Grease fitting
22. Lock nut
23. Cap screw
24. Lock washer
25. Travel limiting bolt
26. A-arm (RH)
27. Bushing
28. Decal
29. Cable tie
30. Front frame
31. Pivot yoke
32. Flange head screw
33. Front frame tab
34. Hardened washer

A-arm Removal (Fig. 13 and 14)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.

3. Remove front wheel and spindle from A-arm (see Lower Steering and Front Wheel Removal).

4. Remove lock nut (22) and travel limiting bolt (25) from the frame.

NOTE: To aid reassembly, note hole location of ride height adjustment bolt in A-arm.

5. Remove flanged nut (18) and ride height adjustment bolt (19) from the adjustment pattern of the A-arm and frame.

6. Remove both cap screws (23) and lock washers (24) securing the A-arm to the the frame. Lower A-arm from the frame.

A-arm Installation (Fig. 13 and 14)

1. Position A-arm to the frame. Secure A-arm to the frame with cap screws (23) and lock washers (24). Do not tighten cap screws.

2. Install spindle and front wheel to the A-arm (see Lower Steering and Front Wheel Installation).

NOTE: If A-arm is being replaced, look for number between 200 and 400 written next to the serial tag on the bottom of the replacement A-arm. This number should be used to identify the location of the ride height adjustment bolt (Fig. 15):

Number from 200 to 220 use hole 4.
Number from 225 to 285 use hole 3.
Number from 290 to 400 use hole 2.

3. Lower machine to ground.

4. Adjust front ride height (see Adjust Front Ride Height).

5. Align front wheel toe-in (see Adjust Front Wheel Toe-in).

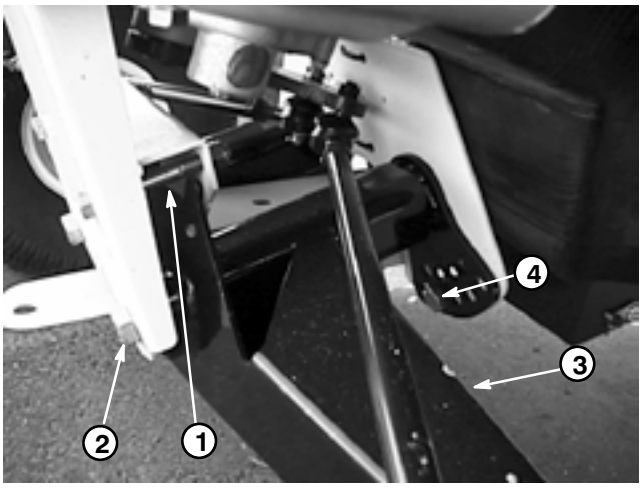

Figure 14

1. Travel limiting bolt
2. Centering bolt
3. A-arm
4. Ride hgt. adj. bolt

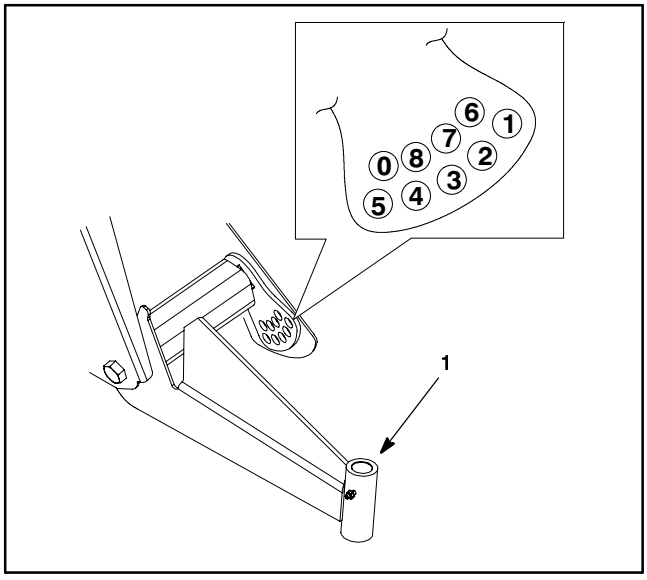

Figure 15

1. Front A-arm (LH shown)

Pivot Yoke Removal (Fig. 13 and 16)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove cargo bed from the rear frame (see Cargo Bed and Tailgate Removal).

3. Remove seat base from the front frame (see Seat Base Removal in Engine Chapter).

WARNING

Make sure all tires are chocked to prevent the machine from moving. Before removing the pivot yoke, make sure front and rear frames are supported with jack stands. Support both the front and back of each frame.

4. Remove four cap screws and flat washers securing the pivot yoke to the rear frame.

5. Remove cap screw and hardened washer securing the pivot yoke to the front frame tab.

WARNING

Support pivot yoke while removing it from the front frame to prevent dropping and causing serious injury and damage to the machine.

6. Remove four flange head screws and flanged lock nuts securing the pivot yoke to the front frame. Remove pivot yoke from the machine.

Pivot Yoke Installation (Fig. 13 and 16)

WARNING

Support pivot yoke while installing it to the front frame to prevent dropping and causing serious injury and damage to the machine.

1. Position pivot yoke to the front frame so the diamond pattern faces up. Secure yoke to front frame with four flange head screws and flanged lock nuts. Tighten lower two fasteners first, then tighten upper two fasteners.

2. Secure pivot yoke to the front frame tab with cap screw and hardened washer. Torque cap screw from 240 to 290 ft-lb (325 to 393 N-m).

3. Secure pivot yoke to the rear frame with four cap screws and flat washers.

4. Install seat base to the front frame (see Seat Base Installation in Engine Chapter).

5. Install cargo bed to the rear frame (see Cargo Bed and Tailgate Installation).

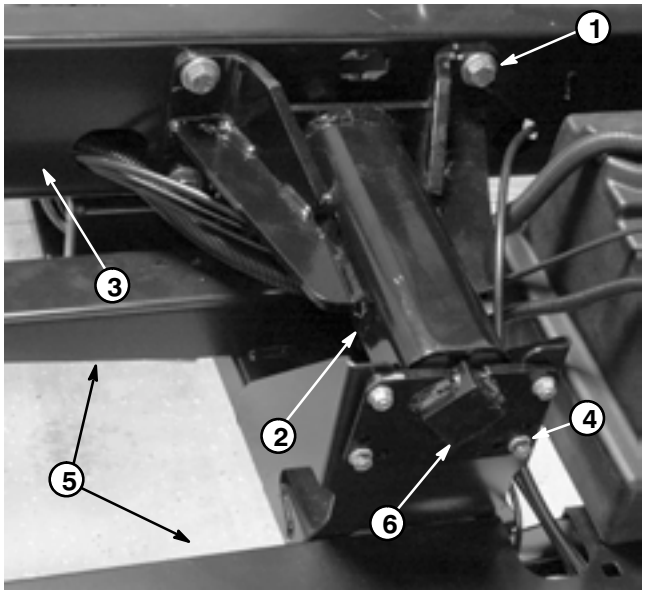

Figure 16

1. Cap screw & flat washer
2. Pivot yoke
3. Rear frame
4. Flange lock nut
5. Front frame
6. Diamond pattern

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Rear Wheels and Brakes (Twister 1400)

