TORO MID-MOUNT Z SERVICE MANUAL

Table of Contents – Page 1 of 3

TORO MID-MOUNT Z SERVICE MANUAL

Table of Contents – Page 2 of 3

TORO MID-MOUNT Z SERVICE MANUAL

Table of Contents – Page 3 of 3

TORO®

Mid-Mount Z
Service Manual

PREFACE

ABOUT THIS MANUAL

This service manual was written expressly for the Toro Mid-Mount Z product line. The Toro Company has made every effort to make the information in this manual complete and correct.

This manual was written for the service technician; basic mechanical/electrical skills are assumed. The Table of Contents lists the systems and the related topics covered in this manual.

For additional information on the electrical systems, please refer to the LCB Electrical Troubleshooting CD (PN 492-4757). For information specific to the engines used on these products, refer to the appropriate engine manufacturer's service and repair instructions.

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

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Bloomington, MN 55420

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

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

ELECTRICAL SYSTEMS (cont'd)

ELECTRICAL SYSTEMS (cont'd)

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ENGINE

Z100 Series

Model	Manufacturer	HP	Oil Capacity	High Idle	Low Idle	Cooling System
74170	Kawasaki	17	1.9 Qts.	3600 ± 100	1500	Air-Cooled
74171	Kohler	22	2 Qts.	3600 ± 100	1500	Air-Cooled
74172	Kohler	20	2 Qts.	3600 ± 100	1500	Air-Cooled
74173	Kawasaki	19	2 Qts.	3600 ± 100	1500	Air-Cooled
74174	Kohler	23	2 Qts.	3600 ± 100	1500	Air-Cooled
74175	Kawasaki	23	2 Qts.	3600 ± 100	1500	Air-Cooled
74176	Kawasaki	17	2 Qts.	3600 ± 100	1500	Air-Cooled
74178	Kohler	20	2 Qts.	3600 ± 100	1500	Air-Cooled
74179	Kawasaki	19	2 Qts.	3600 ± 100	1500	Air-Cooled
74197	Kohler	23	2 Qts.	3600 ± 100	1500	Air-Cooled
74198	Kawasaki	23	2 Qts.	3600 ± 100	1500	Air-Cooled

Z250 Series

Model	Manufacturer	HP	Oil Capacity	High Idle	Low Idle	Cooling System
74200	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74201	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74202	Kohler	23	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74203	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74204	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74205	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74209	Kohler	23	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74211	Kawasaki	22	2.1 Qts.	3600 ± 100	1500	Liquid-Cooled
74212	Kawasaki	22	2.1 Qts.	3600 ± 100	1500	Liquid-Cooled
74218	Kohler	26	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74219	Kohler	26	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74228	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74225	Kohler	23	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74226	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74227	Kohler	25	2.1 Qts.	3600 ± 100	1500	Air-Cooled

Z280 Series

Model	Manufacturer	HP	Oil Capacity	High Idle	Low Idle	Cooling System
74213	Kawasaki	27	2.1 Qts.	3600 ± 100	1500	Liquid-Cooled
74214	Kawasaki	27	2.1 Qts.	3600 ± 100	1500	Liquid-Cooled
74240	Kohler	26	2.1 Qts.	3600 ± 100	1500	Air-Cooled
74241	Kohler	26	2.1 Qts.	3600 ± 100	1500	Air-Cooled

SPECIFICATIONS

UNIT DIMENSIONS

Z100 Series

Model	Wheel Base	Length	Width	Height	Weight lb.	Tires		Tire Pressure	
						Rear	Front	Rear	Front
74176	50”	78”	55”	40”	885	23” x 9.50-12”	13” x 5.00”-6”	13 PSI	13 PSI
74178	50”	78”	65”	40”	910	23” x 9.50-12”	13” x 5.00”-6”	13 PSI	13 PSI
74179	50”	78”	65”	40”	910	23” x 9.50-12”	13” x 5.00”-6”	13 PSI	13 PSI
74197	50”	78”	65”	40”	910	23” x 9.50-12”	13” x 5.00”-6”	13 PSI	13 PSI
74198	50”	78”	65”	40”	910	23” x 9.50-12”	13” x 5.00”-6”	13 PSI	13 PSI

Z250 Series

Model	Wheel Base	Length	Width	Height	Weight lb.	Tires		Tire Pressure	
						Rear	Front	Rear	Front
74228	50”	79.8”	66”	44.5”	1045	23” x 9.5”-12”	13” x 6.50”-6”	13 PSI	13 PSI
74225	53”	81.5”	74”	44.5”	1105	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI
74226	53”	81.5”	74”	44.5”	1105	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI
74227	55.25”	84.5”	85”	44.5”	1170	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI

Z280 Series

Model	Wheel Base	Length	Width	Height	Weight lb.	Tires		Tire Pressure	
						Rear	Front	Rear	Front
74213	50”	83”	74”	48”	1320	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI
74214	53.12”	84.5”	85”	48”	1320	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI
74240	53”	83”	74”	44.5”	1105	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI
74241	55.25”	84.5”	85”	44.5”	1170	24” x 12.00”-12”	13” x 6.50”-6”	13 PSI	13 PSI

HYDRAULIC SYSTEM

Model	Pumps	Motors	Fluid Type	Fluid Capacity
Z100 Series	(2) Hydro-Gear BDP10A	(2) Ross MB15 Torquemotors	Mobil 1 15W20 Synthetic	2.1 Qts.
Z250 Series	(2) Hydro-Gear BDP10A	(2) Ross MB15 Torquemotors	Mobil 1 15W20 Synthetic	2.1 Qts.
Z280 Series	(2) Hydro-Gear BDP10A	(2) Ross MB15 Torquemotors	Mobil 1 15W20 Synthetic	2.1 Qts.

TORQUE SPECIFICATIONS

Hydraulic Hoses & Fittings

Item	Torque
Fitting to hydraulic oil tank	50 - 70 ft. lbs.
Fittings to hydraulic pumps	50 - 70 ft. lbs.
Hoses to pump fittings	34 - 41 ft. lbs.
Straight fittings to wheel motors	72 - 82 ft. lbs.

CHASSIS

Item	Torque
Wheel lug nuts	45 - 55 ft. lbs.
Rear hubs to drive motors	300 - 400 ft. lbs.

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Recommended Maintenance Schedule

Maintenance Service Interval	Maintenance Procedure
After first 5 hours	• Hydraulic fluid—check level • Engine Oil—check • Hydraulic filter—change
Each Use	• Oil—check level • Safety System—check • Mower Housing—clean • Engine Cooling System—clean[1]
Every 5 Hours	• Cutting Blades—check • Blade Spindle Bearings—grease • Every 25 Hours • Chassis—grease[1] • Linkage bushings—oil[1] • Hydraulic fluid—check level • Foam Air Cleaner—service[1] • Battery—check electrolyte
Every 50 Hours	• Belts—check for wear/cracks • Tires—check pressure
Every 100 Hours	• Engine Oil—change[1] • Hydraulic lines—check • Engine Cooling System—clean[1]
Every 200 Hours	• Oil Filter—change (200 hours or every other oil change)[1] • Hydraulic filter—change • Spark Plug(s)—check • Fuel Filter—replace • Replace or clean primary air cleaner filter[1]
Every 500 Hours or at Storage	• Wheel Hub Slotted Nut— adjustment • Castor Pivot— adjustment
Every 600 Hours or at Storage	• Replace safety air cleaner[1]
Before Storage Service	• Battery–charge, Disconnect cables • Gasoline—drain • Chipped Surfaces—paint

Perform all maintenance procedures listed above before storage.

[1]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 from the spark plug(s) before you do any maintenance. Set the wire aside so that it does not accidentally contact the spark plug.

Checking the Oil Level

Note: Check oil when engine is cold.

1. Disengage the power take off (PTO) and turn the ignition key to off. Move levers to neutral locked position and apply parking brake. Remove the key.

2. Clean around the oil dipstick so dirt cannot fall into the filler hole and damage the engine.

3. Pull the oil dipstick and wipe the metal end clean (Figure 1).

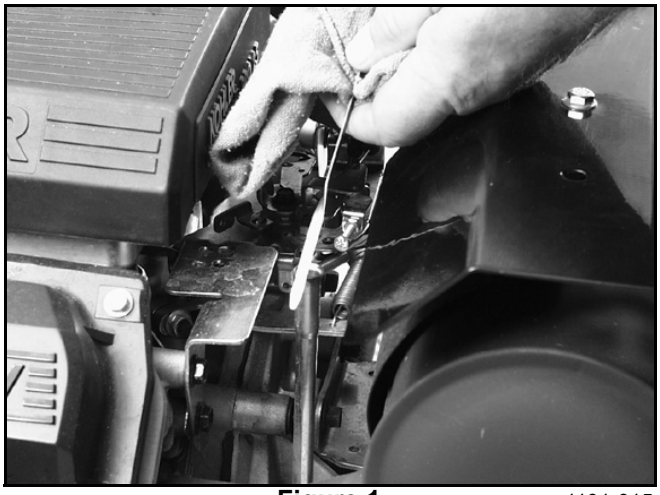


Figure 1 1101-015

4. Slide the oil dipstick fully into the filler tube. Pull the dipstick out and look at the metal end. If oil level is low, add oil to raise the level to the full mark.

Important Do not overfill the crankcase.

Changing Oil and Filter

1. Start the engine and let it run five minutes. This warms the oil so it drains better.

2. Park the machine so that the drain side is slightly lower than the opposite side to assure the oil drains completely. Disengage the power take off (PTO), set the parking brake, and turn the ignition key to off. Remove the key.

3. Place a pan below the oil drain. Rotate oil drain valve to allow oil to drain (Figure 2).

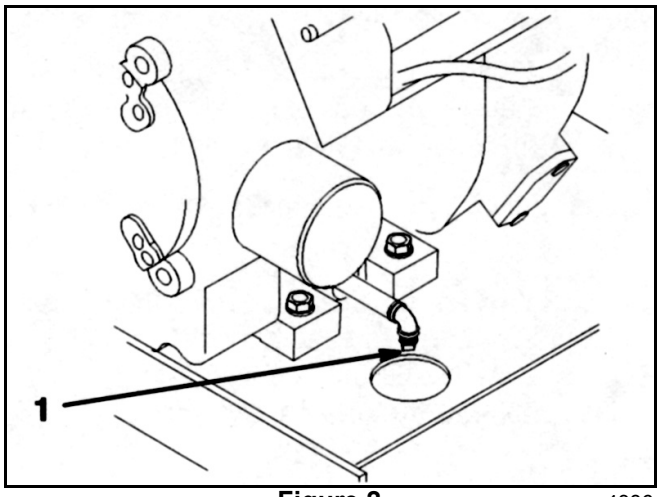


Figure 2 m-4386

(1) Oil Drain Plug

4. When oil has drained completely, close the drain valve.

Slowly pour approximately 2 quarts of the specified oil into the filler tube (Figure 2). Now check the oil level. Slowly add additional oil to bring it to the “FULL” mark on the dipstick.

Change oil:

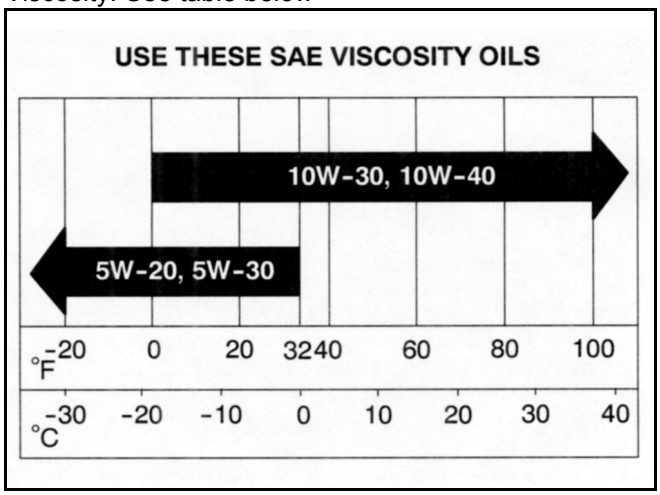
- After the first 8 operating hours.
- After every 100 operating hours.

Note: Change oil more frequently when operating conditions are extremely dusty or sandy.

Oil Type: Detergent oil (API service SG or SH)

Crankcase Capacity: w/filter, 67 oz. (2.0 l)

Viscosity: See table below



Servicing the Air Cleaner

Primary Filter: Clean or replace after every 200 operating hours.

Safety Filter: Replace after every 600 operating hours.

Note: Check the filters more frequently if operating conditions are extremely dusty or sandy.

Removing the Filters

1. Disengage the power take off (PTO), set the parking brake, and turn the ignition key to off. Remove the key. Remove spark plug wire(s).

2. Release the latches on the air cleaner and pull the air cleaner cover off of the air cleaner body (Figure 3).

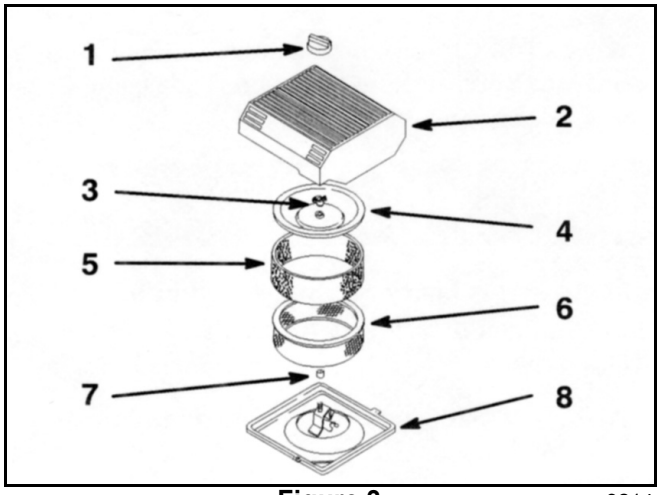


Figure 3 m-3214

(1) Knob	(5) Foam Element
(2) Air Cleaner Cover	(6) Paper Element
(3) Cover Nut	(7) Rubber Seal
(4) Cover	(8) Air Cleaner Base

3. Clean the inside of the air cleaner cover with compressed air.

4. Gently slide the primary filter out of the air cleaner body (Figure 3). Avoid knocking the filter into the side of the body. Do not remove the safety filter, unless you intend to replace it as well.

5. Inspect the primary filter for damage by looking into the filter while shining a bright light on the outside of the filter. Holes in the filter will appear as bright spots. If the filter is damaged discard it.

Important Never attempt to clean the safety filter. If the safety filter is dirty, then the primary filter is damaged and you should replace both filters. Blow compressed air from the inside to the outside of the primary filter.

Important Do not exceed 100 psi and keep the hose at least 2 inches from the filter. Replace air filters if they are damaged or cannot be cleaned.

Important Do not clean safety filter. Replace it after 600 operating hours.

Installing the Filters

Important To prevent engine damage, always operate the engine with both air filters and cover installed.

1. If installing new filters, check each filter for shipping damage. Do not use a damaged filter.

2. If the safety filter is being replaced, carefully slide it into the filter body (Figure 3).

3. Carefully slide the primary filter over the safety filter (Figure 3). Ensure that it is fully seated by pushing on the outer rim of the filter while installing it.

Important Do not press on the soft inside area of the filter.

Install the air cleaner cover with the side indicated as **UP** facing up and secure the latches (Figure 3).

Servicing Models Equipped With the Heavy-Duty Air Cleaner

Primary Filter: Clean or replace every 200 operating hours or when Filter Minder reaches **Change Filter** level.

Safety Filter: Replace after every 600 operating hours.

Note: Service the air cleaner more frequently if operating conditions are extremely dusty or sandy.

Using the Filter Minder

This machine contains an air cleaner **Filter Minder** gauge.

Filter Minder: Check this daily.

The plunger inside the gauge canister will change to red when the air cleaner element becomes dirty and restricted. When it changes red, air cleaner maintenance is required.

1. Start by visually checking the condition of the primary element. If the element is visually dirty, replace the primary element. Do not attempt to clean it.

2. Reset the gauge by depressing the button in the bottom of the canister until the plunger returns to the lowest point (Figure 4).

Figure 4 0508-001

3. Test run the engine and recheck the gauge. If the plunger changes to red, the primary element is restricted and must be replaced, even though it may not appear to be dirty.

4. The gauge may be reset at any time, however it will return to red if correct filter servicing has not been performed.

Removing the Air Cleaner

1. Disengage the power take off (PTO), set the parking brake, and turn the ignition key to off. Remove the key. Remove spark plug wire(s).

2. Release the latches on the air cleaner and pull the air cleaner cover off of the air cleaner body (Figure 5).

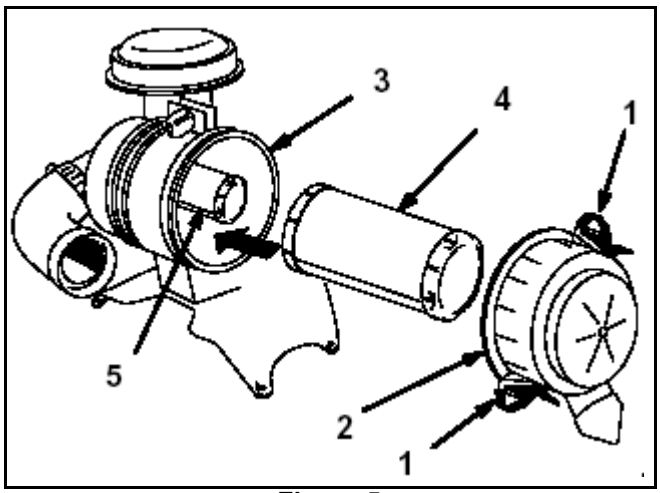


Figure 5 m-4815

(1) Latches	(4) Primary Filter
(2) Air Cleaner Cover	(5) Safety Filter
(3) Air Filter Body	

3. Clean the inside of the air cleaner cover with compressed air.

4. Gently slide the primary filter out of the air cleaner body (Figure 5). Avoid knocking the filter into the side of the body. Do not remove the safety filter, unless you intend to replace it as well.

5. Inspect the primary filter for damage by looking into the filter while shining a bright light on the outside of the filter. Holes in the filter will appear as bright spots. If the filter is damaged discard it.

Important Never attempt to clean the safety filter. If the safety filter is dirty, then the primary filter is damaged and you should replace both filters.

Cleaning the Primary Filter

Blow compressed air from the inside to the outside of the primary filter.

Important Do not exceed 100 psi and keep the hose at least 2 inches from the filter. Replace air filters if they are damaged or cannot be cleaned.

Installing the Filters

Important To prevent engine damage, always operate the engine with both air filters and cover installed.

1. If installing new filters, check each filter for shipping damage. Do not use a damaged filter.

2. If the safety filter is being replaced, carefully slide it into the filter body (Figure 5).

3. Carefully slide the primary filter over the safety filter (Figure 5). Ensure that it is fully seated by pushing on the outer rim of the filter while installing it.

Important Do not press on the soft inside area of the filter.

4. Install the air cleaner cover with the side indicated as UP facing up and secure the latches (Figure 5).

Servicing the Air Cleaner Liquid-Cooled Models

Paper Element:
- Clean after 50 operating hours.

- Replace after 300 operating hours.

NOTE: Service the air cleaner more frequently (every few hours) if operating conditions are extremely dusty or sandy.

Removing the Paper Element

1. Disengage the power take off (PTO), set the parking brake, stop the engine, and remove the key.

2. Tilt the seat up and tilt the engine cover forward.

3. Clean around the air cleaner to prevent dirt from getting into the engine and causing damage. Loosen the retaining clips and remove the air cleaner cover (Figure 6).

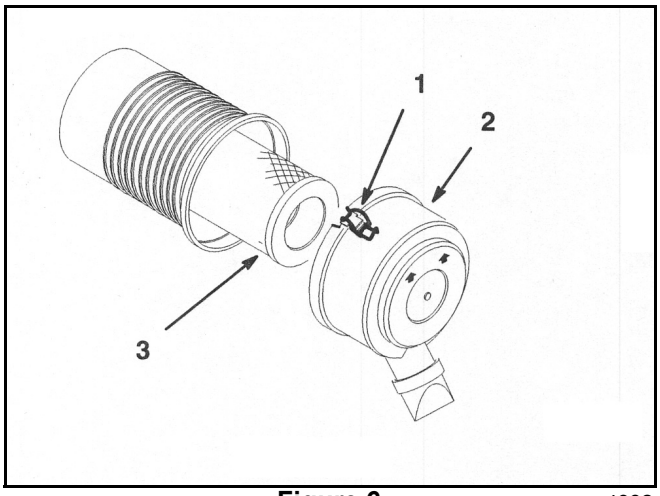


Figure 6 m-4382

(1) Retaining Clip	(3) Air Filter
(2) Air Cleaner Cover	

Cleaning the Paper Elements

1. Lightly tap the element on a flat surface to remove dust and dirt (Figure 7).

2. Inspect the element for tears, an oily film, and damage to the rubber seal.

Important Never clean the paper element with pressurized air or liquids, such as solvent, gas, or kerosene. Replace the paper element if it is damaged, or cannot be cleaned thoroughly.

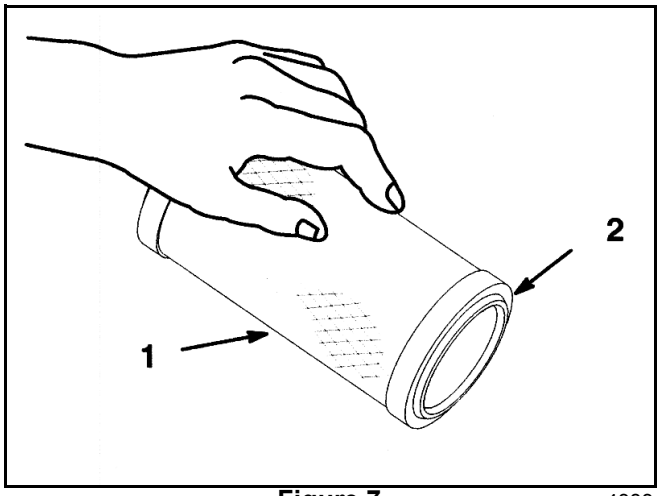


Figure 7 m-4383

(1) Paper Element	(2) Rubber Seal

Installing the Paper Elements

Important To prevent engine damage, always operate the engine with the paper air cleaner installed.

1. Carefully slide the element into the compartment (Figure 6).

2. Place the air cleaner cover into the compartment and latch the retaining clips (Figure 6).

Cleaning the Engine Fins

Every 100 hours clean engine cylinder and cylinder head cooling fins. Also clean around carburetor, governor levers and linkage. This will make sure adequate cooling to hydraulic pumps, motors and engine and will reduce the possibility of overheating and mechanical damage.

Remove the panels from the engine shroud.

Clean the engine cooling fins.

Install the panels onto the engine shroud.

Servicing the Cooling System

Checking the Radiator Coolant

Danger

Discharge of hot pressurized coolant or touching hot radiator and surrounding parts can cause severe burns.

- **Do not remove the radiator cap when the engine is hot. Always allow the engine to cool at least 15 minutes or until the radiator cap is cool enough to touch without burning your hand before removing the radiator cap.**
- **Do not touch radiator and surrounding parts that are hot.**

Check the cooling system level daily.

Fluid Type: 50/50 mix of permanent antifreeze (ethylene glycol) and water.

Cooling System Capacity: 128 oz. (3.8 l).

Danger

Rotating shaft and fan can cause personal injury.

- **Do not operate the machine without the covers in place.**
- **Keep fingers, hands and clothing clear of rotating fan and drive shaft.**
- **Shut off the engine and remove the ignition key before performing maintenance.**

Caution

Swallowing engine coolant can cause poisoning.

- **Do not swallow engine coolant.**
- **Keep out of reach from children and pets.**

1. Position the machine on a level surface, stop the engine, and set the parking brake.
2. Tilt the seat up and tilt the engine hood forward.
3. With the engine cool, remove the radiator cap (Figure 8).
4. If the coolant level is low, add a 50/50 mixture of permanent antifreeze and water until the radiator is completely full without overflowing.
5. Install the radiator cap. Completely seat the cap by pushing down and turning it until it stops.
6. Add a 50/50 coolant mix to the overflow bottle and fill it to the indicator line on the bottle, if required (Figure 8).

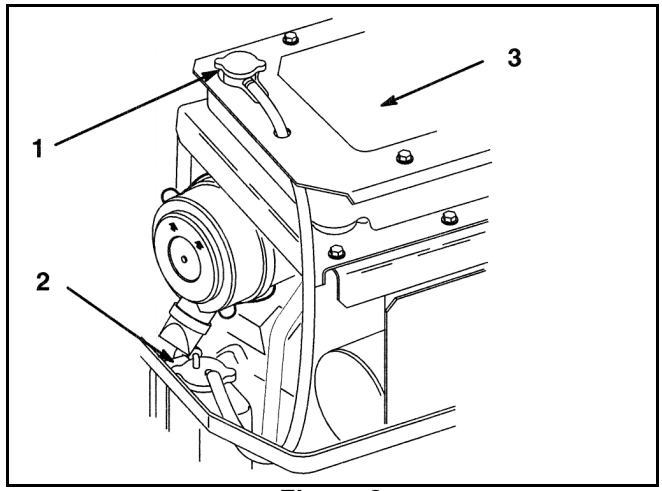


Figure 8 m-5031-1

(1) Radiator Cap	(3) Radiator Core and Screen
(2) Antifreeze Overflow Bottle	

Cleaning the Cooling System

Clean the cooling system daily before each use.

1. Position the machine on a level surface, stop the engine, and set the parking brake.

Important Before starting the engine, clean grass from the pump drive belt compartment. Check more often in dry conditions.

2. Tilt the seat up and raise the rubber flap above the drive belt compartment.
3. Remove debris from the drive belt compartment and hydraulic pumps.

4. Remove debris from the screen on the engine cover.

5. Tilt the engine cover forward.

6. Remove debris from the radiator core and engine (Figure 8).

Important Do not damage the radiator cooling fins.

7. Inspect the seals on the engine cover and replace them if needed.

8. Close the engine cover and tilt the seat back.

Changing the Engine Coolant

Change the engine coolant every 400 hours.

Danger

Discharge of hot pressurized coolant or touching hot radiator and surrounding parts can cause severe burns.

- **Do not remove the radiator cap when the engine is hot. Always allow the engine to cool at least 15 minutes or until the radiator cap is cool enough to touch without burning your hand before removing the radiator cap.**
- **Do not touch radiator and surrounding parts that are hot.**

Danger

Rotating shaft and fan can cause personal injury.

- **Do not operate the machine without the covers in place.**
- **Keep fingers, hands and clothing clear of rotating fan and drive shaft.**
- **Shut off the engine and remove the ignition key before performing maintenance.**

1. Position the machine on a level surface, stop the engine, and set the parking brake.

2. Tilt the seat up and tilt the engine hood forward.

3. With the engine cool, drain the coolant by loosening the drain cock in the right rear corner (Figure 9).

4. The engine block must be drained by removing the drain plug from the engine block (Figure 10).

NOTE: The drain plug is black in color and is located near the oil filter (Figure 10).

5. Install all drain plugs, the radiator hose, and tighten the drain cock.

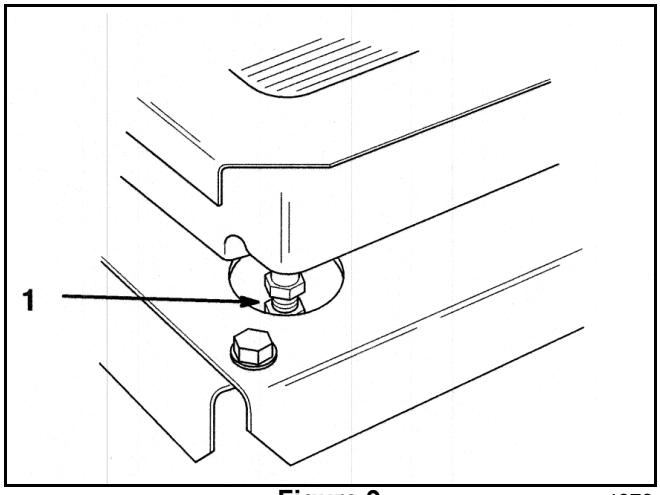


Figure 9 m-4379

(1) Drain Cock (right rear of radiator)

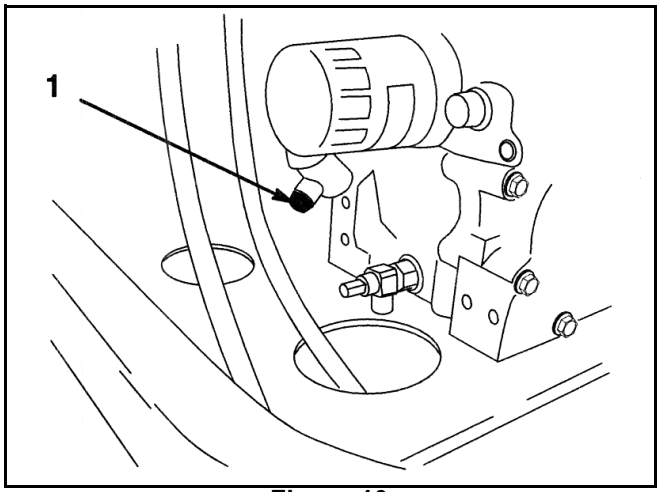


Figure 10 m-5030

(1) Coolant Drain Plug (black in color)

6. Drain the coolant from the overflow bottle.

7. Remove the radiator cap and add a 50/50 mixture of permanent antifreeze and water until the radiator is completely full.

8. Wait 2 minutes and check if the coolant stays up to the full level. Add a 50/50 mixture of permanent antifreeze and water until the radiator is completely full, if required. Repeat until the coolant stays up to the full level.

9. With the radiator cap off, tilt the engine cover down and put the seat down. Start the engine. Run the engine until it is warm.

10. Tilt the seat up, tilt the engine hood forward, and keep the engine running. As air is purged from the engine block and the coolant level drops, add additional coolant to the radiator it is until full.

11. Install the radiator cap. Completely seat the cap by pushing down and turning it until it stops.

12. Shut off the engine.

13. Check for any leaks in the cooling system.

14. Close the engine cover and tilt the seat back.

Important Check the coolant level after the first 8 hours of changing the coolant.

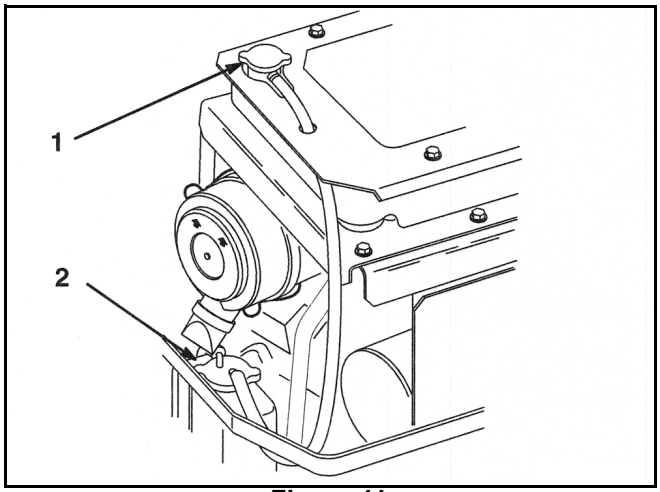


Figure 11 m-5031-2

(1) Radiator Cap	(2) Antifreeze Overflow Bottle

Inspecting the Cooling System

Inspect the radiator and the hoses initially and after the first 8 operating hours.

Inspect the radiator and the hoses every 200 hours.

Check the hoses and radiator for cracks, dents, and fractured seams. Repair or replace damaged hoses or the radiator.

Servicing the Fuel Filter

Replace the fuel filter after every 200 operating hours or yearly, whichever occurs first.

Replacing the Fuel Filter

Never install a dirty filter if it is removed from the fuel line.

1. Disengage the power take off (PTO) and turn the ignition key to off. Move levers to neutral locked position and apply parking brake. Remove the key.

2. Close fuel shut-off valve on console.

3. Squeeze the ends of the hose clamps together and slide them away from the filter (Figure 12).

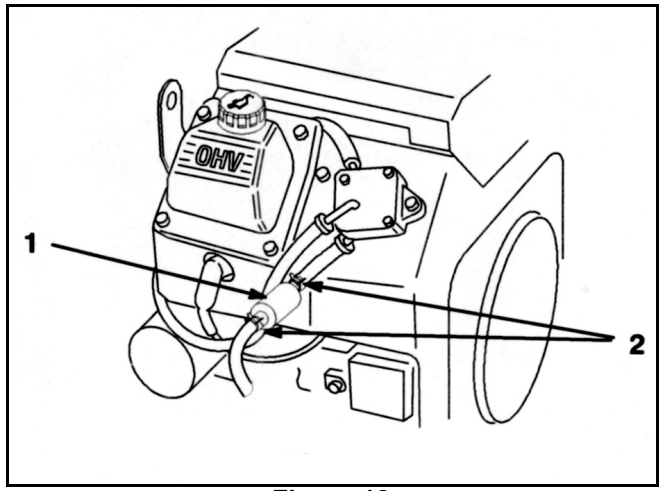


Figure 12 m-3217

(1) Filter	(2) Hose Clamp

4. Remove the filter from the fuel lines.

5. Install a new filter and move the hose clamps close to the filter (Figure 12).

6. Wipe up any spilled fuel.

Open fuel shut-off valve on console.

Servicing the Spark Plug

Check the spark plug(s) after every 200 operating hours. Make sure the air gap between the center and side electrodes is correct before installing the spark plug. Use a spark plug wrench for removing and installing the spark plug(s) and a gapping tool/feeler gauge to check and adjust the air gap. Install a new spark plug(s) if necessary.

Type: Champion RC12YC (or equivalent).

Air Gap: 0.030 in. (0.76mm).

Removing the Spark Plug(s)

1. Disengage the power take off (PTO) and turn the ignition key to off. Move levers to neutral locked position and apply parking brake. Remove the key.

2. Pull the wire(s) off the spark plug(s) (Figure 13). Now clean around the spark plug(s) to prevent dirt from falling into the engine and potentially causing damage.

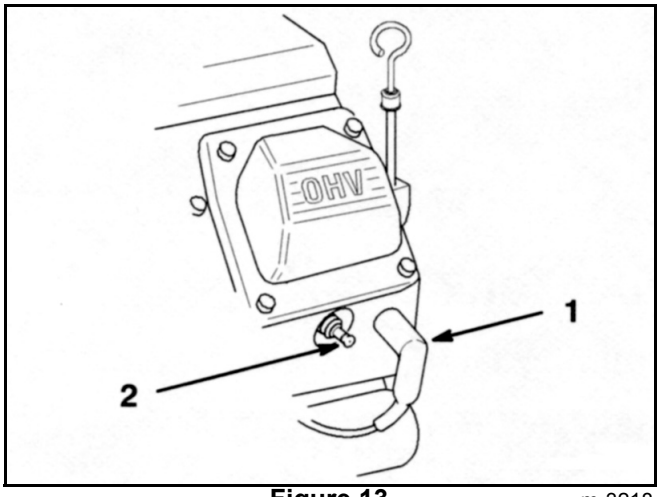


Figure 13 m-3218

(1) Spark Plug Wire	(2) Spark Plug

3. Remove the spark plug(s) and metal washer.

Checking the Spark Plug

1. Look at the center of the spark plug(s) (Figure 14). If you see light brown or gray on the insulator, the engine is operating properly. A black coating on the insulator usually means the air cleaner is dirty.

Figure 14 1101-020

Important Never clean the spark plug(s). Always replace the spark plug(s) when it has: a black coating, worn electrodes, an oily film, or cracks.

2. Check the gap between the center and side electrodes (Figure 14). Bend the side electrode (Figure 14) if the gap is not correct.

Installing the Spark Plug(s)

1. Install the spark plug(s). Make sure the air gap is set correctly.

2. Tighten the spark plug(s) to 20 ft-lb (27 N·m).

3. Push the wire(s) onto the spark plug(s) (Figure 13).

Check Valve Clearance

Refer to the engine manufacturer's service manual for service interval and instructions.

Greasing and Lubrication

Lubricate the machine when shown on the **Check Service Reference Aid** decal (Figure 15). Grease more frequently when operating conditions are extremely dusty or sandy.

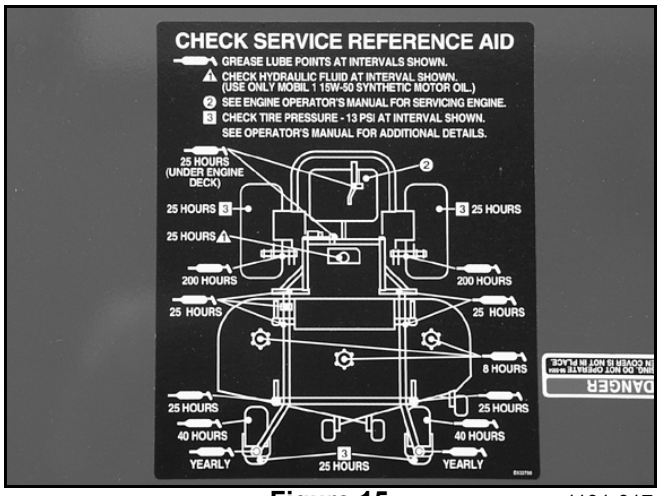


Figure 15 1101-017

Grease Type: General-purpose grease.

How to Grease

1. Disengage the power take off (PTO) and turn the ignition key to off. Move levers to neutral locked position and apply parking brake. Remove the key.

2. Clean the grease fittings with a rag. Make sure to scrape any paint off the front of the fitting(s).

3. Connect a grease gun to the fitting. Pump grease into the fittings until grease begins to ooze out of the bearings.

4. Wipe up any excess grease.

Greasing the Front Castor Pivots

Lubricate the front castor pivots once a year.

1. Remove hex plug and cap. Thread a grease zerk into hole.

2. Pump grease into zerk until it oozes out around top bearing.

3. Remove grease zerk in hole. Reinstall hex plug and cap.

Where to Add Grease

Lubricate the grease fittings as shown on the **Check Service Reference Aid** decal (Figure 15).

Where to Add Light Oil or Spray Lubrication

Lubricate the machine in the following areas with spray type lubricant or light oil. Lubricate every 160 hours.

- Seat switch actuator.
- Brake handle pivot.
- Brake rod bushings.
- Motion control bronze bushings.

Greasing the Bearings

The cutting unit must be lubricated daily. Refer to the “Recommended Maintenance Schedule” on page 2 - 1. Grease with No. 2 general purpose lithium base or molybdenum base grease.

Important Make sure cutting unit spindles are full of grease daily.

1. Stop the engine, set the parking brake, remove the key and disconnect the spark plug wire(s) from the spark plug(s).

2. Grease the fittings on the three spindle bearings until grease comes out lower seals (Figure 15).

3. Grease the fittings on the push arms (Figure 15).

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External Alternator Remove & Replace

1. Disconnect the battery negative cable.

Figure 16 0507-001

2. Remove the lower engine protection bracket and set the coolant recovery bottle off to the side.

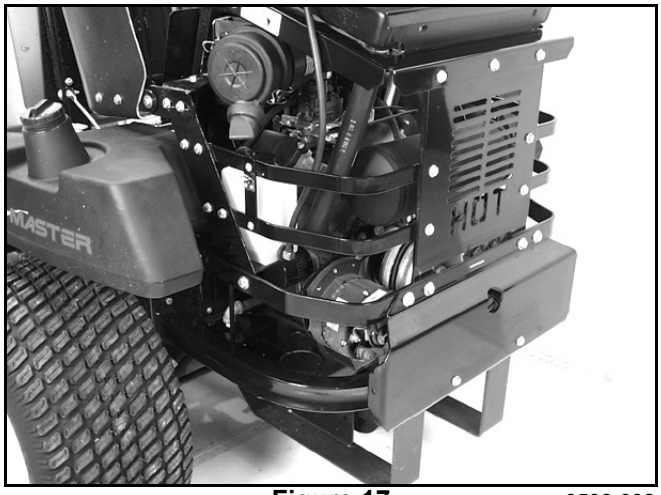

Figure 17 0508-002

3. Remove the alternator adjustment bolt and pivot bolt.

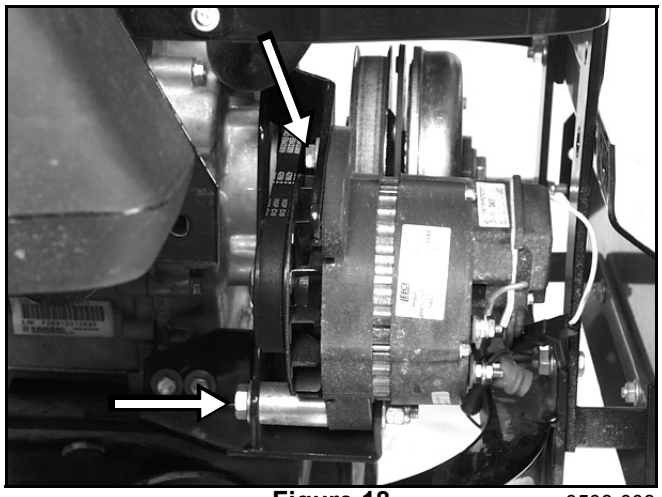

Figure 18 0508-003

4. Remove the alternator belt and rotate the alternator to gain access to the wiring.

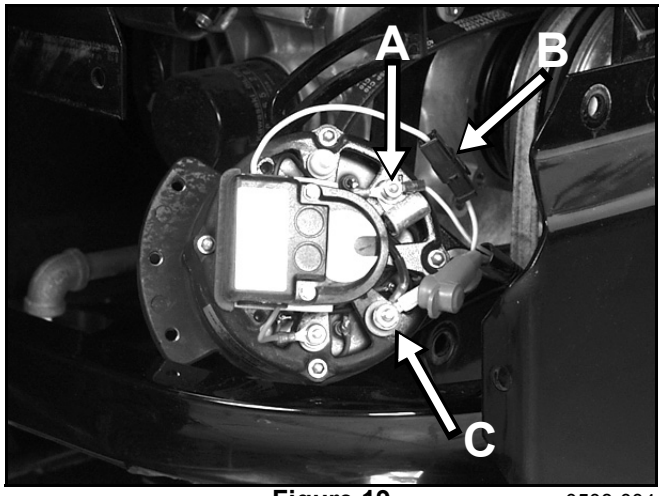

Figure 19 0508-004

(A) Ground Wire	(C) Output Wire
(B) Exciter Wire	

5. Remove the alternator output wire, ground wire, and exciter wire.

6. Inspect the alternator belt for wear, cracking, or other damage.

7. Reverse procedure to reinstall.

Engine Remove & Replace Air-Cooled

1. Disconnect the negative battery cable.
2. Remove the PTO clutch anchor bolt from the clutch guard.
3. Remove the clutch guard and clutch guard brackets (Figure 20).