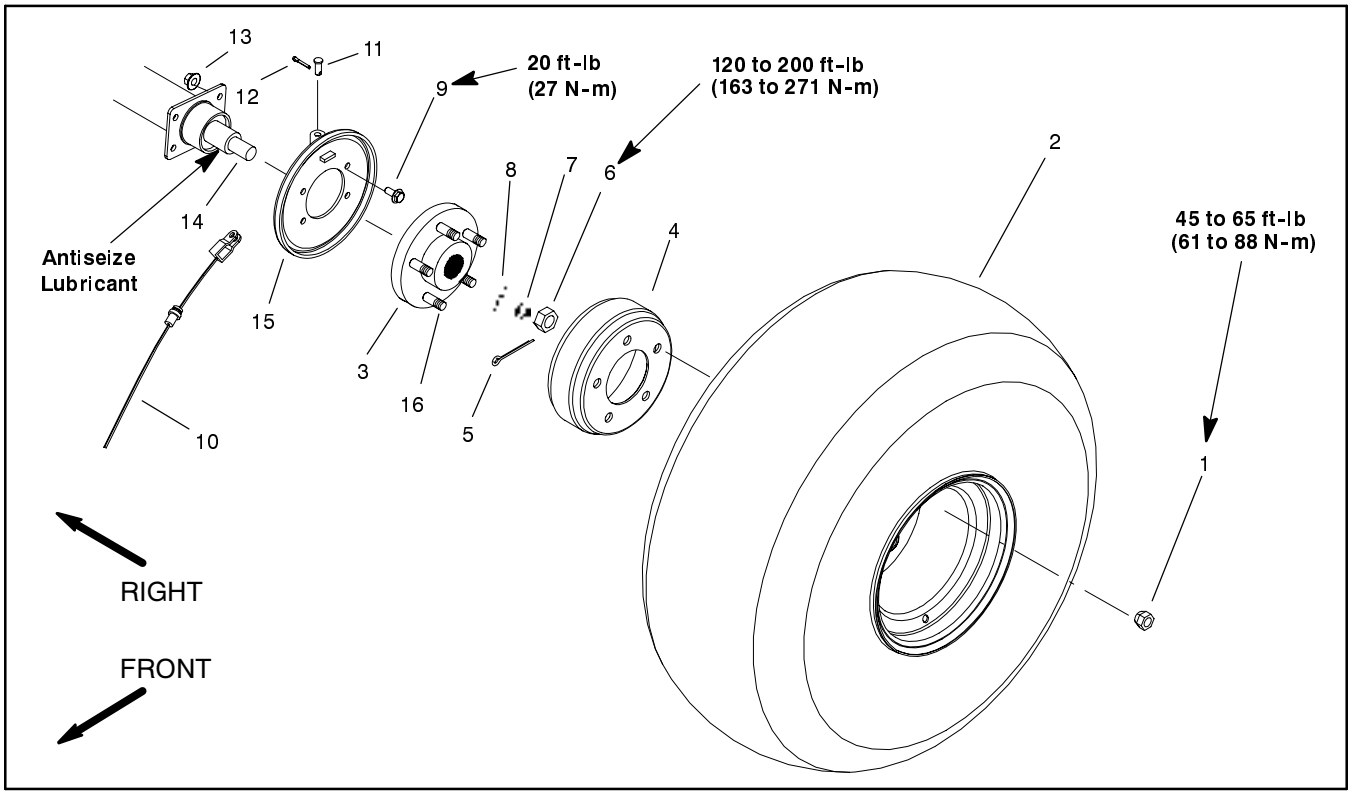

Figure 17

1. Lug nut
2. Wheel assembly
3. Wheel hub
4. Brake drum
5. Cotter pin
6. Castle nut
7. Lock washer
8. Spacer
9. Cap screw
10. Brake cable
11. Clevis pin
12. Cotter pin
13. Flange lock nut
14. Transaxle shaft
15. Brake assembly (LH shown)
16. Wheel stud

Removal (Fig. 17)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

2. Chock wheels not being jacked up. Lift rear wheel off the ground using a jack, and place blocks beneath the frame under the axle tube.

3. Remove five lug nuts, tire and wheel, and brake drum from the wheel hub.

4. Remove cotter pin from the castle nut and transaxle shaft. Remove castle nut, lock washer, and spacer from the shaft. Remove the wheel hub from the shaft.

NOTE: The brake assembly can be removed from the transaxle shaft for disassembly.

5. Remove brake assembly as follows:

   A. Remove cotter pin and clevis pin securing the cable bracket to the actuator lever (Fig. 18).

   B. Remove four cap screws and flanged lock nuts securing the anchor plate of the brake assembly to the transaxle. Remove brake assembly from the transaxle.

Installation (Fig. 17)

IMPORTANT: Brake actuator levers must be positioned above the transaxle mount. When positioned correctly, actuator lever will point toward the rear of the axle (Fig. 18).

1. If brake assembly was removed from axle, position brake assembly to the transaxle. Secure backing plate of the brake assembly to the transaxle with four cap screws and flanged lock nuts. Torque screws to 20 ft-lb (27 N-m).

2. Secure cable bracket to the actuator lever with clevis pin and cotter pin (Fig. 18).

IMPORTANT: Do not get antiseize lubricant onto brake shoes.

3. Apply light coat of antiseize lubricant to the transaxle shaft splines.

4. Secure wheel hub to the shaft with spacer, lock washer, and castle nut.

5. Torque castle nut to the shaft between 120 to 200 ft-lb (163 to 271 N-m) while aligning nut to hole in shaft. Install cotter pin.

6. Slide brake drum onto wheel hub.

7. Position wheel assembly to the machine with valve stem facing out and secure with five lug nuts. Torque lug nuts in a criss-cross pattern from 45 to 65 ft-lb (61 to 88 N-m).

8. Lower machine to ground.

CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

9. Check and adjust brakes (see Brake Adjustment).

Burnish Brake Shoes

Sintered metal linings may not provide maximum brake stopping distance after brake shoes are replaced. It is necessary to burnish new brake shoe linings.

IMPORTANT: Do not drive machine with the brakes applied. The brake shoe linings will overheat.

IMPORTANT: Do not allow the brakes to lock up. Allow brakes to cool between applications.

1. Drive machine while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at 10 to 15 mph (16 to 24 KPH).

2. Make several normal stops with the machine going in the reverse direction. This will self adjust the clearance between the brake shoe and drum.

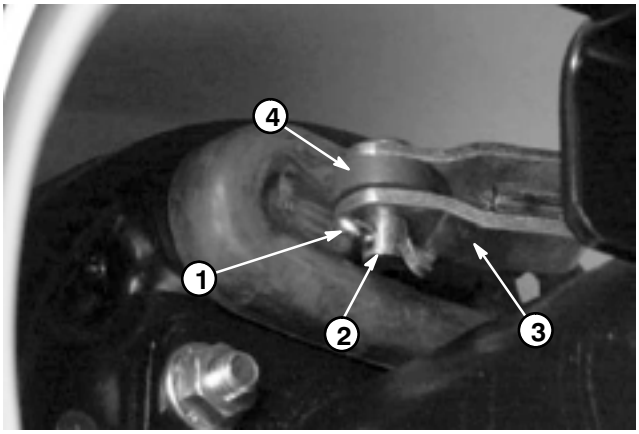

Figure 18

1. Cotter pin
2. Clevis pin
3. Brake cable bracket
4. Actuator lever

Rear Brake Service (Twister 1400)

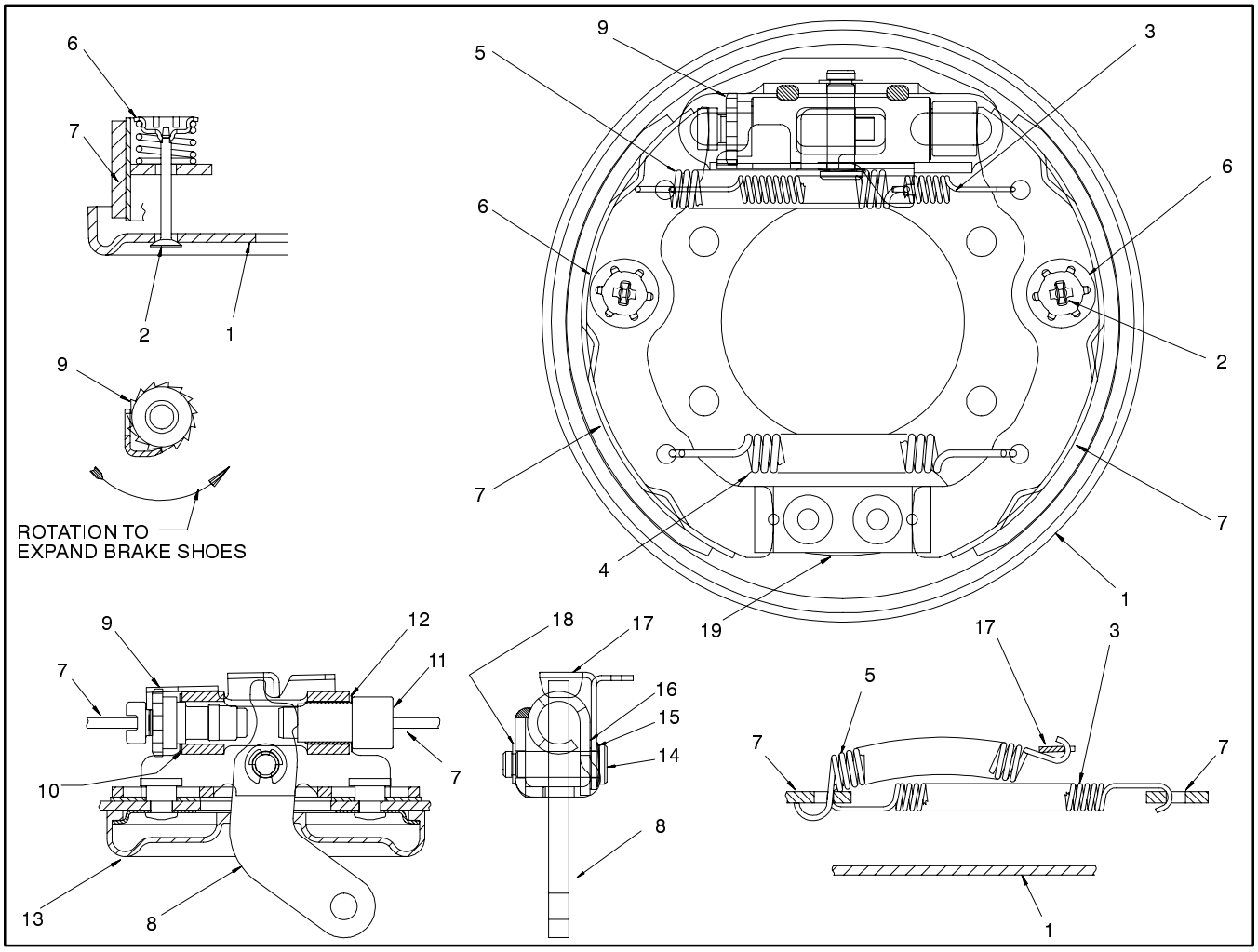

Figure 19

1. Backing plate
2. Hold down pin
3. Top shoe-to-shoe spring
4. Bottom shoe-to-shoe spring
5. Auto adjust spring
6. Shoe cup (spring loaded)
7. Brake shoe
8. Actuator lever
9. Adjusting screw
10. Teflon coated washer
11. Push rod
12. Shim washer
13. Protective boot
14. Pivot pin
15. Wave washer
16. Washer
17. Adjusting lever
18. Retaining clip
19. Anchor abutment