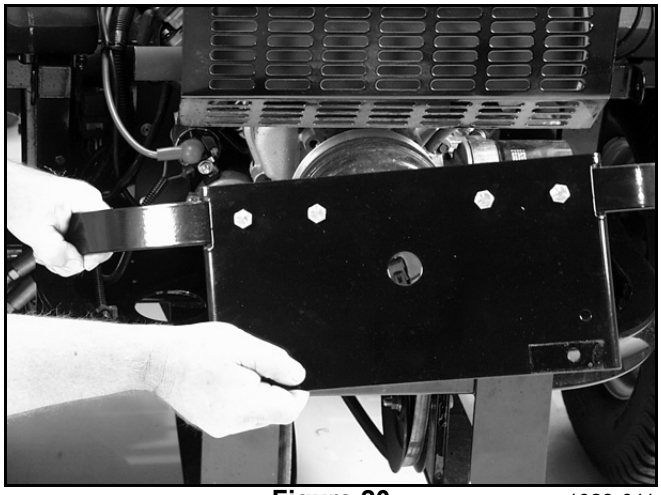

Figure 20 1023-011

4. Remove the battery cable, main power feed, and solenoid wire from the starter solenoid (Figure 21).

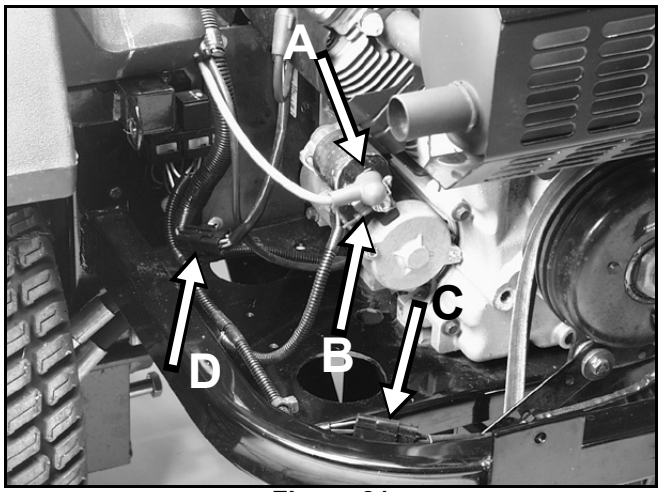

Figure 21 1023-008

(A) Battery Cable/ Power Feed	(C) Clutch Plug
(B) Solenoid Wire	(D) Main Harness Connector

5. Disconnect the PTO clutch electrical plug and main wiring harness connector (Figure 21).
6. Release the tension from the drive belt by raising the lever against the spring tension and remove the belt from the PTO pulley (Figure 22).

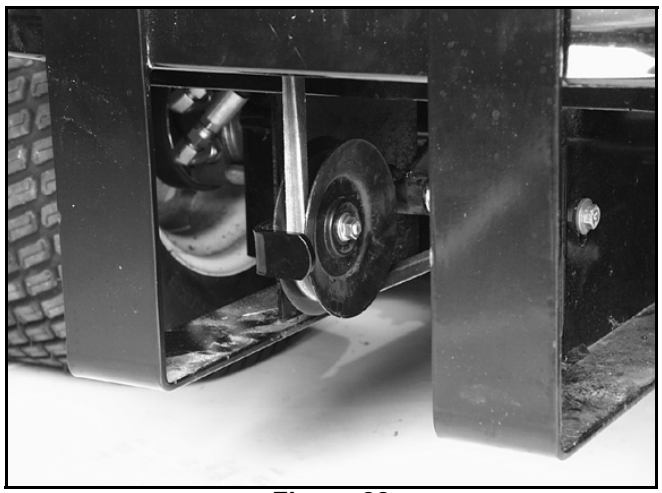

Figure 22 1101-011

7. Remove the clamps securing the choke and throttle cables. Then remove the Z bends from the choke and throttle levers (Figure 23).

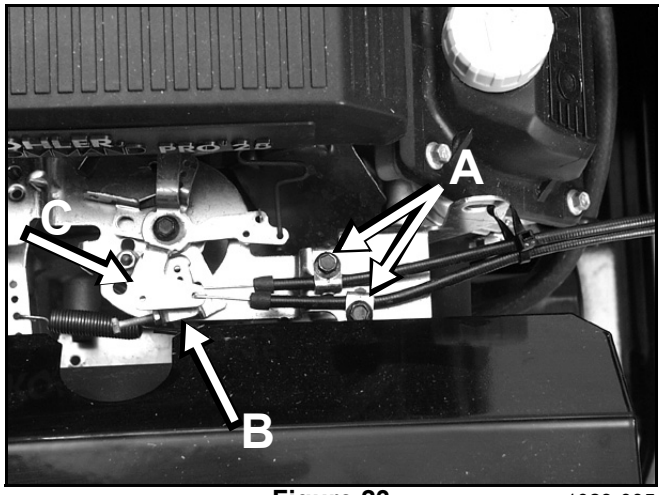

Figure 23 1023-005

(A) Cable Clamps	(C) Choke Lever
(B) Throttle Lever	

8. Place the fuel tank selector lever in the off position and disconnect the fuel supply line from the fuel filter.

9. Using a suitable pry bar, release the idler pulley spring tension and remove the hydraulic pump drive belt.

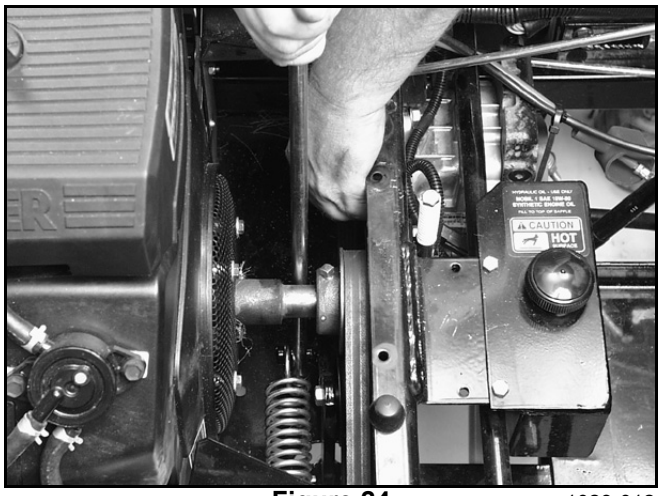

Figure 24 1023-012

10. Remove the 4 engine mounting bolts.

11. Slide the engine toward the rear of the machine and rotate it slightly counterclockwise until the hydraulic pump belt drive pulley clears the chassis. Then, lift the engine from the chassis.

Engine Remove & Replace Liquid-Cooled

1. Disconnect the negative battery cable.

Figure 25 0507-001

2. Remove the pins from the radiator cover and lift off the cover.

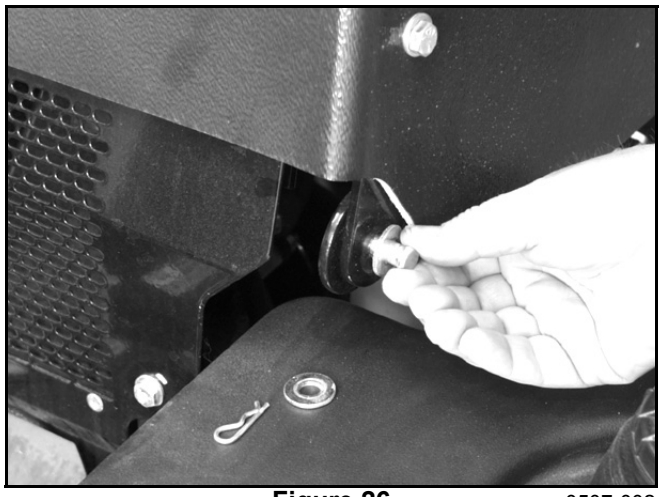

Figure 26 0507-002

3. Remove the radiator cap and open the drain petcock to drain the coolant into a suitable container.

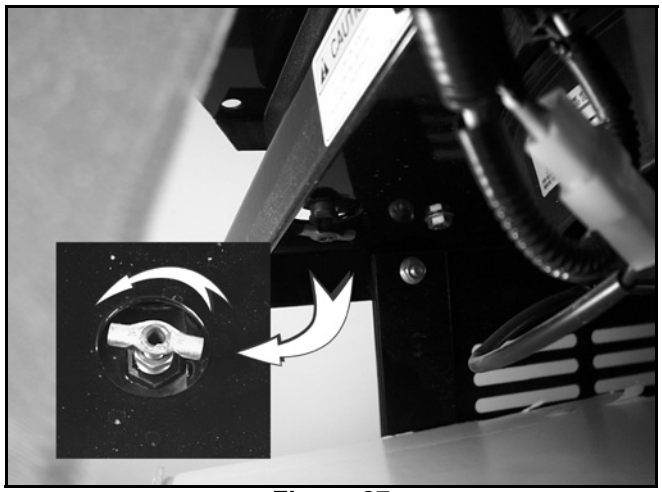

Figure 27 0507-003

4. To drain the block, remove the drain bolts. **NOTE**: apply sealant to the bolt threads during reassembly.

Figure 28 0507-004

5. Loosen the radiator hose clamps at the water pump and thermostat housing and remove the hoses from the fittings.

6. Unplug the electrical connections from the temperature sender and fan motor.

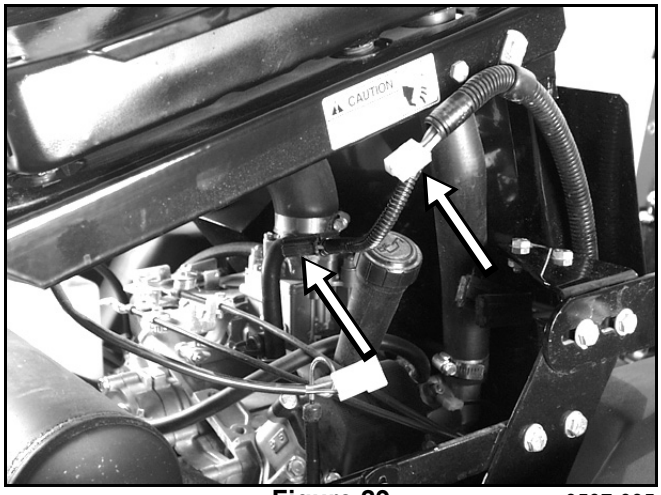

Figure 29 0507-005

7. Remove the bolts securing the overflow bottle to the engine guard.

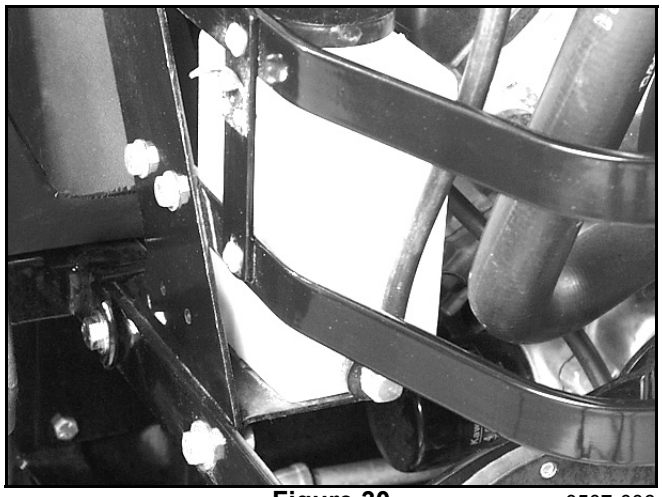

Figure 30 0507-006

8. Remove the 7 bolts securing the radiator support to the engine guard.

9. Carefully lift the radiator assembly from the unit.

Figure 31 0507-007

10. Remove the hose clamp from the air cleaner duct at the carburetor.

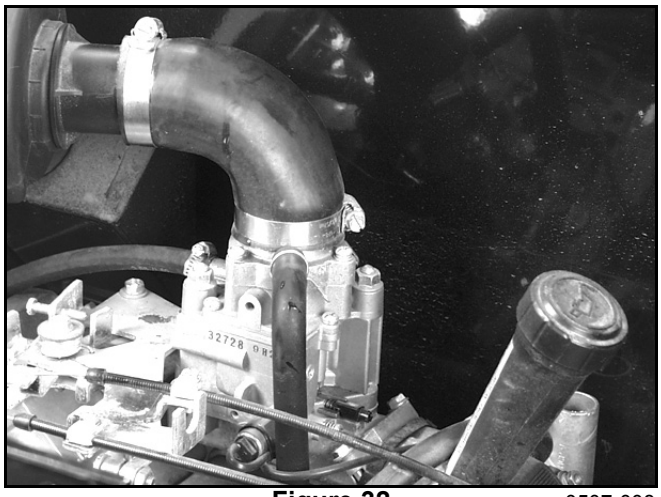

Figure 32 0507-008

11. Remove the 2 bolts securing the air cleaner to the frame and remove the air cleaner.

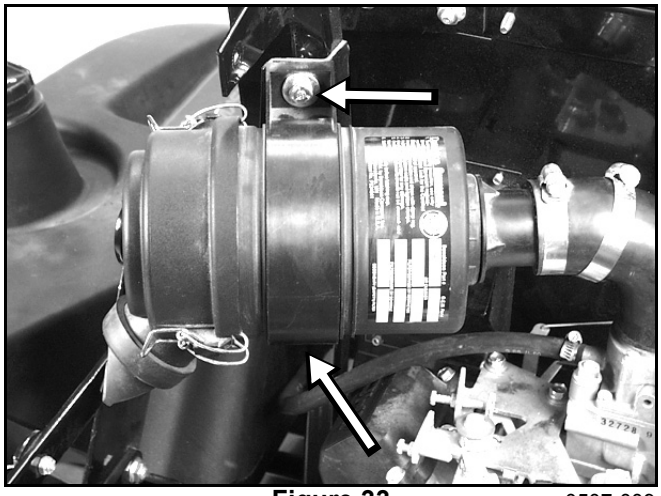

Figure 33 0507-009

12. Remove the 6 bolts securing the rear bumper to the engine guard.

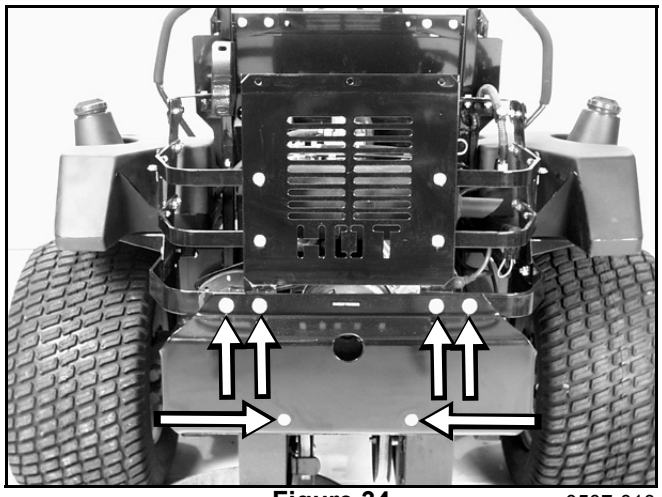

Figure 34 0507-010

13. Remove the bolts securing the engine guard bars to the brackets.

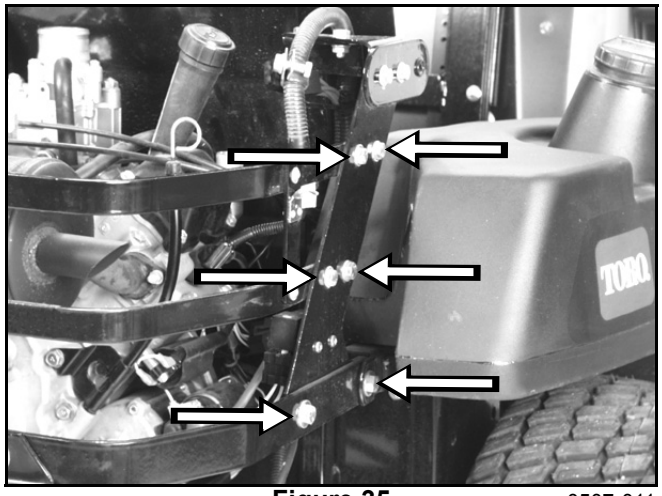

Figure 35 0507-011

14. Remove the bolts holding the engine guard to the frame, and then remove the guard.

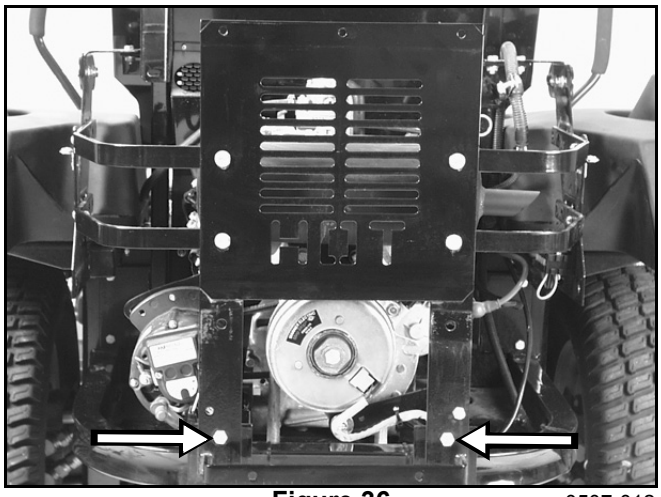

Figure 36 0507-012

15. Disconnect the positive battery cable and main power feed from the starter. Then separate the engine harness connector and electric clutch connector. Then remove the engine ground wires.

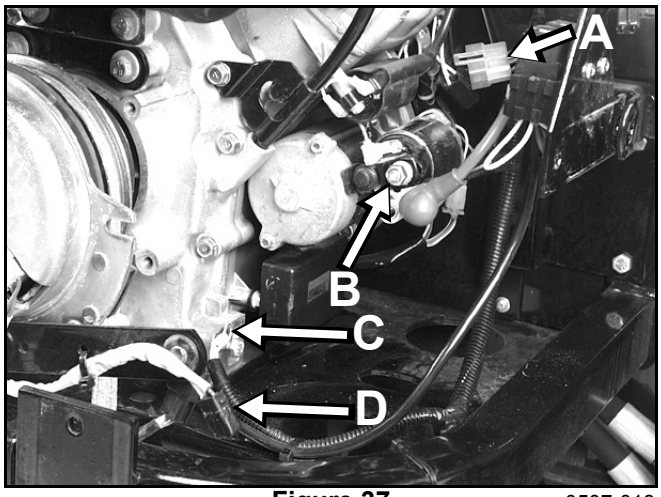

Figure 37 0507-013

(A) Engine Harness	(C) Engine Ground
(B) Positive Battery Cable	(D) Clutch Connector

16. Remove the alternator output and ground wires.

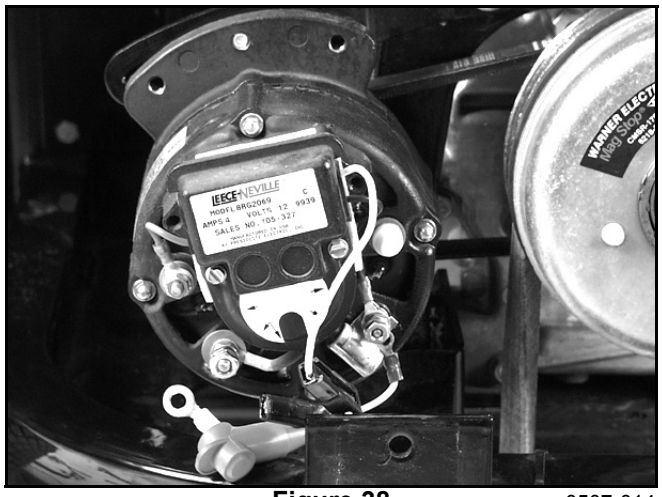

Figure 38 0507-014

17. Lift the lever on the deck belt tension pulley and remove the belt.

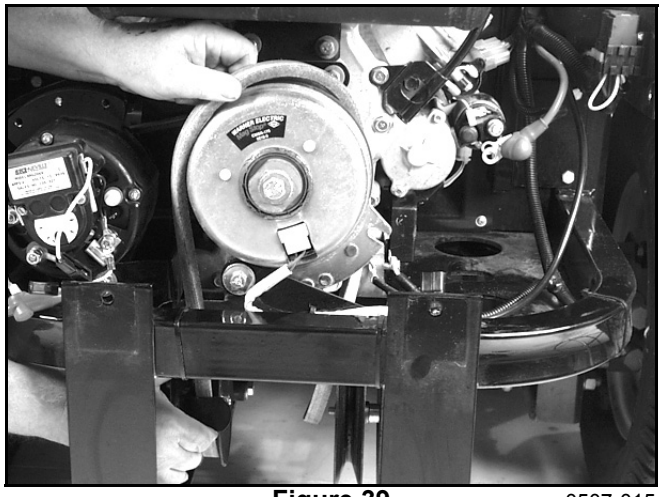

Figure 39 0507-015

18. Remove the control wires for the carburetor choke and throttle control.

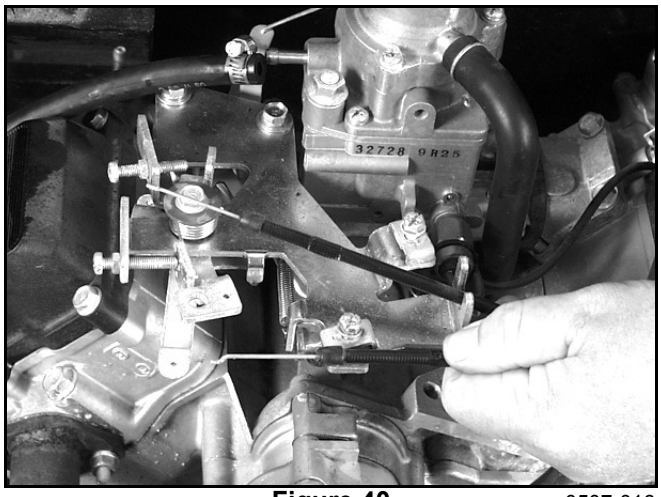

Figure 40 0507-016

19. Use a bar to release the drive belt tension and remove the belt.

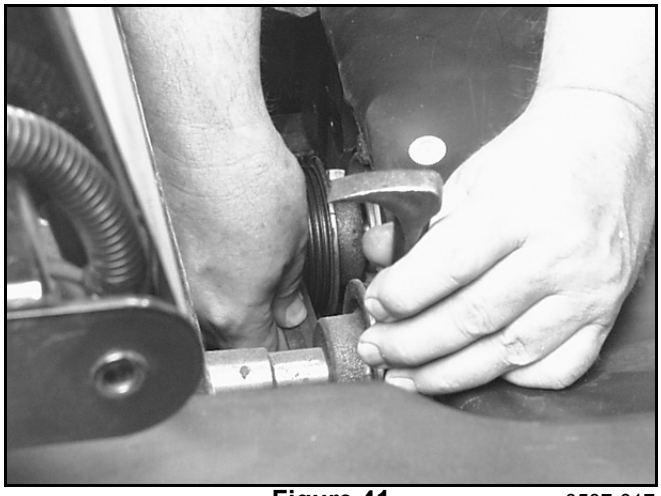

Figure 41 0507-017

20. Make sure the fuel selector is in the off position. Then remove the fuel line from the carburetor. **CAUTION:** Gasoline is extremely flammable. Drain into a suitable container and keep away from any source of combustion.

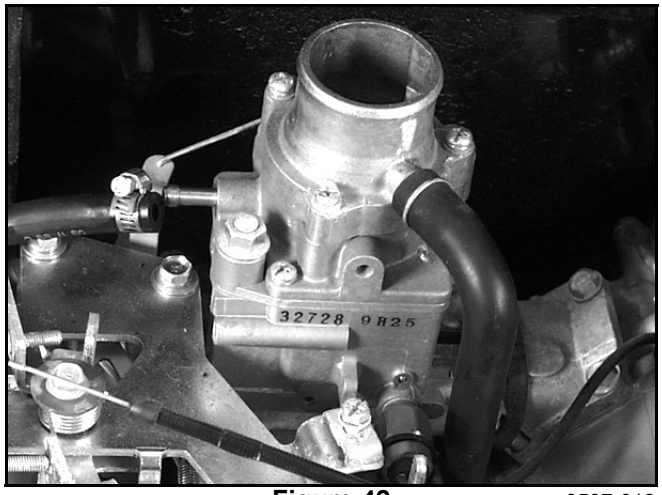

Figure 42 0507-018

21. Remove the bolts securing the engine base to the chassis. Then carefully slide the engine back, making sure that the fan clears the fan shroud.

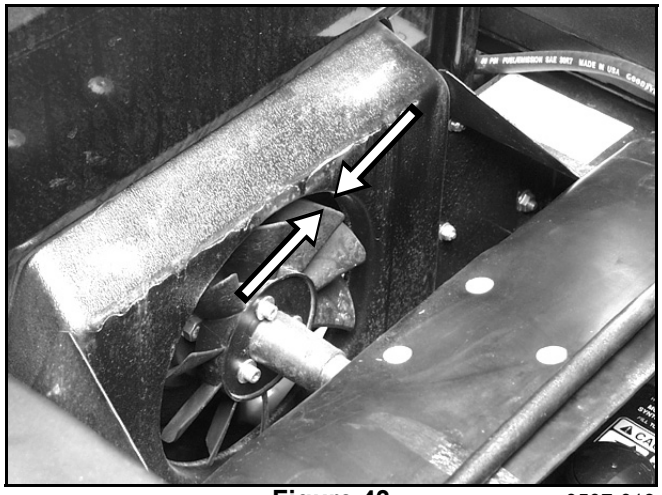

Figure 43 0507-019

Radiator Remove & Replace Liquid-Cooled Mowers

1. Disconnect the negative battery cable.

Figure 44 0507-001

2. Remove the pins from the radiator cover and lift off the cover.

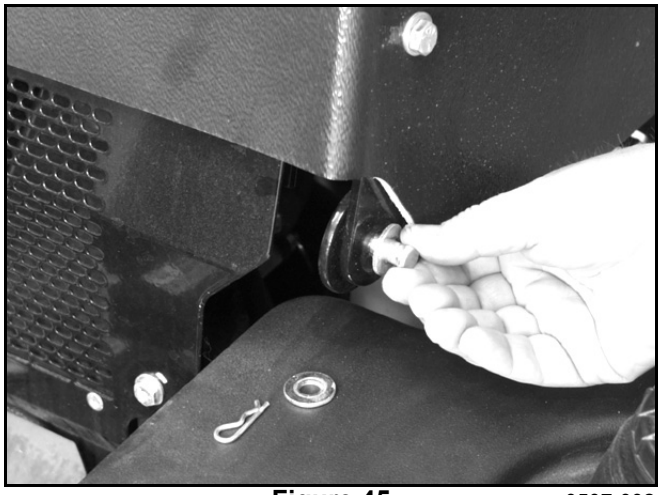

Figure 45 0507-002

3. Remove the radiator cap and open the drain petcock to drain the coolant into a suitable container.

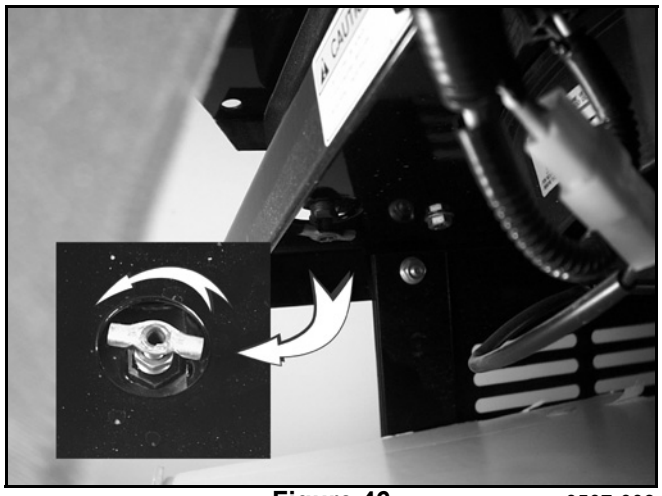

Figure 46 0507-003

4. To drain the block, remove the drain bolts.
   NOTE: Apply sealant to the bolt threads during reassembly.

Figure 47 0507-004

5. Loosen the radiator hose clamps at the water pump and thermostat housing and remove the hoses from the fittings.

6. Unplug the electrical connections from the temperature sender and fan motor.

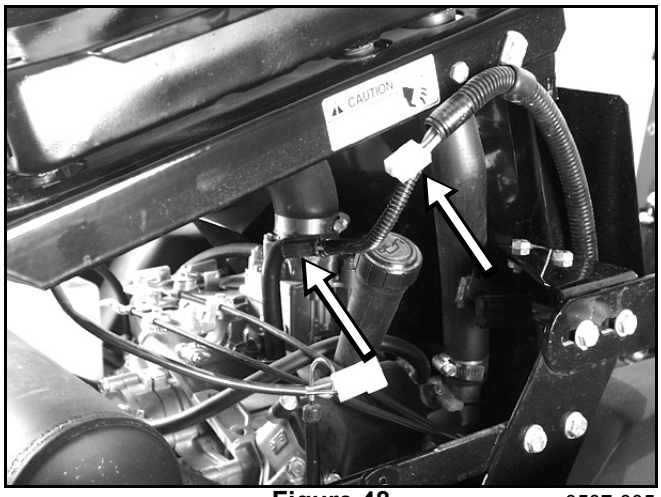

Figure 48 0507-005

7. Remove the overflow hose from the radiator.

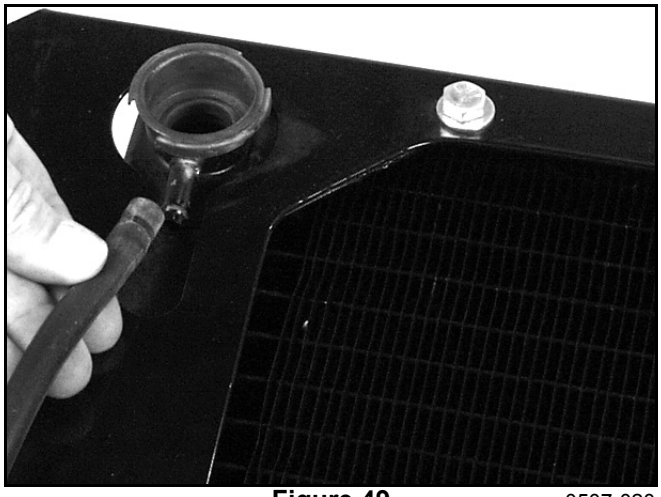

Figure 49 0507-020

8. Remove the 7 bolts securing the radiator support to the engine guard.

9. Carefully lift the radiator assembly from the unit.

Figure 50 0507-007

10. Remove the hose clamps from the radiator fittings.

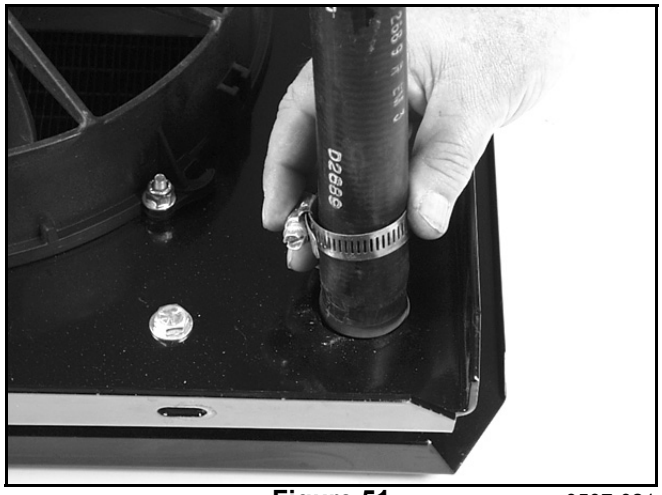

Figure 51 0507-021

11. Remove the 6 bolts securing the lower radiator support to the radiator, and then lift off the support.

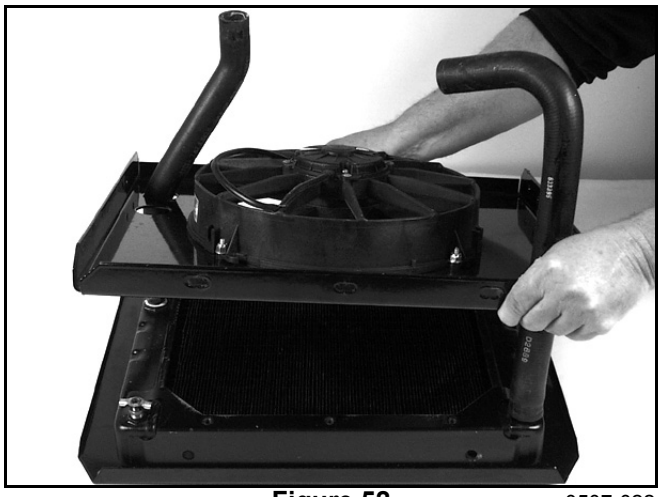

Figure 52 0507-022

12. Carefully work the hoses free from the radiator fittings.

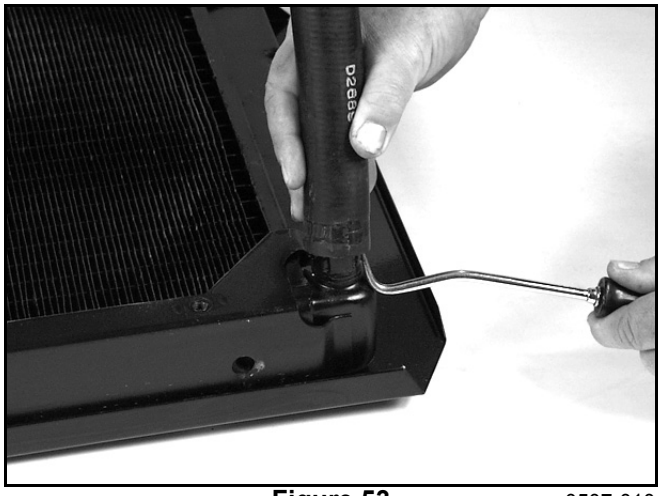

Figure 53 0507-010

13. Turn the radiator over. Remove the 6 bolts securing the upper radiator support to the radiator and remove the support.

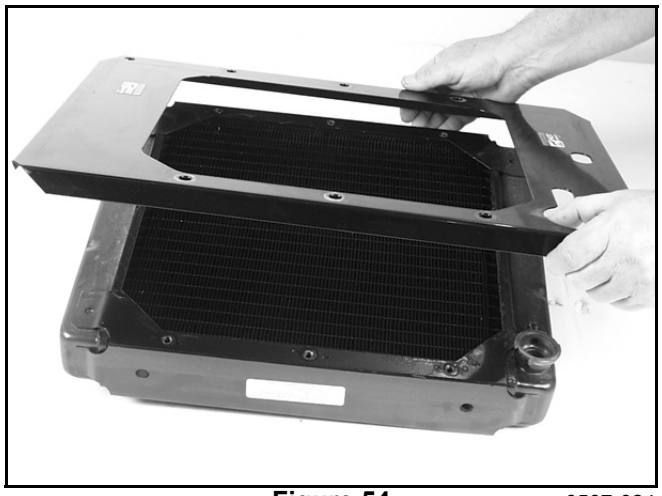

Figure 54 0507-024

14. If it is necessary to remove the electric fan assembly, remove the 4 nuts and bolts securing it to the lower radiator support.

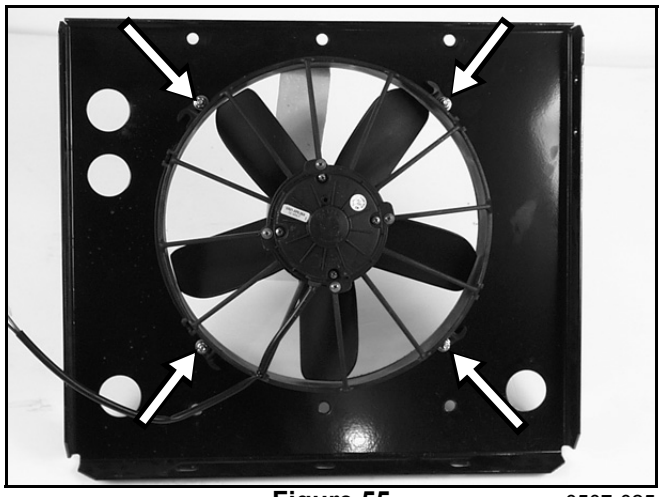

Figure 55 0507-025

Models Equipped With Electronic Fuel Injection (EFI)

For engine specific service or diagnostics procedures consult the engine manufacture's service manuals.

The following are the locations of components which are EFI related but mounted to the unit's chassis.

1. The fuel pressure regulator is mounted to the right side of the frame behind the rear tire.

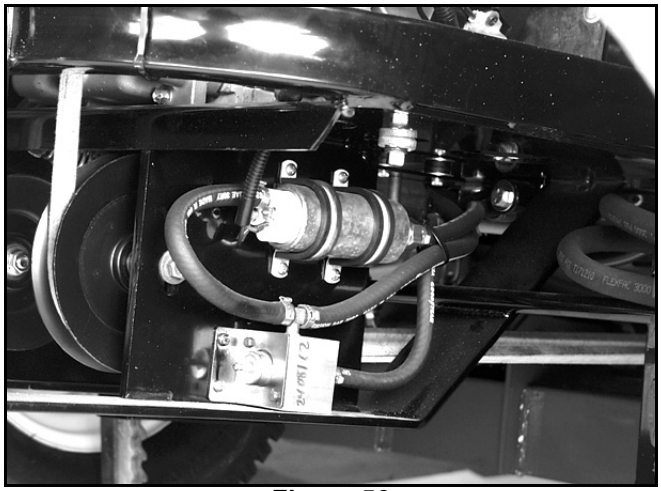

Figure 56 0507-026

2. The electronic control unit (ECU) is located under the engine at the rear of the unit.

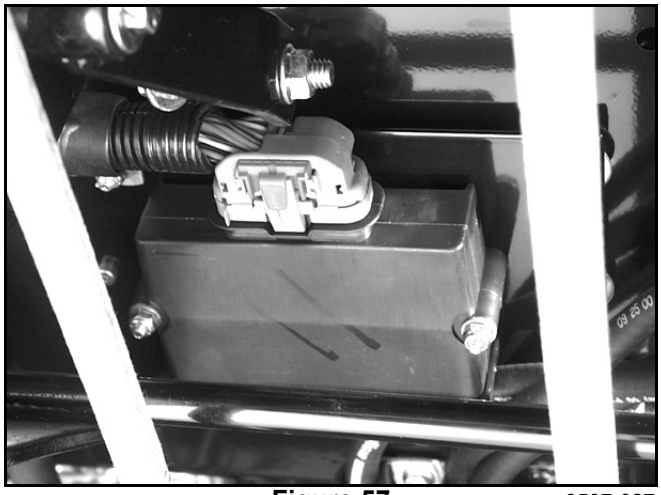

Figure 57 0507-027

3. The diagnostic plug is installed on the right side of the machine near the starter.

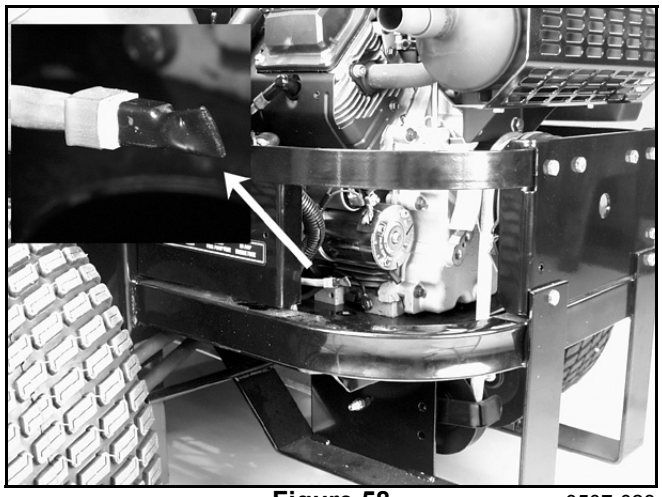

Figure 58 0507-028

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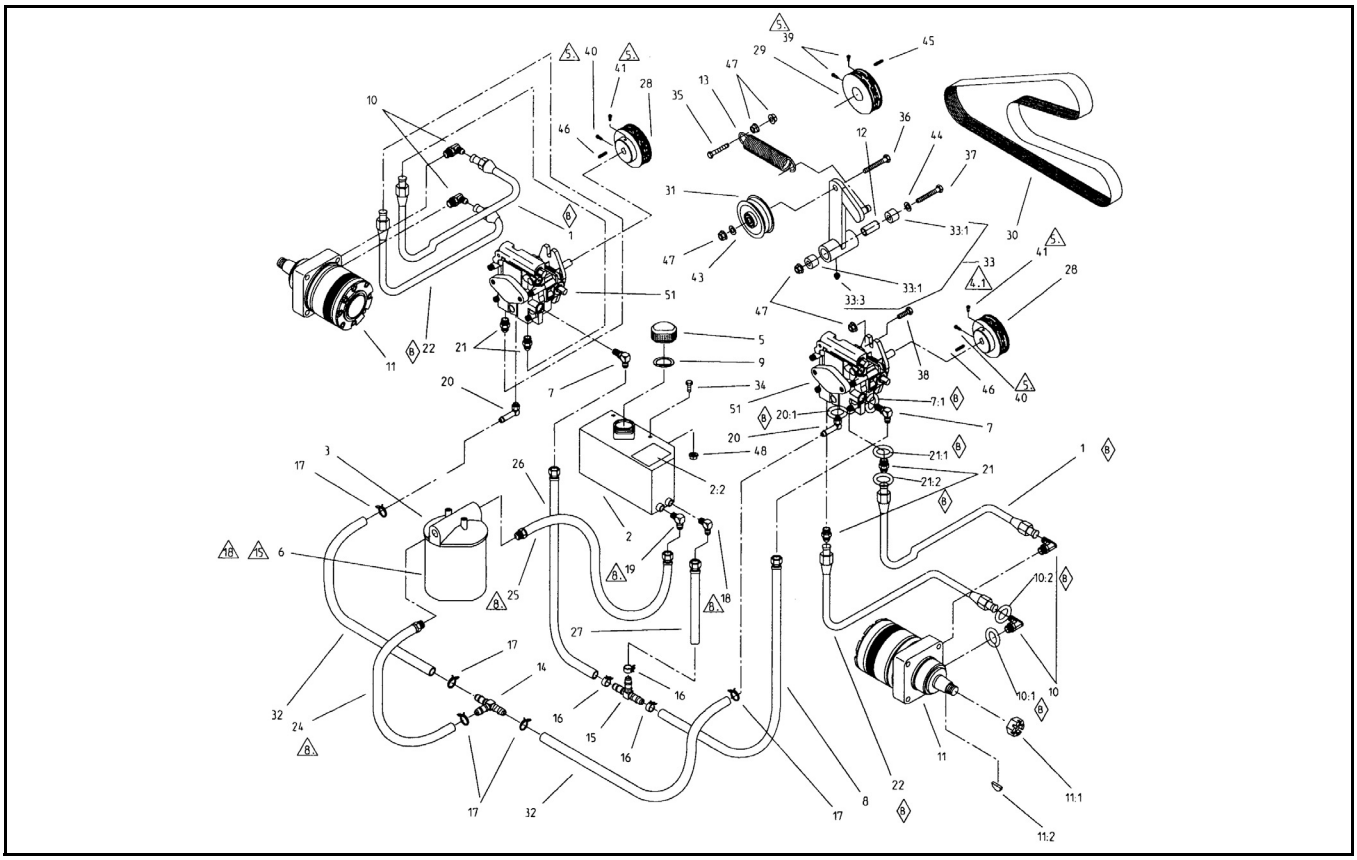
Hydraulic System, Typical



Ref. No.	Qty.	Description
1	2	Upper Hose
2	1	Hydraulic Tank ASM
3	1	Head Filter
5	1	Cap (Hydraulic Reservoir)
6	1	Hyd Filter
6	1	Winter Hyd Filter
7	2	90 Deg Fitting
8	1	Low Pressure Hose ASM
9	1	Tank Cap Gasket
10	4	Connector Fitting
10	4	90 Deg Fitting
11	2	Wheel Motor
12	1	Idler Pivot Bushing
13	1	Extension Spring
14	1	Hose Tee Fitting
15	1	Hose Tee Fitting
16	3	Hose Clamp
17	5	Hose Clamp
18	1	Elbow Fitting
19	1	Elbow Fitting
20	2	Elbow Fitting
21	4	Straight Fitting
22	2	Lower Hose
24	1	Hose ASM

Ref. No.	Qty.	Description
25	1	Hose ASM
26	1	Hose ASM
27	1	Hose ASM
28	2	Sheave
29	1	Sheave
30	1	Pump Drive Belt
31	1	Idler Sheave
32	2	Lower Pressure Hose
33	1	Bearing Arm ASM
34	2	HH Screw
35	1	HH Screw
36	1	HH Screw
37	1	HH Screw
38	4	HH Screw
39	2	Screw
40	2	Screw
41	2	Set Screw
43	1	Flat Washer
44	1	Flat Washer
45	1	Square Key
46	2	Machine Key
47	8	Flange Nut
48	2	HF Nut
51	2	RH Hydraulic Pump
51	1	Overhaul Seal Kit

HYDRAULIC SYSTEMS

Description

The hydraulic system consists of a fluid reservoir supplying 2 Hydro-Gear BDP-10L hydrostatic pumps through a spin-on filter. The pumps are controlled by adjustable wrap around handles through a bellcrank and linkage to the pump control lever. These pumps also feature a bypass valve which may be opened to allow the unit to be pushed by hand.

Fluid from the main hydraulic passages of each pump are routed through high pressure rubber hoses and fittings to Ross MB15 Motors located at each wheel. Refer to the appropriate Hydro-Gear or Ross service manual for pump and motor service procedures.

General Hydraulic Assembly Guidelines

The following guidelines must be followed to in order to maintain a leak free unit:

1. Extreme care must be taken to prevent any dirt/ debris from entering the hydraulic system. Always cover open lines and fitting with clean plugs or aluminum foil.

2. Do not pull plastic plugs until just prior to assembly. Make sure that no paint flakes fall into the open port. Do not remove plastic plugs with a sharp knife.

3. Ensure that the fittings are clean, free from nicks, and corrosion. The insides of all hoses and lines must be clean.

4. Always apply clean oil to all O-rings prior to assembly.

5. Once a hose or steel line is started, it is important to continue to tighten until finger tight. This is done to ensure the O-ring stays in its groove.

6. A back-up wrench must be used any time a hose is tightened. This prevents the hose from turning and damaging or dislodging the O-ring.

7. All hydraulic fittings must be torqued to specifications (see Torque Recommendations For Hydraulic Fittings chart on page 1 - 3.

Replacing the Pump Drive Belt

Check pump drive belt for wear after every 50 hours of operation.

1. Using a suitable pry bar, release the spring tension on the idler pulley and remove the drive belt from the pump pulley (Figure 59).

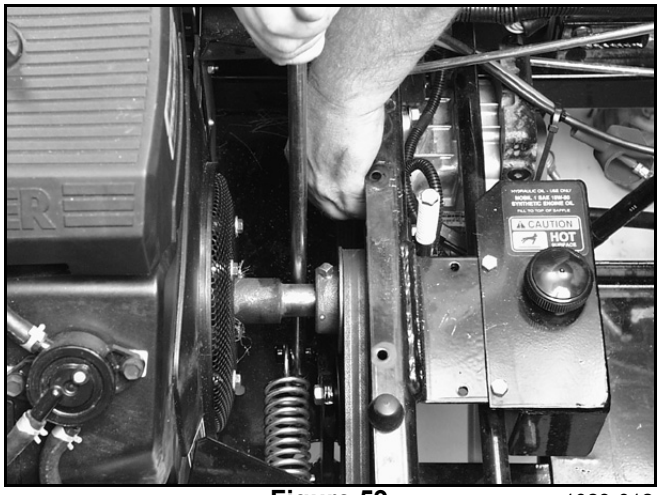


Figure 59 1023-012

2. Install new belt around engine and hydro pump pulleys (Figure 60).

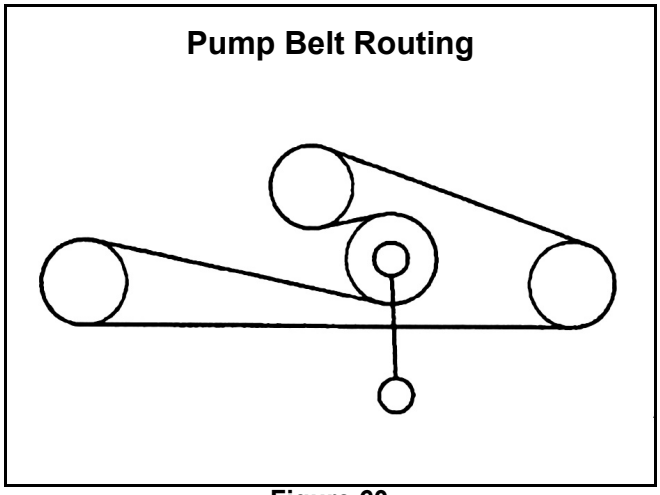


Figure 60

3. Pull spring loaded idler down and align below traction belt. Release pressure on spring loaded idler (Figure 60).

Pump Removal

1. Clean the pump of any dirt and debris that may be around the hoses to prevent dirt from entering the hydraulic system (Figure 61).

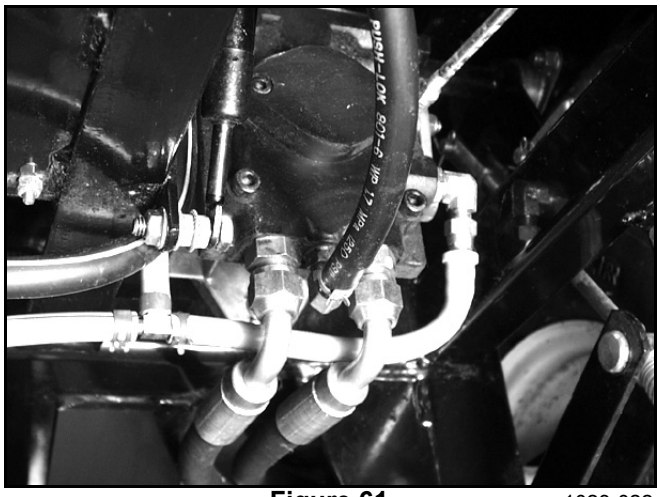


Figure 61 1023-022

2. Remove the control rod from the trunion lever (Figure 62).

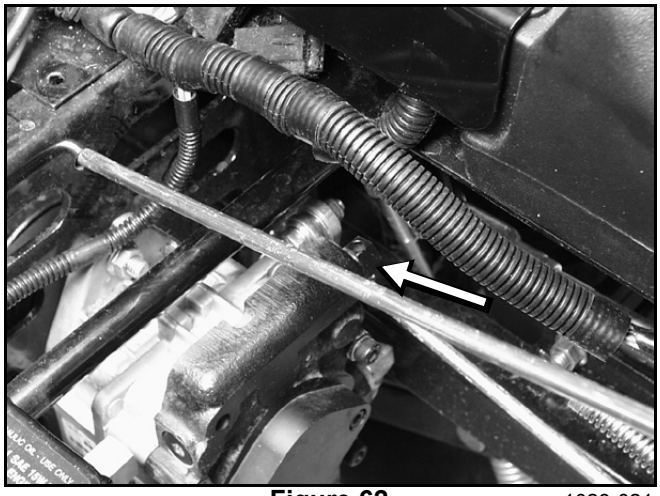


Figure 62 1023-021

3. Place a drain pan below the pump and remove the supply and return hoses from the pump.

4. Mark the location of the wheel motor supply hoses as to which fitting they go on the wheel motor. Remove the hose fittings to the pump and install caps to keep dirt out.

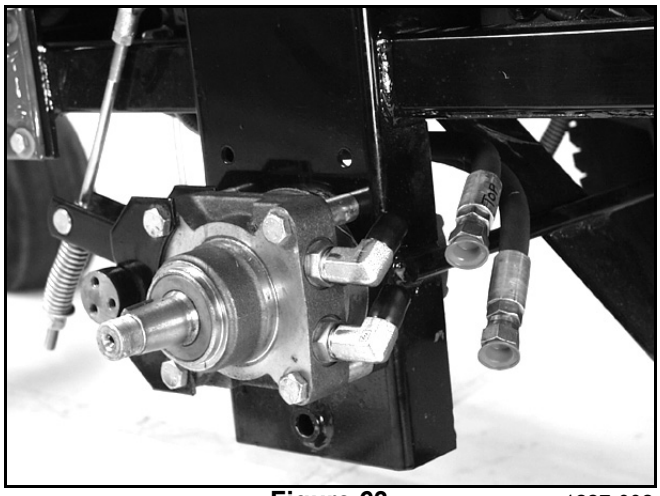


Figure 63 1227-002

5. Using a suitable pry bar, release the spring tension on the idler pulley and remove the drive belt from the pump pulley (Figure 64).

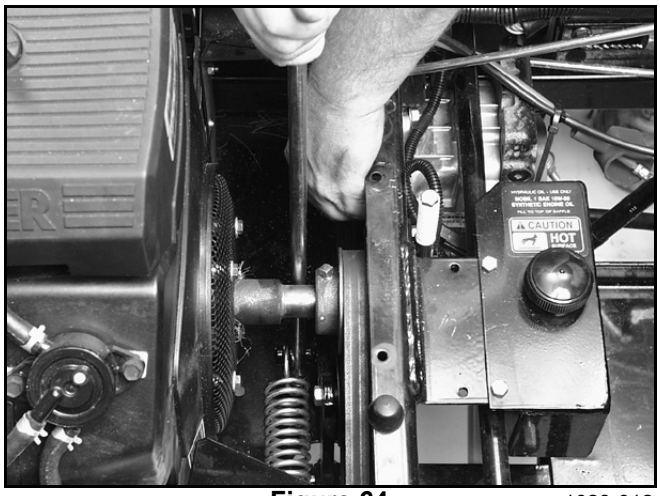


Figure 64 1023-012

6. Remove the 2 nuts and bolts securing the pump to the chassis and remove the pump.

7. Reverse steps 2 - 6 to install.

Adjusting the Hydraulic Pump Neutral

Note: Adjust handle neutral first. That has to be correct before the following adjustment can be made.

Refer to "Replacing the Parking Brake and Linkage" on page 5 - 4.

DANGER

Mechanical or hydraulic jacks may fail to support machine and cause a serious injury.

- **Use jack stand when supporting machine.**
- **Do not use hydraulic jacks.**

1. This adjustment must be made with drive wheels turning. First raise the frame and block up so drive wheels can rotate freely.

WARNING

Engine must be running so motion control adjustment can be performed. Contact with moving parts or hot surfaces may cause personal injury.

Keep hands, feet, face, clothing and other body parts away from rotating parts, muffler and other hot surfaces.

2. Slide seat forward, disconnect prop rod and tilt seat fully forward.

3. Disconnect electrical connector from the seat safety switch. **Temporarily** install a jumper wire across terminals in the wiring harness connector.

4. Loosen locknut at ball joint on pump control rod (Figure 65).

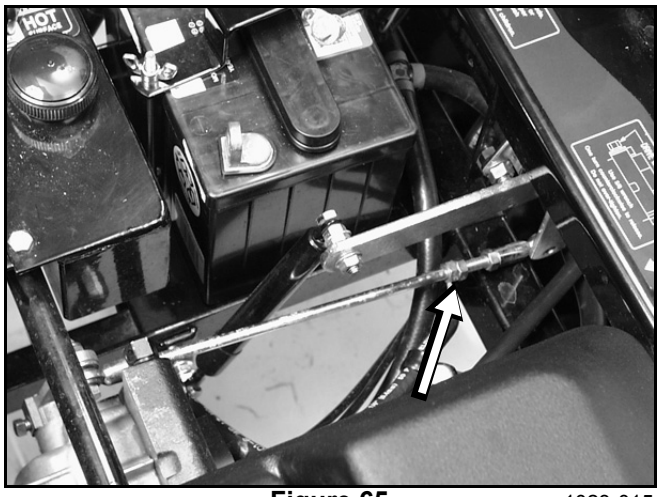


Figure 65 1023-015

5. Start engine, open throttle 1/2 way and release parking brake.

Note: The front nut of each rod has left-hand threads.

6. Adjust pump rod length by rotating double nuts on rod, in the appropriate direction, until wheel is still or slightly creeps in reverse (Figure 66).

Figure 66 1227-005

7. Move motion control lever forward and reverse, then back to neutral. Wheel must stop turning or slightly creep in reverse.

Note: Motion control lever must be in neutral while making any adjustments.

8. Open throttle to fast. Make sure wheel remains stopped or slightly creeps in reverse, re-adjust if necessary.

9. Repeat on opposite side of unit. Tighten locknuts against ball joints.

WARNING

Electrical system will not perform proper safety shut off with jumper wire installed.

- **Remove jumper wire from wire harness connector and plug connector into seat switch when adjustment is completed.**
- **Never operate this unit with jumper installed and seat switch bypassed.**

10. Shut off unit. Remove jumper wire from wire harness connector and plug connector into seat switch.

11. Reinstall prop rod and lower seat.

Wheel Motor R & R

1. Disconnect the battery negative cable

2. Raise the rear wheels of the machine off the ground and support frame with safety stands.

3. Apply the parking brake and remove the drive wheel (Figure 67).

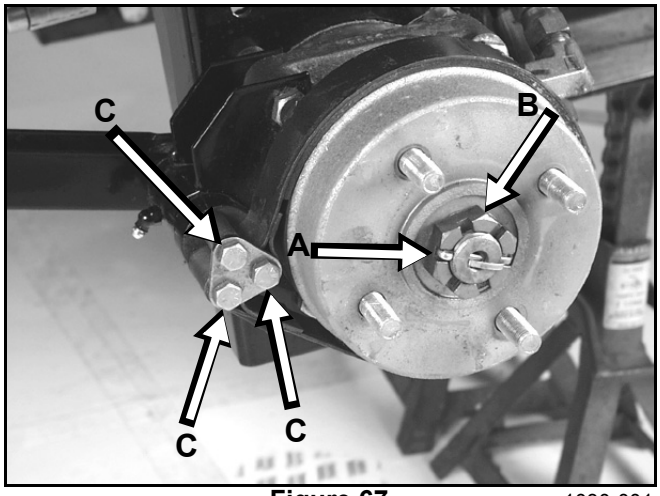


Figure 67 1030-001

4. Remove the cotter pin (A) (Figure 67) from the wheel motor output shaft. Then loosen the nut (B) (Figure 67) securing the hub to the output shaft. Release the parking brake.

5. Remove the 3 bolts securing the brake band (C) (Figure 67) to the brake actuator. Then, remove the brake band from the hub.

6. Install the special puller on to the hub and tighten the forcing screw until the hub is free of the wheel motor output shaft (Figure 68).

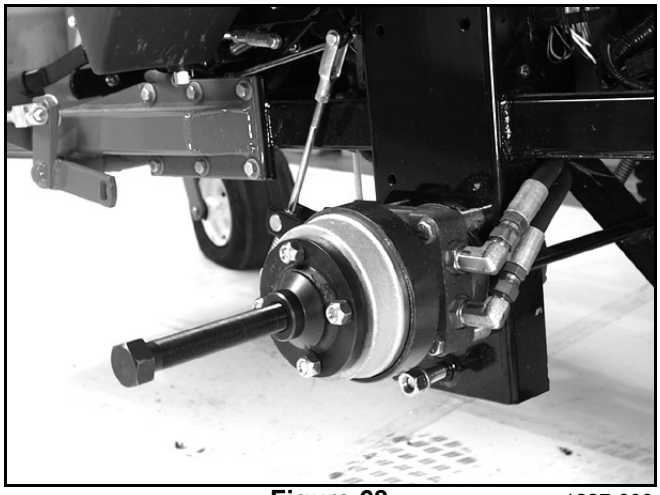


Figure 68 1227-003

7. Clean any dirt and debris away from the hydraulic line fittings. Then, remove the hydraulic hoses from the fittings and cap the fittings and hoses to prevent dirt from entering the hydraulic system (Figure 69).

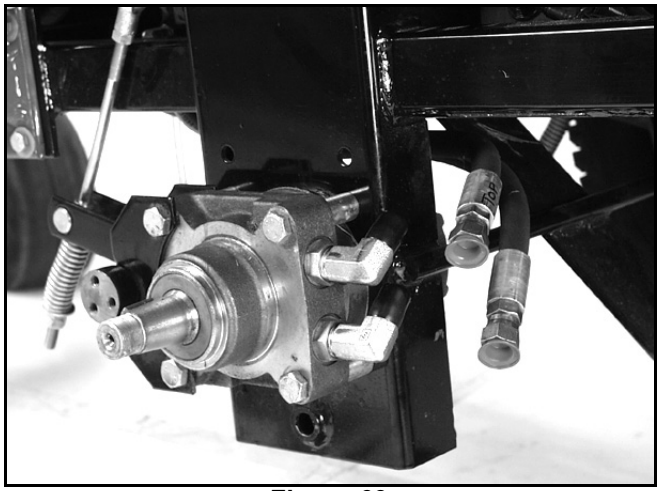


Figure 69 1227-002

8. Remove the front two wheel motor mounting bolts and swing the brake linkage out of the way (Figure 70).

9. Remove the rear two wheel motor mounting bolts and then remove the wheel motor from the chassis (Figure 70).

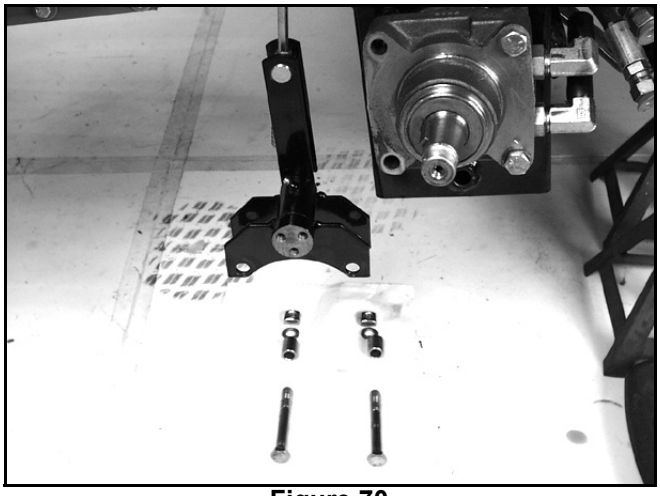


Figure 70

Motion Control Linkage - Remove and Replace

1. Remove the 6 bolts securing the console to the rear frame assembly. Then, carefully lower the console to gain access to the motion control linkage (Figure 71).

Figure 71 1023-014

2. Remove the electrical plug from the neutral switch (Figure 72).

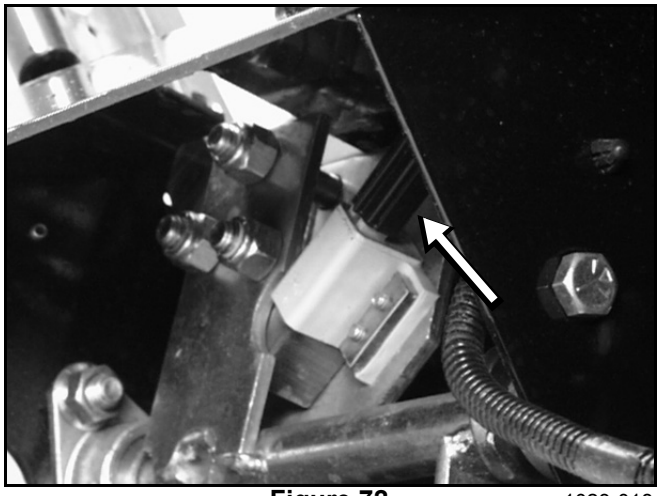


Figure 72 1023-018

3. Remove the motion control handle.

4. Remove the pin from the clevis on the control lever centering rod (Figure 73).

5. Remove the control link from the bell crank (Figure 73).

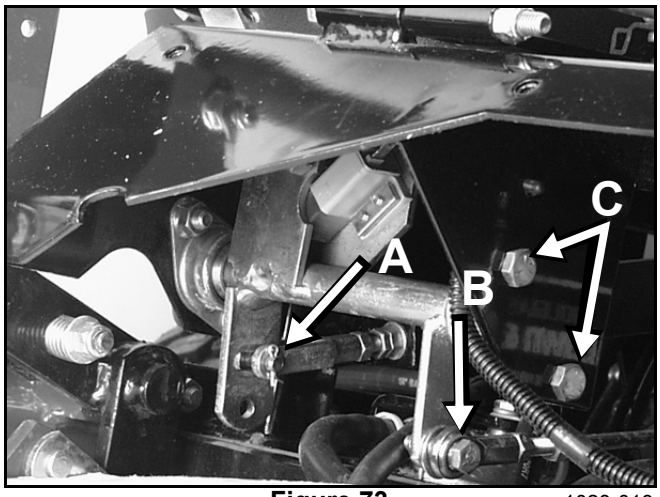


Figure 73 1023-013

(A) Clevis Pin	(C) Inner Bearing Bolts
(B) Control Rod	

6. Disconnect the steering dampening cylinder from the bell crank.

7. Remove the bolts securing the bell crank inside bearing (Figure 73).

8. Remove the bolt securing the bell crank outside bearing (Figure 74).

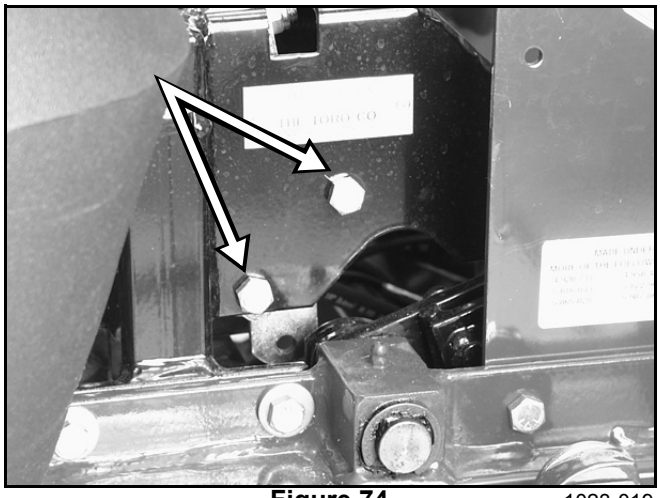


Figure 74 1023-019

9. Carefully remove the bell crank from the chassis (Figure 75).

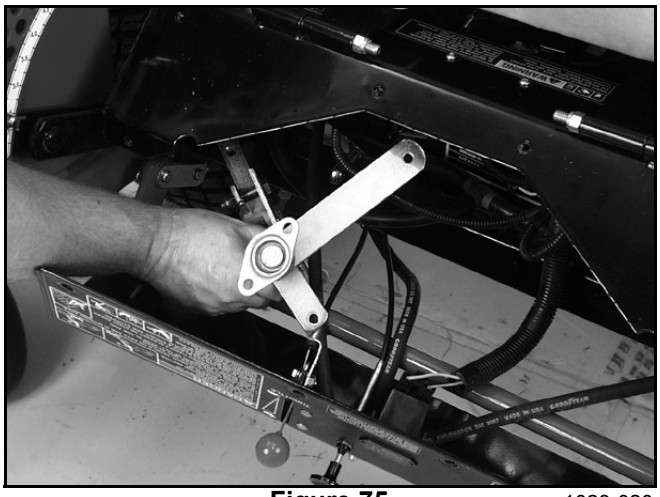


Figure 75 1023-020

Adjusting the Handle Neutral

If motion control levers do not align, or move easily into the console notch, adjustment is required. Adjust each lever, spring and rod separately.

1. Stop engine, remove ignition key and tilt seat forward.

2. Begin with either the left or right motion control lever. Move lever to the neutral (but not locked) position and pull lever back until the clevis pin (on arm below pivot shaft) contacts the end of the slot (just beginning to put pressure on spring) (Figure 76).

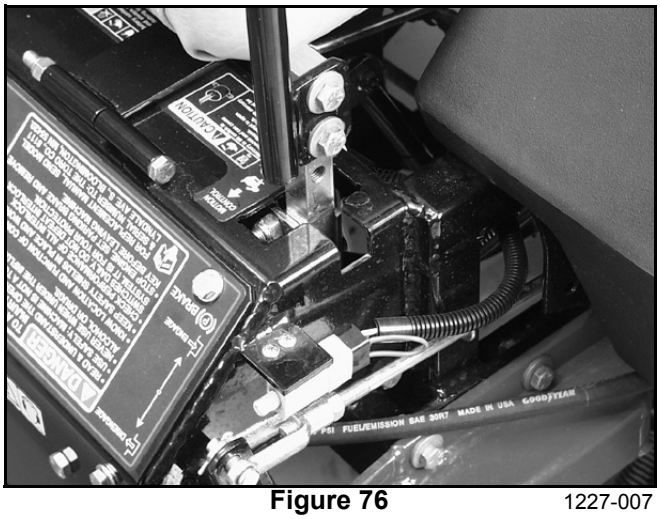


Figure 76 1227-007

3. Check where lever is relative to notch in console (should be centered allowing lever to pivot outward to the neutral lock position) (Figure 76).

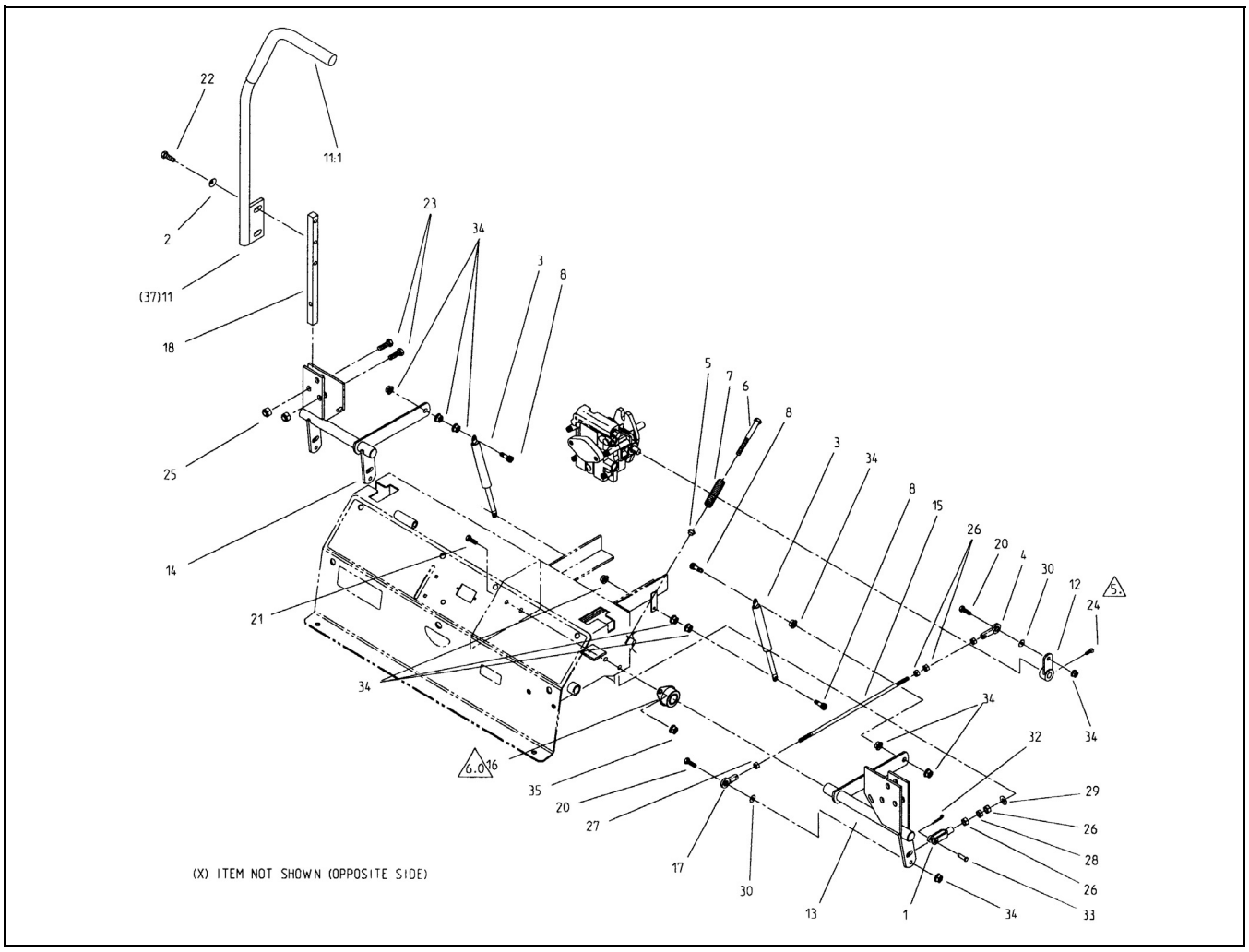
4. If adjustment is needed, loosen the nut against the yoke.

5. Apply slight rearward pressure on the motion control lever, turn the head of the adjustment bolt in the appropriate direction until lever is centered in neutral lock position (keeping rearward pressure on the lever 40 will keep the pin at the end of the slot and allow the adjustment bolt to move the lever to the appropriate position).

6. Tighten nut and jam nut.

Repeat on opposite side of unit.

Control Linkage, Typical



Ref. No.	Qty.	Description
1	2	Adjustable Yoke
2	4	Belleville Washer
3	2	Control Damper
4	2	RH Ball Joint
5	2	Nylon Flanged Bushing
6	2	Neutral Return Bolt
7	2	Neutral Return Spring
8	4	HH Screw
11	1	RH Lever/Grip ASM
12	2	Pump Control Arm WLD
13	1	LH Motion Control
14	1	RH Motion Control
15	2	Pump/Lever Linkage
16	4	Side Flange Bearing
17	2	LH Thread Ball Joint
18	2	Control Shaft Arm

Ref. No.	Qty.	Description
20	4	HH Screw
21	8	HH Screw
22	4	HH Screw
23	6	HH Screw
24	2	Screw
25	6	Lock Nut
26	10	Hex Nut
27	2	Nut
28	2	Nut
29	2	Flat Washer
30	4	Flat Washer
32	2	Cotter Pin
33	2	Clevis Pin
34	16	HF Nut
35	8	Flange Nut
37	1	LH Lever/Grip ASM

Replacing the Parking Brake and Linkage

1. Remove the negative battery cable.
2. Raise the drive wheels and place the unit on safety stands.
3. Remove the tire and wheel assemblies.
4. Remove the 3 bolts securing the brake band to the brake pivot (Figure 77).

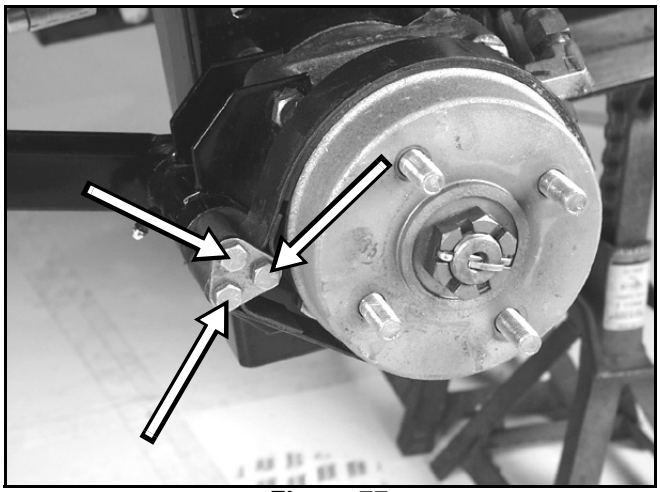


Figure 77 1030-001

5. Inspect the brake bands for wear, damage, or overheating (Figure 78).

Figure 78 1030-002

6. Using the special puller, remove the brake hub from the wheel motor (Figure 79).

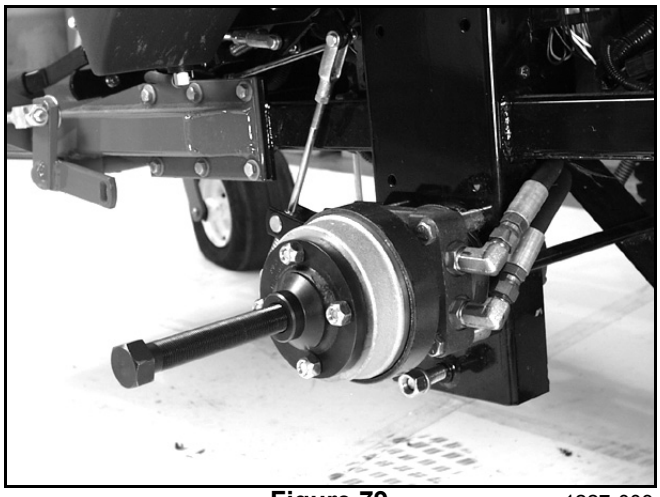


Figure 79 1227-003

7. Remove the 3 clevis pins from the brake rods and remove the brake rods from the brake shaft (Figure 80). The third pin is on the opposite end of the brake shaft.

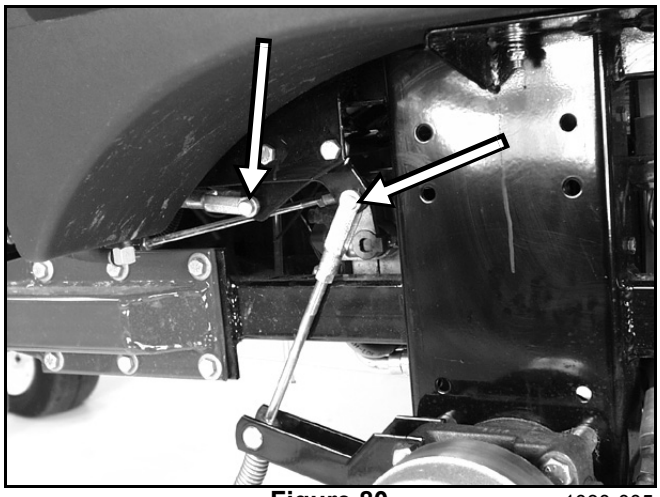


Figure 80 1030-005

8. To remove the brake brackets, remove the 2 bolts at the front of the wheel motor and remove the bracket (Figure 81).

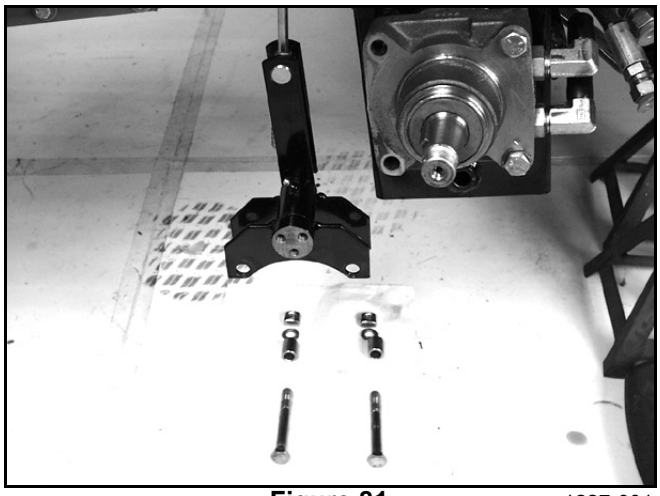


Figure 81 1227-001

9. To remove the brake shaft, first remove the hydraulic fluid reservoir which is held in place by 2 cap screws and nuts (Figure 82).

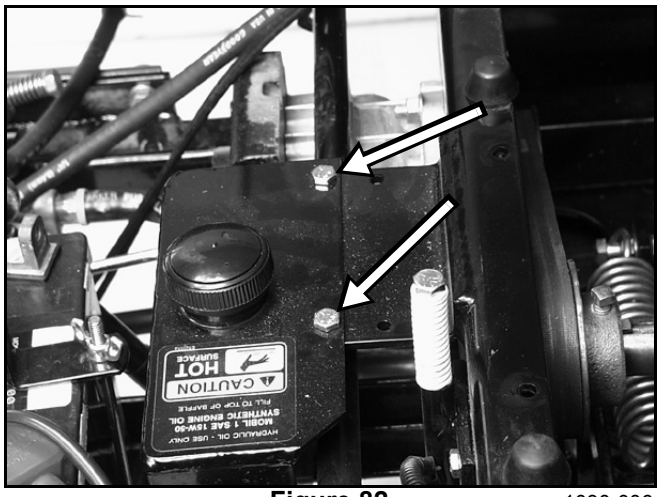


Figure 82 1030-006

10. Then remove the brake shaft bearing bolts at either end of the shaft (Figure 83).

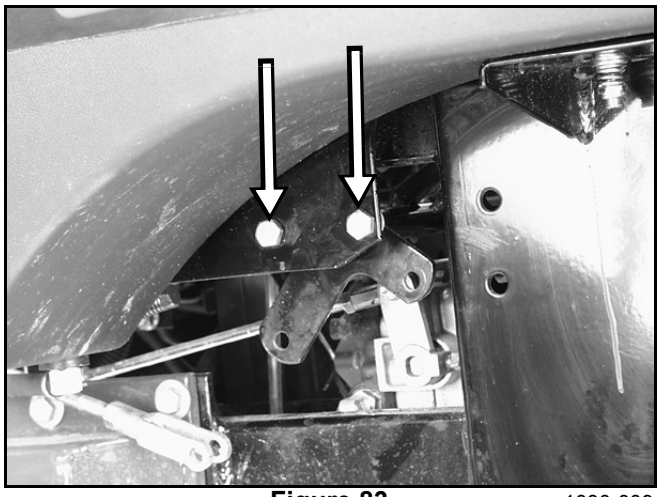


Figure 83 1030-009

11. Then lift the brake shaft out of the chassis.

12. To remove the brake lever, first remove the control panel at the console (Figure 84).

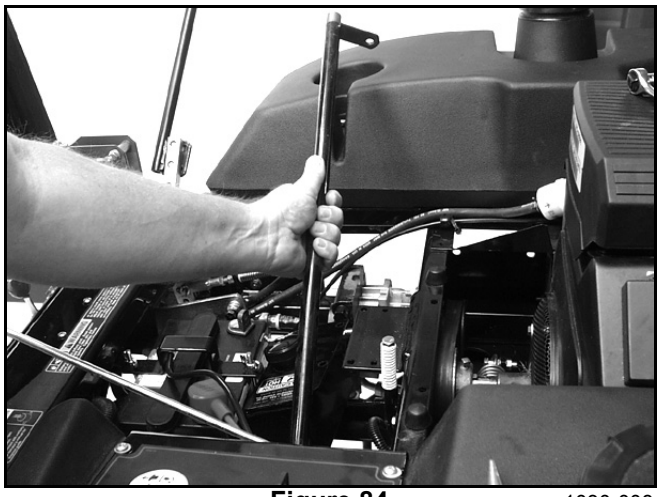


Figure 84 1030-008

13. To remove the brake handle, remove the cotter pin from the brake handle pivot shaft (Figure 85).

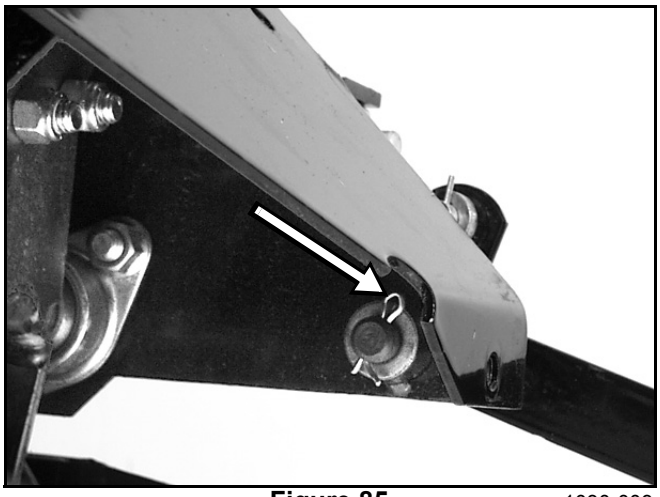


Figure 85 1030-003

14. Then, pull the brake handle out of the brass bearing (Figure 86).

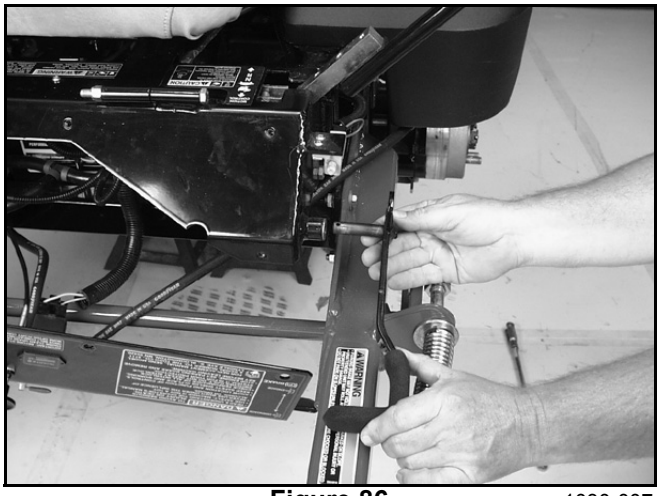
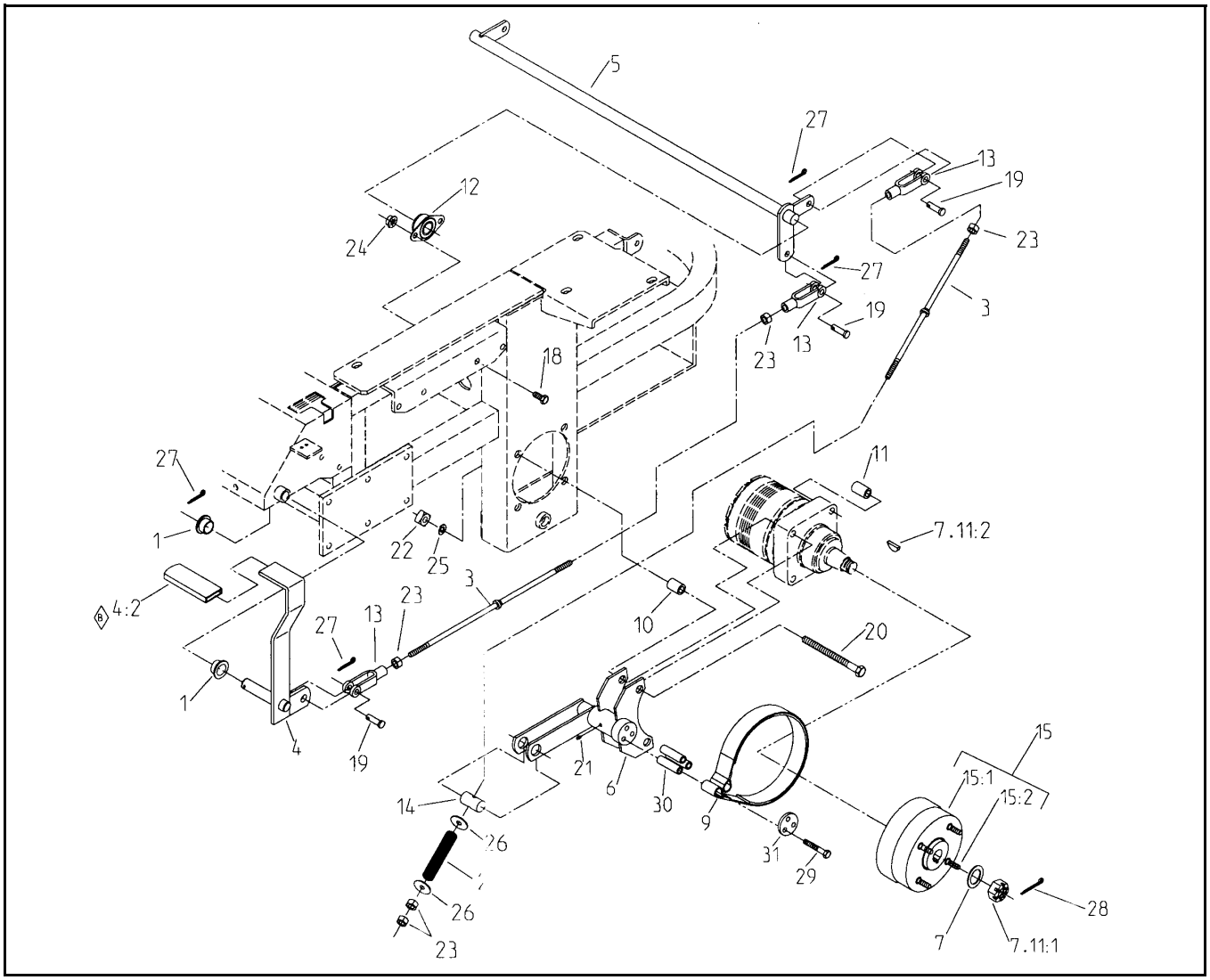


Figure 86 1030-007

Parking Brake, Typical



Ref. No.	Qty.	Description
1	2	Control Bearing
2	2	Brake Spring
3	3	Brake Rod
4	1	Brake Lever/Grip ASM
5	1	Brake Shaft
6	2	Brake Bracket
7	2	Spacer Washer
9	2	Brake Bank
6	2	Brake Bracket
10	4	Short Wheel Spacer
11	4	Long Wheel Spacer
12	2	Side Flange Bearing
13	4	Brake Linkage Yoke
14	2	Trunion Pin
15	2	Wheel Hub

Ref. No.	Qty.	Description
18	4	HH Screw
19	4	Clevis Pin
20	8	HH Screw
21	2	Grease Fitting
22	8	Square Nut
23	8	HH Nut
24	4	Flange Nut
25	8	Lock Washer
26	4	Flat Washer
27	7	Cotter Pin
28	2	Cotter Pin
29	6	HH Screw
30	6	Spacer
31	2	Brake Band Retainer

Adjusting the Parking Brake

Check parking brake for proper adjustment.