Disassembly (Fig. 19)

1. Remove auto adjust spring and shoe-to-shoe springs from brake shoes.

2. Remove hold down pins and shoe cups securing the brake shoes to the backing plate.

3. Remove brake shoes from backing plate.

Inspection (Fig. 17 and 19)

1. Inspect brake drums.

IMPORTANT: Brake drum machining is not recommended. Replace brake drums as a set to maintain equal braking forces.

A. Clean drums with denatured alcohol. Check braking surface diameter in at least three places. If the diameter exceeds 6.320 inches (16.05 cm), replace both brake drums.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out-of-round, scored, excessively rusted, or heat spotted.

C. Minor scoring can be removed with sandpaper.

2. Inspect brake shoe linings.

IMPORTANT: Replace brake shoes as a set (all four shoes) to maintain equal braking forces.

A. Replace brake shoes if damaged or if lining is worn to 1/16" (1.6 mm). Replace if lining is contaminated by oil, grease, or other fluids.

NOTE: Overheated springs lose their tension, and can cause brake linings to wear out prematurely.

B. Inspect brake shoe webbing, shoe-to-shoe springs, and auto adjust spring for overheating. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

C. Inspect hold down pins and shoe cups for bends, rust, and corrosion. Replace as necessary.

3. Inspect backing plate surfaces, which contact with the brake shoes for grooves that may restrict shoe movement. Replace plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace plate if cracked, warped, or excessively rusted.

4. Inspect anchor abutment and rivets for deformation. Replace entire brake assembly if deformation or excessive rust is found.

5. Replace adjuster screw and shim washers if rusted, corroded, bent, or fatigued.

6. Replace brake cables if frayed, stretched, or kinked.

Assembly (Fig. 19)

IMPORTANT: Brake shoe lining surfaces must be free of grease, oil, and other foreign matter.

1. Apply a light film of lubricant to the following:

A. Surfaces of the shoe web that contact the backing plate, push rod, and adjusting screw.

B. Six ledges on which the brake shoes rest.

C. Entire surfaces of Teflon coated washers.

D. Entire surface of pivot pin.

E. Slot in push rod that contacts actuator lever.

F. Surfaces of adjusting lever that contact wave washer, washer, and pivot pin.

G. Surfaces of the actuator bracket that contact the star wheel of the adjusting screw.

2. Position brake shoes to backing plate. Secure shoes to plate with shoe cups and hold down pins.

3. Secure brake shoes with shoe-to-shoe springs and auto adjust spring.

Rear Wheels and Brakes (Twister 1600)

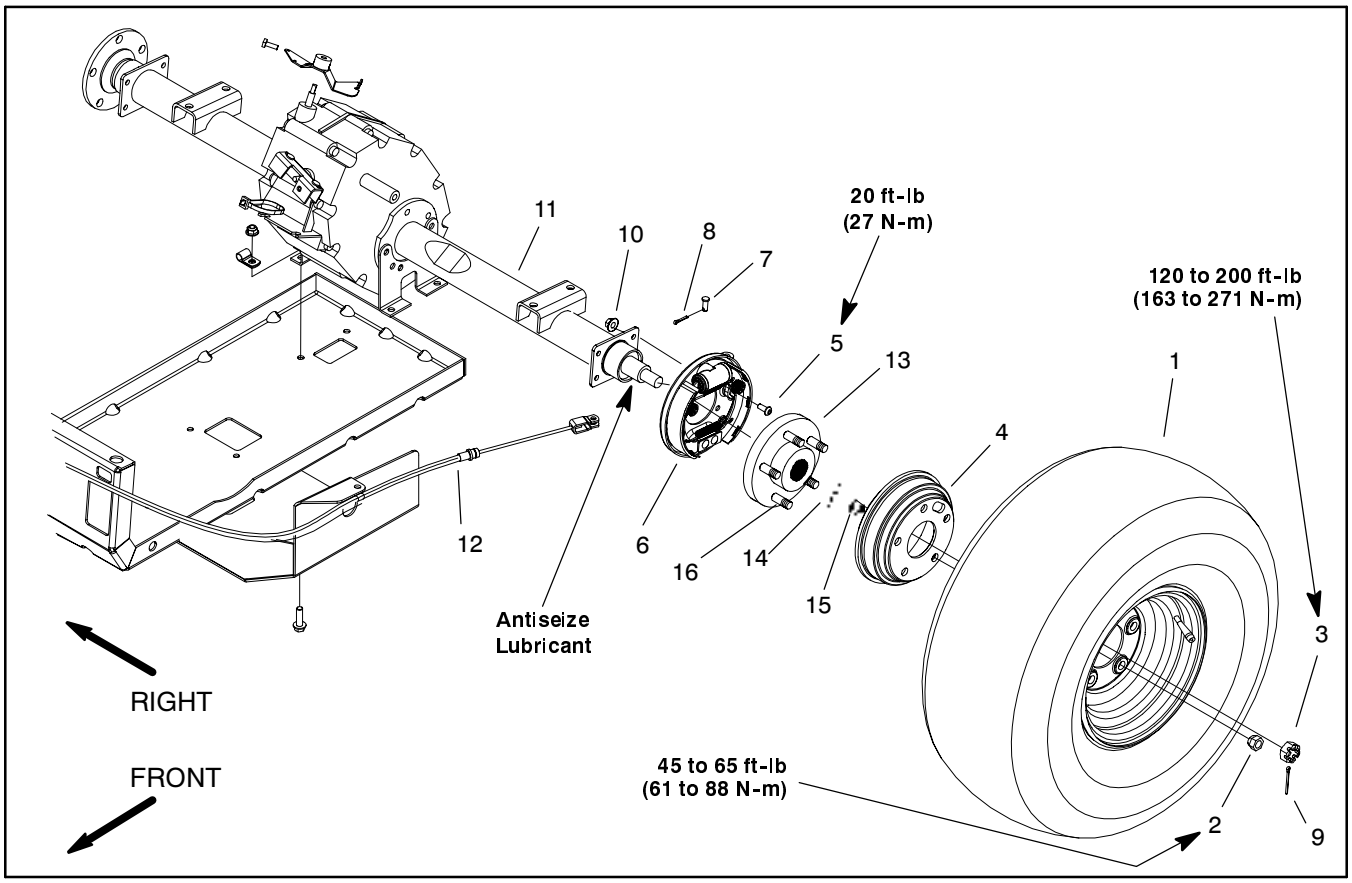

Figure 20

1. Wheel assembly
2. Lug nut
3. Castle nut
4. Brake drum
5. Socket head screw
6. Brake assembly (LH shown)
7. Clevis pin
8. Cotter pin
9. Cotter pin
10. Flange lock nut
11. Transaxle
12. Parking brake cable
13. Wheel hub
14. Washer
15. Spring washer
16. Wheel stud

Removal (Fig. 20)

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Chock wheels not being jacked up. Lift rear wheel off the ground using a jack, and place blocks beneath the frame under the axle tube.

3. Remove five lug nuts, wheel assembly, and brake drum from the wheel hub.

4. Remove cotter pin from the castle nut and transaxle shaft. Remove castle nut, spring washer, and washer from the shaft. Remove the wheel hub from the shaft.

NOTE: The brake assembly can be removed from the transaxle shaft for disassembly.

5. If required, remove brake assembly as follows:

   A. Remove cotter pin and clevis pin securing the parking brake cable to the parking brake lever on the rear of the brake assembly.

   B. Clean hydraulic brake line area of brake assembly to prevent contamination. Loosen and disconnect brake line from wheel cylinder. Plug brake line and position it away from brake assembly.

   C. Remove four socket head screws and flange lock nuts that secure the brake assembly to the transaxle.

   D. Remove brake assembly from the transaxle.

Installation (Fig. 20)

IMPORTANT: Parking brake levers must be positioned above the transaxle mount. When positioned correctly, brake lever will point toward the rear of the axle.