1. Disengage brake lever (lever down).

2. Measure the length of the spring. Measurement should be 2.75 in. (70mm) between washers (Figure 87).

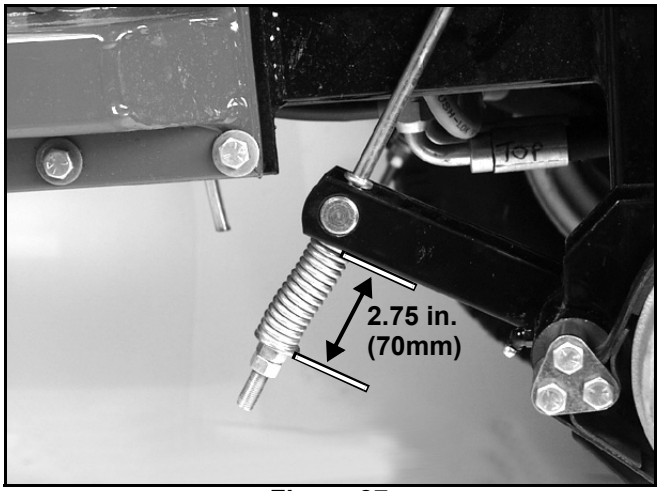


Figure 87 1227-011

3. If adjustment is necessary, loosen the jam nut below the spring and tighten the nut directly below the yoke (Figure 87). Turn the nut until the correct measurement is obtained. Tighten the two nuts together and repeat on opposite side of unit.

4. Turn nuts clockwise to shorten spring length and turn counterclockwise to lengthen the spring.

5. Engage parking brake.

   A. Measure the distance between the trunnion roller and the collar on brake rod. Measurement should be 3/16 - 1/4 in. (5 -7mm) (Figure 88).

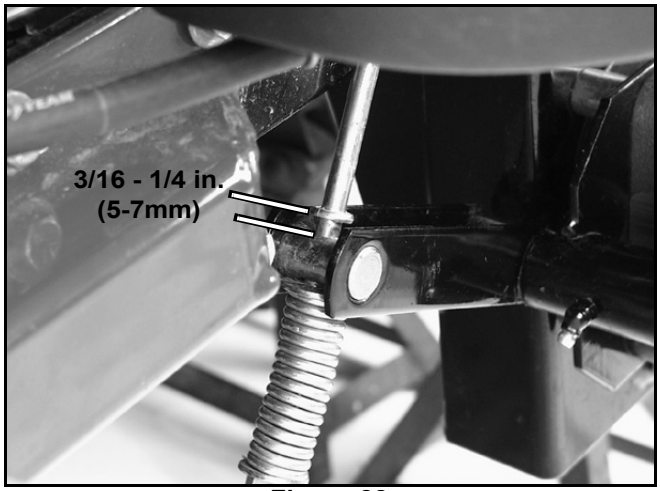
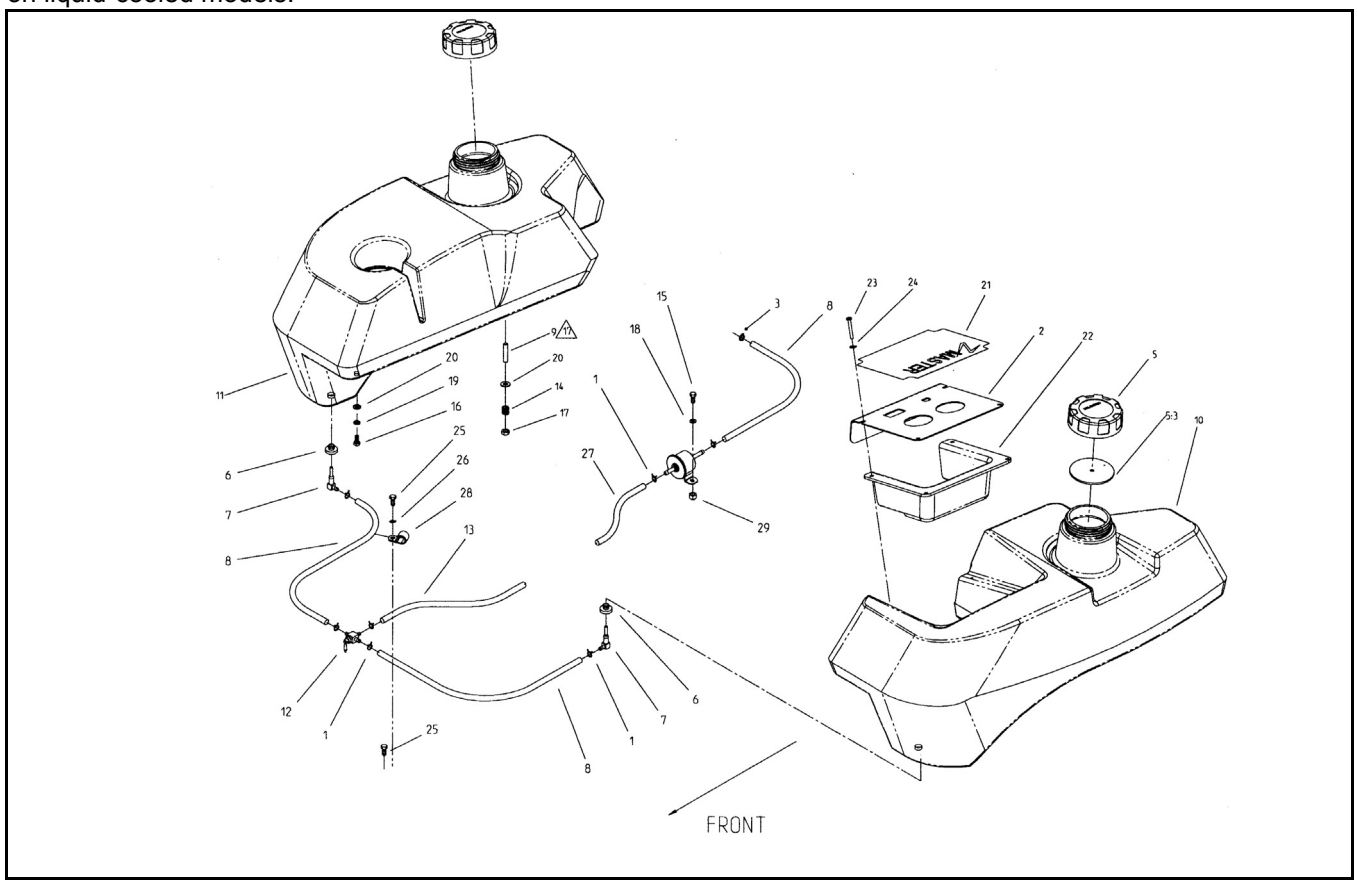


Figure 88 1227-010

6. If adjustment is necessary, loosen the jam nut directly below the yoke. Turn the bottom rod until the correct measurement is obtained (Figure 88). Tighten jam nut at the yoke.

Description - Fuel System

The Z Master fuel system consists of dual fuel tanks with a total capacity of 12 gallon for the 200 Series and 10 gallons for the 100 Series. Fuel is routed to a 3 position selector valve, then to a fuel filter and the engine fuel pump. The left fuel tank houses an electrical panel containing the key switch, PTO switch, and temperature gauge on liquid-cooled models.



Ref. No.	Qty.	Description
1	9	Fuel Line Clamp
2	1	Control Panel
3	1	Hose Clamp
5	2	Gas Cap ASM
6	2	Fuel Valve Bushing
8	3	Fuel Hose
8	2	Fuel Hose
9	6	Stud
10	1	LH Fuel Tank
11	1	RH Fuel Tank
12	1	Fuel Valve
13	1	Fuel Line Hose
14	6	Fuel Tank Spring
15	2	HH Screw

Ref. No.	Qty.	Description
16	2	HH Screw
17	6	Lock Nut
18	2	Flat Washer
19	2	Lock Washer
20	8	Flat Washer
21	1	Control Panel Decal
22	1	Control Panel Shield
23	4	Screw
24	4	Spring Washer
25	2	HH Screw
27	1	Fuel Hose
28	1	Loom Clip
29	2	HF Nut
99	1	Fuel Hose

Fuel Tank - Remove and Replace

1. Remove the battery negative cable.

2. Drain the fuel tank. To do this, first place the fuel selector valve in the off position. Then, remove the fuel line from the fuel filter. Place the fuel line into a suitable container (Figure 89). Use the fuel valve to select the tank to be removed (Figure 90).

Figure 89

Figure 90 1030-031

3. If the left tank is to be removed, remove the electrical control panel from the tank (Figure 91).

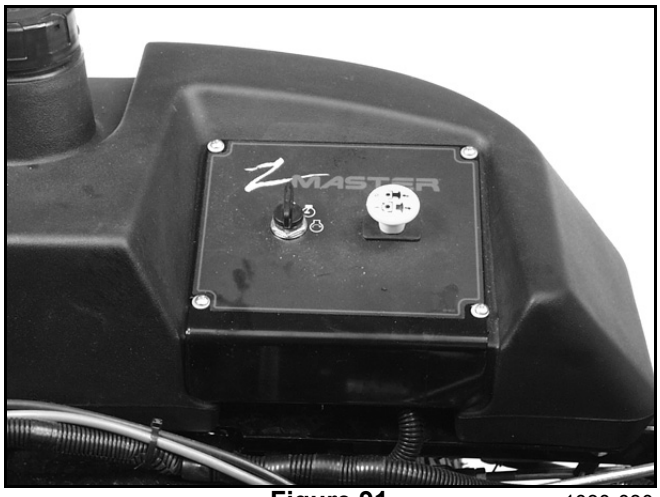


Figure 91 1030-030

4. Remove the tire. Then, remove the 2 nuts, springs, and washers securing the center of the fuel tank to the frame (Figure 92).

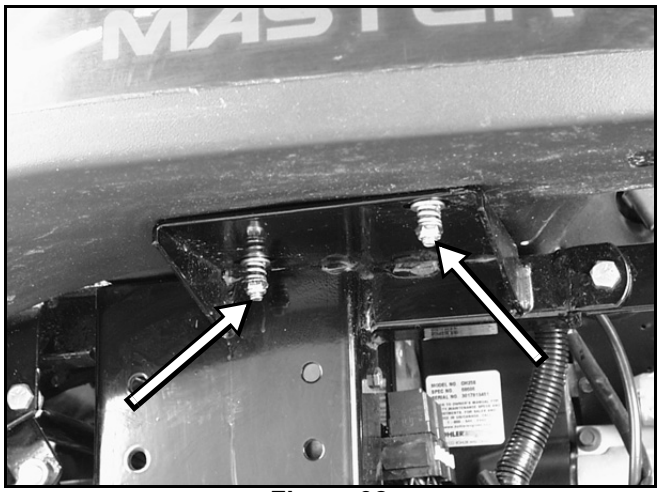


Figure 92 1030-029

5. Remove the bolt securing the front of the fuel tank to the frame (Figure 93).

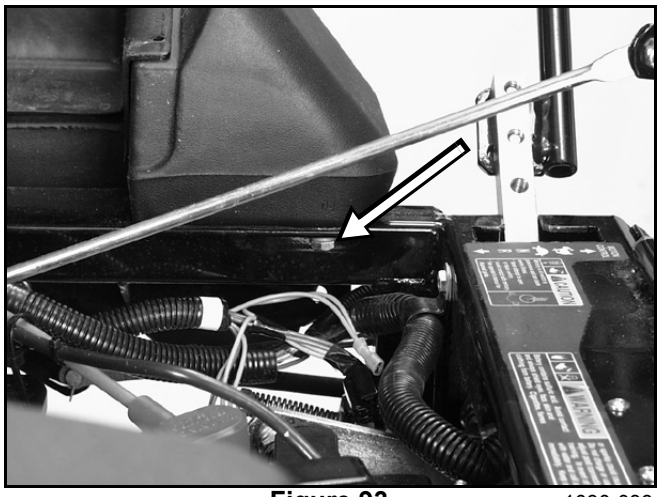


Figure 93 1030-033

6. Remove the nut and spring assembly securing the rear of the fuel tank to the frame (Figure 94).

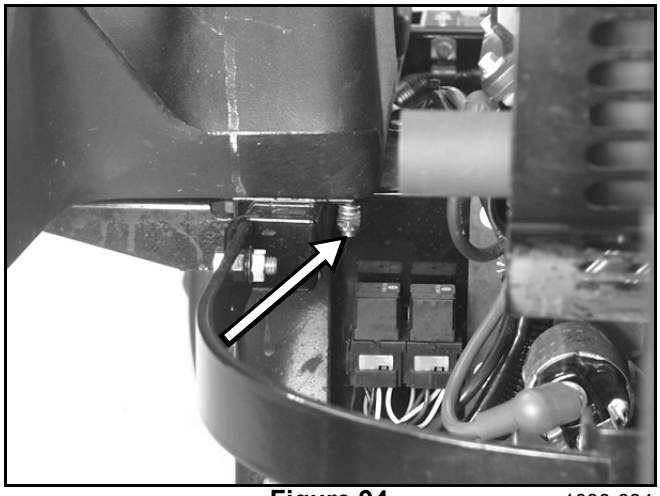


Figure 94 1030-034

7. Lift the tank and make sure it is completely drained of fuel.

8. Remove the fuel line from the fitting at the front of the tank (Figure 95).

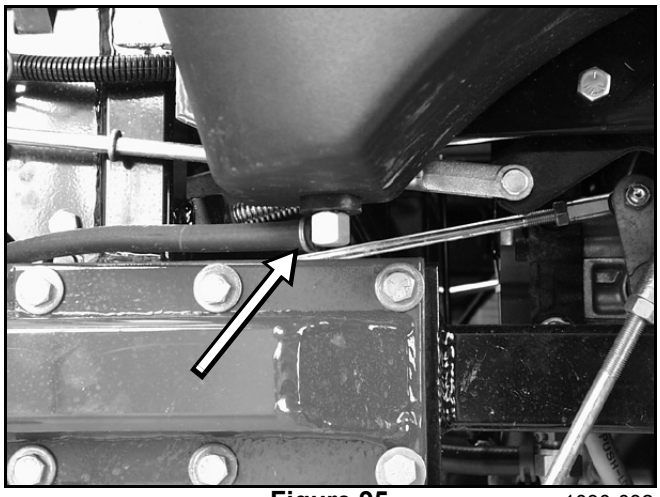


Figure 95 1030-032

Reverse these steps to reinstall.

NOTE: When replacing the nut, spring, and washer assemblies, only tighten the nut so that approximately 1/8” (3.2mm) of threads are exposed (Figure 96).

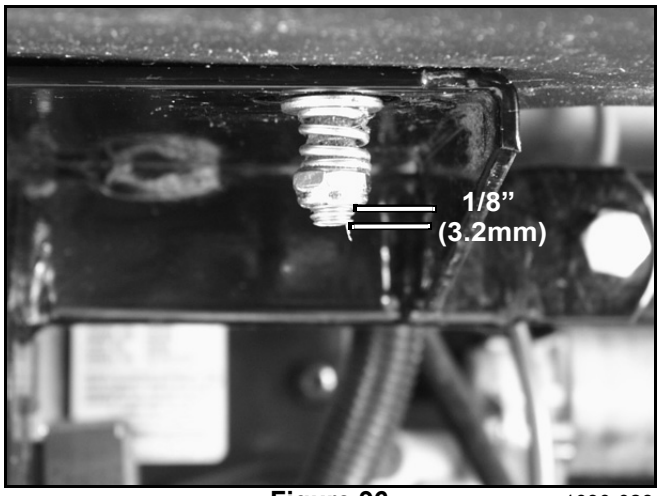


Figure 96 1030-028

Replace Front Wheel Bearings

1. Raise the front of the unit so that the front wheels are off the ground.

2. Remove the through bolt holding the wheel to the caster assembly (Figure 97).

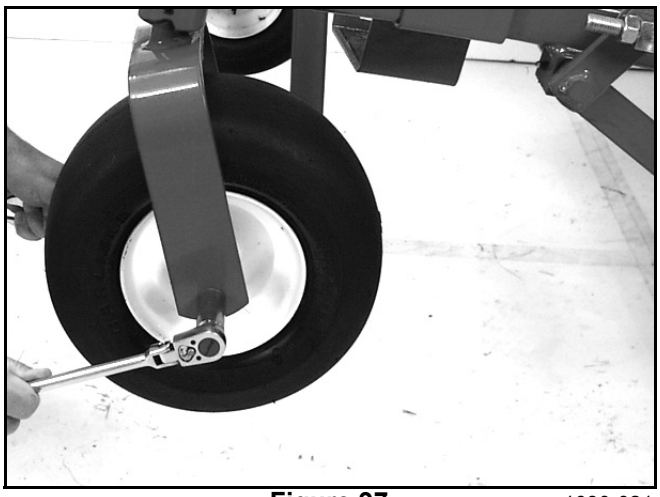


Figure 97 1030-021

3. Remove the sleeve that passes through the wheel bearings(Figure 98).

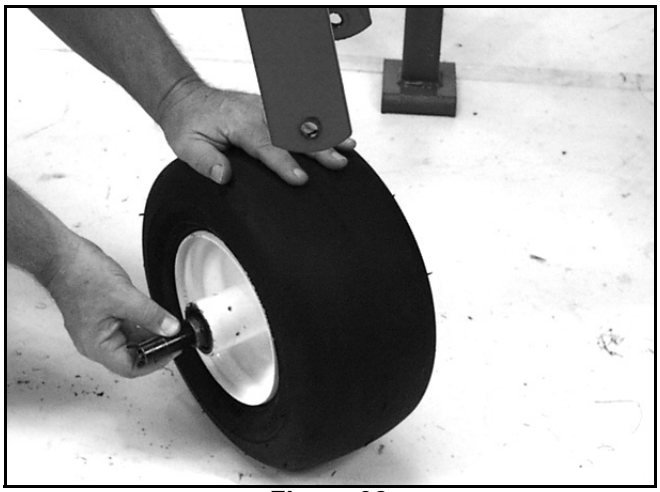


Figure 98 1030-023

4. Remove the 2 wheel spacers (Figure 99).

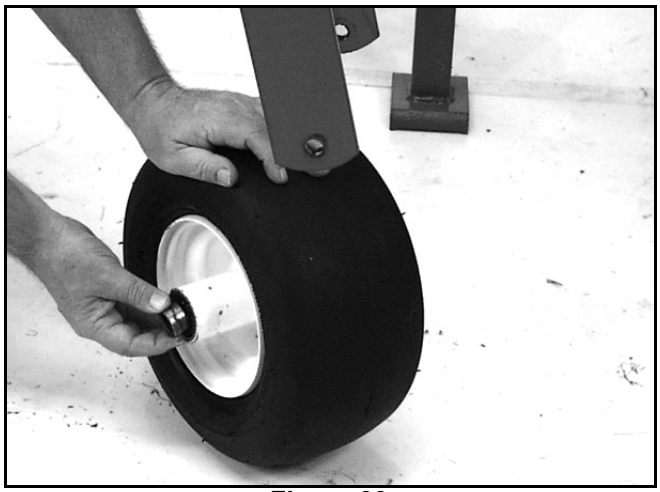


Figure 99 1030-024

5. Remove the bearing seal (Figure 100).

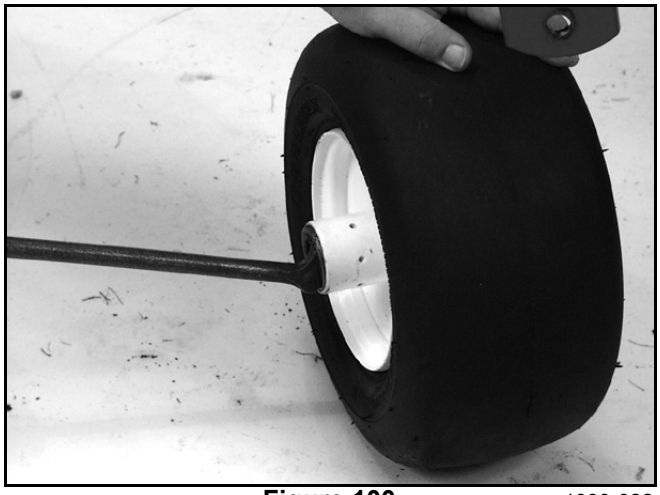


Figure 100 1030-022

6. Remove the wheel bearing (Figure 101).

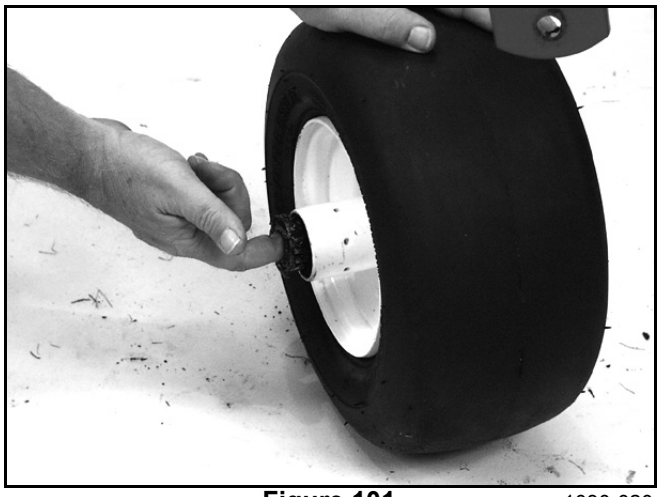


Figure 101 1030-020

7. Drive the bearing race out from the opposite side of the wheel using a long drift (Figure 102).

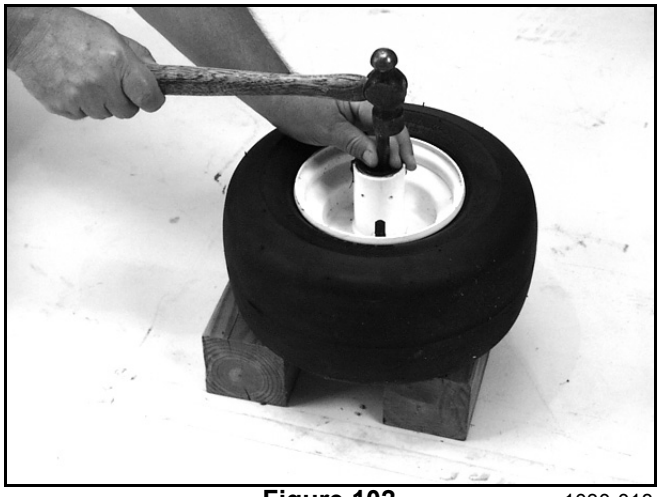


Figure 102 1030-018

8. Clean the bearing and bearing race and inspect for signs of pitting or other damage (Figure 103).

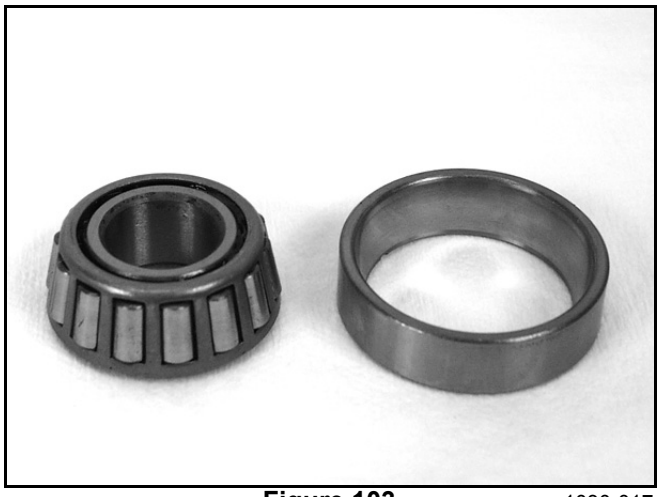


Figure 103 1030-017

9. Press a new race into the wheel hub (Figure 104).

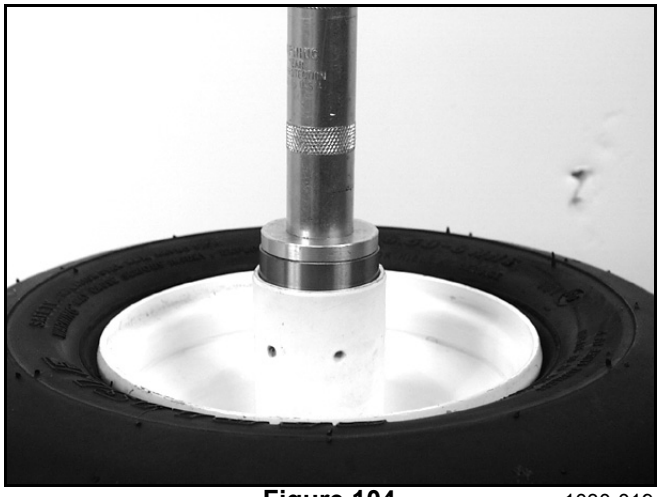


Figure 104 1030-019

10. Pack the bearing with grease and install it on the race (Figure 105).

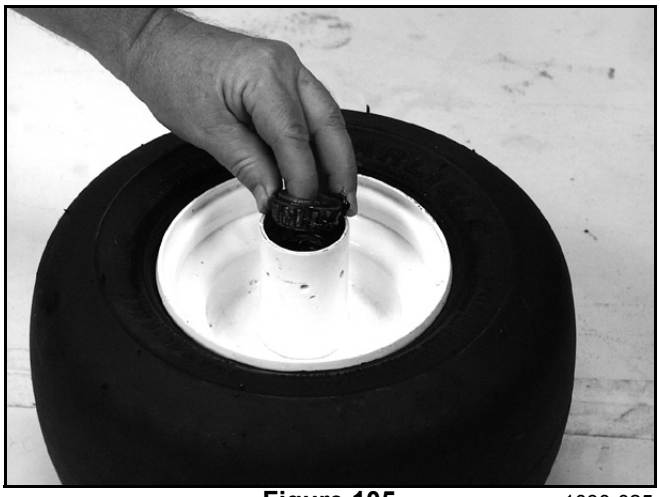


Figure 105 1030-025

11. Press a new bearing seal into the hub (Figure 106).

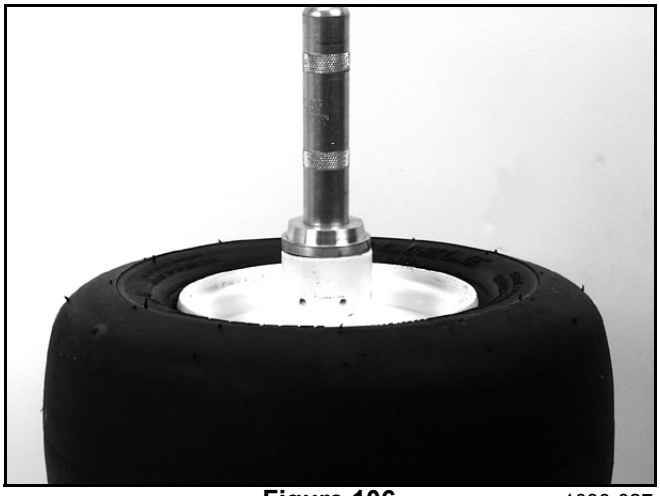


Figure 106 1030-027

12. Reverse steps 1-4 to reassemble.

Front Caster Bearings - Remove & Replace

1. Remove the dust cap at the top of the caster assembly (Figure 107).

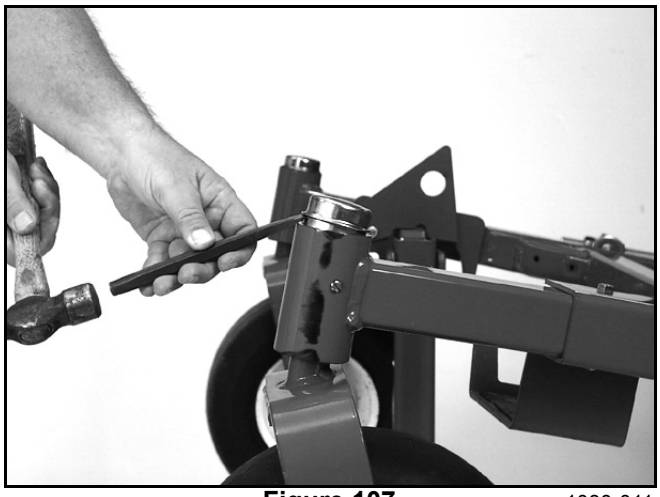


Figure 107 1030-011

2. Hold the caster assembly stationary and loosen the bearing adjustment nut (Figure 108).

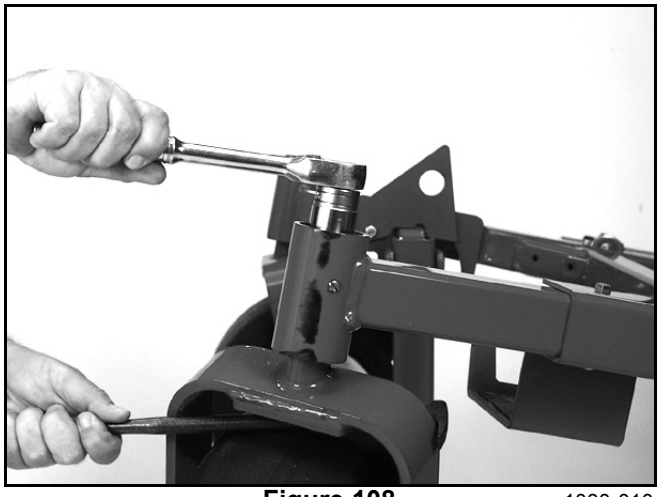


Figure 108 1030-010

3. Remove the bearing adjuster nut while holding the caster assembly.

4. Remove the upper caster bearing.

5. Pry the lower bearing seal out of the housing and remove the lower bearing.

6. Inspect the tapered caster bearings and races for pitting or other damage (Figure 109).

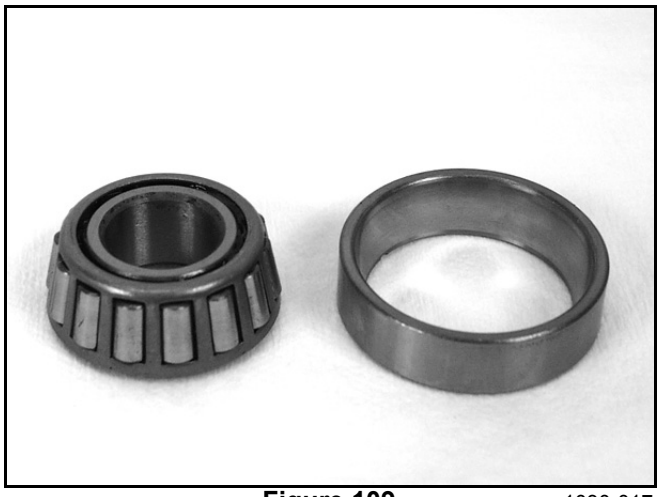


Figure 109 1030-017

7. Pack the bearings with grease and reinstall in the housing. Press in a new seal.

8. Reassemble the caster into the bearings (Figure 110).

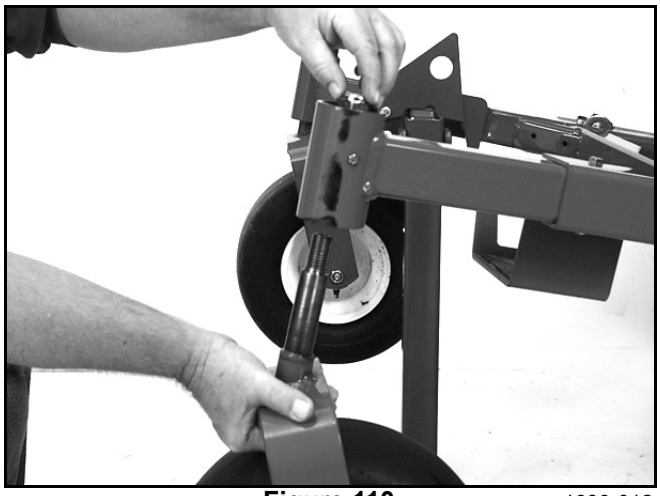
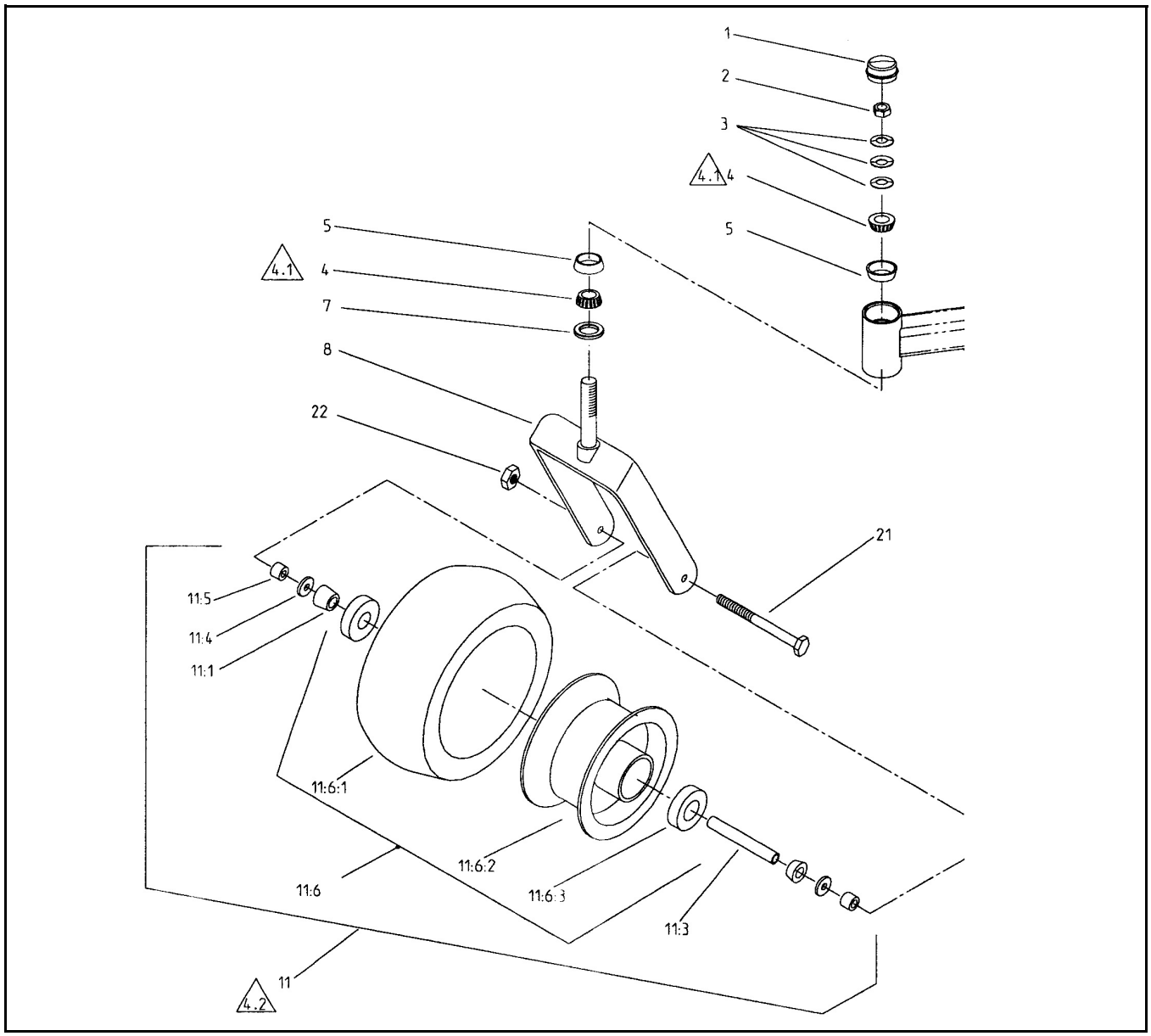


Figure 110 1030-012

9. Tighten the bearing adjustment nut until there is a slight drag felt in the bearings.

10. Replace the dust cap.

Wheel and Caster Assembly



Ref. No.	Qty.	Description
1	2	Grease Cap
2	2	Lock Nut
3	6	Belleville Washer
4	4	Tapered Roller Bearing
5	4	Cup Bearing
7	2	Grease Seal
8	2	Caster
11	2	Caster Wheel Assembly
21	2	HH Screw
22	2	Lock Nut

Replacing the PTO Drive Belt

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

1. Stop the engine, set the parking brake, remove the key and disconnect the spark plug wire(s) from the spark plug(s).

2. Remove the clutch retaining strap from machine frame and unplug clutch terminal from wire harness (Figure 111).

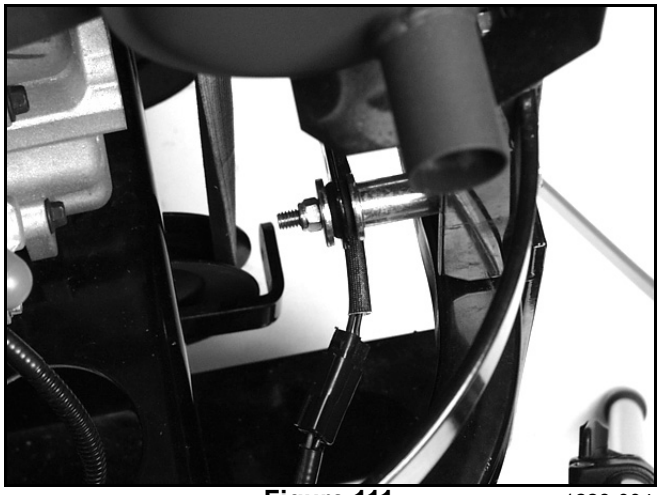


Figure 111 1228-004

3. Remove PTO drive belt from pulley and front idler pulley assembly. Remove the PTO drive belt (Figure 112).

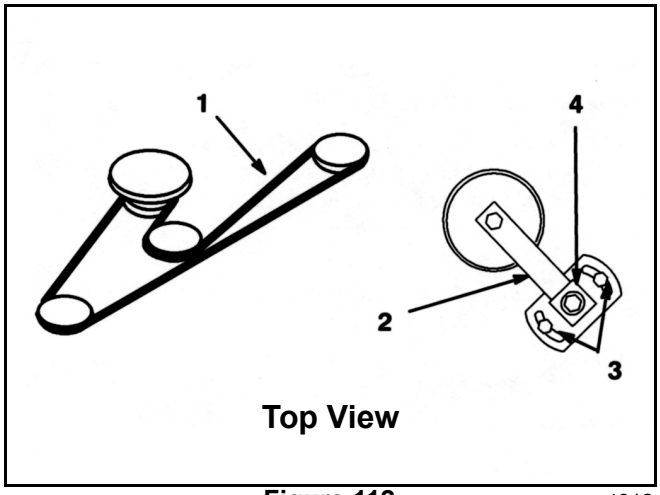


Figure 112 m-4312

(1) Deck Belt	(3) Idler Nuts
(2) Idler Arm	(4) Idler Adjusting Nut

4. Place new drive belt over clutch, around rear idler pulley, installed into rear idler arm assembly, installed into front idler pulley assembly and onto top center pulley (Figure 113).

Important Check the amount of twist in belt between pulleys. Make sure it is only what is specified in Figure 113.

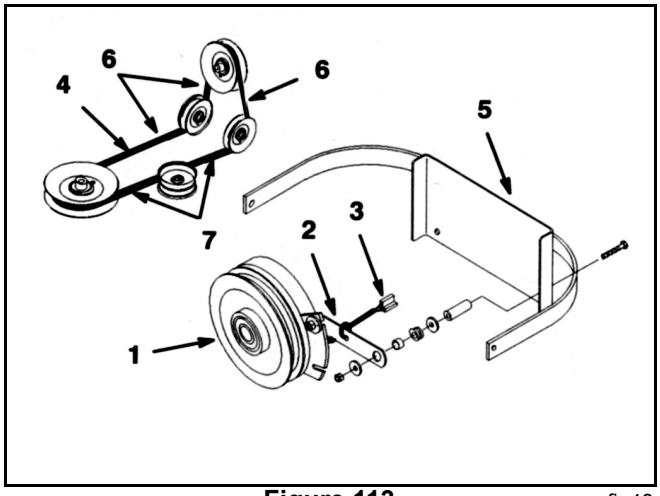


Figure 113 fig48

(1) Clutch	(5) Machine Frame
(2) Clutch Retaining Strap	(6) 1/4” Belt Twist
(3) Clutch Terminal	(7) 1/8” Belt Twist
(4) PTO Belt	

5. Install clutch retaining strap and plug clutch terminal into main wire harness (Figure 111).

6. Check belt tension. The center bolt of spring loaded idler must be between the two alignment holes (A) in left support plate (Figure 114).

   Note: Check position of center bolt in Low Height of Cut. The center bolt must be at or below the top alignment hole.

   Check position of center bolt in a High Height of Cut. The center bolt must be at or above the lower adjustment hole (Figure 114).

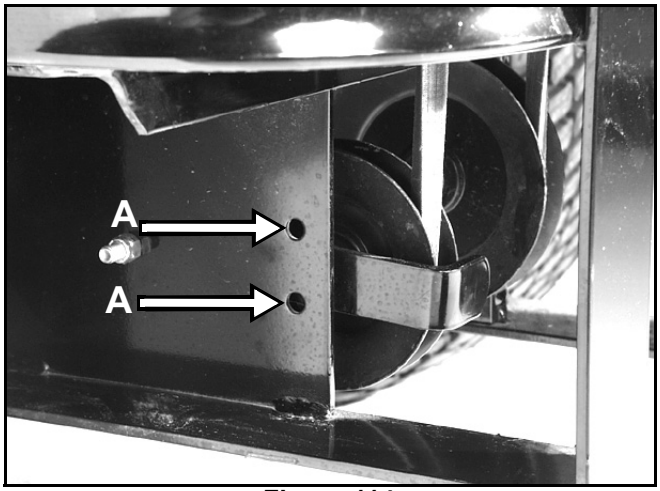


Figure 114 1228-003

7. If adjustment is required, loosen the fixed idler on right support plate and move up or down in adjustment slot. To relieve belt tension lift up on spring loaded idler.

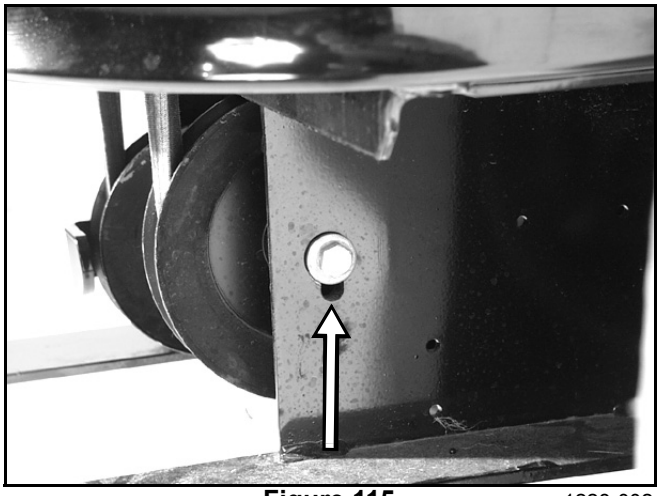


Figure 115 1228-002

8. Check belt tension again. The center bolt of spring loaded idler must be between the two alignment holes in left support plate (Figure 114). Adjust, if necessary, and tighten all hardware securely.

9. If the fixed idler contacts the end of the adjustment slot and more belt tension is required, a small change to lengthen the push arms can be made (Figure 116).

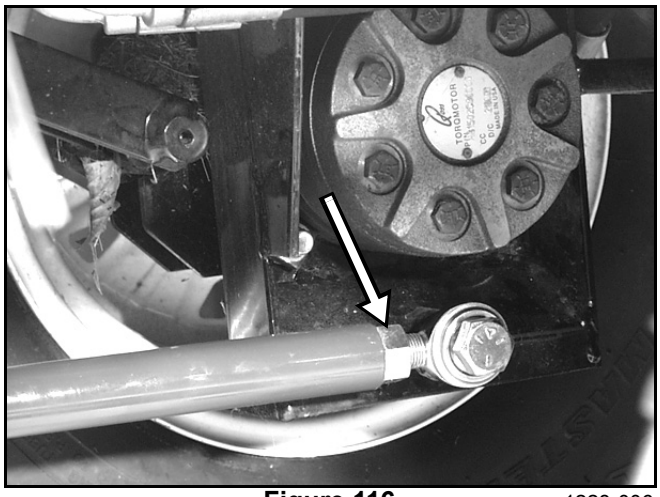


Figure 116 1228-006

10. To lengthen, loosen jam nut and rotate ball joint counterclockwise, one turn at a time. Adjust each side the same amount.

11. Rotate the belt guide, on rear of the mower, so it is 1/8 - 1/4 in. (3 - 7mm) away from the vertical side of the PTO belt (Figure 117).

Figure 117 1228-001

Mower Deck Removal

1. Raise the handle on the mower deck drive belt tensioning pulley to release the belt tension and slide the belt off the idler pulley.

2. Slip the belt off the deck drive pulley.

3. Remove the bolt and spacer from the mower deck belt guide and remove the belt from the deck (Figure 118).

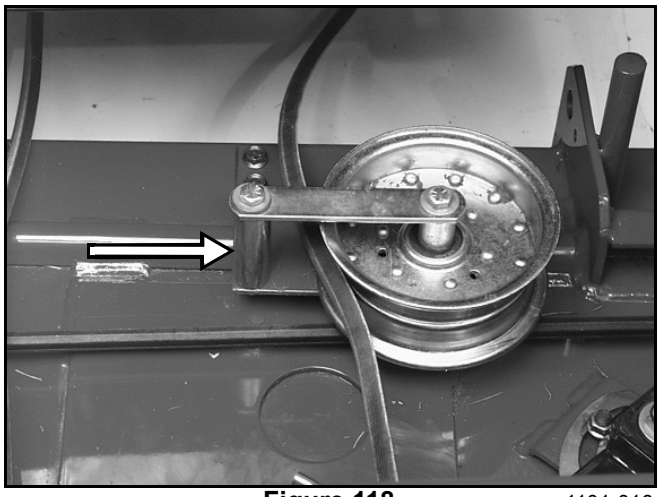


Figure 118 1101-016

4. Remove the bolt from the ball joint securing the deck struts to the mower frame (Figure 119).

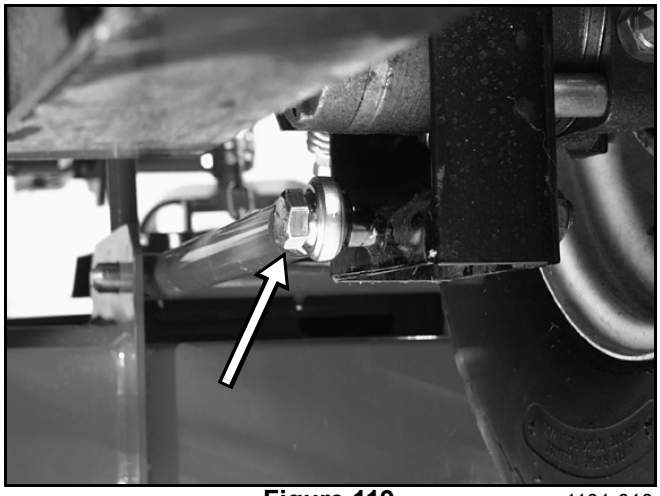


Figure 119 1101-010

5. Remove the struts from the deck by first removing the nut and bolt that holds the pin to the deck. Slide the pin out of the strut to release it from the deck (Figure 120).

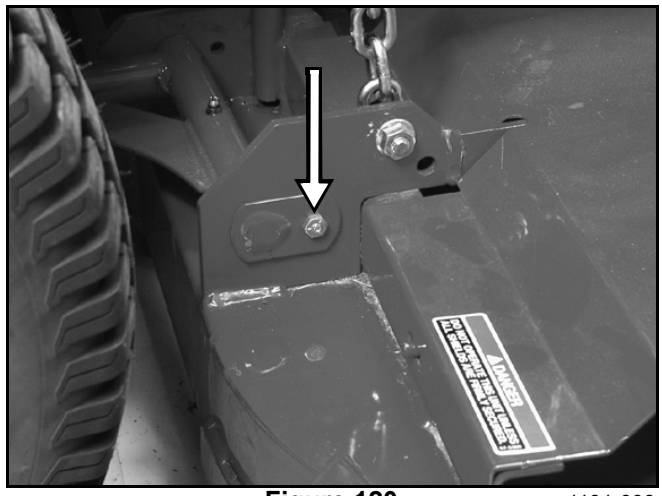


Figure 120 1101-009

6. The first step in deck removal is to place the deck in the lowest position.

7. The second step is to lock the deck height lever in position by placing the pin above the lever to prevent it from springing back when the weight of the deck is removed.

8. Remove the lifting chains from the lifting arms.

9. Slide the deck out from under the mower from left to right.

Spindle Repair

1. Stop the engine, remove the key and engage the parking brake.

2. Remove covers from the cutting unit.

3. Using a floor jack raise the machine until you can access the underside the cutting unit.

4. Support the machine using a properly rated jack stand.

5. Inspect the assembly before removing. Look for the following:

   A. Bent or damaged blade.

   B. Missing or unused grease zerk.

   C. String, wire, rope, etc. wrapped around the spindle under the deck.

6. Remove the drive belt(s) from the pulley. Consult the machine owner's manual for this procedure.

7. Remove the nut and washer retaining the spindle pulley. Then remove the pulley from the shaft (Figure 121).

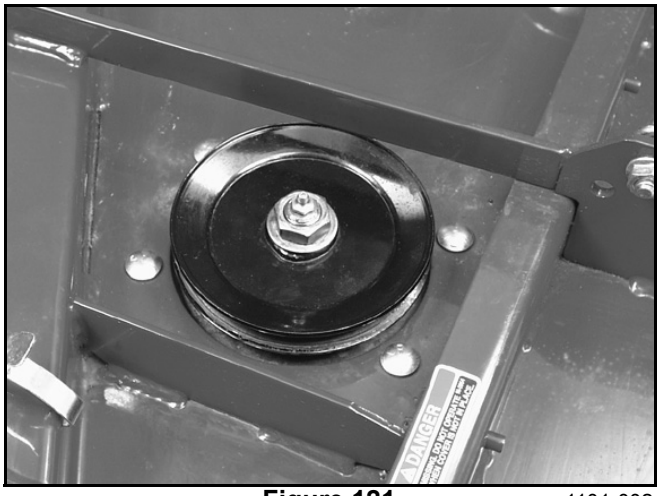


Figure 121 1101-002

8. Unbolt the spindle housing from the deck. Place spindle assembly on a bench or in a vise and remove the blade.

9. Remove the spindle shaft from the spindle housing. It may need to be pressed out of the housing. **Note:** The lower bearing spacer will remain on the spindle shaft.

10. Inspect the spindle shaft for the following (Figure 122):

    A. Elongated grease axis hole (A) - Normally this hole is perfectly round if it is deformed it is directly a result of impact.

    B. Damaged splines (B) - If the splines are twisted, it is a sign of impact. If they are worn, it's an indication that the assembly was running with the pulley loose.

    C. Damaged shaft (C) - When the shaft is worn at the point where the upper bearing is located in the assembly, it is a result of the assembly running loose.

    There are two causes for this:

    1. Improper torque on the pulley retention nut. This allows individual components of the assembly to move and wear against other components.

    2. Impacts cause the shaft to stretch, which will lessen the clamp load and cause the assembly to wear as if the nut did not have proper torque.

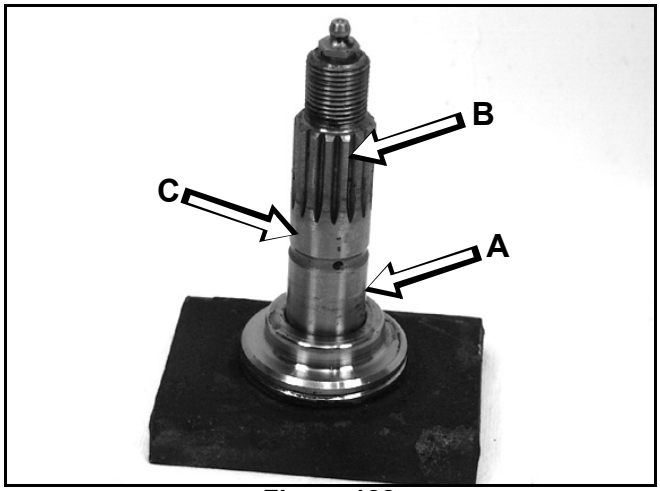


Figure 122 1101-006

11. Remove the seals, note the direction of the seals. This will be important during reassembly. The upper seal faces inward, and the lower seal faces outward (Figure 127). If the lower seal is installed incorrectly, the lower bearing spacer will crush the seal and allow dirt into the assembly, causing bearing failure to occur.

12. Remove the bearings and the two small diameter spacers from the housing. One of the two spacers removed will look like a “C” clip and the other will be a thicker spacer with a hole in it. The open side on the “C” shaped spacer, in addition to the lubrication hole in the thicker spacer, allows grease to pass from the spindle shaft to the bearings (Figure 123).

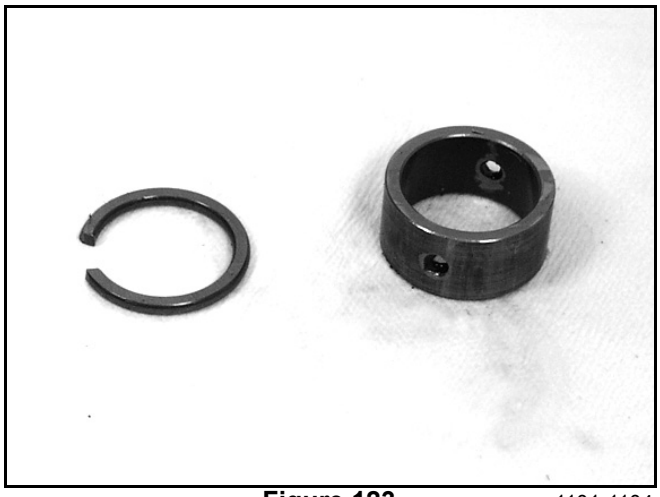


Figure 123 1101-1104

NOTE: When removing the bearings, mark or isolate the top bearing from the lower bearing. This will allow the bearings to be installed in their original operating position. Failure to do this may cause premature bearing failure when reassembled.

Inspect the bearings as follows (Figure 124):

A. Look for the presence of grease, particularly in the upper bearing. Dry or cooked grease indicates a lack of maintenance.

B. Look for dirt in the grease. Dirt in the grease indicates a bad seal or a worn lower bearing spacer. If the unit was recently rebuilt, look for proper installation of the lower seal.

C. Clean the bearings and look for any pitting or flaking on the rollers.

D. Roll the clean bearings in your hand and feel for rough spots. If the bearing catches or the rollers get stuck in the cage, replace the bearing.

NOTE: With this spindle design, both bearings and bearing cups must be replaced as a set. Even if only one of the two bearings is damaged.

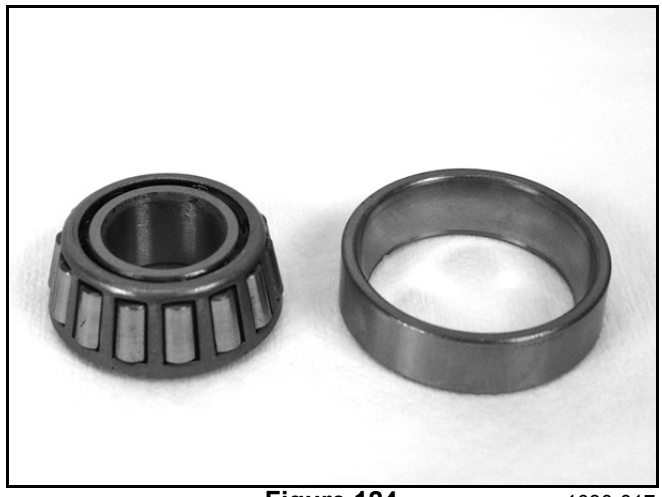


Figure 124 1030-017

13. If replacing the bearings, use a punch and hammer to drive both of the bearing cups out of the spindle housing. Also, remove the large diameter spacer at this time.

CAUTION: Do not use old bearing cups with new bearings. This may cause premature bearing wear and result in failure.

14. A large snap ring is still inside the spindle housing. It locates the matched bearing set in the bore of the spindle housing. There is no need to remove and replace this snap ring (Figure 125).

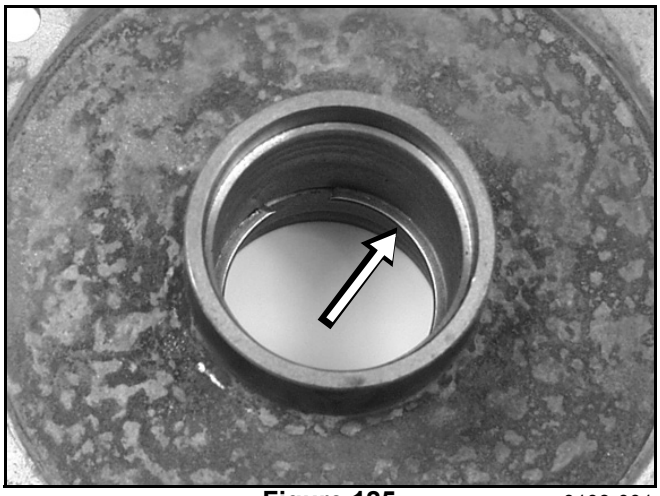


Figure 125 0103-001

Assembly

15. Thoroughly clean and inspect the parts prior to assembly:

    A. Spindle shaft for bearing surface damage or signs of impact. Also check for damage to the threaded areas for both the blade bolt and pulley retention nut.

    B. Bottom bearing spacer for wear. If the spacer is damaged, the seal may not be able to keep dirt out properly.

    C. Bearings for wear. If reusing the bearings, you must examine them carefully for wear. Also, make sure to put the same bearing and bearing saddle together as they were. As noted above, look for pitting on the rollers of the bearings and replace the bearing set if any pitting is present.

    NOTE: If using compressed air to dry the bearing after cleaning, **DO NOT** allow it to spin. The bearing could come apart and cause serious injury. Always wear safety glasses.

    D. Spindle housing for any damage or wear.

    E. Pulley assembly - If the shaft shows signs of wear, inspect the pulley for excessive wear in the splines. If excessive wear is found, replace the pulley. Excessive wear of the splines will show up as a sharp edge on the splines.

    NOTE: New bearings are only available in matched sets. The matched set is necessary because the bearing endplay is not adjustable. The small “C” shaped spacer is machined to specifically match the bearings in the set. The advantage of a matched set is the ability to torque the assembly to a specified value and have a preset endplay. Alternatively, most tapered bearing applications use either a crush washer or a castle nut with key as a means to set endplay.

16. Install the snap ring into spindle housing. Discard the new snap ring if the spindle housing is being reused.

17. Press in lower bearing cup until it firmly contacts the snap ring (Figure 126).

    NOTE: The machined stop for the seal may cause your driver to stop before the bearing cup is seated completely. **NEVER** use a punch to drive in a bearing cup. This will damage the cup.

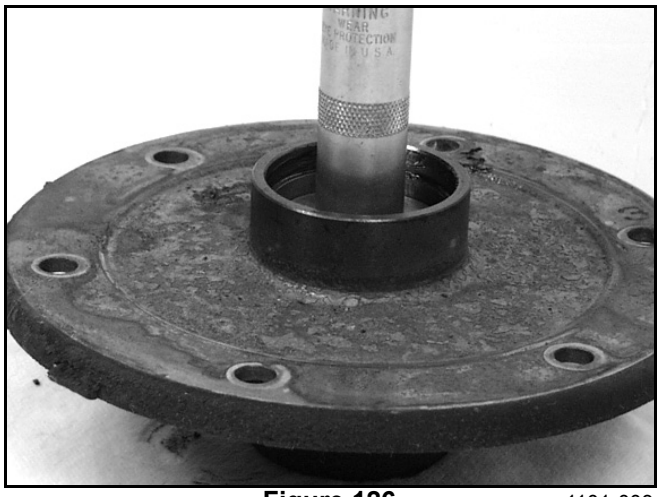


Figure 126 1101-003

18. Slide in the large spacer in from the top until it also contacts the snap ring. Now press the upper bearing cup in against the spacer. Apply a layer of grease to both bearing surfaces.

19. Pack both bearings with grease. Smearing grease on the outside of the bearing is not enough lubrication. Pack the bearing by hand or use a bearing packing tool.

20. With the spindle upside down, set the lower bearing in the bearing cup. Now install the lower seal. Use a seal driver to prevent damage (Figure 127).

    NOTE: Remember to install the seal with the lip facing out.

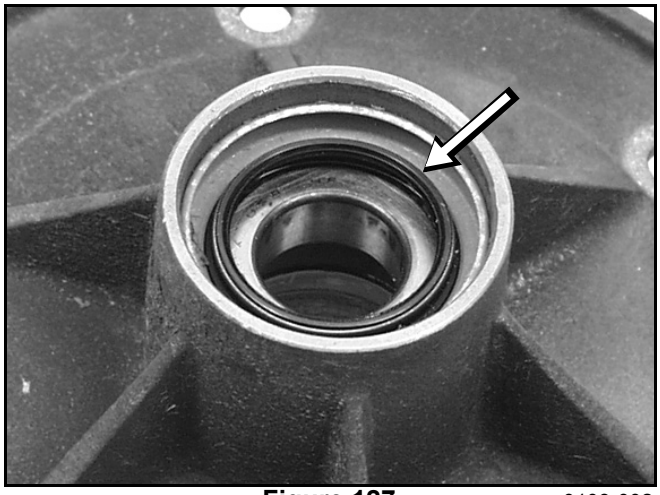


Figure 127 0103-002

21. With the spindle right side up, install the small “C” shaped spacer first, then the small thick spacer. The order of these two is not critical to the performance of the spindle, but by putting the thinner spacer in first, it prevents the possibility of the open part of the spacer from dropping down on the thicker spacer.

22. Now install the upper bearing and seal. The upper seal must face inward. Again, be sure to use a seal driver.

23. Lubricate both seal lips with grease and insert the bearing spacer into the lower seal. By inserting the spacer individually and not with the shaft you will prevent possible damage to the lower seal.

24. Bolt the assembly back into the deck shell.

25. Install the spindle shaft. Note the shaft will slide out if not supported.

26. Slide the pulley down onto the shaft and secure with the washer and nut. Be certain to only use the washer specified because it is hardened. A softer washer will deform and spindle damage will occur. Torque the nut to 100 - 120 ft. lbs. and rotate the assembly to make sure that it turns smoothly and freely.

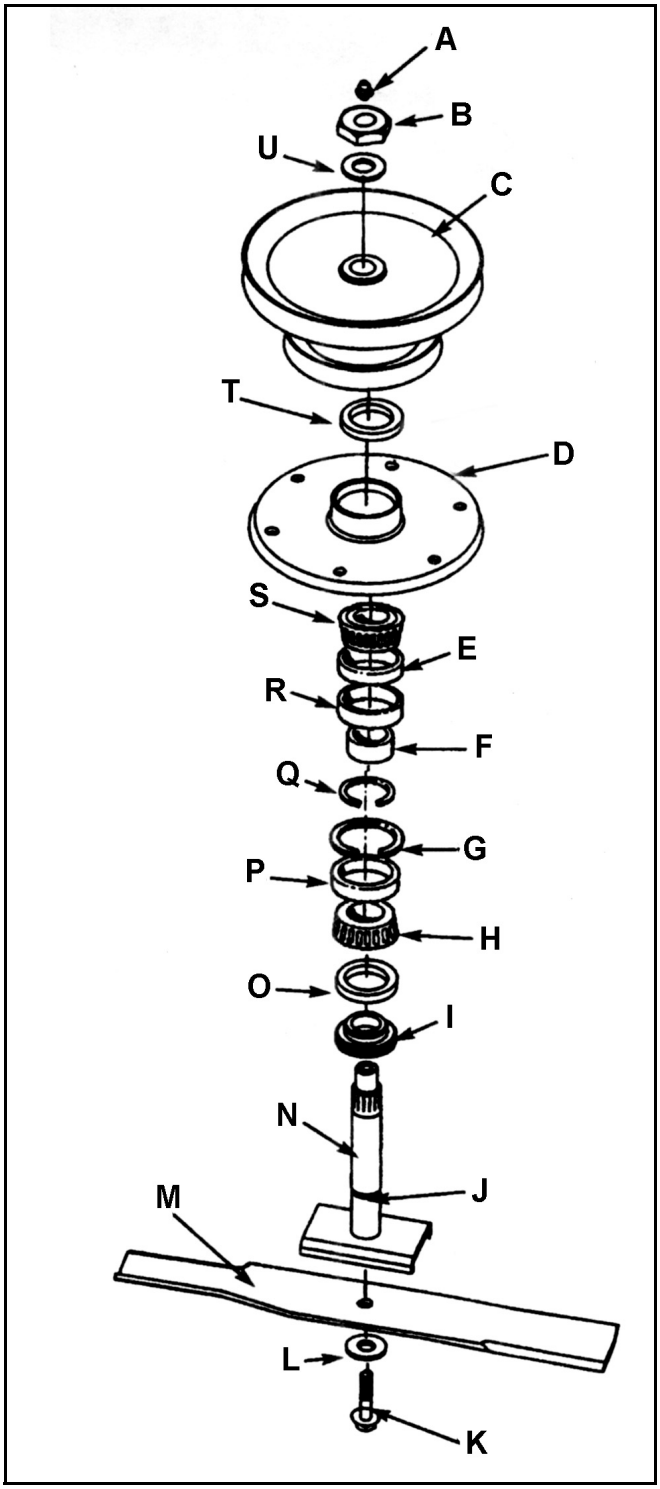
27. Pump grease into the assembly until grease is relieved pass the lower seal. The ability to relieve grease without pushing out the seal is why the lower seal is installed with the lip facing out. Make sure the blade bolt is threaded into the spindle shaft or grease will push out that opening.

28. Install the blade and torque the blade bolt to 85 - 110 ft. lbs.

29. Install the drive belts.

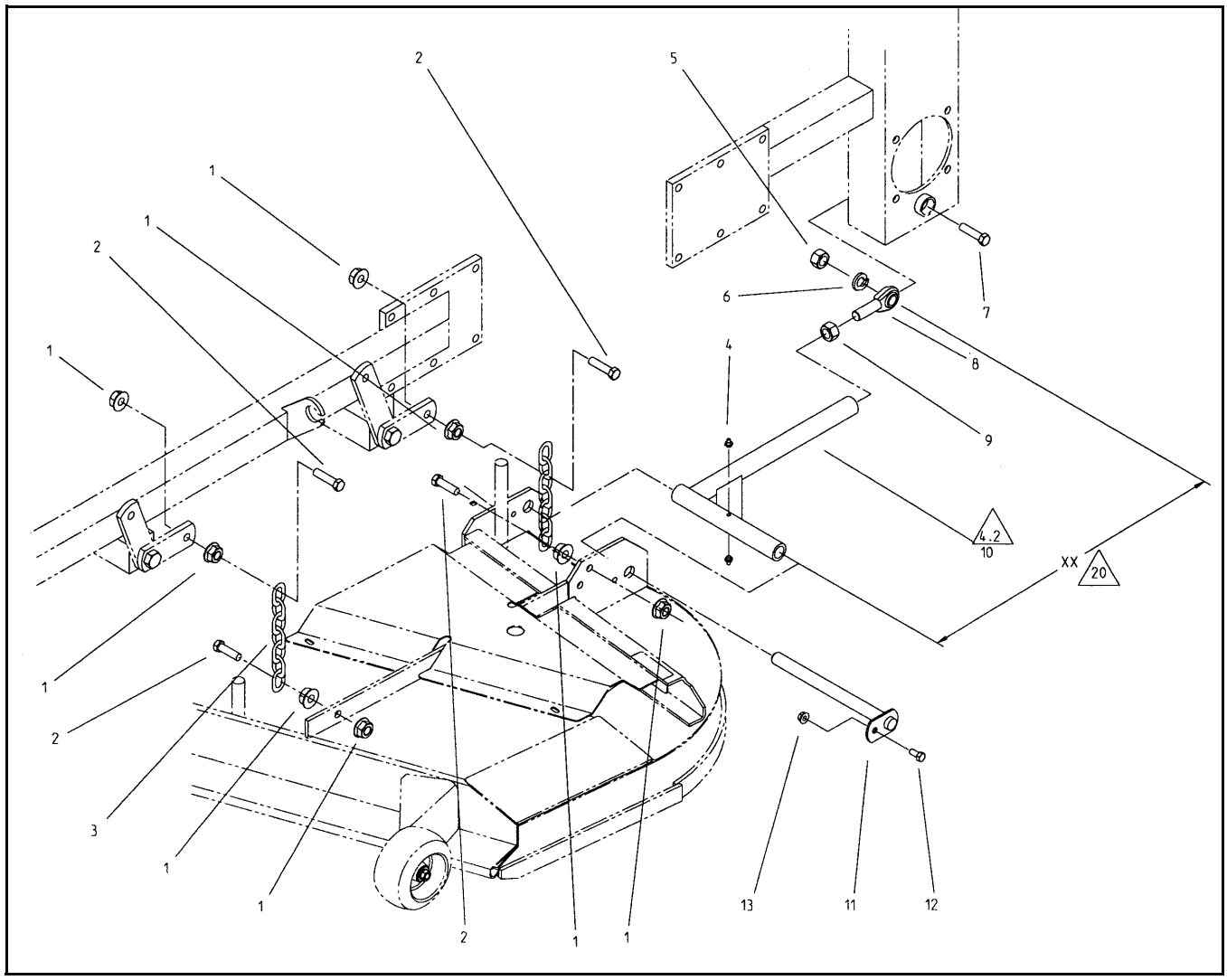
30. Replace the deck covers.

31. Remove the machine from the jack stands.



(A) Zerk
(B) Nut
(C) Pulley
(D) Spindle Housing
(E) Bearing Cup
(F) Small Spacer
(G) Snap Ring
(H) Bearing Cone
(I) Bearing Spacer
(J) Grease Axis Hole
(K) Blade Bolt
(L) Spring Washer
(M) Blade
(N) Spindle Shaft
(O) Seal
(P) Bearing Cup
(Q) Machined “C” Spacer
(R) Large Spacer
(S) Bearing Cone
(T) Seal
(U) Hardened Washer

Deck Mounting, Typical



Ref. No.	Qty.	Description
1	16	HF Nut
2	8	HH Cap Screw
3	4	Deck Lift Chain
4	4	Grease Fitting
5	2	Hex Nut
6	2	Lock Washer
7	2	HH Screw
8	2	Spherical Balljoint
9	2	Hex Nut
10	2	Deck Strut
11	2	Deck Strut Pin
12	2	HH Screw
13	2	Lock Nut

Leveling the Mower

1. Position mower on a flat surface. Stop the engine, set the parking brake, remove the key and disconnect the spark plug wire(s) from the spark plug(s).

2. Check tire pressure of all four tires. If needed, adjust to 13 psi (90 kPa).

3. Set anti-scalp rollers to top holes or remove them completely for this adjustment.

4. Raise the deck to the transport position and take all force off of the two large deck lift springs by loosening nut in front of each spring (Figure 128).

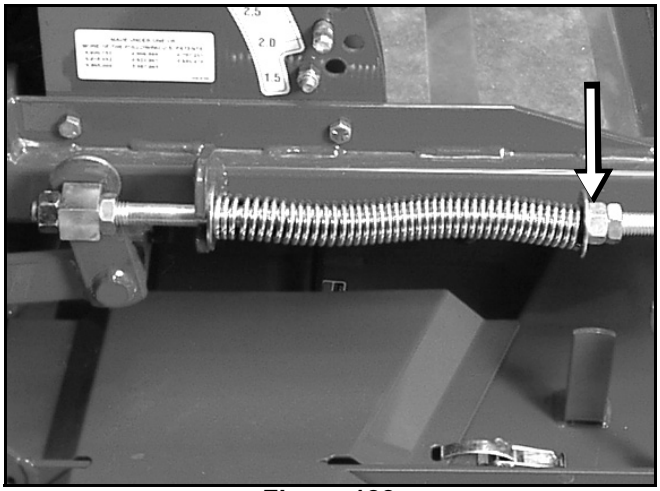


Figure 128 1101-008-02

5. Place two 1-1/2 in. (38mm) thick blocks under rear left and right lower edge of mower. Place one 2-1/4 in. (57mm) block under front center lower edge of mower (Figure 129).

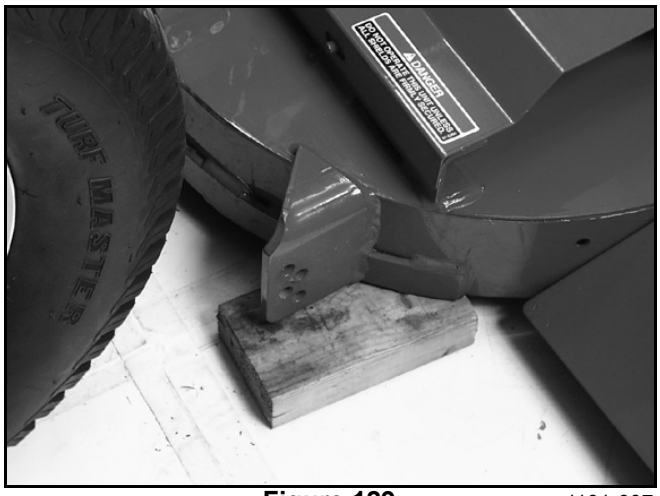


Figure 129 1101-007

Lower mower to the 2 in. (51mm) height-of-cut position.

6. Loosen the four top chain bolts in slots. Check the length of the rod/swivel assemblies. Distance from outside of rear swivel to outside of front swivel should be 19-17/32 in. (496mm) (Figure 130). Make sure that all four swivels move freely in holes.

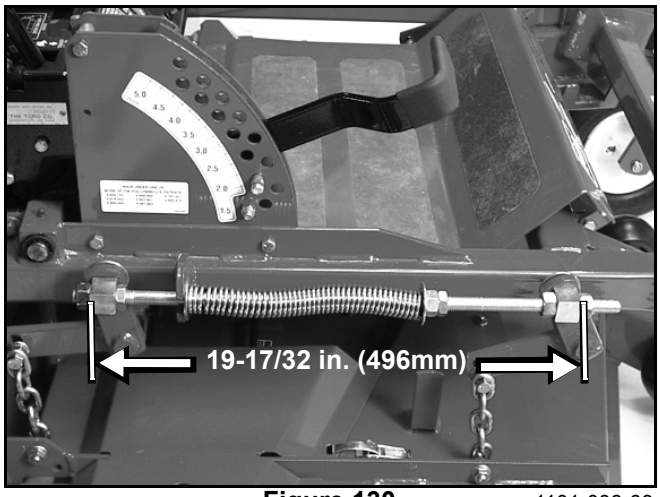


Figure 130 1101-008-03

7. If measurement is not 19-17/32 in. (496mm) on each side, adjust by turning nuts on either side of front swivels.

8. Lift up on four top chain attachment bolts, in the slots, to take slack out of chains and tighten flange lock nuts. (Deck is still supported by two rear and one front blocks under mower.)

9. If bolts contact the end of slots, shorten or lengthen rod/swivel assemblies as required, for extra clearance, adjust each side same amount.

Note: When properly adjusted, the front blade tip will be slightly lower than the rear blade tip. Refer to "Checking for Bent Blades" on page 6 - 11 to measure.

10. Recheck that blocks just fit just under the mower and that tension on all four chains is approximately equal. Tighten chain attachment bolts securely.

11. Measure height of cut. This can be checked with the same procedure as "Checking for Bent Blades" on page 6 - 11.

12. Install anti-scalp rollers for proper height-of-cut and tighten securely.

Checking for Bent Blades

1. Rotate the blades until the ends face forward and backward (Figure 131). Measure from a level surface to the cutting edge of the blades (Figure 132). Note this dimension.

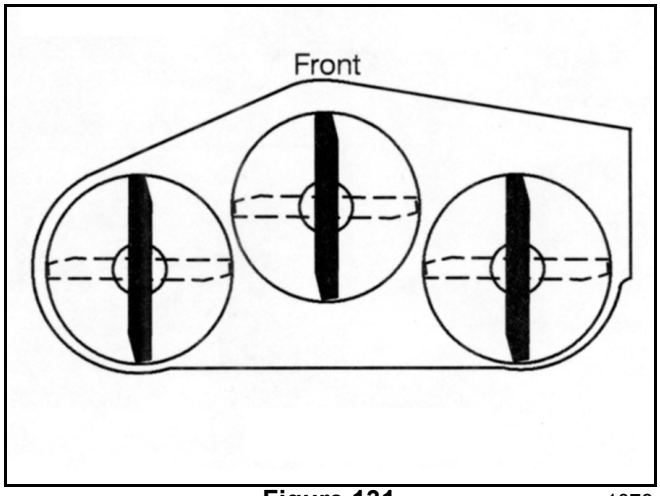


Figure 131 m-1078

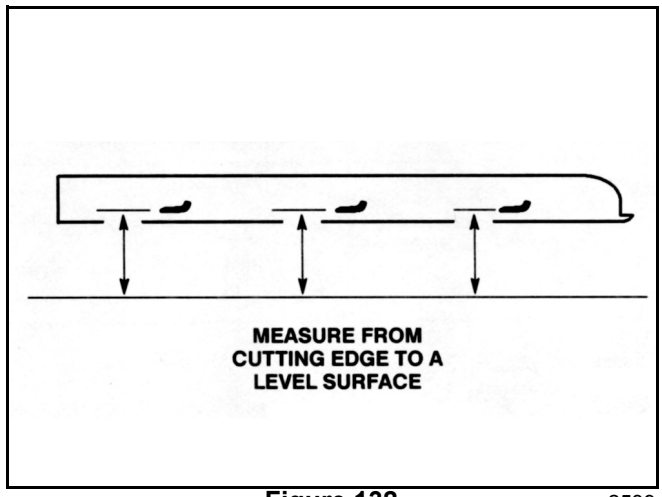


Figure 132 m-2539

2. Rotate the opposite ends of the blades forward. Measure from a level surface to the cutting edge of the blades at the same position as in step 1 above. The difference between the dimensions obtained in steps 1 and 2 must not exceed 1/8” (3mm). If this dimension exceeds 1/8” (3mm), the blade is bent and must be replaced.

WARNING

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

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

Adjusting the Compression Spring

1. Raise deck lift lever to the transport position, (Figure 133).

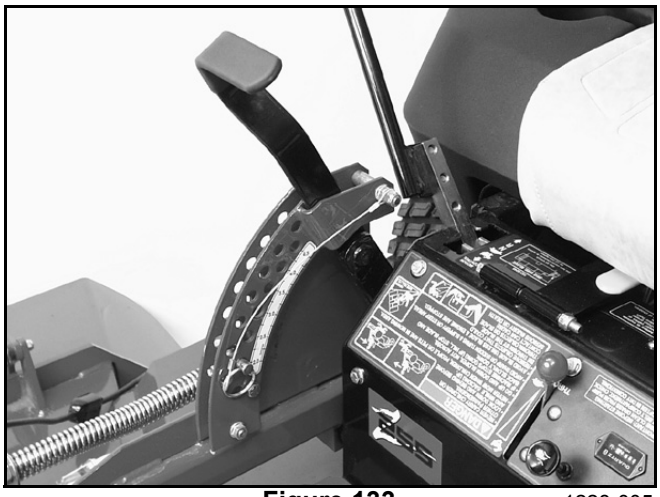


Figure 133 1228-005

2. Springs are compressed so the distance between the two large washers should be 11 in. (279mm) (Figure 134).

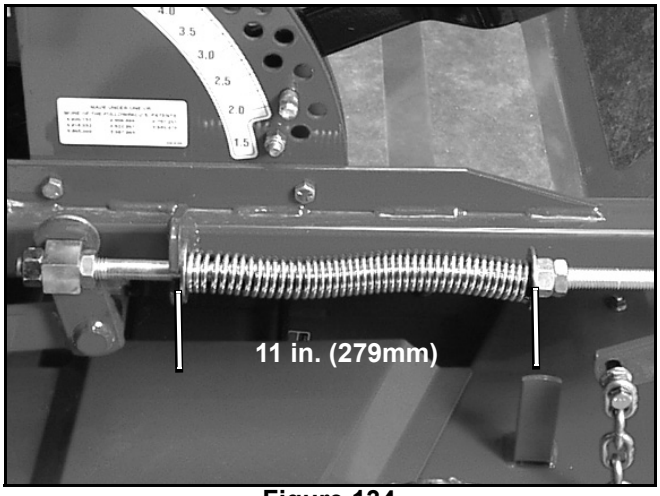
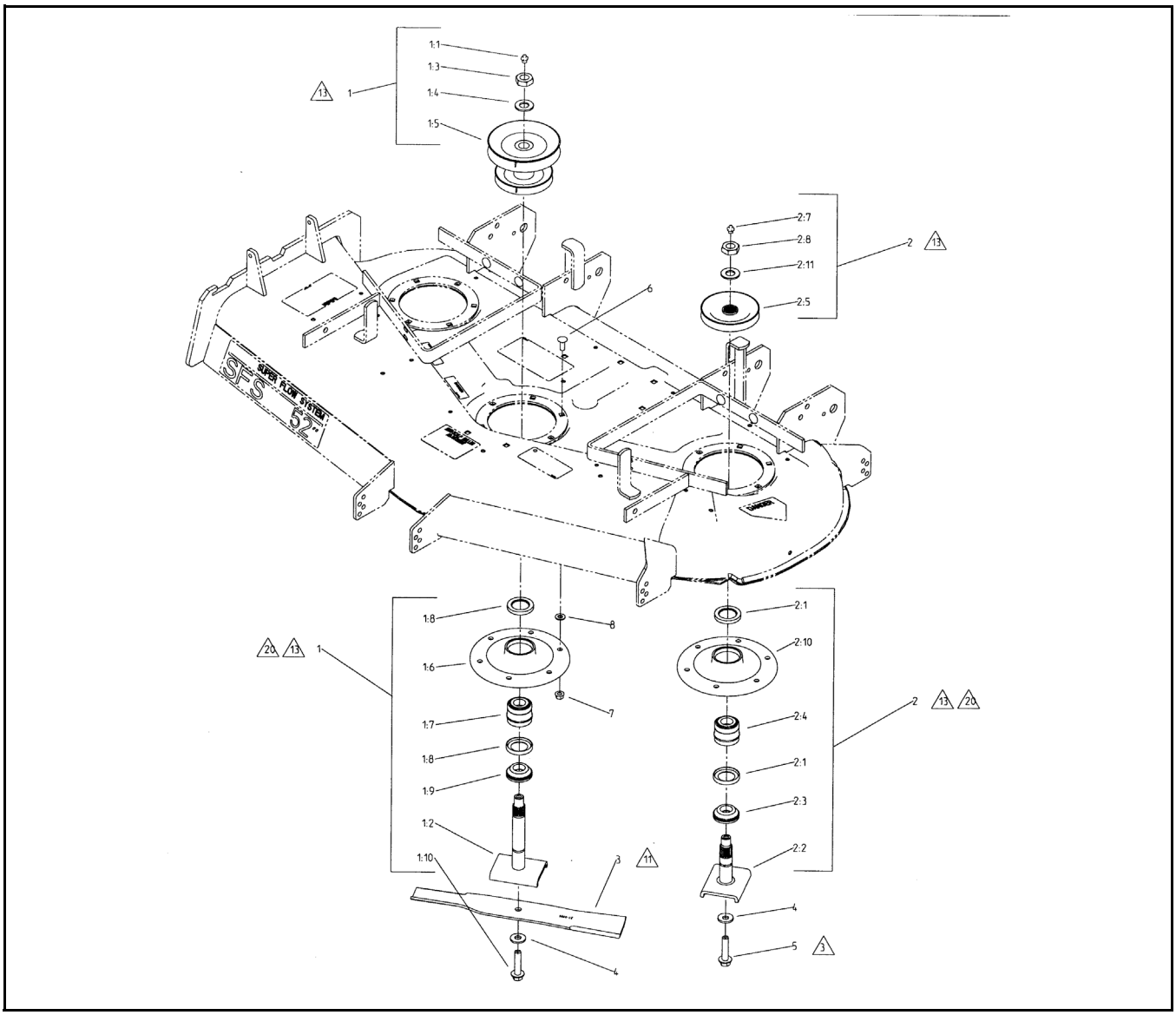


Figure 134

Adjust by turning nut in front of each spring (Figure 134). Clockwise will shorten spring; counterclockwise will lengthen spring.