1. Position brake assembly to the transaxle. Secure backing plate of the brake assembly to the transaxle with four socket head screws and flanged lock nuts. Torque screws to 20 ft-lb (27 N-m).

2. Secure parking brake cable to the brake lever with clevis pin and cotter pin.

IMPORTANT: Do not get antiseize lubricant onto brake shoes.

3. Apply light coat of antiseize lubricant to the transaxle shaft splines.

4. Secure wheel hub to the shaft with washer, spring washer, and castle nut.

5. Torque castle nut from 120 to 200 ft-lb (163 to 271 N-m) while aligning nut to hole in transaxle shaft.

6. Secure castle nut to shaft with cotter pin.

7. Slide brake drum onto wheel hub.

8. Position wheel assembly to the machine with valve stem facing out and secure with five lug nuts. Torque lug nuts in a criss-cross pattern from 45 to 65 ft-lb (61 to 88 N-m).

9. Lower machine to ground.

10. Check and adjust parking brake (see Parking Brake Adjustment).

11. Bleed brakes (see Bleed Brake System).

CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

12. Check brake operation.

Burnish Brake Shoes

Sintered metal linings may not provide maximum brake stopping distance after brake shoes are replaced. It is necessary to burnish new brake shoe linings.

IMPORTANT: Do not drive machine with the brakes applied. The brake shoe linings will overheat.

IMPORTANT: Do not allow the brakes to lock up. Allow brakes to cool between applications.

1. Drive machine while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at 10 to 15 mph (16 to 24 KPH).

Rear Brake Service (Twister 1600)

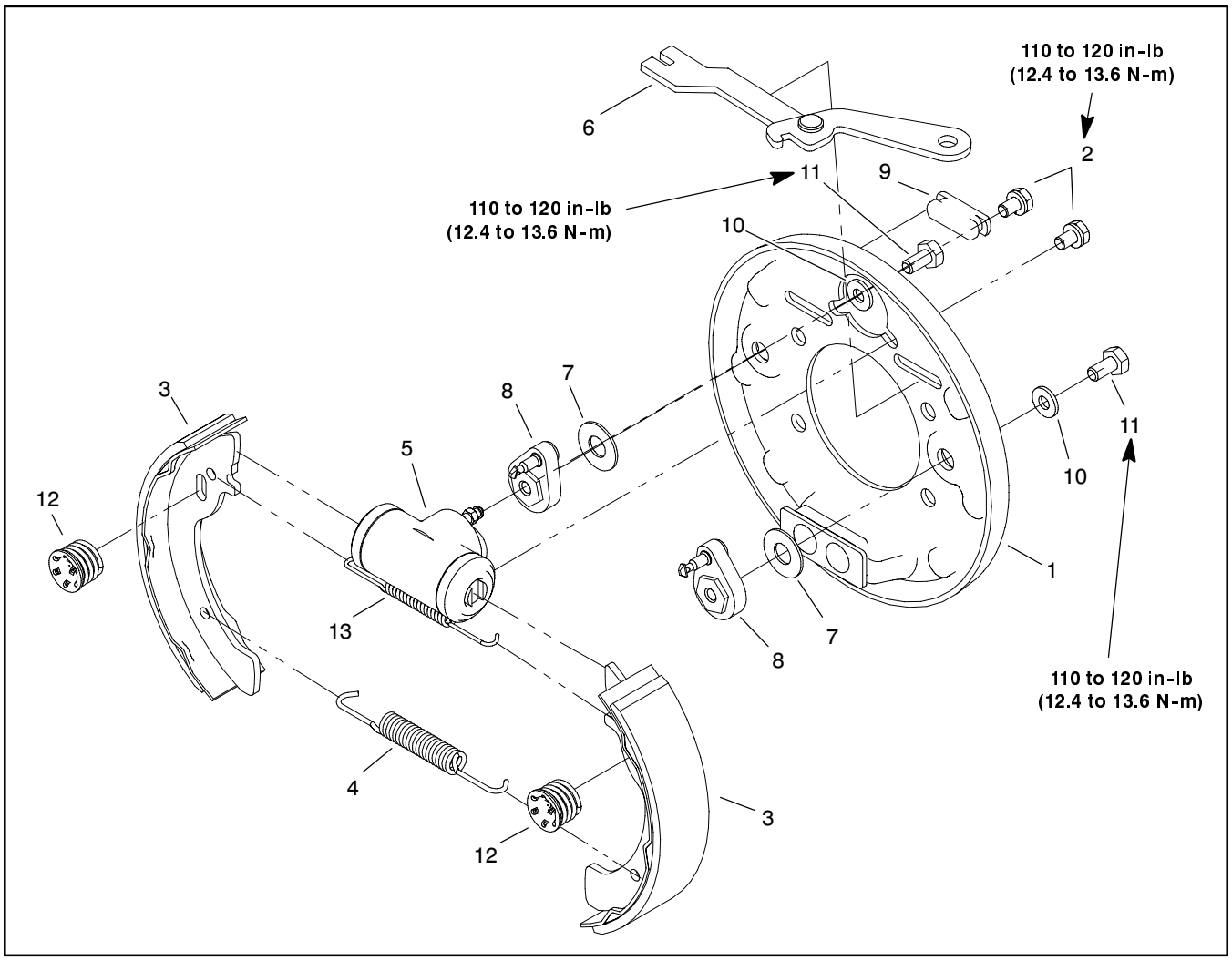

Figure 21

1. Brake backing plate
2. Washer head screw
3. Brake shoe
4. Lower spring
5. Wheel cylinder
6. Parking brake lever (LH shown)
7. Belleville washer
8. Adjuster lever
9. Dust cover
10. Flat washer
11. Bolt
12. Shoe hold down cup and spring
13. Upper spring

Disassembly (Fig. 21)

CAUTION

Be careful when removing springs from brake shoes. The springs are under heavy load and may cause personal injury.

1. Remove upper and lower springs from brake shoes.

2. Remove shoe hold down cups and springs that secure the brake shoes to the backing plate.

3. Remove brake shoes from backing plate.

4. If required, slide parking brake lever from slot and dust cover in backing plate.

5. If necessary, remove two washer head screws that secure wheel cylinder to backing plate. Remove wheel cylinder from backing plate.

6. If necessary, remove bolts and washers to allow adjuster levers to be separated from backing plate. Locate and remove belleville washers from between adjuster levers and backing plate.

Inspection (Fig. 21)

1. Inspect brake drums.

IMPORTANT: Brake drum machining is not recommended. Replace brake drums as a set to maintain equal braking forces.

A. Clean drums with denatured alcohol. Check braking surface diameter in at least three places. If the diameter exceeds 6.320 inches (16.05 cm), replace both brake drums.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out-of-round, scored, heat spotted, or excessively rusted.

C. Minor scoring can be removed with sandpaper.

2. Inspect brake shoe linings.

IMPORTANT: Replace brake shoes as a set (all four shoes) to maintain equal braking forces.

A. Replace brake shoes if damaged or if lining is worn to 1/16" (1.6 mm). Replace if lining is contaminated by oil, grease, or other fluids.

NOTE: Overheated springs lose their tension, and can cause brake linings to wear out prematurely.

B. Inspect brake shoe webbing, upper and lower springs, and shoe hold down springs for overheating. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

C. Inspect hold down pins on adjuster levers for bends, rust, and corrosion. Replace as necessary.

3. Inspect backing plate surfaces, which contact with the brake shoes for grooves that may restrict shoe movement. Replace plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace plate if cracked, warped, or excessively rusted.

4. Inspect adjuster levers for deformation. Replace levers if deformation or excessive rust is found.

5. Replace parking brake cables if frayed, stretched, or kinked.

Assembly (Fig. 21)

IMPORTANT: Brake shoe lining surfaces must be free of grease, oil, and other foreign matter.

1. Apply a light film of lubricant to the following:

A. Ledges on which the brake shoes rest.

B. Pin surfaces on adjuster levers.

C. Anchor block surface that contacts shoe webs.

D. Both surfaces of belleville washers that are positioned between adjuster levers and backing plate.

2. If removed, position lubricated belleville washer between lever adjuster and backing plate. Secure adjuster to backing plate with washer and bolt. Torque bolt from 110 to 120 in-lb (12.4 to 13.6 N-m).

3. If removed, secure wheel cylinder to backing plate with two washer head screws. Torque screws from 110 to 120 in-lb (12.4 to 13.6 N-m).

4. If removed from backing plate, slide parking brake lever into slot and dust cover in backing plate.

5. Position brake shoes to backing plate. Make sure that each shoe is properly positioned at anchor block, parking brake lever, wheel cylinder, and pin on adjuster lever. Secure shoes to backing plate with shoe hold down cups and springs.

CAUTION

Be careful when installing springs to brake shoes. The springs are under heavy load and may cause personal injury.