Spindle Assemblies, Typical



Ref. No.	Qty.	Description
3	1	Cap Screw
4	1	Torsion Spring
5	1	Belt Guide
7	1	ASM Deflector
8	1	Lock Nut
9	1	HH Screw
10	1	Flat Washer
11	8	Flange Lock Nut
13	8	HWH Screw
14	4	Slotted Clamp
15	2	Blade Bolt

Ref. No.	Qty.	Description
17	3	Spring Washer
18	3	Blade
19	1	Flat Washer
20	18	HF Nut
21	2	Outer Spindle ASM
22	1	Middle Spindle ASM
23	17	Carr Screw
26	1	Deflector Mounting

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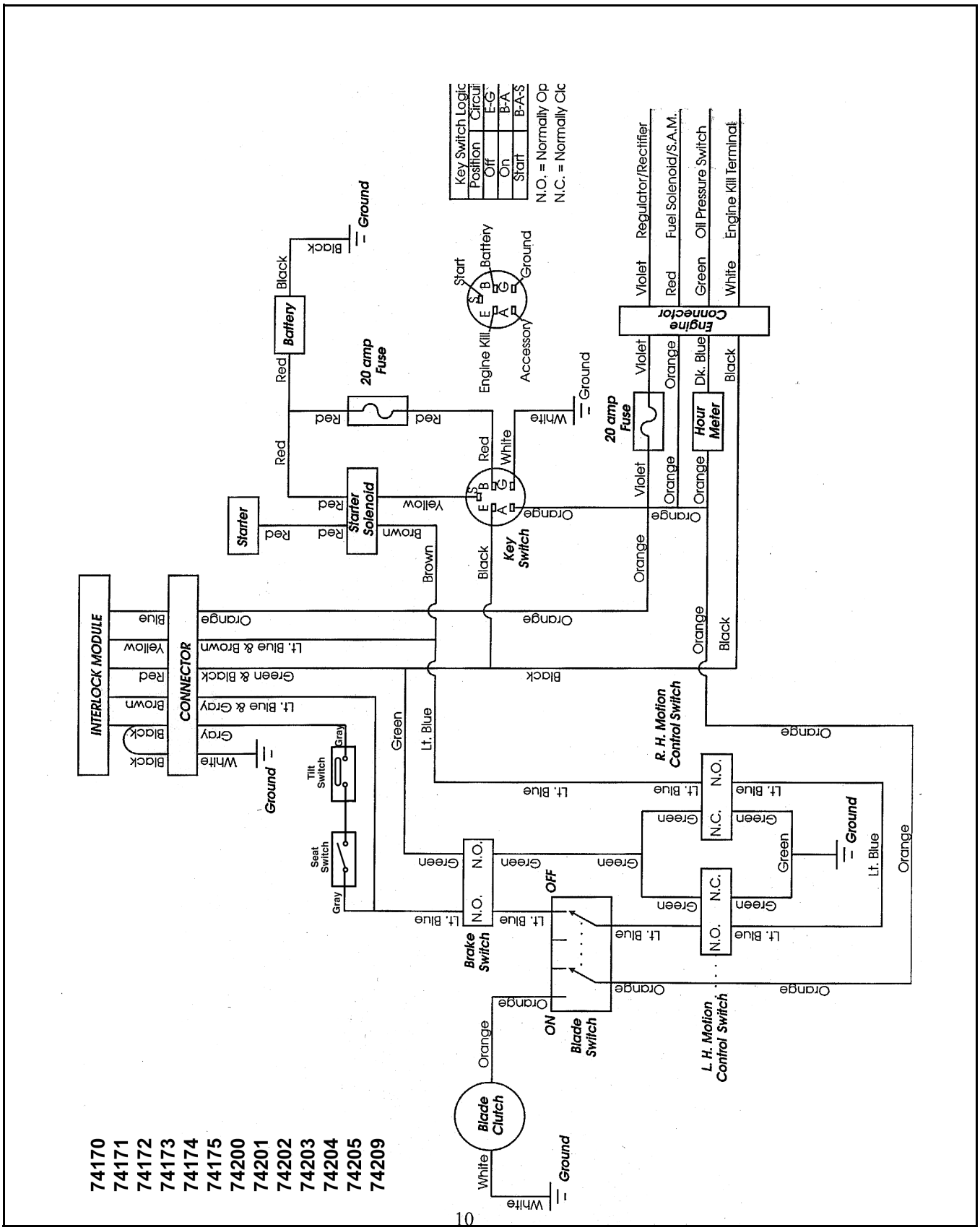
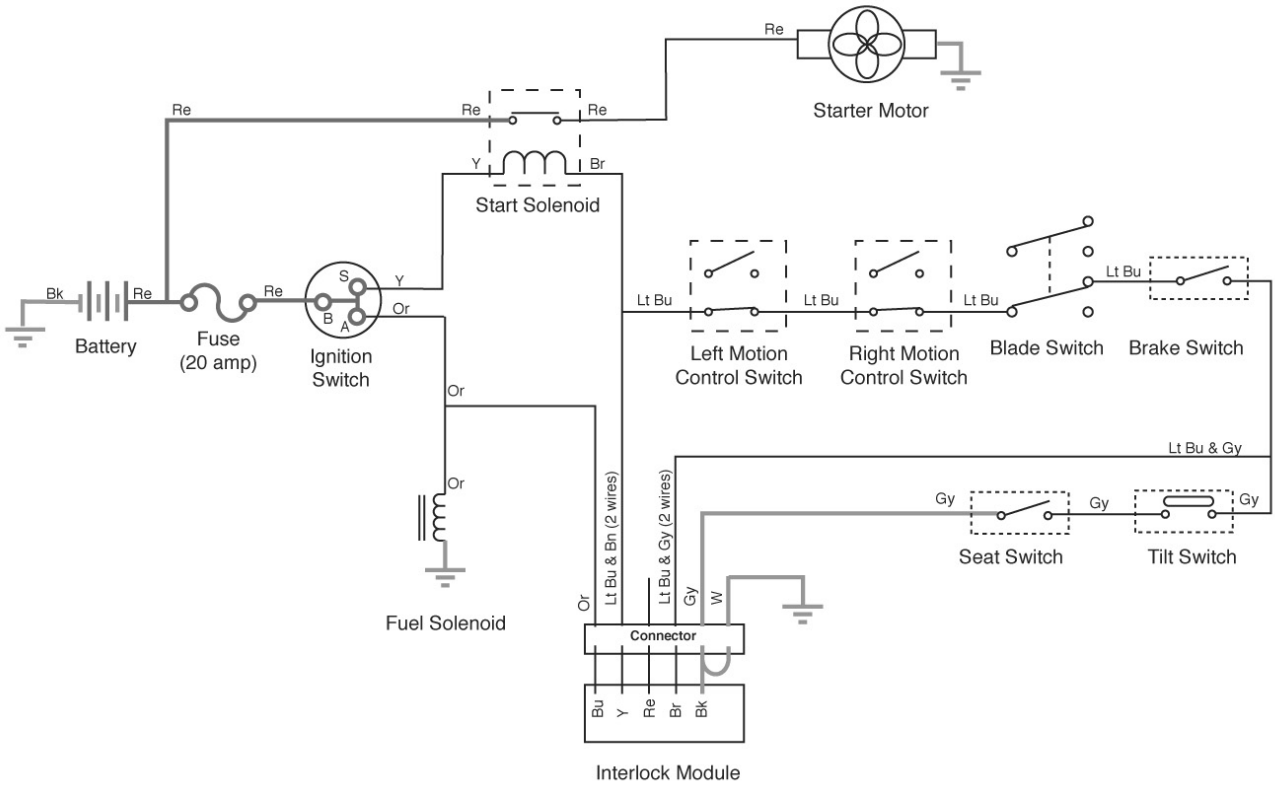


74170
74171
74172
74173
74174
74175
74200
74201
74202
74203
74204
74205
74209

Models

74170	**74200**
74171	**74201**
74172	**74202**
74173	**74203**
74174	**74204**
74175	**74205**
	74209

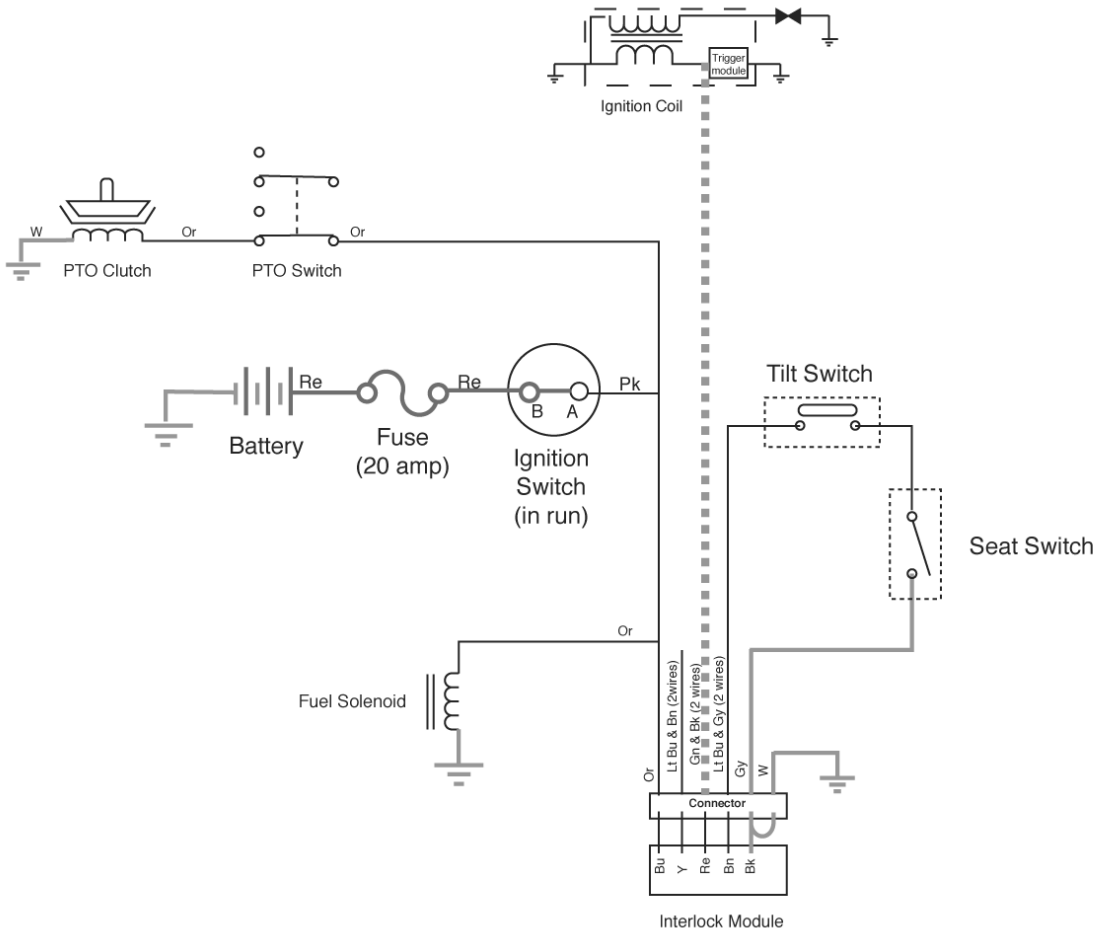
Start Circuit



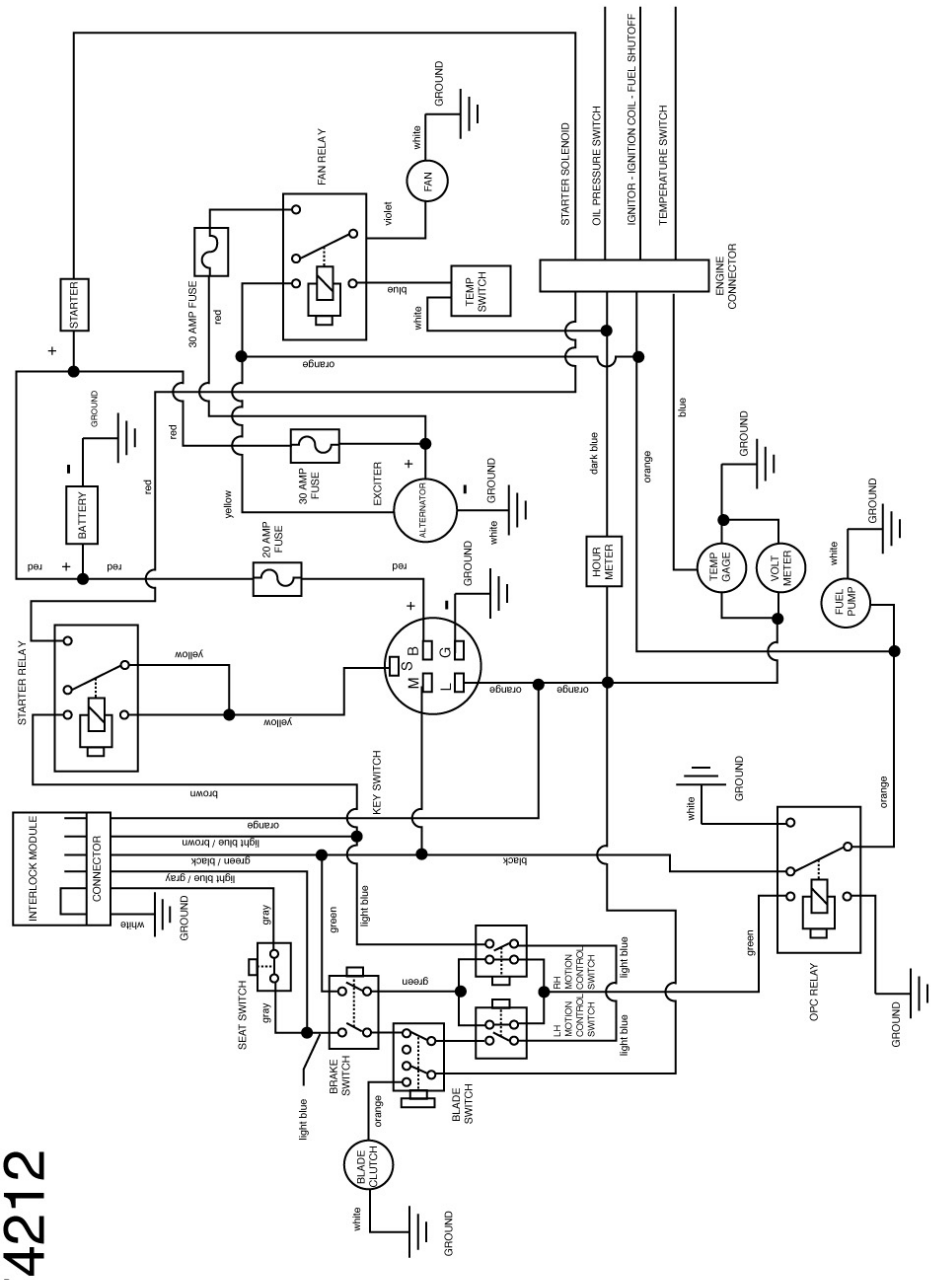
Models

74170	**74200**
74171	**74201**
74172	**74202**
74173	**74203**
74174	**74204**
74175	**74205**
	74209

Run Circuit

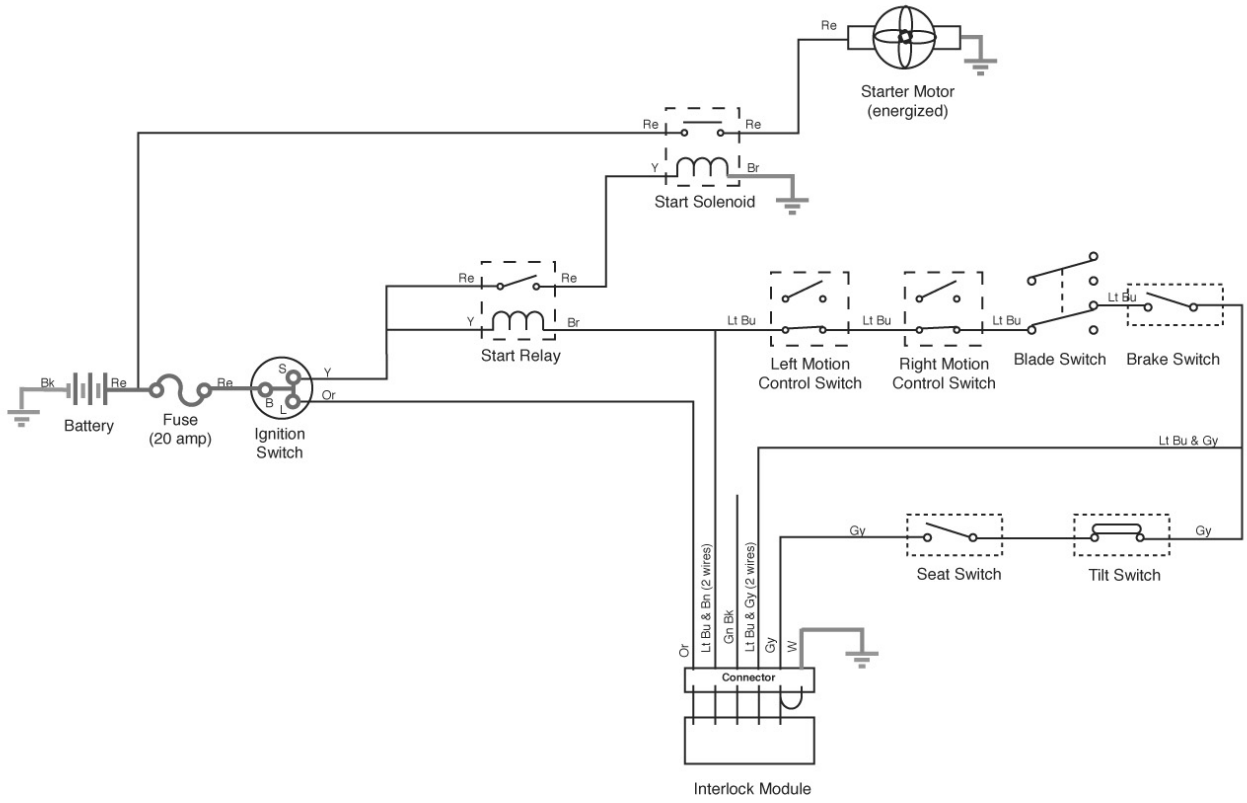


Liquid cooled
74211
74212



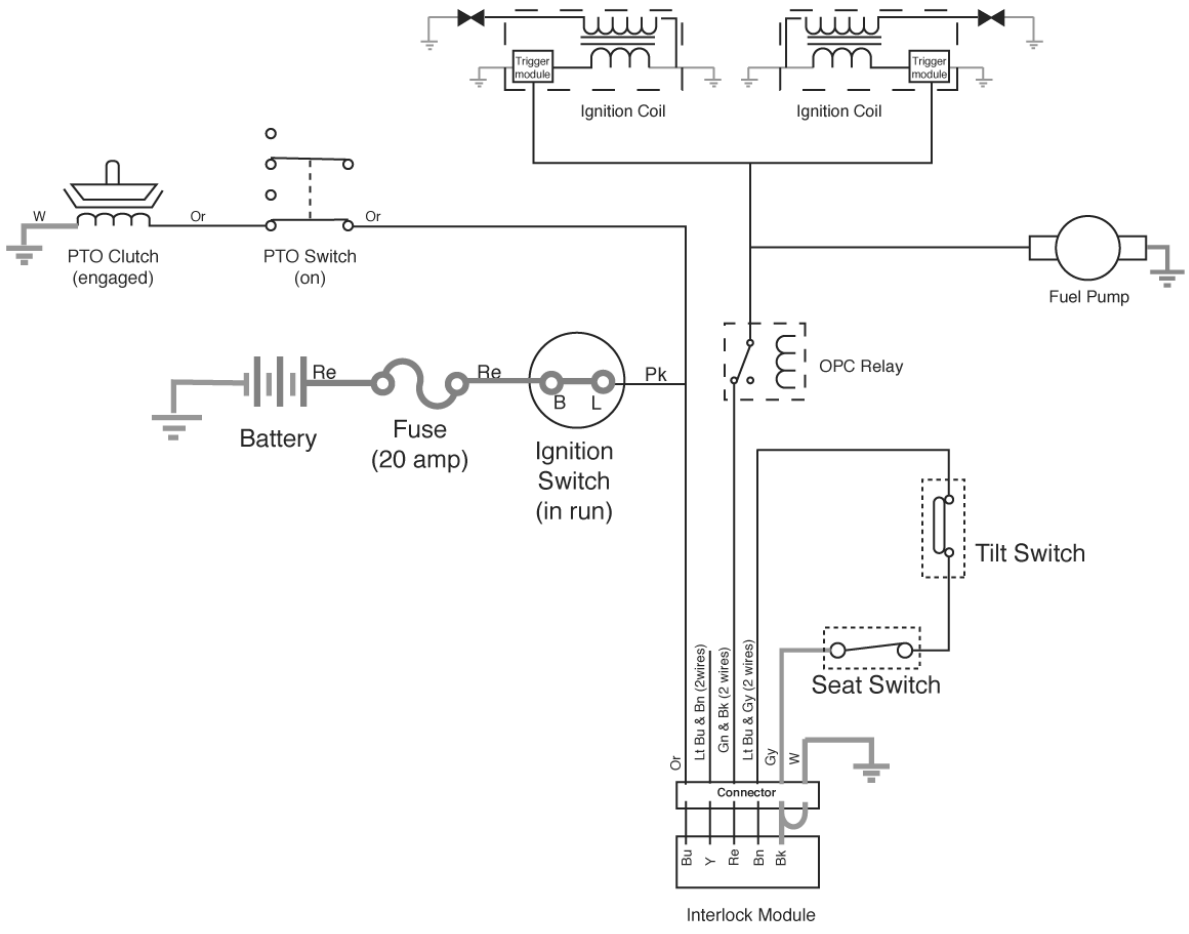
Models
74211
74212

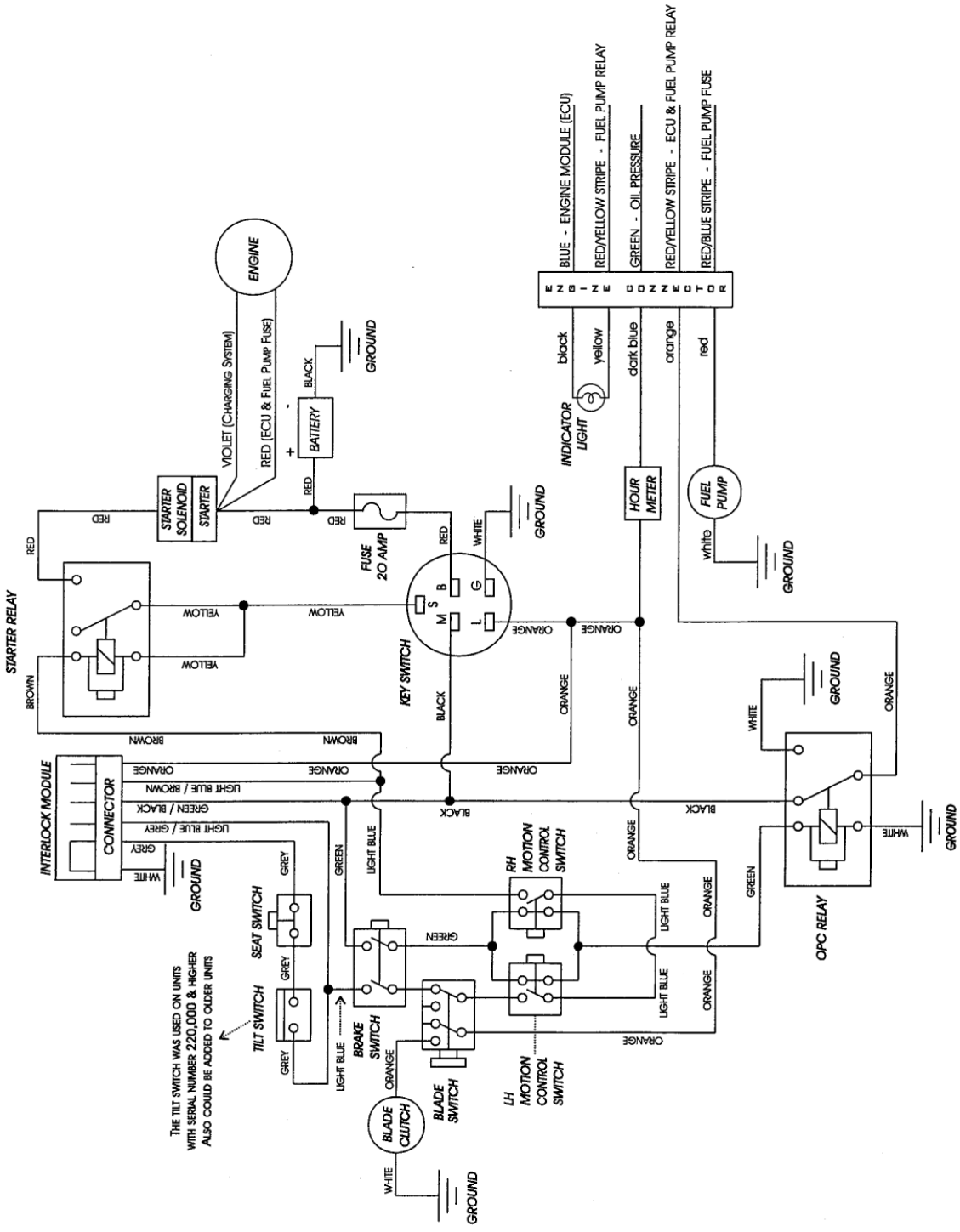
Start Circuit



Models
74211
74212

Run Circuit

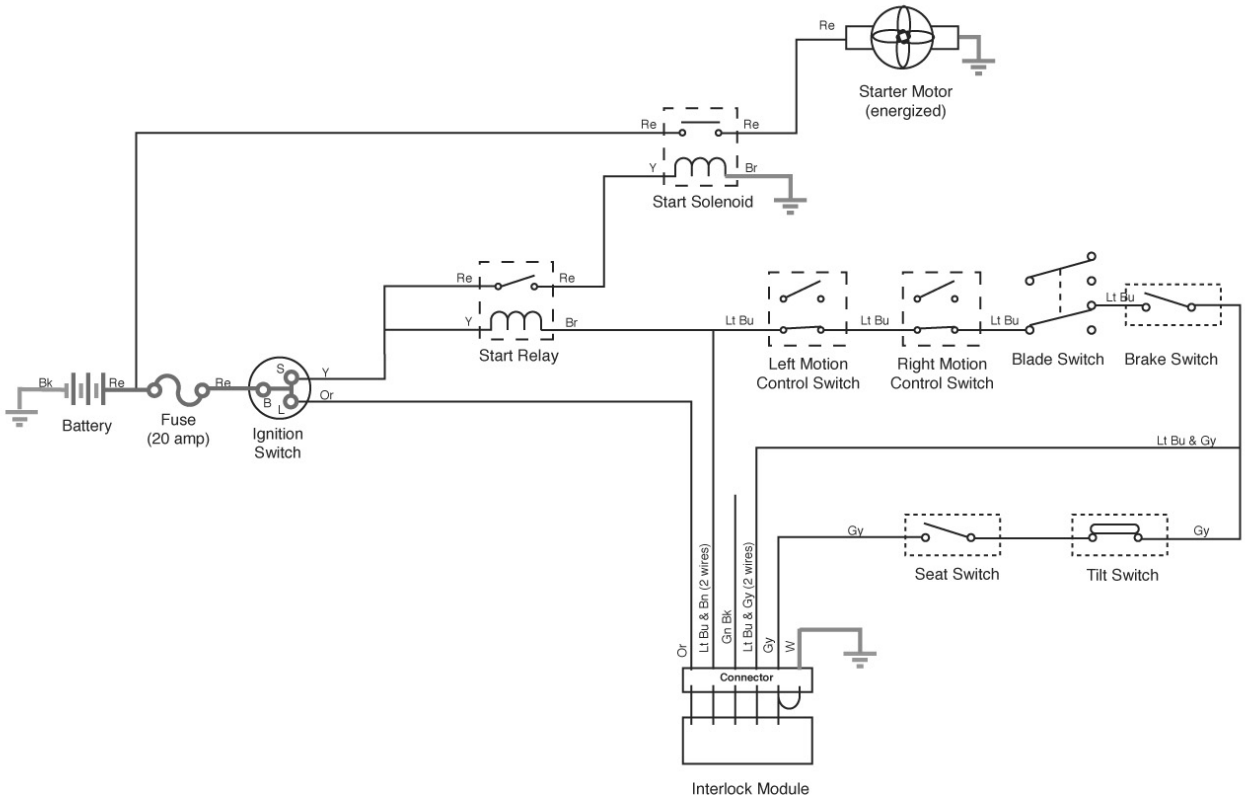



ENGINE
VIOLET (CHARGING SYSTEM)
RED (ECU & FUEL PUMP FUSE)
BATTERY
BLACK
GROUND
STARTER SOLENOID
STARTER
RED
FUSE 20 AMP
STARTER RELAY
YELLOW
BROWN
KEY SWITCH
WHITE
ORANGE
BLACK
INDICATOR LIGHT
black
yellow
dark blue
orange
red
BLUE - ENGINE MODULE (ECU)
RED/YELLOW STRIPE - FUEL PUMP RELAY
GREEN - OIL PRESSURE
RED/YELLOW STRIPE - ECU & FUEL PUMP RELAY
RED/BLUE STRIPE - FUEL PUMP FUSE
ENGINE
CONNECTOR
HOUR METER
FUEL PUMP
white
INTERLOCK MODULE
CONNECTOR
LIGHT BLUE / BROWN
GREEN / BLACK
LIGHT BLUE / GREY
GREY
WHITE
SEAT SWITCH
TILT SWITCH
THE TILT SWITCH WAS USED ON UNITS WITH SERIAL NUMBER 220,000 & HIGHER ALSO COULD BE ADDED TO OLDER UNITS
LIGHT BLUE
GREEN
BRAKE SWITCH
BLADE CLUTCH
BLADE SWITCH
RH MOTION CONTROL SWITCH
LH MOTION CONTROL SWITCH
OPC RELAY

74218
74219

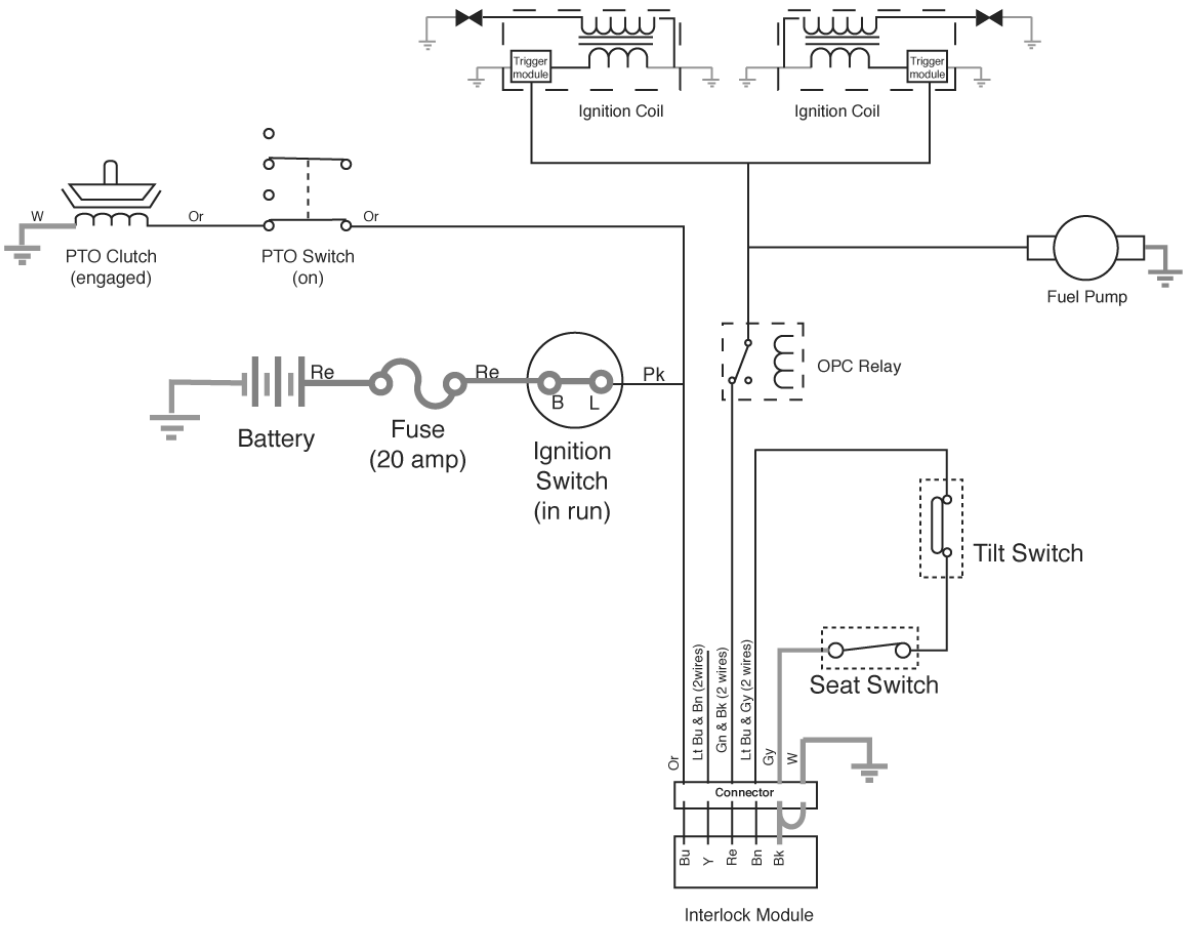
Models
74218
74219

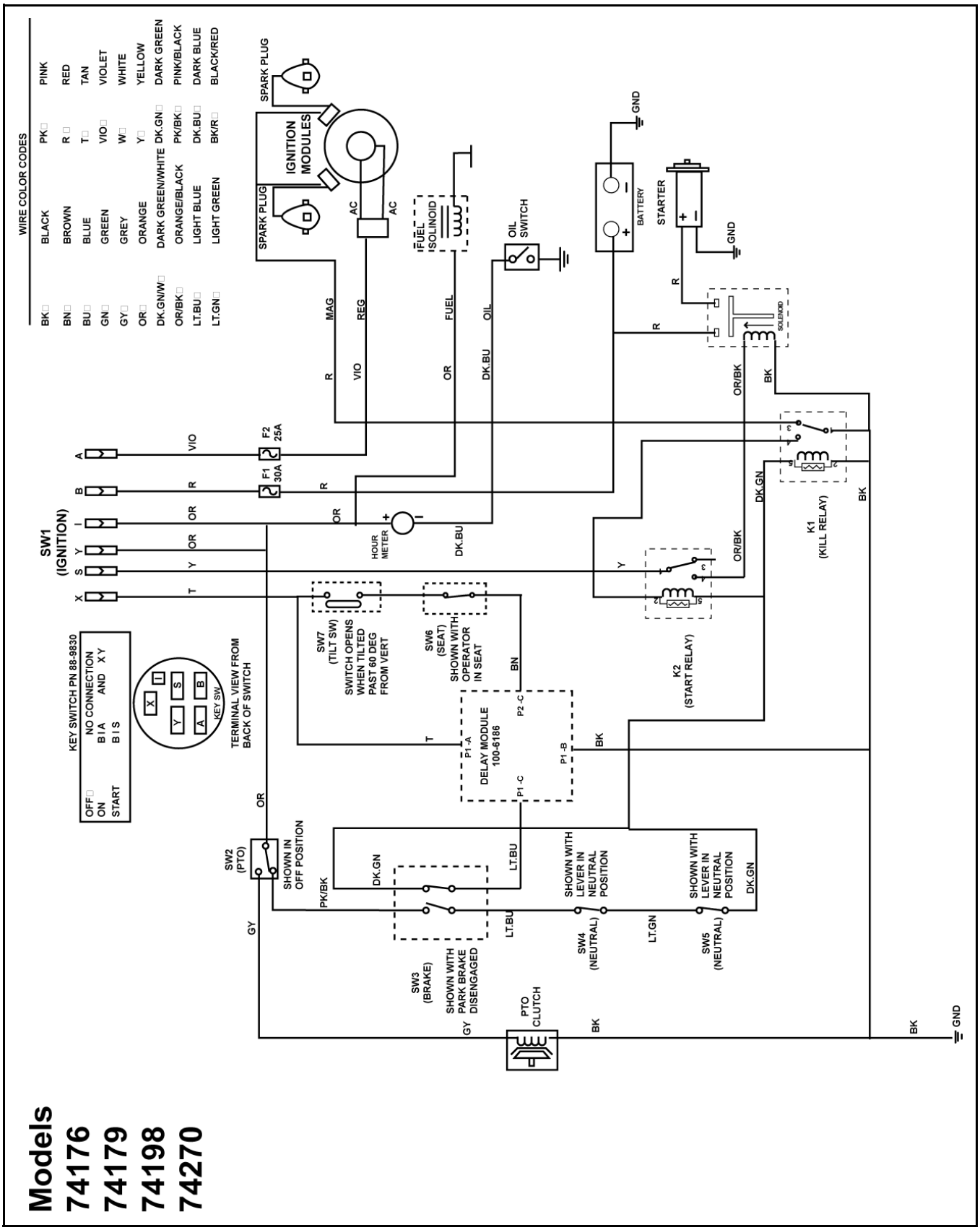
Start Circuit



Models
74218
74219

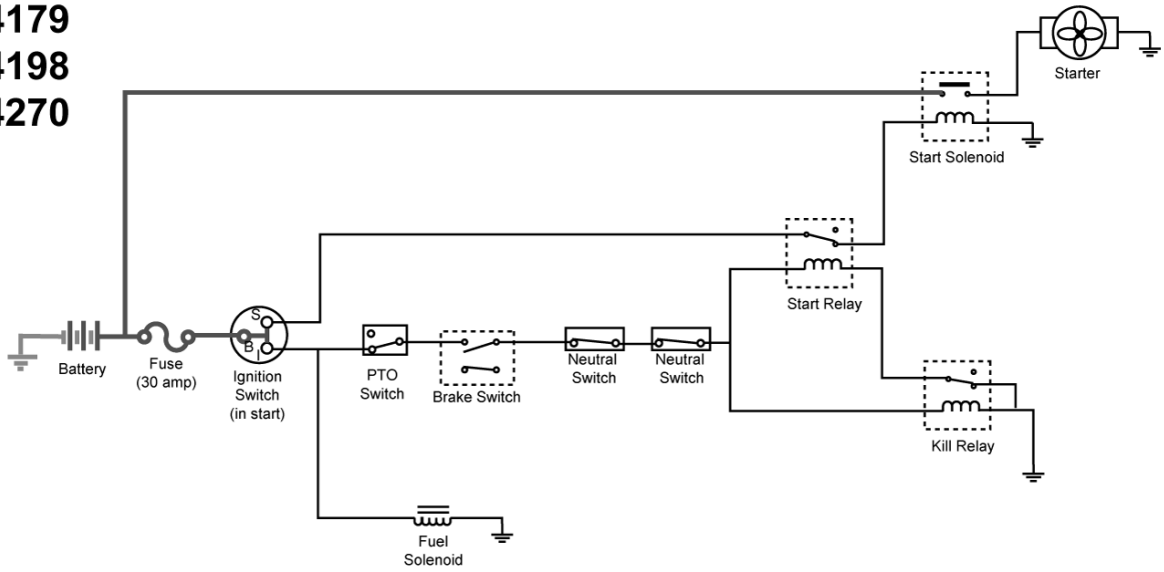
Run Circuit



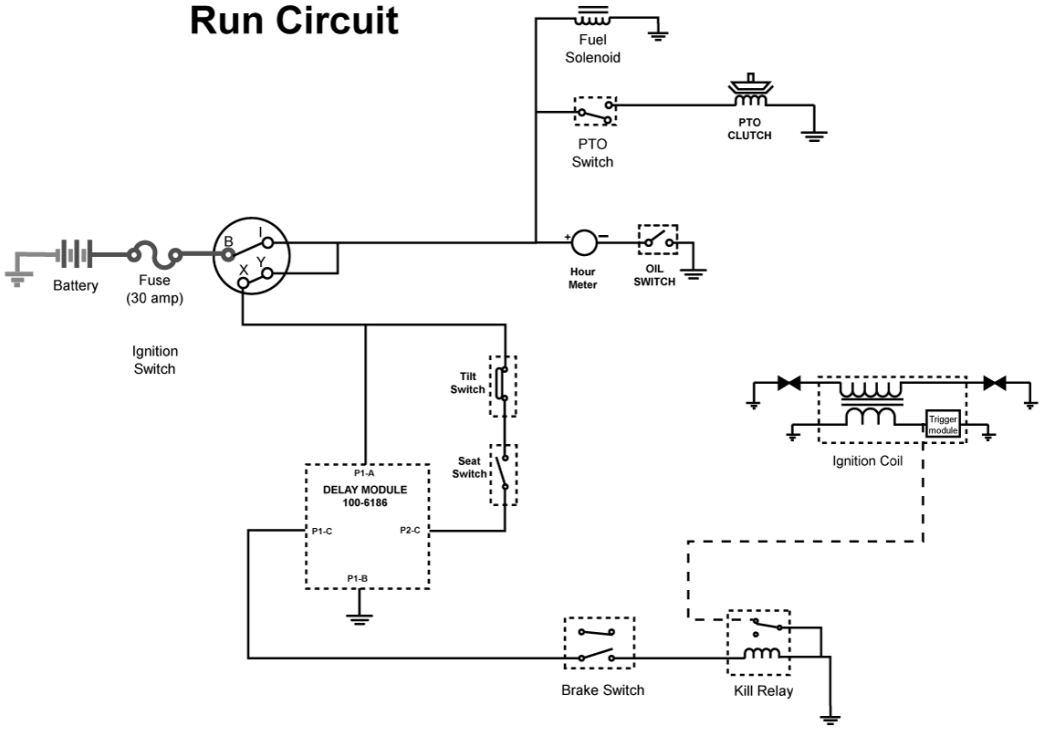

Models
74176
74179
74198
74270
WIRE COLOR CODES
BK BLACK PK PINK
BN BROWN R RED
BU BLUE T TAN
GN GREEN VIO VIOLET
GY GREY W WHITE
OR ORANGE Y YELLOW
DK.GN/W DARK GREEN/WHITE DK.GN DARK GREEN
OR/BK ORANGE/BLACK PK/BK PINK/BLACK
LT.BU LIGHT BLUE DK.BU DARK BLUE
LT.GN LIGHT GREEN BK/R BLACK/RED
SPARK PLUG
IGNITION MODULES
SPARK PLUG
AC
AC
MAG
REG
FUEL
OIL
FUEL SOLINOID
OIL SWITCH
BATTERY
STARTER
GND
GND
SOLENOID
SW1 (IGNITION)
A
B
I
Y
S
X
VIO
R
OR
OR
Y
T
F2 25A
F1 30A
HOUR METER
KEY SWITCH PN 88-9830
OFF NO CONNECTION
ON B I A AND X Y
START B I S
KEY SW
TERMINAL VIEW FROM BACK OF SWITCH
SW7 (TILT SW)
SWITCH OPENS WHEN TILTED PAST 60 DEG FROM VERT
SW6 (SEAT)
SHOWN WITH OPERATOR IN SEAT
BN
P2 -C
P1-A
DELAY MODULE 100-6186
P1 -C
P1 -B
T
BK
K2 (START RELAY)
OR/BK
DK.GN
K1 (KILL RELAY)
BK
SW2 (PTO)
SHOWN IN OFF POSITION
OR
PK/BK
DK.GN
LT.BU
SHOWN WITH LEVER IN NEUTRAL POSITION
SHOWN WITH LEVER IN NEUTRAL POSITION
DK.GN
GY
LT.BU
LT.GN
SW3 (BRAKE)
SHOWN WITH PARK BRAKE DISENGAGED
SW4 (NEUTRAL)
SW5 (NEUTRAL)
GY
PTO CLUTCH
BK
BK
GND

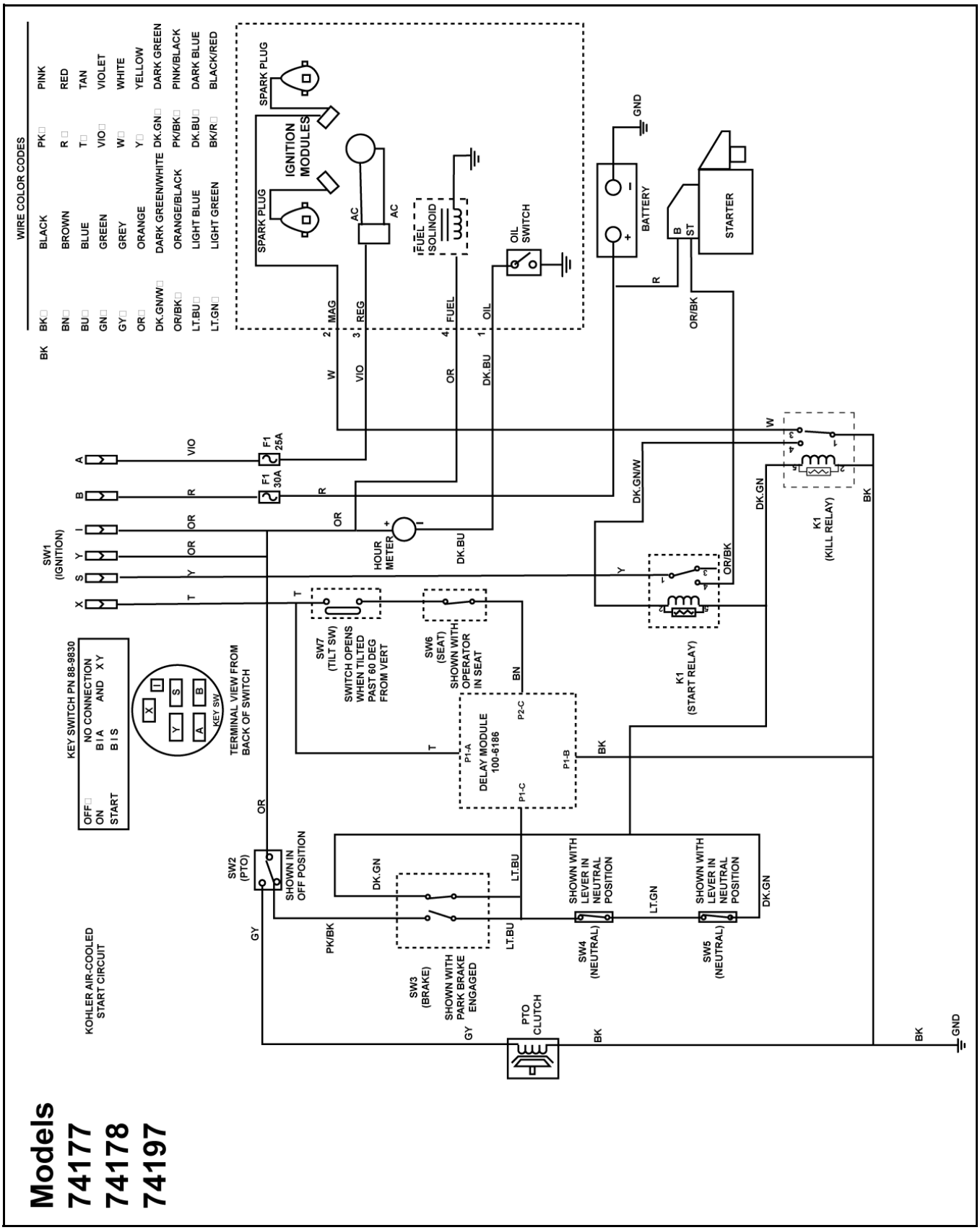
Models
74176
74179
74198
74270

Start Circuit



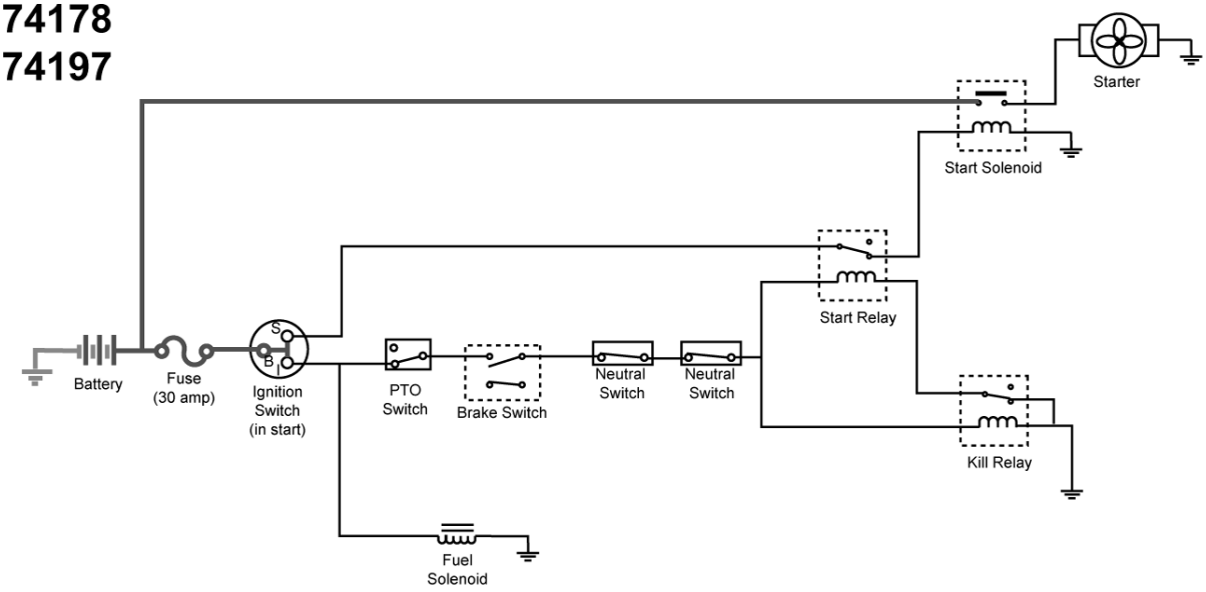
Run Circuit



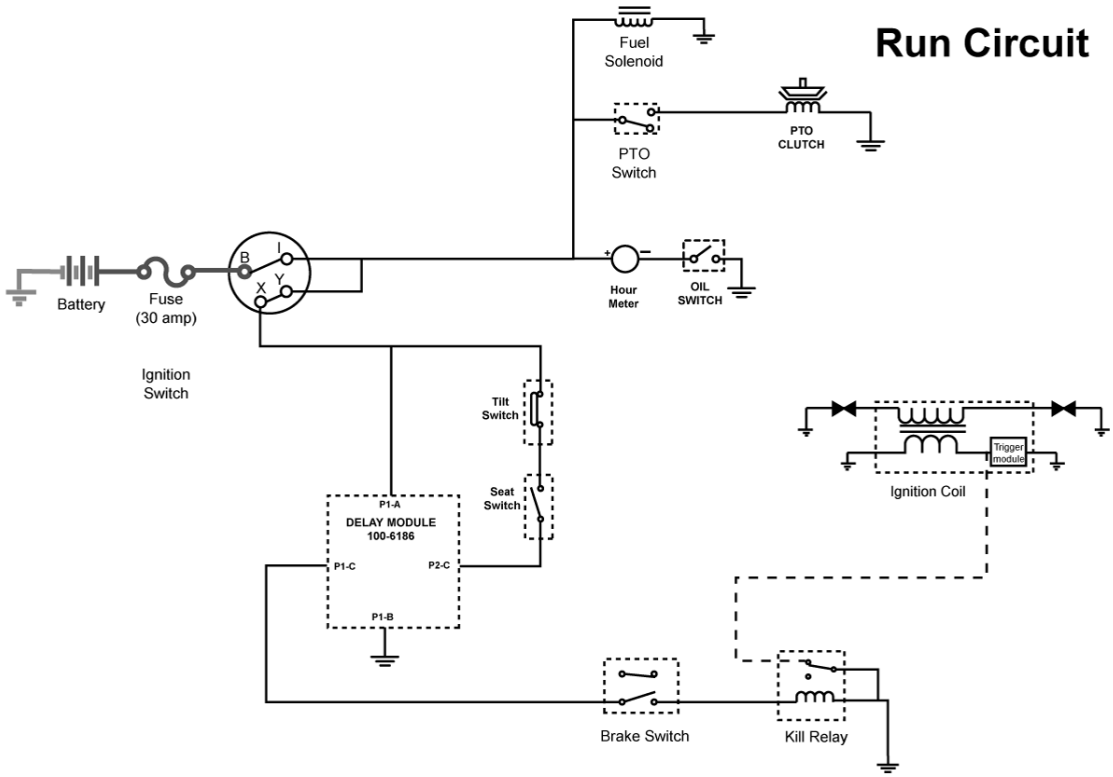

Models
74177
74178
74197
WIRE COLOR CODES
BK BLACK PK PINK
BN BROWN R RED
BU BLUE T TAN
GN GREEN VIO VIOLET
GY GREY W WHITE
OR ORANGE Y YELLOW
DK.GN/W DARK GREEN/WHITE DK.GN DARK GREEN
OR/BK ORANGE/BLACK PK/BK PINK/BLACK
LT.BU LIGHT BLUE DK.BU DARK BLUE
LT.GN LIGHT GREEN BK/R BLACK/RED
SPARK PLUG
IGNITION MODULES
SPARK PLUG
AC
AC
FUEL SOLINOID
OIL SWITCH
BATTERY
GND
STARTER
B
ST
2 MAG
3 REG
4 FUEL
1 OIL
W
VIO
OR
DK.BU
R
OR/BK
SW1 (IGNITION)
A
B
I
Y
S
X
VIO
R
OR
OR
Y
T
F1 25A
F1 30A
R
OR
HOUR METER
DK.BU
W
DK.GN/W
DK.GN
BK
K1 (KILL RELAY)
Y
OR/BK
K1 (START RELAY)
T
SW7 (TILT SW)
SWITCH OPENS WHEN TILTED PAST 60 DEG FROM VERT
SW6 (SEAT)
SHOWN WITH OPERATOR IN SEAT
BN
KEY SWITCH PN 88-9830
NO CONNECTION AND B I A X Y B I S
OFF
ON
START
KEY SW
X
I
Y
S
A
B
TERMINAL VIEW FROM BACK OF SWITCH
P2-C
DELAY MODULE 100-6186
P1-A
P1-B
P1-C
T
BK
OR
SW2 (PTO)
SHOWN IN OFF POSITION
DK.GN
LT.BU
SHOWN WITH LEVER IN NEUTRAL POSITION
LT.GN
SHOWN WITH LEVER IN NEUTRAL POSITION
DK.GN
GY
PK/BK
LT.BU
SW3 (BRAKE)
SHOWN WITH PARK BRAKE ENGAGED
SW4 (NEUTRAL)
SW5 (NEUTRAL)
GY
PTO CLUTCH
BK
BK
GND
KOHLER AIR-COOLED START CIRCUIT

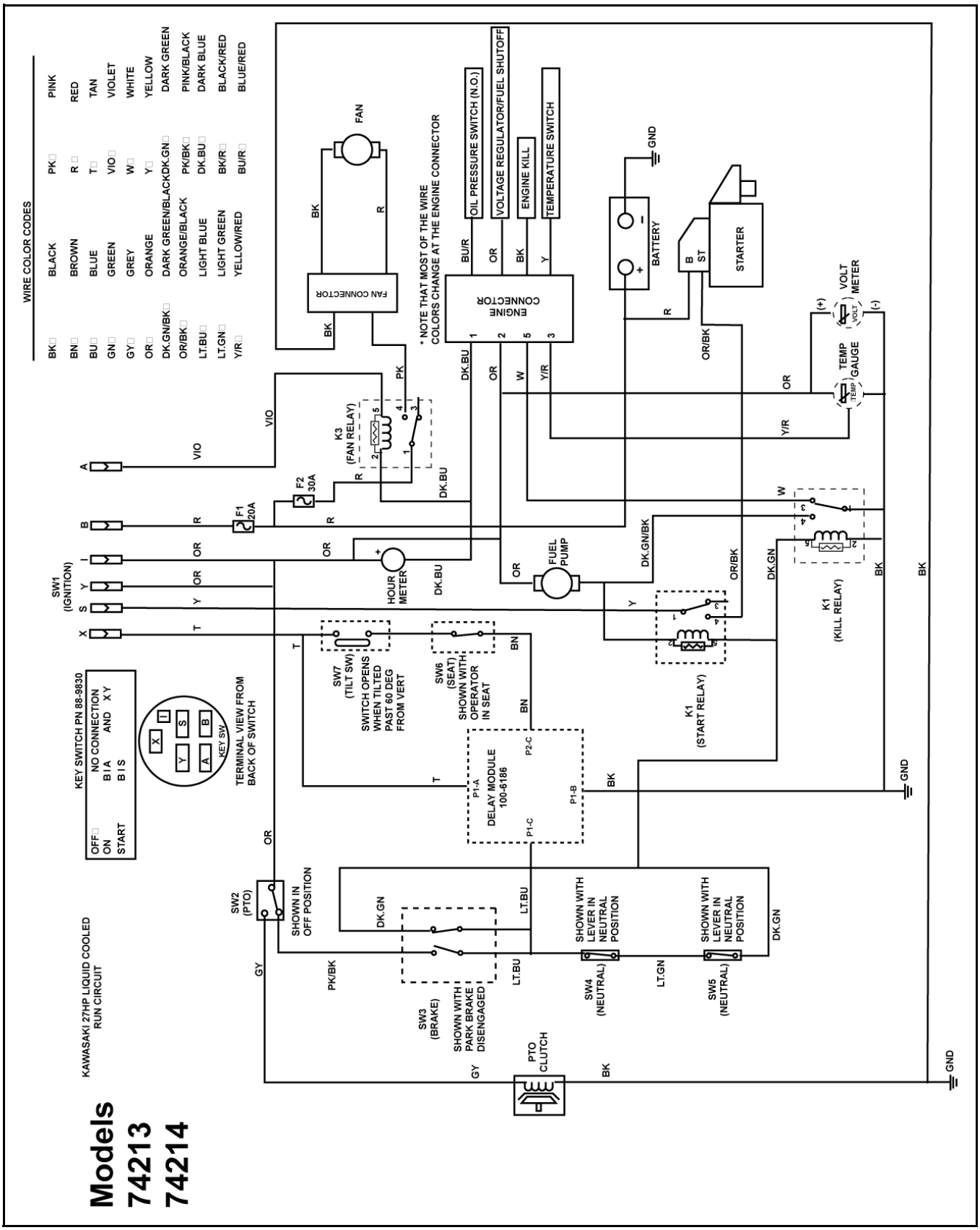
Models
74177
74178
74197

Start Sircuit



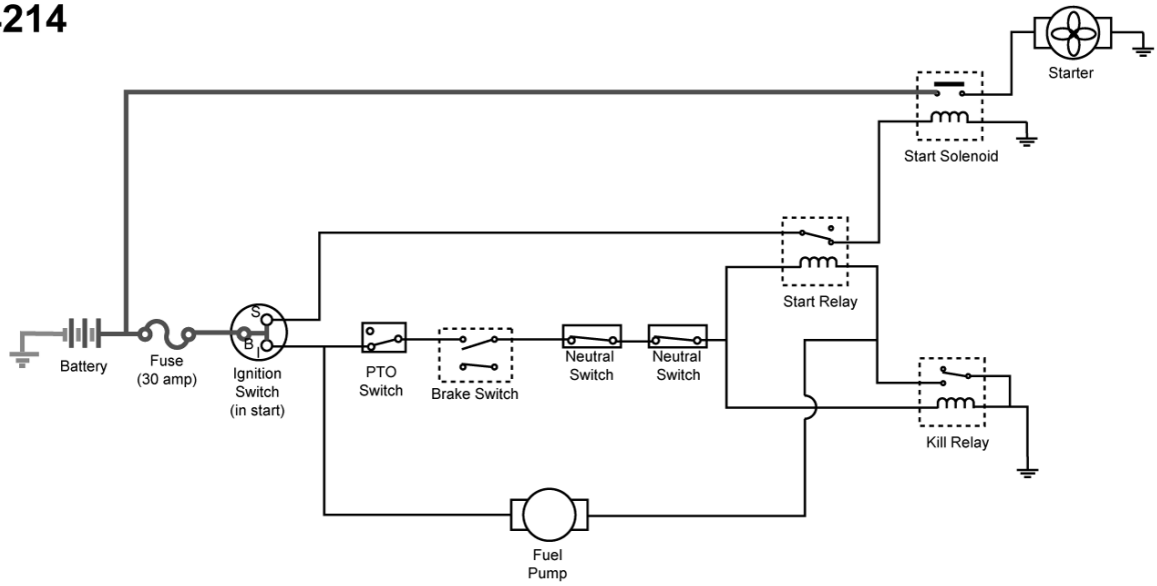
Run Circuit



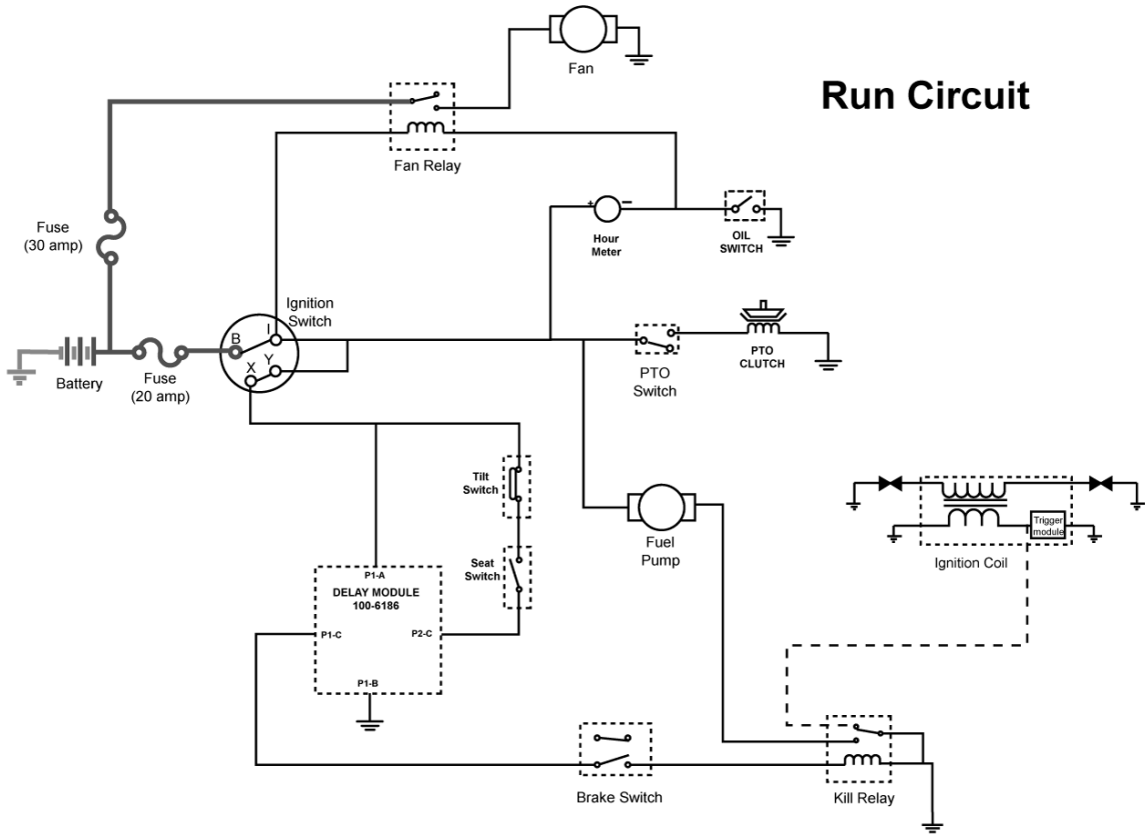

Models
74213
74214
KAWASAKI 27HP LIQUID COOLED
RUN CIRCUIT
WIRE COLOR CODES
BK BLACK PK PINK
BN BROWN R RED
BU BLUE T TAN
GN GREEN VIO VIOLET
GY GREY W WHITE
OR ORANGE Y YELLOW
DK.GN/BK DARK GREEN/BLACK DK.GN DARK GREEN
OR/BK ORANGE/BLACK PK/BK PINK/BLACK
LT.BU LIGHT BLUE DK.BU DARK BLUE
LT.GN LIGHT GREEN BK/R BLACK/RED
Y/R YELLOW/RED BU/R BLUE/RED
KEY SWITCH PN 88-9830
OFF NO CONNECTION
ON B I A AND X Y
START B I S
TERMINAL VIEW FROM BACK OF SWITCH
KEY SW
SW1 (IGNITION)
SW2 (PTO)
SHOWN IN OFF POSITION
SW3 (BRAKE)
SHOWN WITH PARK BRAKE DISENGAGED
SW4 (NEUTRAL)
SHOWN WITH LEVER IN NEUTRAL POSITION
SW5 (NEUTRAL)
SHOWN WITH LEVER IN NEUTRAL POSITION
SW6 (SEAT)
SHOWN WITH OPERATOR IN SEAT
SW7 (TILT SW)
SWITCH OPENS WHEN TILTED PAST 60 DEG FROM VERT
DELAY MODULE 100-6186
P1-A
P1-B
P1-C
P2-C
K1 (START RELAY)
K1 (KILL RELAY)
K3 (FAN RELAY)
F1 20A
F2 30A
HOUR METER
FUEL PUMP
PTO CLUTCH
FAN
FAN CONNECTOR
ENGINE CONNECTOR
* NOTE THAT MOST OF THE WIRE COLORS CHANGE AT THE ENGINE CONNECTOR
OIL PRESSURE SWITCH (N.O.)
VOLTAGE REGULATOR/FUEL SHUTOFF
ENGINE KILL
TEMPERATURE SWITCH
BATTERY
STARTER
TEMP GAUGE
VOLT METER
GND

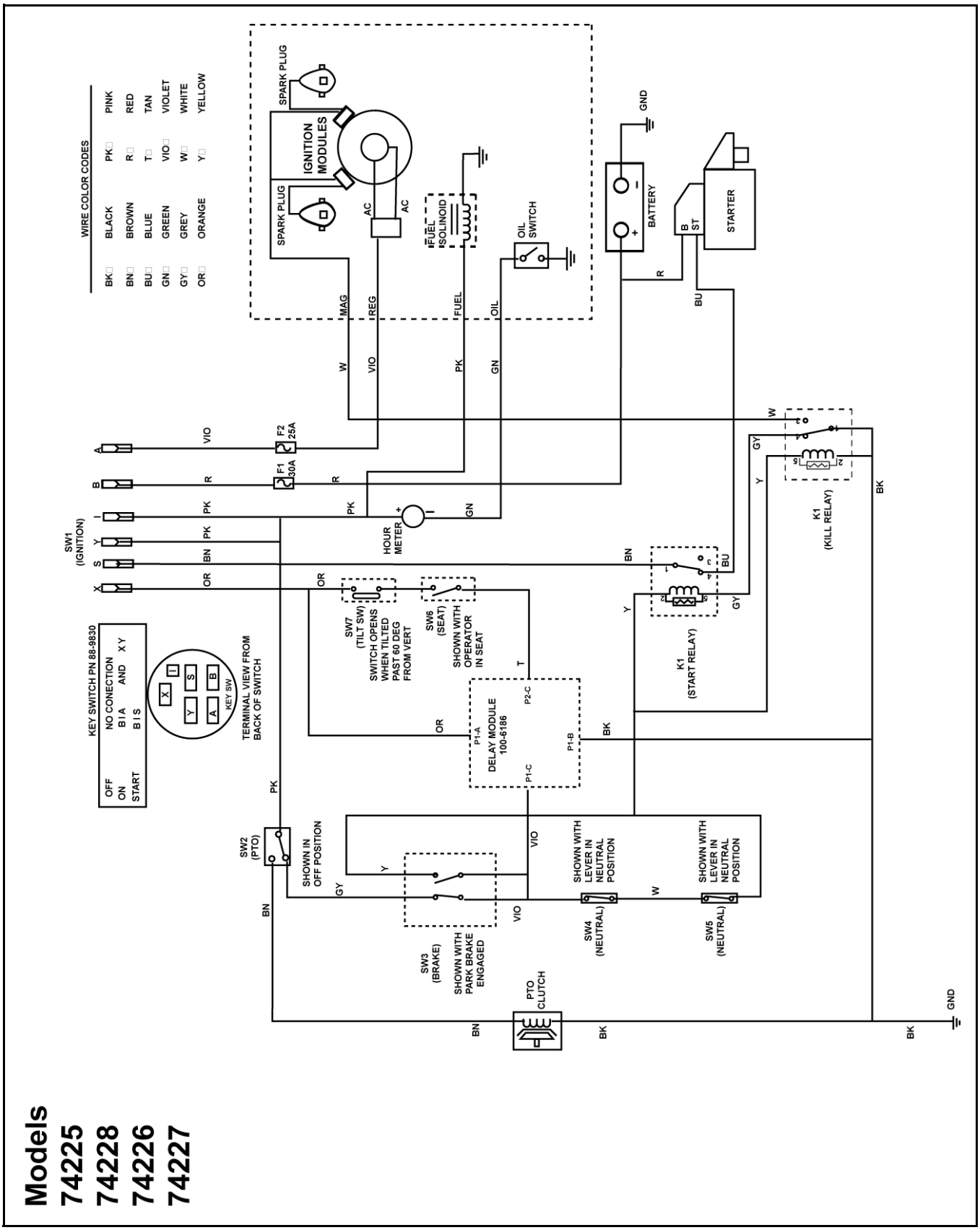
Models
74213
74214

Start Sircuit



Run Circuit

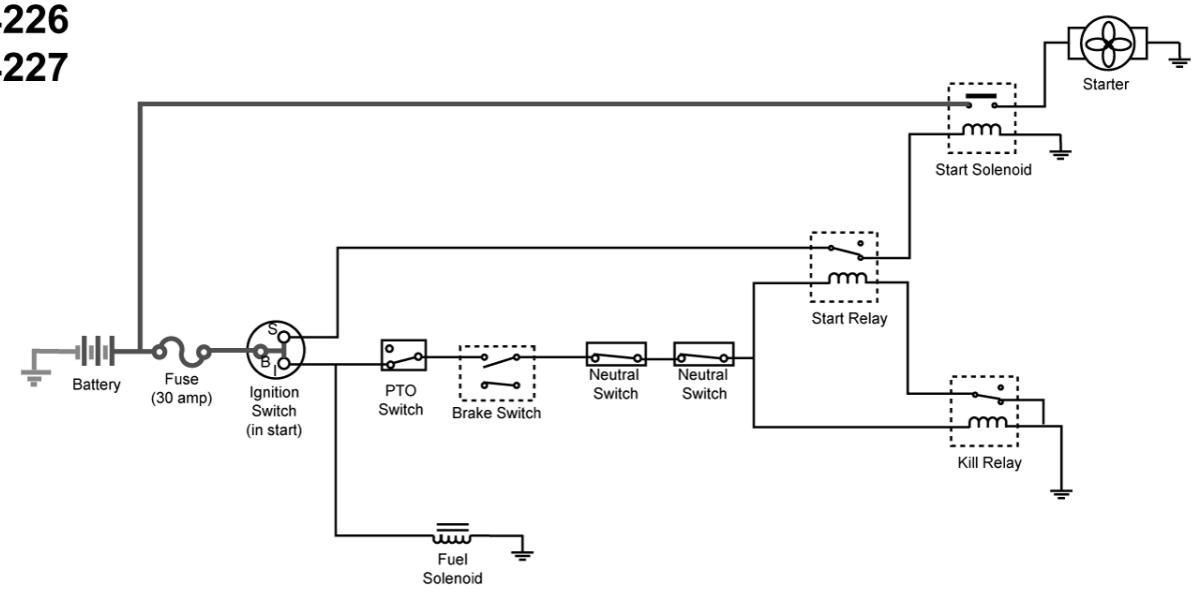




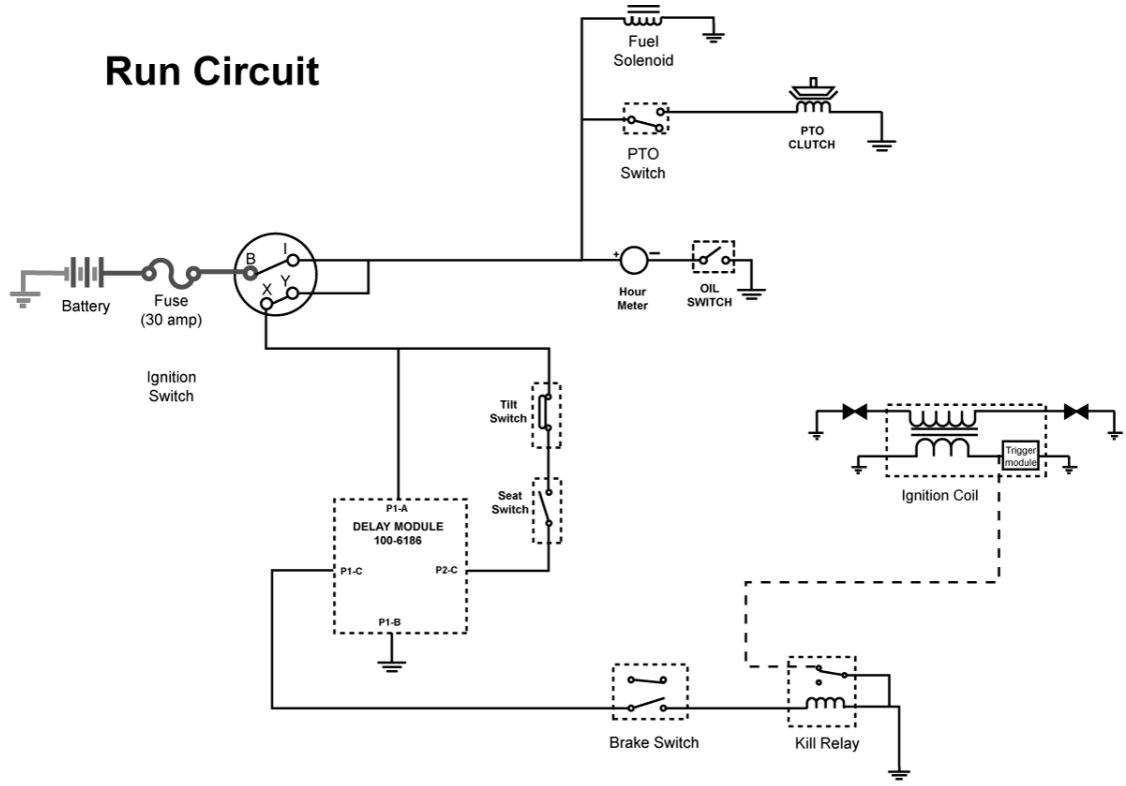
Models
74225
74228
74226
74227

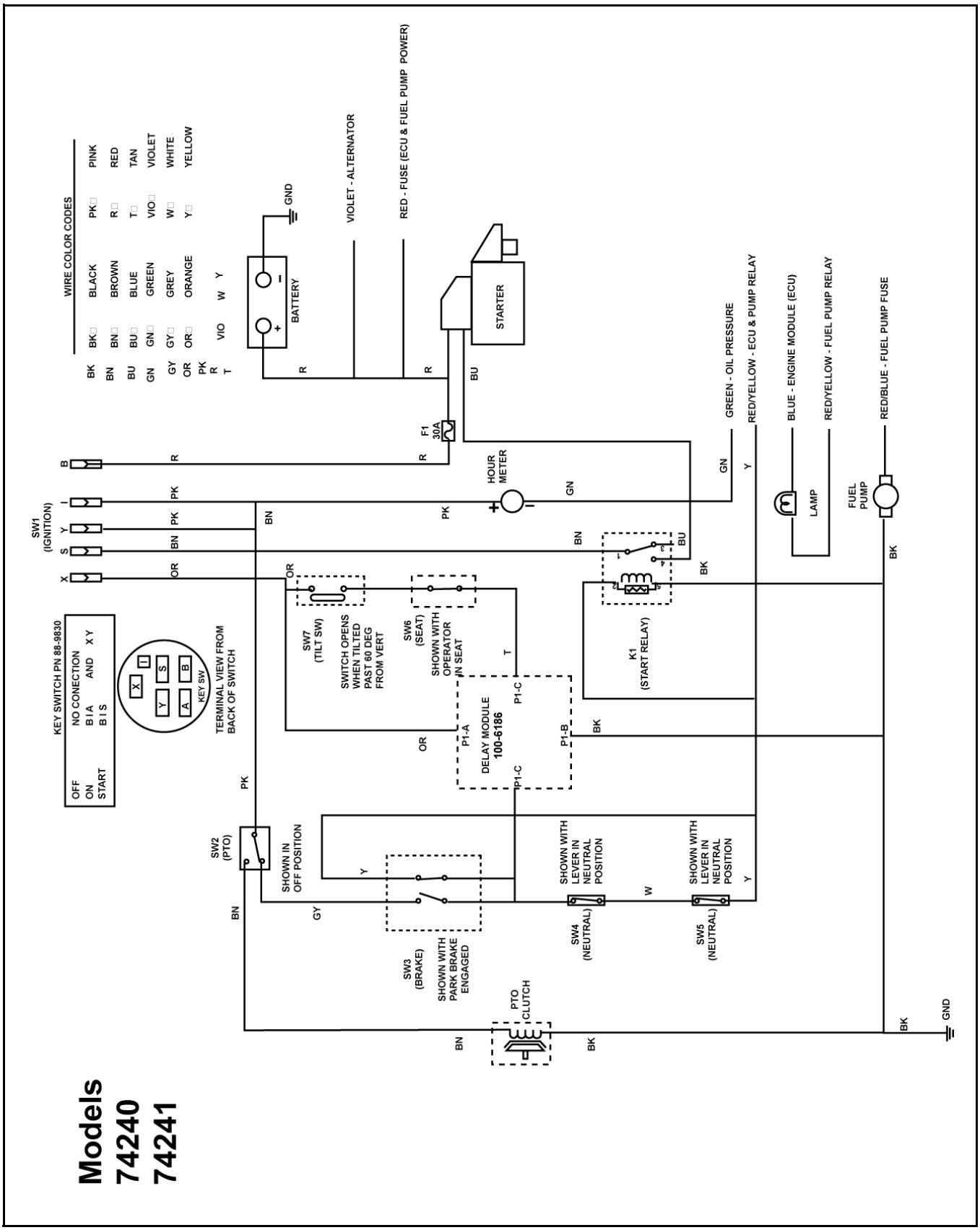
Models
74225
74228
74226
74227

Start Circuit



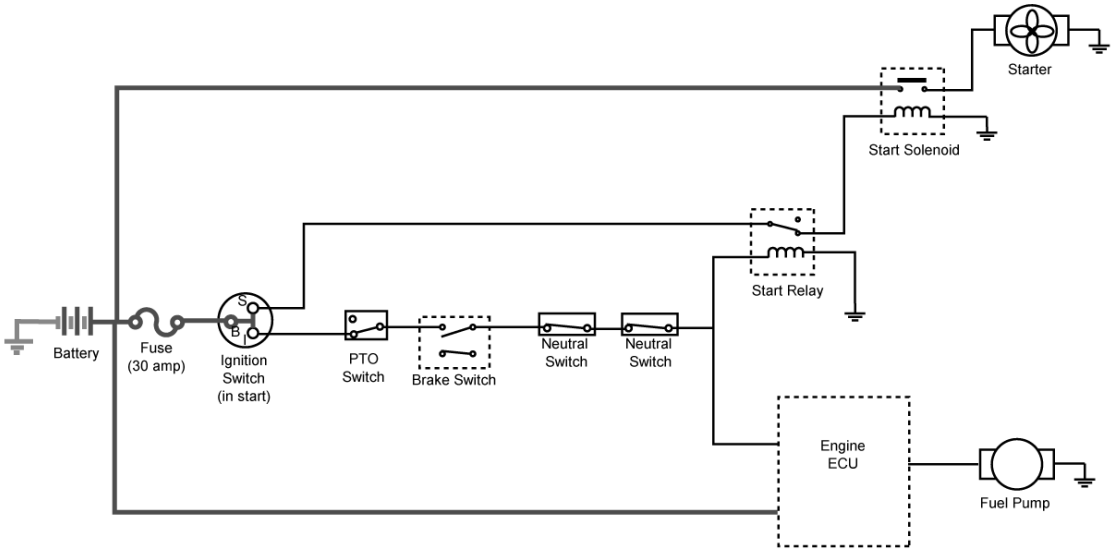
Run Circuit



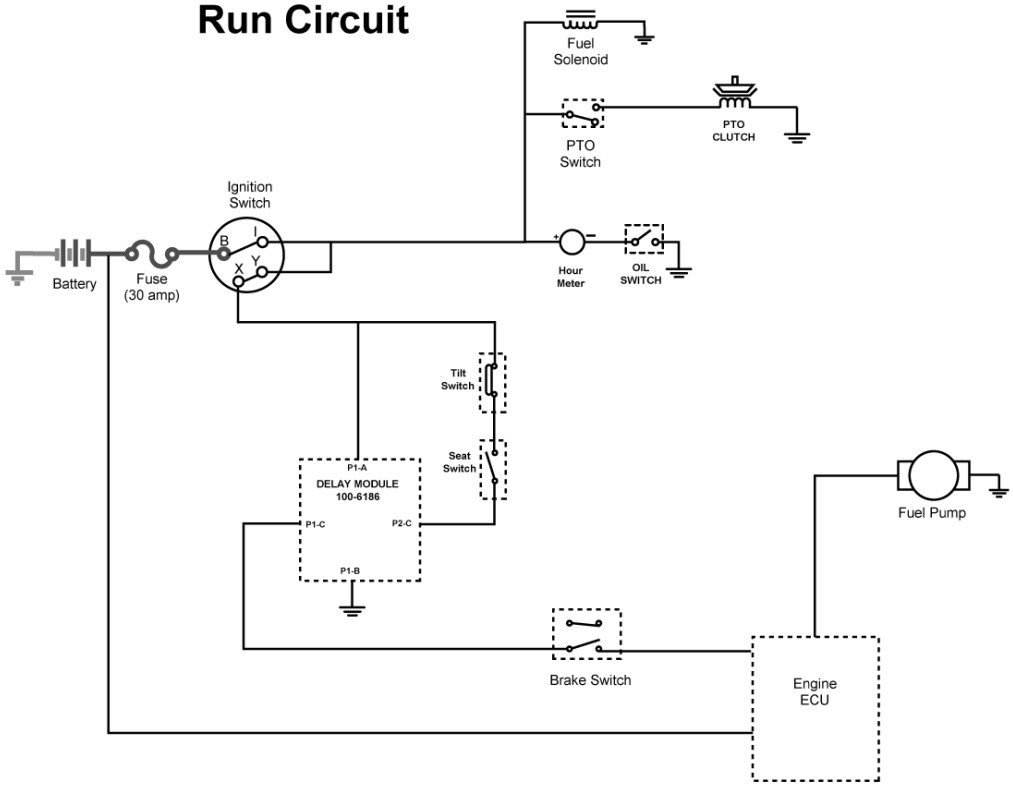

Models
74240
74241
WIRE COLOR CODES
BK BLACK PK PINK
BN BROWN R RED
BU BLUE T TAN
GN GREEN VIO VIOLET
GY GREY W WHITE
OR ORANGE Y YELLOW
BATTERY
GND
VIOLET - ALTERNATOR
RED - FUSE (ECU & FUEL PUMP POWER)
STARTER
F1 30A
HOUR METER
GREEN - OIL PRESSURE
RED/YELLOW - ECU & PUMP RELAY
BLUE - ENGINE MODULE (ECU)
RED/YELLOW - FUEL PUMP RELAY
RED/BLUE - FUEL PUMP FUSE
LAMP
FUEL PUMP
SW1 (IGNITION)
KEY SWITCH PN 88-9830
OFF
ON
START
NO CONECTION
B I A AND X Y
B I S
KEY SW
TERMINAL VIEW FROM BACK OF SWITCH
SW7 (TILT SW)
SWITCH OPENS WHEN TILTED PAST 60 DEG FROM VERT
SW6 (SEAT)
SHOWN WITH OPERATOR IN SEAT
K1 (START RELAY)
DELAY MODULE 100-6186
P1-A
P1-B
P1-C
SW2 (PTO)
SHOWN IN OFF POSITION
SW3 (BRAKE)
SHOWN WITH PARK BRAKE ENGAGED
SW4 (NEUTRAL)
SHOWN WITH LEVER IN NEUTRAL POSITION
SW5 (NEUTRAL)
SHOWN WITH LEVER IN NEUTRAL POSITION
PTO CLUTCH

Models
74240
74241

Start Circuit



Run Circuit



Purpose

The stator generates 25 amps of alternating current to charge the battery.

How It Works

Whenever a magnet passes by a coil of wire on an iron core, electricity is produced. The amount will depend on the thickness of wire, the number of windings on each coil, the strength of the magnet, and the speed at which the magnet is moving.

This particular coil has 18 poles to produce 25 amps at 28 or more volts A.C. when the engine is running at 3600 rpm. The current produced is alternating current since no diode or rectifier is internal to the stator.