6. Secure brake shoes with upper and lower springs.

Front Brake Calipers (Twister 1600)

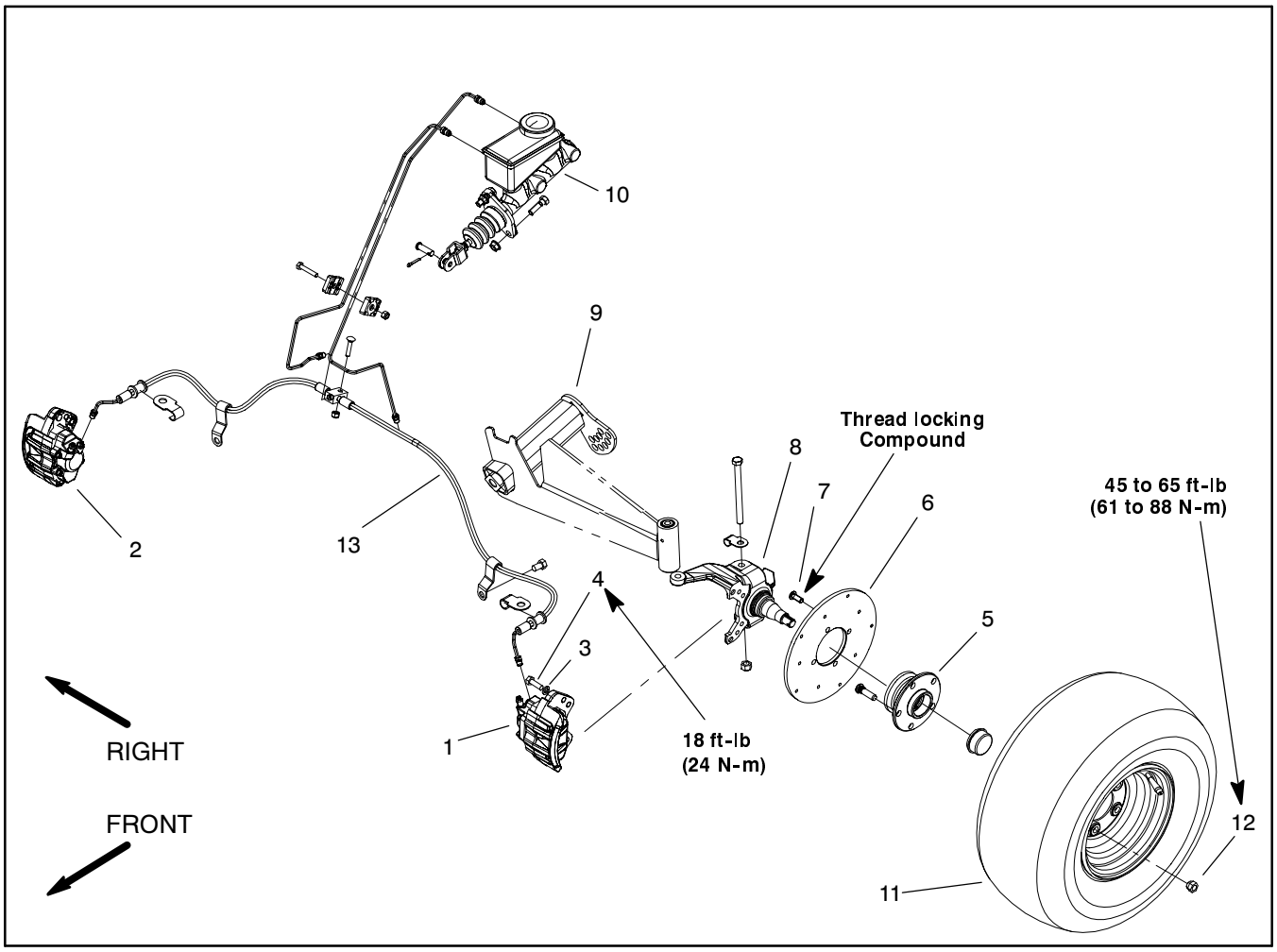

Figure 22

1. LH brake caliper
2. RH brake caliper
3. Lock washer (2 per caliper used)
4. Cap screw (2 per caliper used)
5. Wheel hub assembly
6. Brake rotor
7. Socket head screw (4 per rotor used)
8. Spindle (LH shown)
9. A-arm (LH shown)
10. Brake master cylinder
11. Wheel assembly
12. Lug nut
13. Brake hose

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

2. Chock wheels not being jacked up. Jack front wheel off the ground and place blocks beneath the frame.

3. Remove front wheel from machine (see Lower Steering and Front Wheel Removal).

4. Clean hydraulic brake line area of brake caliper to prevent contamination. Loosen and disconnect brake line from caliper. Plug brake line and position it away from caliper.

5. Remove two cap screws and lock washers that secure the brake caliper to the spindle.

6. Slide brake caliper from brake rotor and remove caliper from machine.

Installation

1. Slide brake caliper onto brake rotor. Make sure that rotor is between brake pads.

2. Align caliper mounting holes with spindle. Secure caliper with cap screws and lock washers. Torque screws 18 ft-lb (24 N-m).

3. Install brake hose to caliper.

4. Install front wheel assembly. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m).

5. Lower machine to ground.

6. Bleed brakes (see Bleed Brake System).

CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

7. Check brake operation.

Front Brake Caliper Service (Twister 1600)

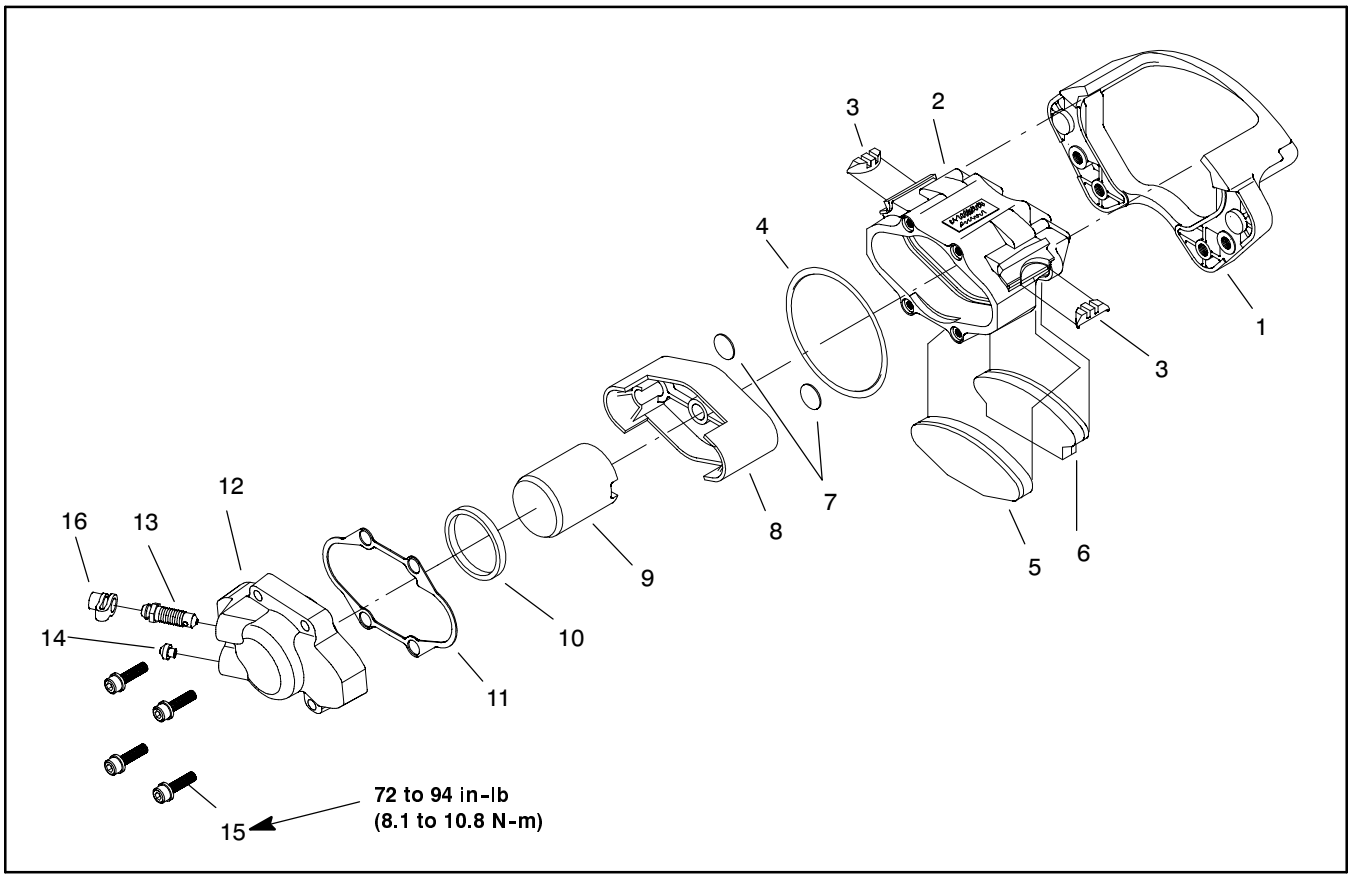

Figure 23

1. Caliper bracket
2. Caliper housing
3. Rubber spring
4. O-ring
5. Inner brake pad
6. Outer brake pad
7. Piston plug
8. Oval piston
9. Round piston
10. Square seal
11. Gasket
12. Cover (LH shown)
13. Bleeder screw
14. Seat insert
15. Cover screw (4 used)
16. Cap

Disassembly

1. Slide caliper from bracket rails being careful not to damage rubber springs.

2. Remove inner and outer brake pads from housing.

3. Remove four cover screws and separate cover from caliper housing. Remove gasket from between cover and housing.

4. Remove oval piston and o-ring from housing. Remove round piston and square seal from cover.

IMPORTANT: The seat insert is pressed into the caliper cover and should not be removed.

5. If necessary, remove rubber springs from housing and piston plugs from oval piston.

Inspection

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure components are thoroughly clean.

2. Check piston bore and pistons for damage or excessive wear. Replace caliper parts as required.

3. Replace pads when pad thickness is less than .250 in (6.35 mm).

Assembly

1. Coat round piston with a small amount of silicone grease and coat square seal with clean brake fluid.

2. Install square seal and round piston into cover.

3. Insert o-ring into bore of caliper housing.

4. Coat housing bore with a small amount of silicone grease. Insert oval piston into housing with logo on piston face orientated to the rubber spring side of the housing.

5. Rotate round piston so the piston slot will mate with oval piston boss.

6. Position gasket and cover to housing. Secure cover to housing with four cover screws. Torque screws from 72 to 94 in-lb (8.1 to 10.8 N-m).

7. If removed, press piston plugs into oval piston and place rubber springs to housing.

8. Apply light coat of grease to rubber springs.

9. Place outer and inner brake pads to caliper assembly.

10. Push caliper on to bracket rails being careful not to damage rubber springs.

Brake Master Cylinder (Twister 1600)

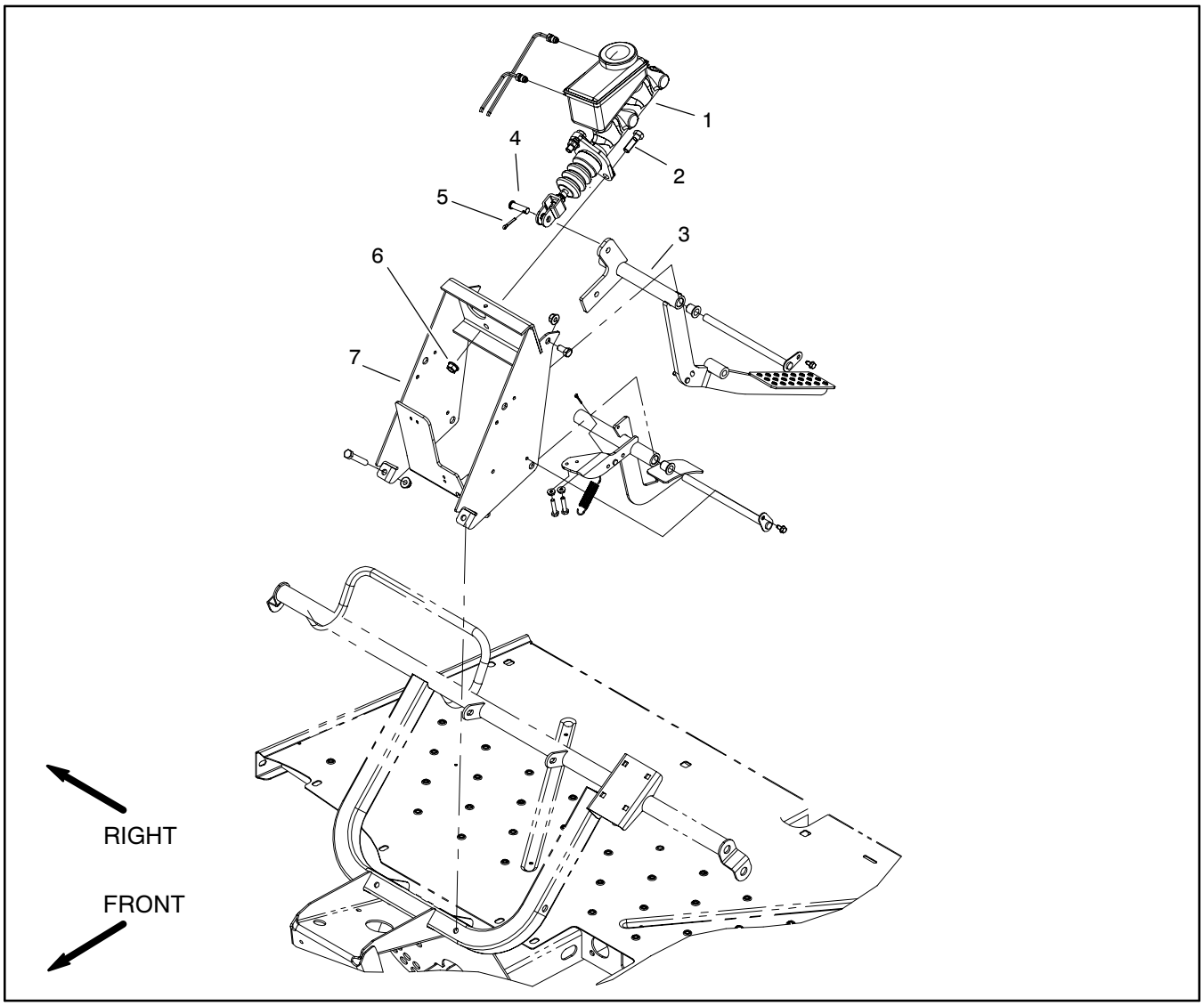

Figure 24

1. Master cylinder
2. Cap screw
3. Brake pedal
4. Clevis pin
5. Cotter pin
6. Flange head nut
7. Pedal frame

Removal

1. Remove front hood from machine.

2. Remove cotter pin from the clevis pin that connects master cylinder to brake pedal.

3. Clean hydraulic brake line area of master cylinder to prevent contamination. Remove both brake lines from master cylinder. Cap ends of brake lines and position them away from master cylinder.

4. Remove flange head nuts from cap screws that secure master cylinder to pedal frame.

5. Pull master cylinder from machine.

Installation

1. Position master cylinder to pedal frame and secure with cap screws and flange nuts.

2. Remove plugs from brake lines. Install brake lines to master cylinder.

3. Connect master cylinder to brake pedal with clevis pin and cotter pin.

4. Install front hood to machine.

5. Bleed brakes (see Bleed Brake System). Check brake operation.

Brake Master Cylinder Service (Twister 1600)

Disassembly (Fig. 25)

1. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.

2. Disconnect lower end of the dust cover from the housing.

3. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.

4. Remove primary piston assembly and secondary piston assembly from cylinder housing.

Inspection

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.

2. Check cylinder bore, pistons, and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring, or cracks are evident in cylinder bore.

Assembly (Fig. 25)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.

2. Install secondary piston assembly and primary piston assembly into cylinder.

3. Install retainer washer.

4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.

5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.

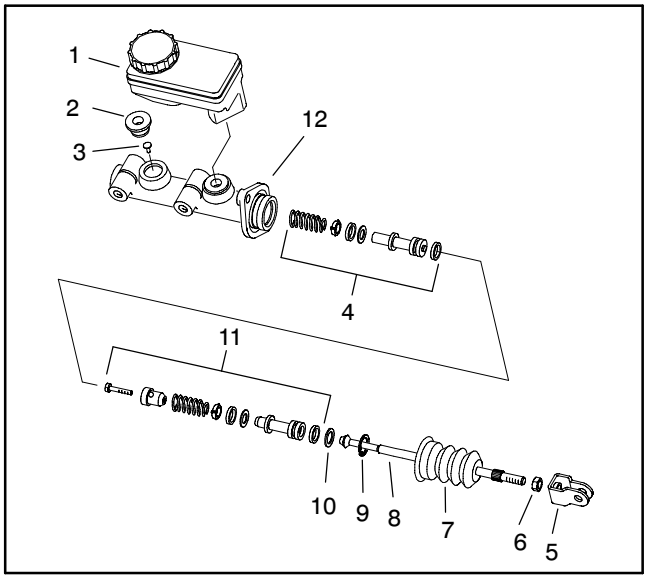

Figure 25

1. Reservoir
2. Flange seal
3. Stop pin
4. Secondary piston assy
5. Clevis
6. Jam nut
7. Dust cover
8. Push rod
9. Circlip
10. Retainer washer
11. Primary piston assy
12. Cylinder housing

Hydraulic Brake System (Twister 1600)

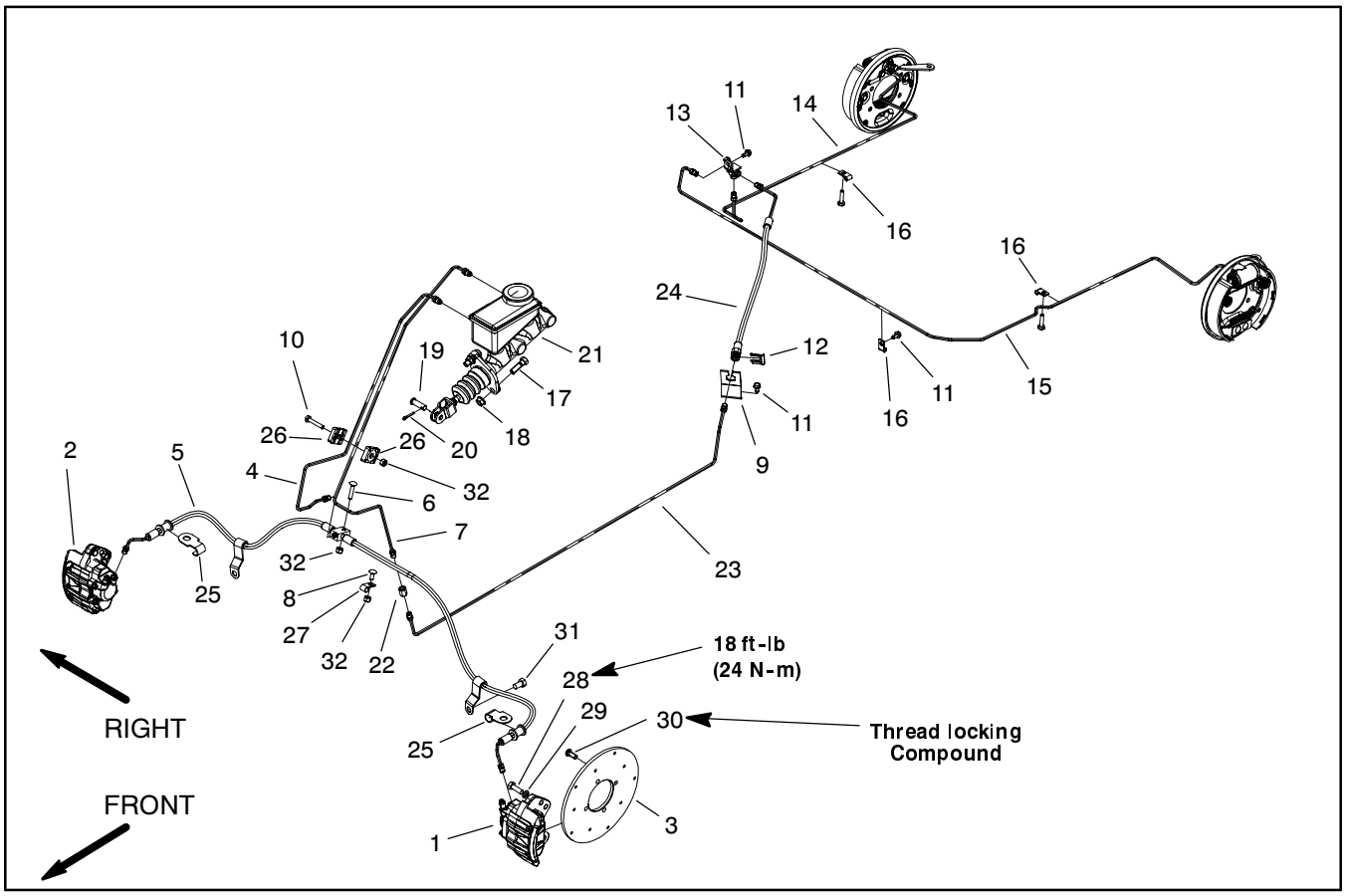

Figure 26

1. Brake caliper (LH)
2. Brake caliper (RH)
3. Brake rotor
4. Front brake tube
5. Front brake hose
6. Carriage screw
7. Rear brake tube
8. Carriage screw
9. Rear brake hose bracket
10. Cap screw
11. Thread forming screw
12. Clip
13. Tee fitting
14. Rear brake tube (RH)
15. Rear brake tube (LH)
16. Insulated clip
17. Cap screw
18. Flange head screw
19. Clevis pin
20. Cotter pin
21. Master cylinder
22. Union fitting
23. Rear brake tube
24. Rear brake hose
25. Hose bracket
26. Tube clamp
27. Clamp
28. Cap screw (2 per caliper used)
29. Lock washer (2 per caliper used)
30. Socket head screw (4 per rotor used)
31. Cap screw
32. Lock nut

When performing service work on the Twister 1600 hydraulic brake system, make sure to clean components before disassembly. Use Figure 26 as a guide for removal and installation of hydraulic brake components.

Check Brake Fluid Level (Twister 1600)

The brake fluid reservoir is filled and shipped from the factory with DOT 3 brake fluid. Check the level before the engine is first started and every 8 hours or daily, thereafter.

1. Park the machine on a level surface, set the parking brake, turn the ignition off, and remove the key.

2. Look at the side of the reservoir. The level should be above the Minimum line (Fig. 27). If the fluid level is low, clean the area around the cap, remove the cap, and fill the reservoir to above the Minimum line. **Do not overfill.**

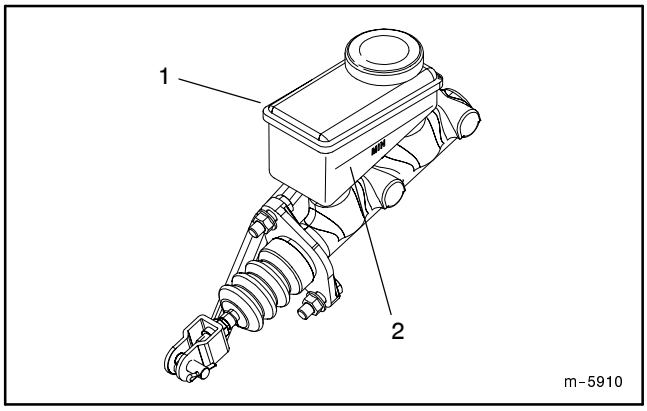

Figure 27

1. Brake fluid reservoir
2. Minimum line

Bleed Brake System (Twister 1600)

1. Connect a suitable transparent hose to bleeder valve on wheel cylinder or caliper and submerge other end of hose in a glass container partially filled with clean brake fluid.

2. Have a helper pump brake pedal several times, then hold pedal down firmly.

3. With pedal firmly depressed, open bleeder valve of brake until pedal fades to floor. Close bleeder valve before releasing pedal.

4. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve. **Make sure fluid level is maintained in brake fluid reservoir at all times**.

5. Repeat steps 1 to 4 for other brake cylinders and calipers.

CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

6. After bleeding of brakes is completed, road test vehicle to make sure brakes are operating correctly and pedal is solid.

Front Hood

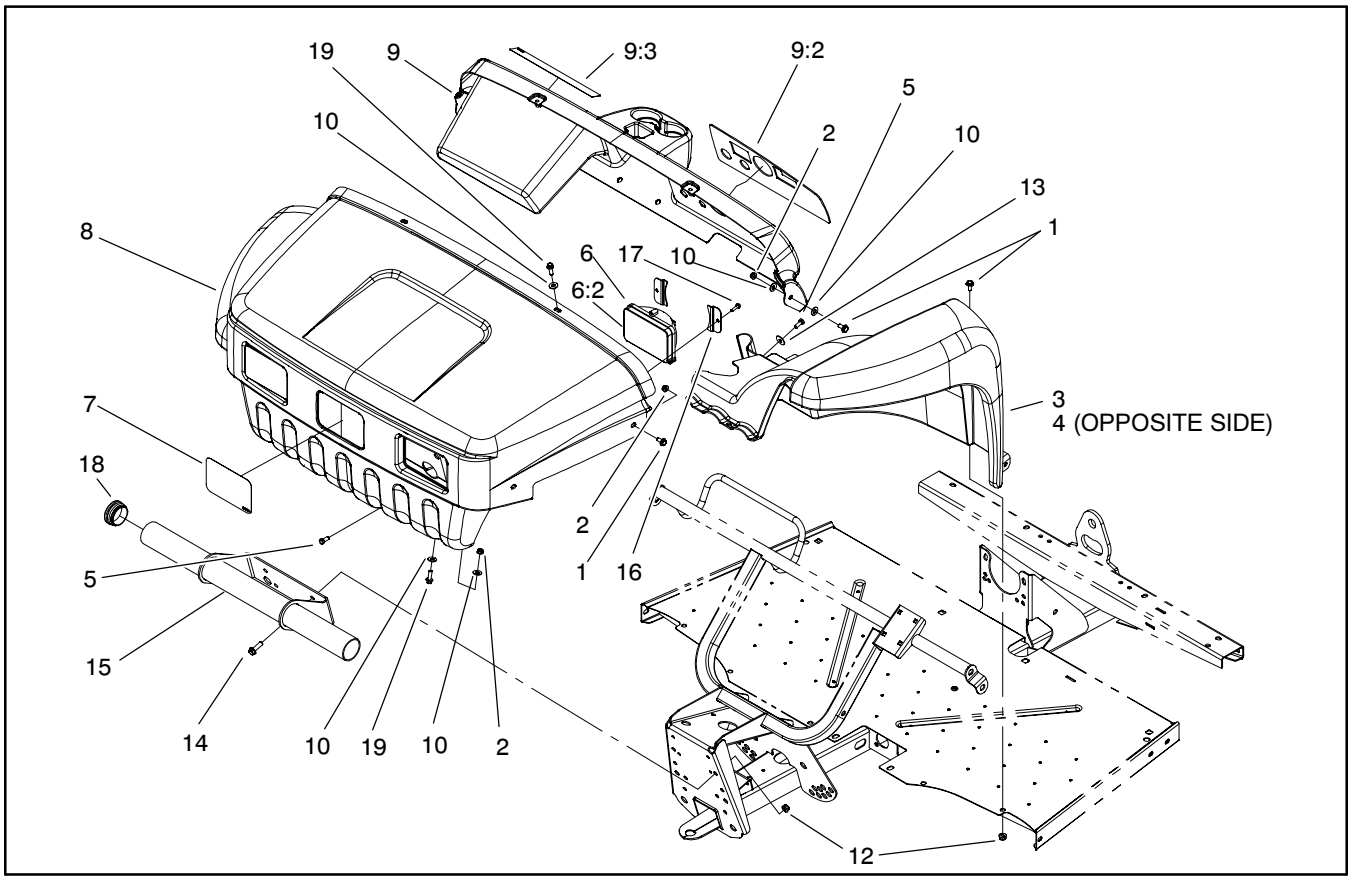

Figure 28

1	Screw	7	Decal-Toro	15	Bumper-Tube
2	Nut-Flange, NI	8	Hood ASM	16	Bracket-Headlight
3	Fender ASM-LH	9	Dash ASM	17	Screw-HWH
4	Fender ASM-RH	9:2	Decal-Warning, Dash	18	Cap-End
5	Screw-HH	9:3	Decal-Danger, General	19	Screw-HHF
6	Headlight	10	Washer-Flat		
6:1	Lamp-12 Volt (not illustrated)	12	Nut-Flange, NI		
6:2	Lens-Light, Head	14	Screw		

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition.

2. Remove screws attaching the wire harness to each head light.

3. Remove both self tapping screws (5) securing the center-lower hood to the front frame support.

4. Remove flange lock nut (2), both flat washers (10), and cap screw (19) securing the hood to each fender front.

5. Remove both flange lock nuts (2) and hex flange head screws (1) securing the hood to the top of each fender.

6. Remove both hex flange head screws (19) securing the hood to the dash. Remove hood from the vehicle.

Installation

Note: Do not tighten fasteners securing the hood until all fasteners are in place.

1. Position hood to the machine. Secure hood to the dash with both hex flange head screws (19).

2. Secure hood to the top of each fender with two hex flange head screws (1) and flange lock nuts (2).

3. Secure hood to each fender front with cap screw (19), two flat washers (10), and flange lock nut (2).

4. Secure center-lower hood to the front frame support with two self tapping screws (5).

5. Connect each headlight to the wire harness with screws. Tighten all fasteners securing the hood.

Cargo Bed and Tailgate

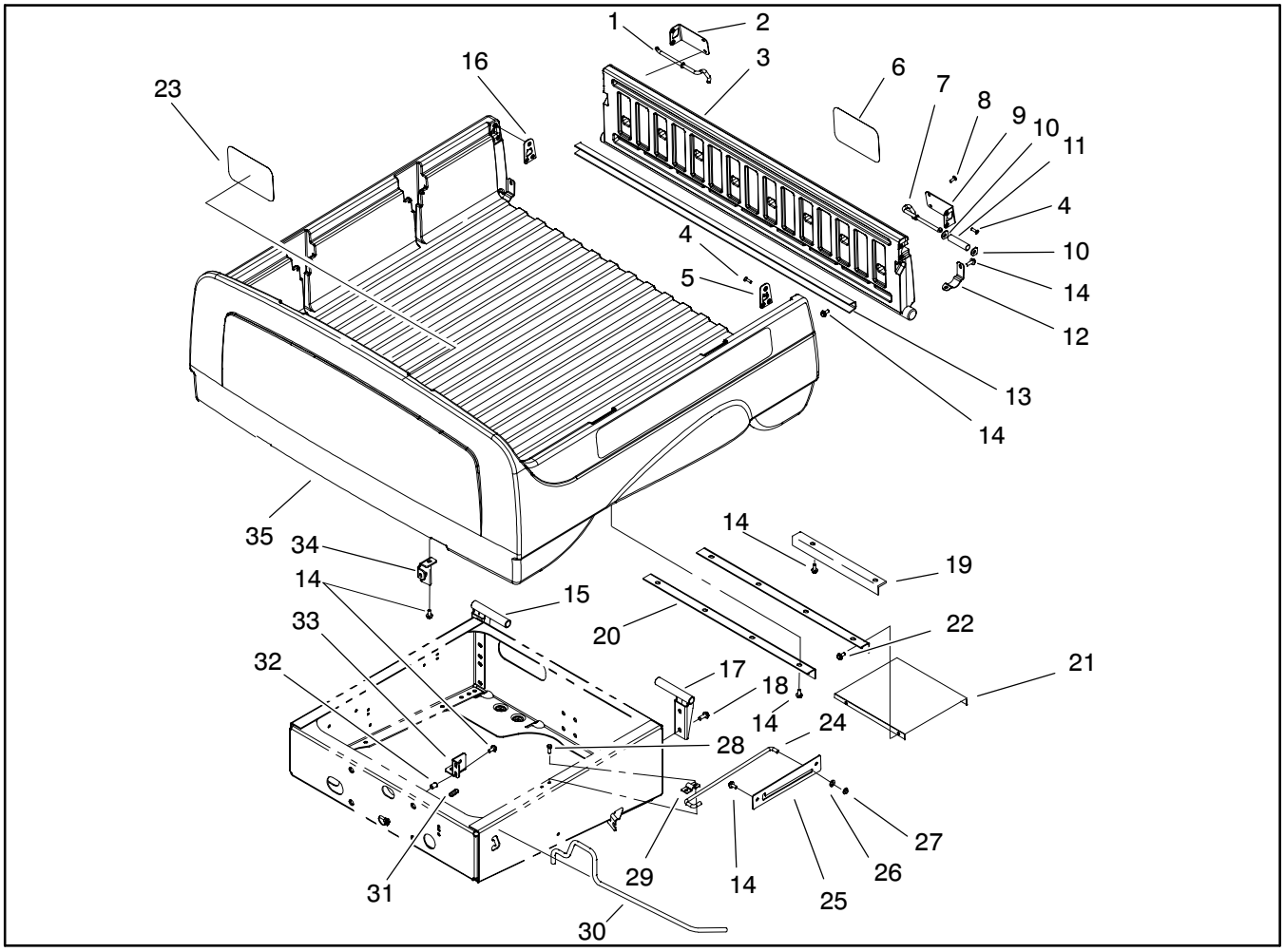

Figure 29

1. Tailgate rod (RH)
2. Tailgate latch bracket (RH)
3. Tailgate
4. Cap screw
5. Striker plate (LH)
6. Decal
7. Tailgate rod (LH)
8. Screw
9. Tailgate latch bracket (LH)
10. Latch washer
11. Spring
12. Tailgate pivot bracket
13. Tailgate channel
14. Hex flange head screw
15. Pivot bracket (RH)
16. Striker plate (RH)
17. Pivot bracket (LH)
18. Hex flange head screw
19. Box brace (short)
20. Box brace (long)
21. Heat shield
22. Screw
23. Decal
24. Prop rod
25. Prop rod bracket
26. Flat washer
27. Push on retainer
28. Cap screw
29. Prop rod clip
30. Latch rod
31. Spring
32. Insert nut
33. Latch bracket
34. Latch hook (RH)
35. Cargo bed

Removal

1. Park machine on a level surface, stop engine, set parking brake, and remove key from the ignition switch.

2. Remove hex flange head screws securing both pivot brackets to the rear frame.

3. Release latch rod from the latch bracket. Remove cargo bed from the frame. Disassemble cargo bed as necessary using Figure 29 as a guide.

Installation

1. Reassemble cargo bed using Figure 29 as a guide.

2. Position cargo bed to the frame locking the latch rod to the latch bracket.

3. Secure both pivot brackets to the rear frame with hex flange head screws.

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