Stator Output	Stator Resistance
More than 28 VAC @ 3600 rpm	.64 - .2 ohms

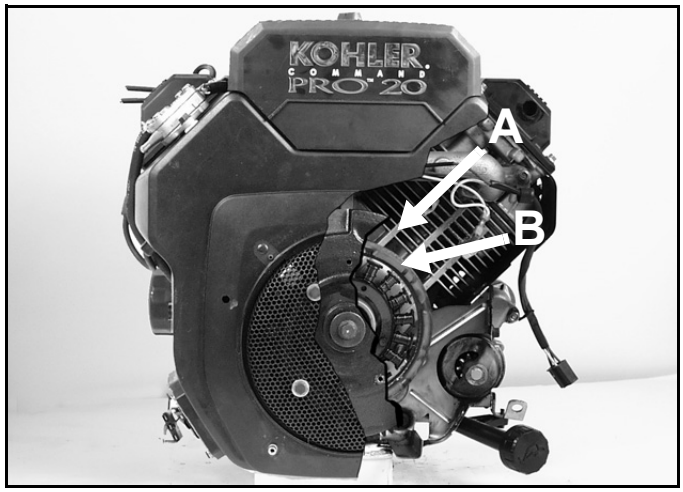
*** With regulator/rectifier disconnected**

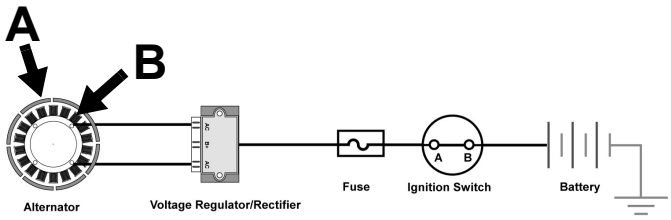
Testing

1. Remove the connector from the regulator rectifier. Measure the voltage across the two A.C. leads on the alternator side of the connector with the engine running at 3600 rpm. If voltage is less than 28 volts, proceed to the next step. Otherwise, stator is OK.

2. With the stator still disconnected and the engine off, measure the resistance across the two A.C. leads running to the stator. The resistance should be .1 to .2 ohms. If not, replace the stator.

Alternator
(Kohler)





(A) Magnets (B) Coil

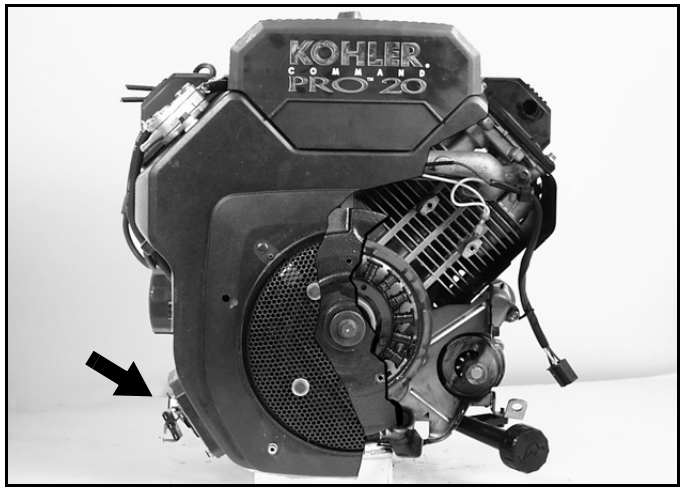
Regulator/Rectifier

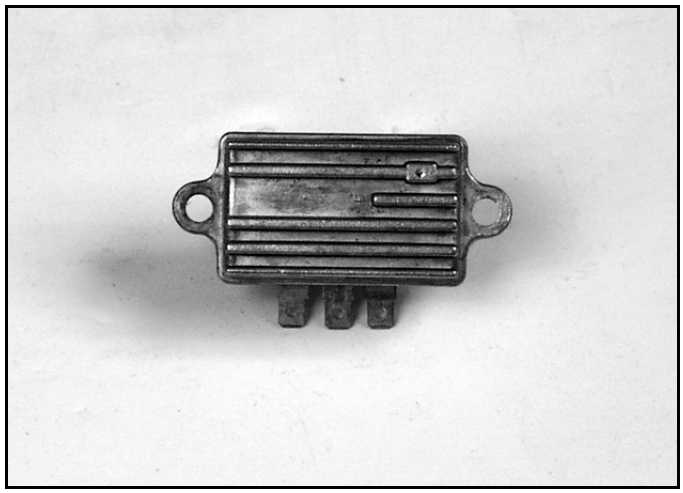
Purpose

The regulator/rectifier prevents battery boiling by shutting off the current when the battery has reached 14.7 volts.

How It Works

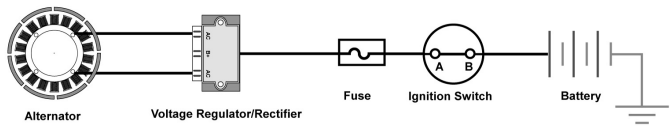
The voltage regulator rectifies the current so that the battery sees only positive current and voltage. The voltage level across the battery is very near constant because the battery has very low impedance. This regulator/rectifier, like many others, must be connected to the battery to function. Once the voltage level of the battery has surpassed 14.7 volts, the voltage regulator shuts off all current and no charging takes place. When the voltage again drops below the specified level, the voltage regulator turns the current back on at the rated amperage of the alternator.





Testing

1. Connect a DC voltmeter across the battery.
2. Run the engine at 3600 RPM.
   - V. If the voltage reading is between 13.6 and 14.2 volts, DC the charging system is OK.
   - W. If the voltage reading is greater then 14.2 volts, DC replace the regulator.
   - X. If the Voltage reading is less then 13.6 volts, DC test the alternator.



Clutch
Electric

Purpose

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

How It Works

The PTO clutch is composed of three major components: the field, the clutch plate, and the friction plate. The clutch plate always turns with the engine. The field is a coil of wire on an iron core which becomes an electro-magnet when power is applied. The friction plate is the only piece that can slide up and down on the crankshaft axis. It is normally spring loaded so that it is not in contact with the clutch plate and is pressed against the brake material opposite the clutch. When power is applied, the friction plate is drawn toward the clutch plate and the two rotate as one.

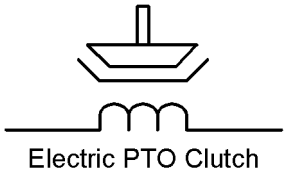
Testing

1. Disconnect the PTO clutch from the harness.

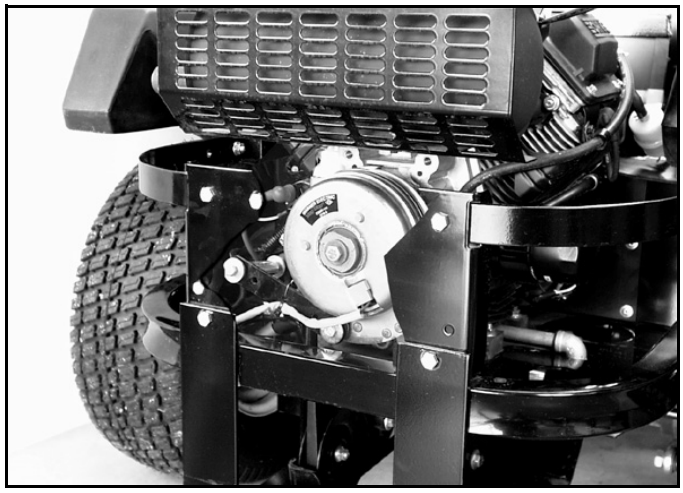
2. Connect a charged 12 volt battery to the clutch (polarity makes no difference.) You should hear a click, the clutch should engage. If not, check the wiring and connectors leading into the field. If no problems can be found, replace the field.

3. Resistance Check: The field should have a resistance of 2.9 . ± 20% (2.4 to 3.5 .).

Mechanical Adjustment: The gap between the clutch and friction plates should be set at .012-.015 inches. Adjust by rotating the three nuts attached to the field.



Electric PTO Clutch



Electric PTO Clutch Removal

1. Remove the PTO clutch anchor bolt.

2. Remove the 4 bolts securing the PTO clutch guard and remove the guard (Figure 135).

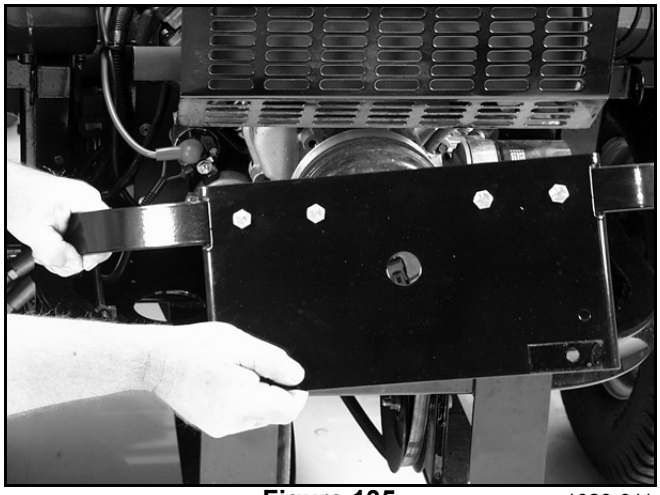


Figure 135 1023-011

3. Disconnect the clutch plug.

4. Use the flats on the washer below the clutch retaining bolt to hold the crankshaft stationary, remove the clutch retaining bolt (Figure 136).

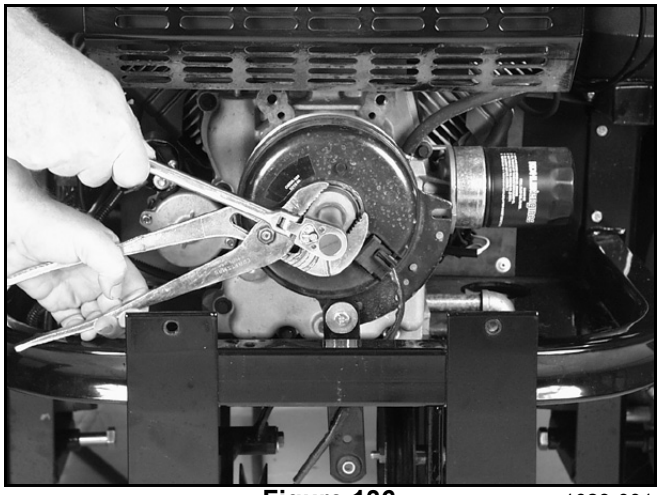


Figure 136 1023-001

5. Rotate the clutch assembly until the anchor will clear the lower clutch guard. Then, slide the clutch assembly off of the crankshaft while holding the 2 clutch halves together (Figure 137).

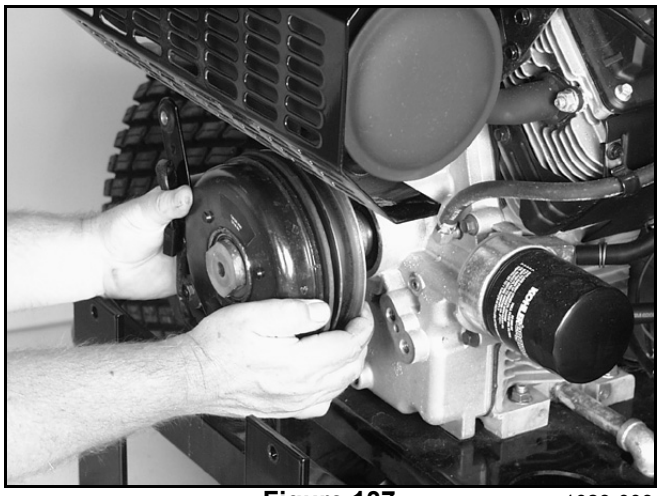


Figure 137 1023-003

NOTE: On reassembly, torque the 7/16” clutch retaining bolt to ??? ft.-lbs.

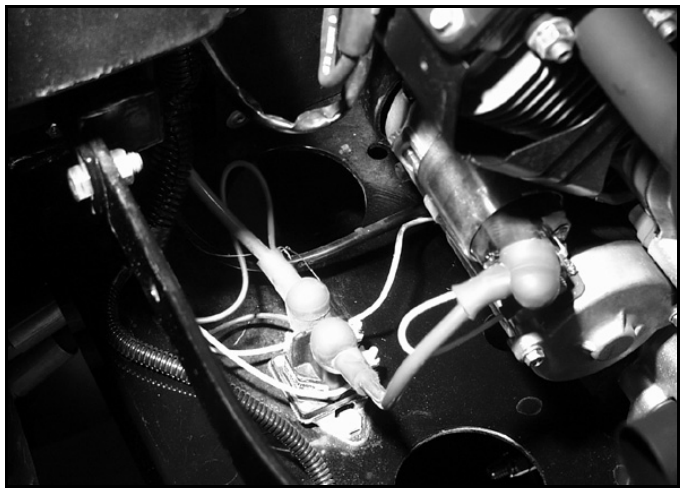
Solenoid

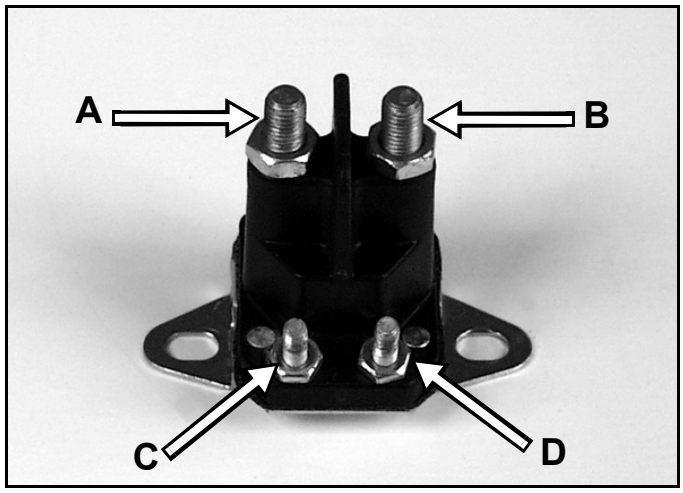
Purpose

The solenoid's purpose is simply to protect the ignition switch from the high current drawn by the starter motor.

How It Works

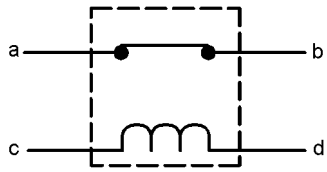
The solenoid has really only two parts. One is a coil of wire wrapped around an iron core. Whenever 12 volts is applied to the coil, it becomes a magnet. The other part is a steel bar type switch. Because it is made of steel it can easily handle the high current loads produced by the starter motor. So how does it protect the ignition switch? When 12 volts is applied to the coil, it becomes an electromagnet. This quickly pulls the steel bar toward the contacts and closes the switch. When power is removed from the coil, the spring loaded bar returns to its "normally open" position. Note: The solenoid closes and opens the switch very quickly. This minimizes the "arcing" that can damage other type switches.





Testing

1. Disconnect the solenoid from the wiring harness.
2. Check to ensure that terminals "c" and "d" are not continuous.
3. Apply a 12 volt power source to "a" and the case. You should be able to hear the solenoid switch "click" when you make the connection.
4. Verify that the switch has closed by making sure that terminals "c" and "d" are closed when power is applied to terminals "a" and "b".



Solenoid
(energized)

Starter
Electric

Purpose

The starter motor pushes the starter pinion into engagement with the flywheel, then rotates the starter motor to start the engine.

How It Works

The starter motor is really just a collection of simple parts:

FIELD: A coil of wire on an iron core that becomes an electromagnet when current is applied. It surrounds the armature.

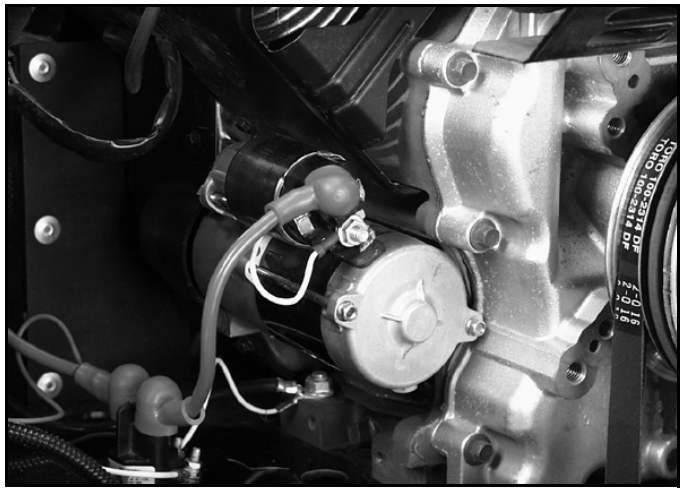
ARMATURE: Eight coils of wire on an iron core that become electromagnets when current is applied. The end of each coil is connected to a section of the commutator. The armature rotates.

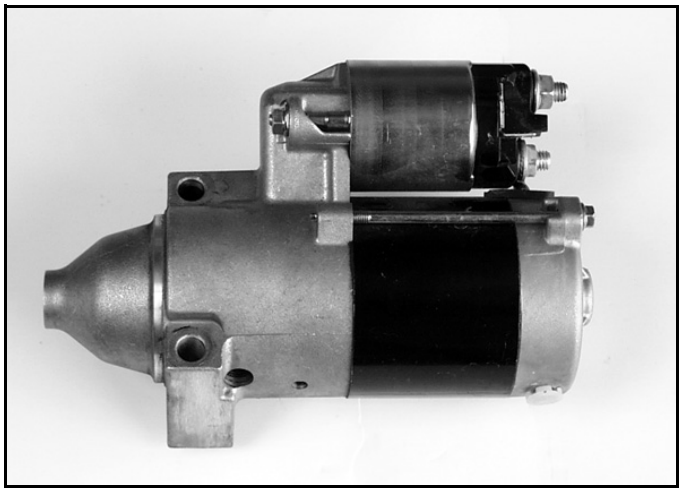
COMMUTATOR: The commutator is the connection point between the brushes and the coils in the armature. The sections are divided such that only one armature coil is “on” at a time. This sets the armature to rotating because the electromagnetic field in the field coil will oppose the one in the armature.

BRUSHES: Supply power to the commutator.

Testing

With the starter assembled, disconnect the connecting lead from the starter solenoid C terminal. Connect a jumper lead from the connecting lead to the battery positive terminal. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal. If the motor doesn’t run, check the motor for problems.





Switch

PTO/Clutch

Purpose

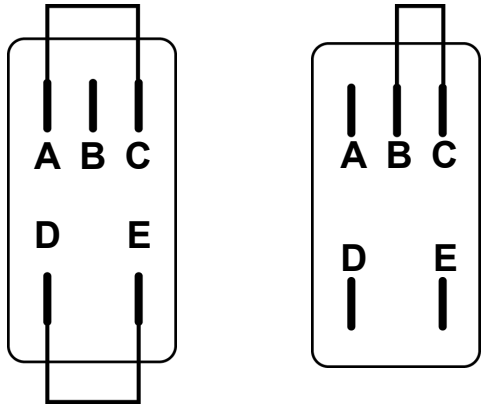
Typically used to turn on the electric blade clutch and to function as part of the safety interlock system.

How It Works

Contacts inside this DPDT switch electrically connect various terminals. It is actually just two SPDT switches tripped by a single lever. One of the SPDT switches is connected to the electric PTO clutch. When in the off position, this side of the switch is open. The other half of the switch is used by the safety interlock system. When the clutch is off, this side of the switch is closed. This allows current to keep the kill relay energized so that the mag is not grounded out.

Testing

1. Disconnect the switch from the wiring harness.
2. Verify the conditions on the diagram.



Brake Switch

Purpose

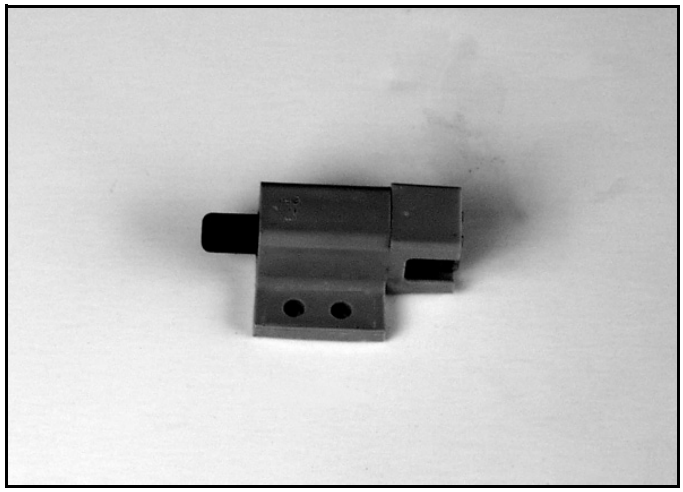
Senses the position of the parking brake handle. Insures that the parking brake is applied on start up and that the parking brake is released before operating the unit.

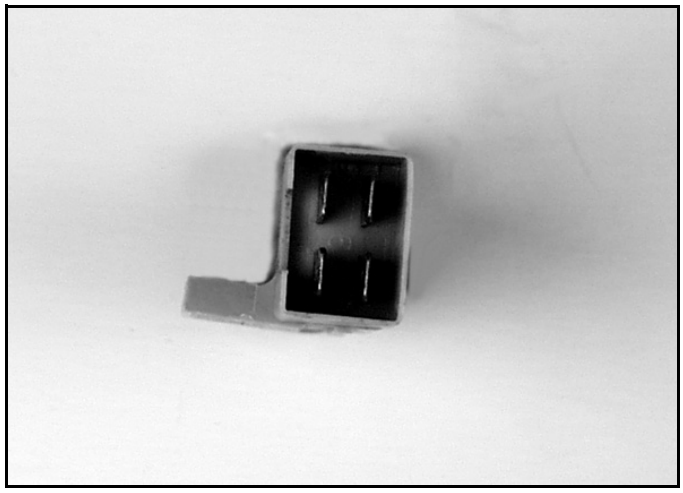
How It Works

When the brake is applied, both sets of contacts are closed. The contacts connected to the light blue wires are part of the interlock circuit and must be closed to provide ground for the starter solenoid. The contacts connected to the green wires must be open (brake released) when the control levers are in the operating position (in) or a ground signal is provided to the ignition kill terminal to shut down the engine.

Testing

Connect an ohmmeter across each pair of contacts in turn. When the switch plunger is out, the circuit is open. When the plunger is in, the circuit is closed.





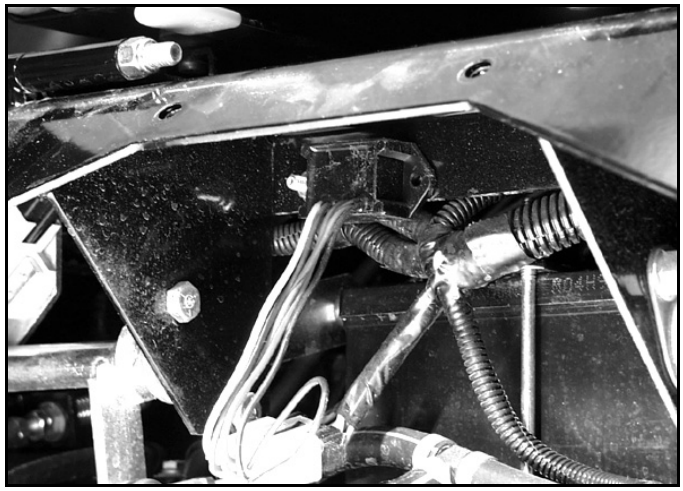
Interlock Module

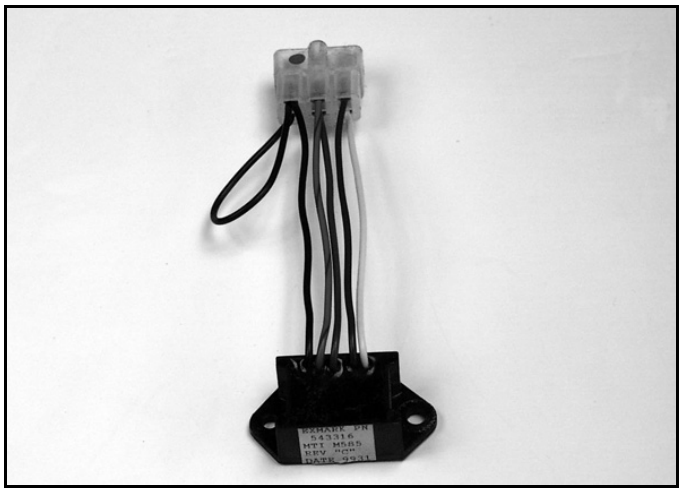
Purpose

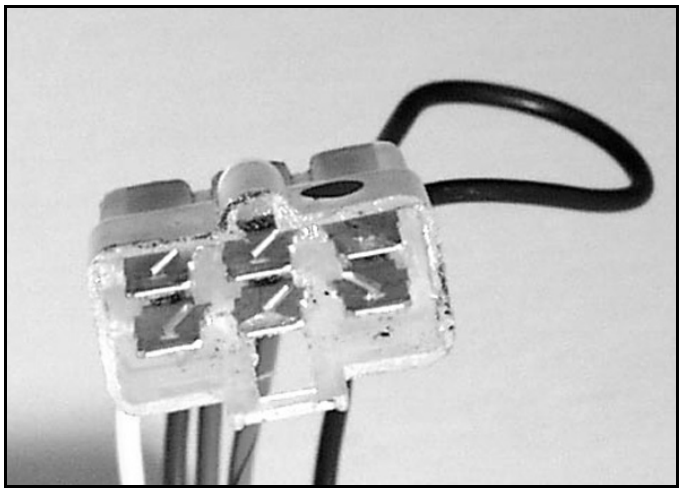
The interlock module monitors the status of the safety switch and prevents the engine from running if an unsafe condition exists.

How It Works

When the ignition switch is in the “ON” or “START” position, B+ to power the module is supplied to the blue wire from the “A” terminal of the ignition switch. The black wires are connected to the chassis ground and provide B- for the module internal circuit and also for the safety switches. The yellow and brown wires are connected together through the blade switch and motion control switches. This circuit is closed when the blade switch is off and the control levers are in the out position, allowing the engine to run with the operator out of the seat. When the unit is in operation (blade switch on and control levers in), the brown wire is connected to ground through the seat switch. If ground is removed from the brown wire, the module waits a half second and then shuts down the engine by sending a ground signal to the kill terminal through the red/black wire.







Testing

1. Apply B+ to blue wire and B- to black wire.

2. Check for continuity between red/black wire and B-.
   Continuity = OK
   No continuity = Bad

3. Connect yellow and brown wires together.

4. Check for continuity between red/black and B-.
   Continuity = Bad
   No continuity = OK

Purpose

The hourmeter keeps track of the amount of hours the engine has been running.

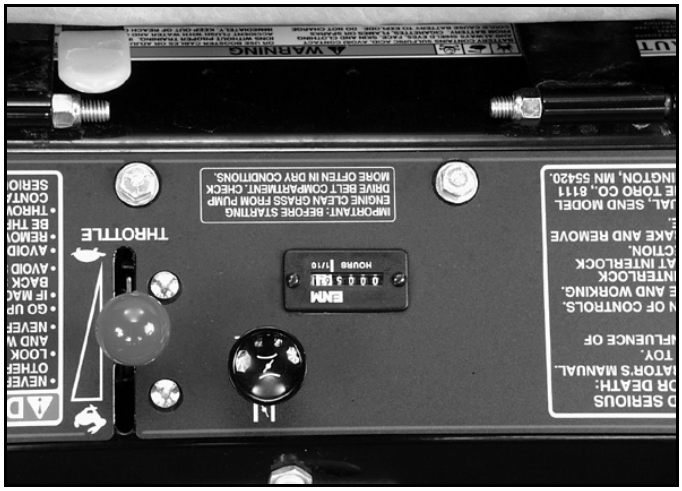
How It Works

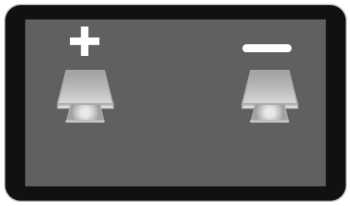
When the ignition switch is in the “ON” position, power is supplied to the + terminal of the hourmeter from the “A” terminal (orange wire) of the ignition switch. When the engine is running, oil pressure closes the oil pressure switch supplying a ground to the - terminal of the hourmeter.

Testing

Connect B+ to the + terminal and ground to the - terminal, the hourmeter should run.

Hourmeter





Hourmeter Back

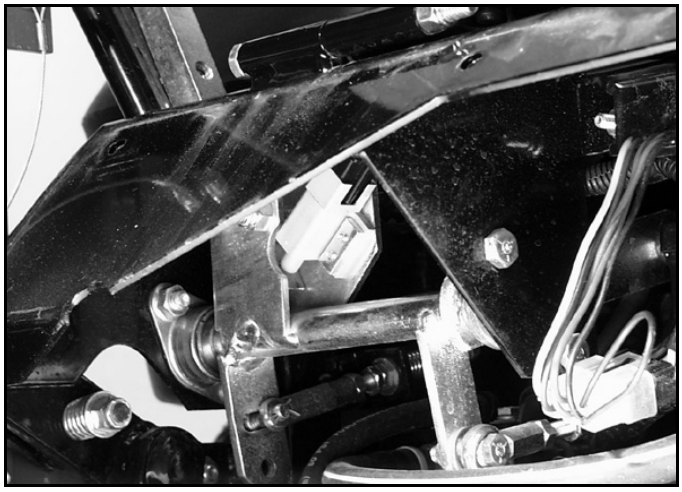
Motion Control Switch

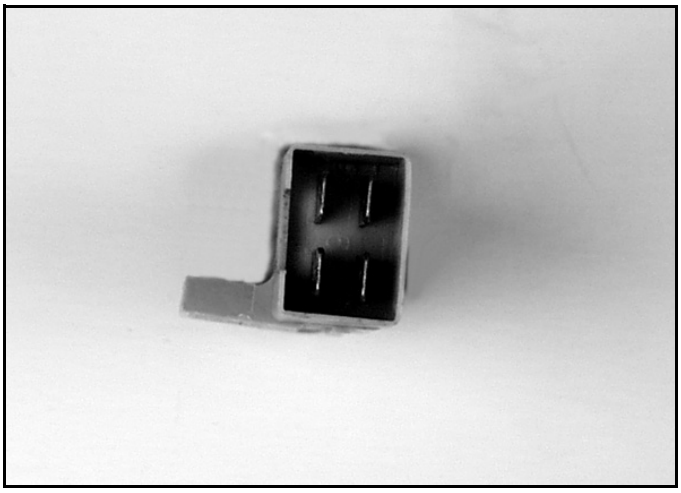
Purpose

There are two motion control switches - one for each lever. They sense the position of the motion control levers.

How It Works

Each motion control switch has two pairs of contacts - one normally open, one normally closed. When the control handles are out, the contacts connected to the light blue wires are closed providing a ground for the start solenoid. When the handles are in these, contacts are open preventing the starter from cranking. The second pair of contacts, connected to the green wires, prevent operation of the unit with the parking brake applied. Moving the control levers in closes these contacts sending a ground signal to the brake switch. If the brake is applied, the ground signal is sent to the engine kill terminal, shutting down the engine.





Testing

1. With the switch out, connect an ohmmeter across each pair of terminals in turn. One pair should be open with the switch plunger extended; the other pair should be closed.

2. Push the switch plunger in; the conditions should reverse.

Key Switch

Purpose

The key switch provides proper switching of the start, run, stop, and interlock circuits.

How It Works

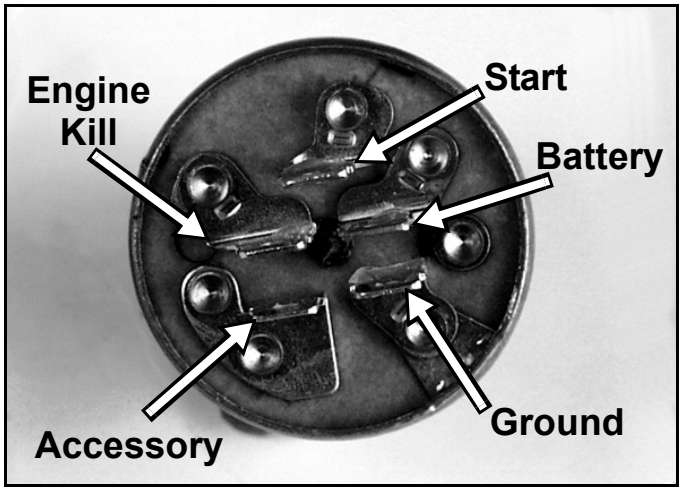
Detents inside the switch give it three positions: “OFF”, “RUN”, and “START”. The “START” position is spring loaded so the switch returns to the “RUN” position when the key is released.

Testing

1. Disconnect the switch from the wiring harness.
2. Verify the conditions in the table.
3. There should not be continuity between any of the switch terminals and ground.

KEY SWITCH LOGIC

Position	Circuit
Off	E-G
On	B-A
Start	B -A-S



Seat Switch

Purpose

To sense when the operator is in position on the seat.

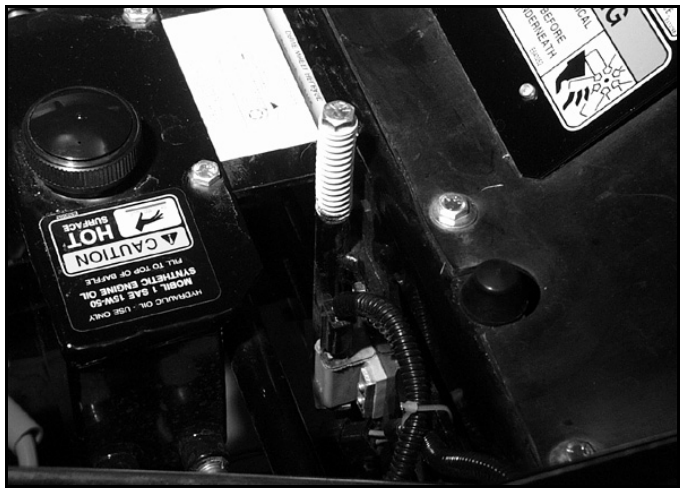
How It Works

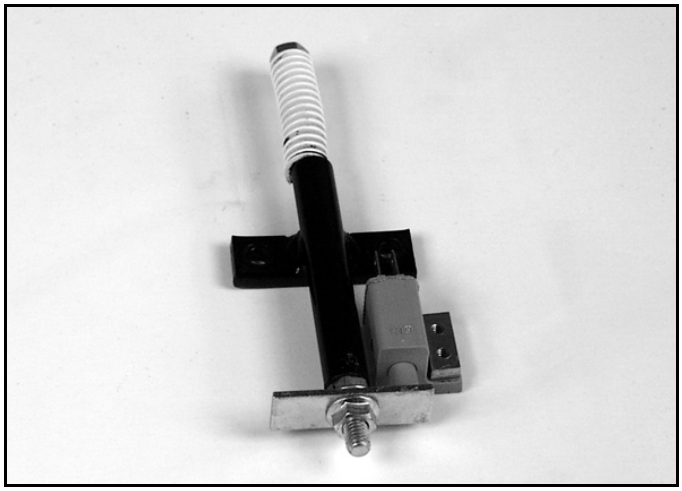
The seat switch is mounted to a spring loaded link so that the switch contacts are open when there is no operator on the seat.

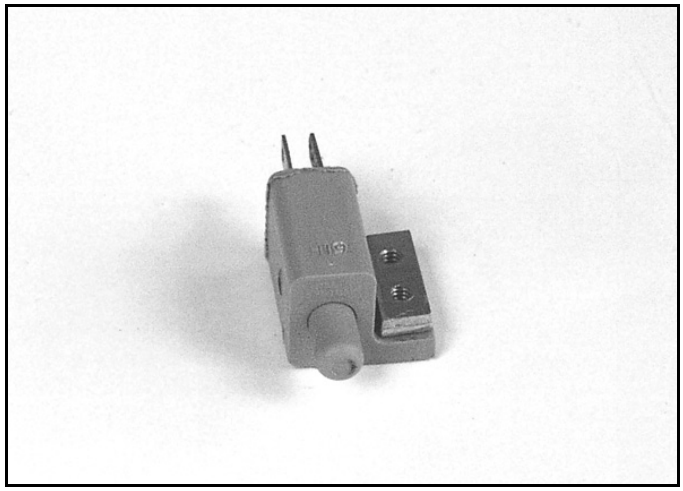
When the operator is in position, the linkage allows the switch plunger to extend closing the contacts.

Testing

With the seat switch removed from the unit, connect an ohmmeter across the contacts. When the plunger is extended, the meter should show continuity. When the plunger is pushed in, the meter should show open circuit.







Mercury Switch

Purpose

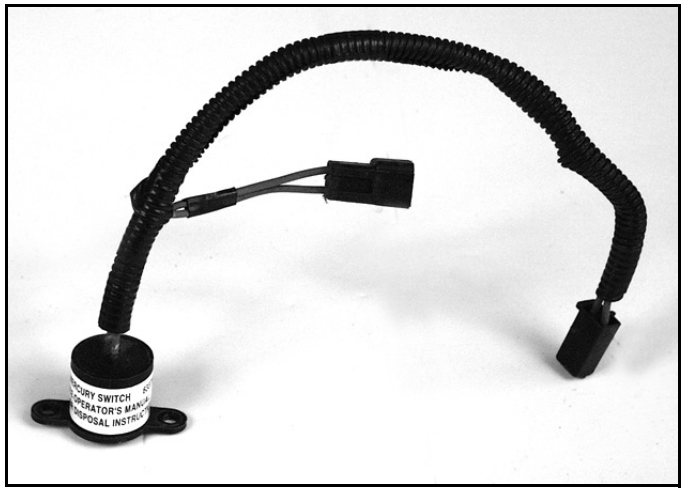
To shut the engine down when the tilt limit has been exceeded.

How It Works

A small amount of mercury is contained in the switch. When the tilt angle of the unit is less than 60°, the mercury connects the contacts in the switch. When the tilt angle exceeds 60°, the mercury flows away from the contacts causing the switch to open.

Testing

1. Connect an ohmmeter across the switch.
2. When the switch is vertical, the meter should show continuity.
3. Tilt the switch 60°. The meter should show open circuit.



Purpose

Fuses are electrical safety valves that protect wiring and electrical components from damage from high current flow by creating an open circuit.

Fuses are rated for specific currents (amps).

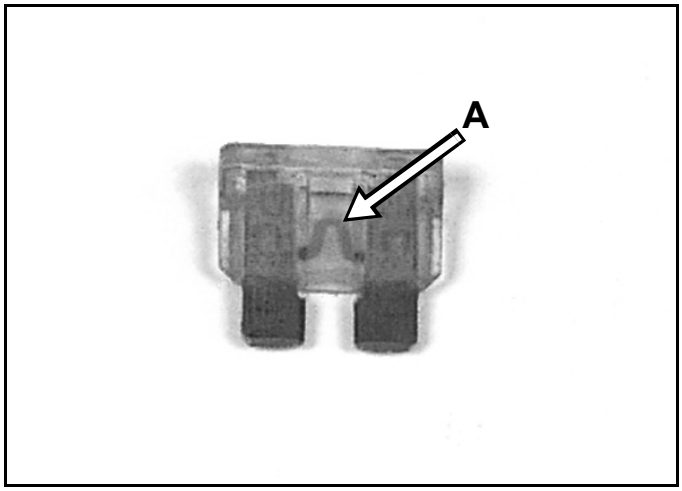
Never connect a jumper wire across a fuse. Never connect additional fuses in parallel.

Always use the proper fuse. Always find and correct the reason for a blown fuse.

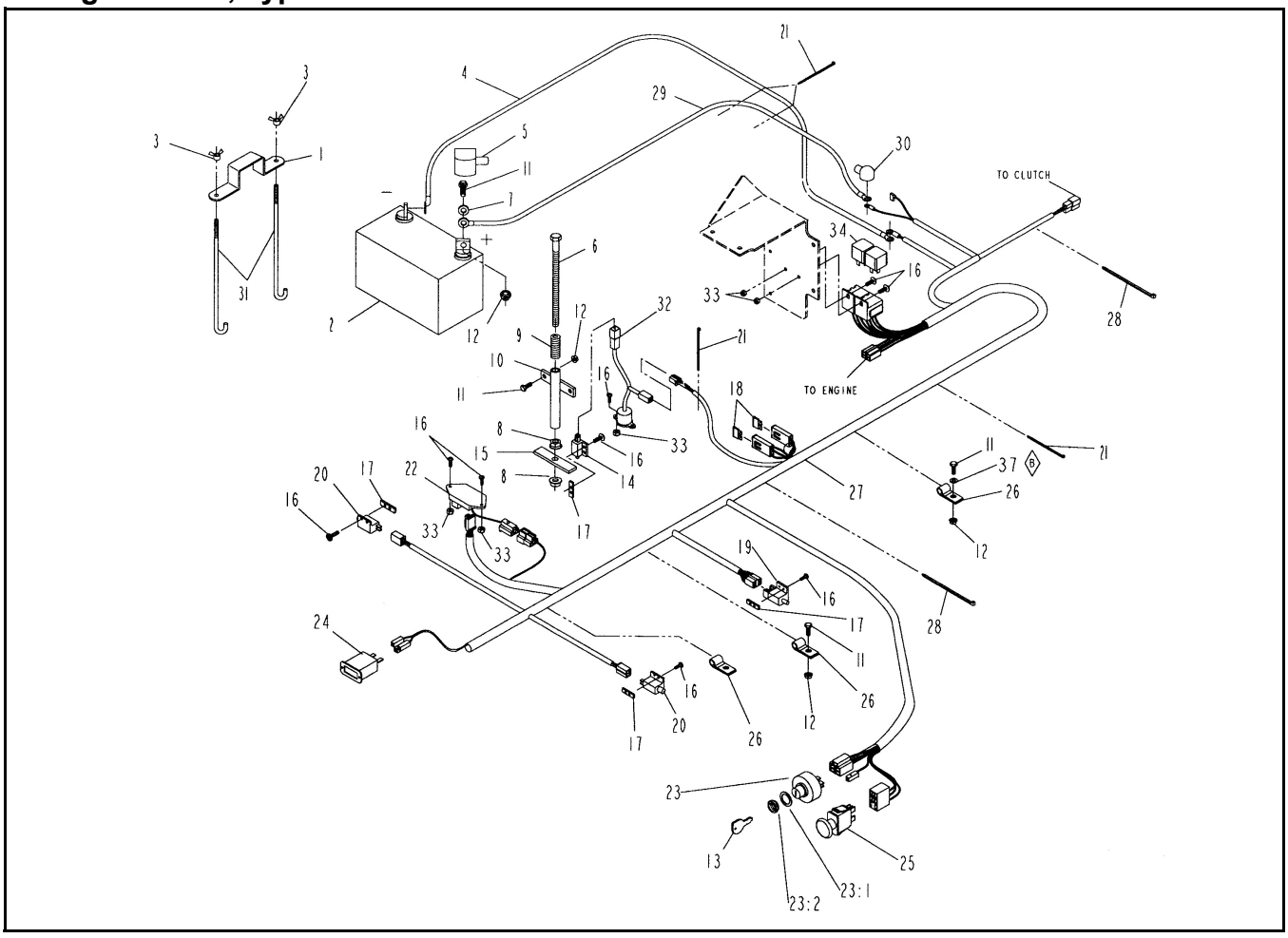
Testing

A blade type fuse may be checked visually. If the loop (A) is open, the fuse is blown. If in doubt, the fuse may also be tested with an ohmmeter.

20 Amp Fuse



Wiring Harness, Typical



Ref. No.	Qty.	Description
1	1	Battery Holddown Strap
2	1	230 CCA Battery
3	2	Wing Nut
4	1	Ground Wire
5	1	Battery Insulator
6	1	HH Screw
7	2	Flat Washer
8	2	HF Nut
9	1	Seat Switch Spring
10	1	Seat Spring Mount
11	6	HH Screw
12	6	HF Nut
13	2	Ignition Key
14	1	Normally Closed Switch
15	1	Seat Switch Plate
16	14	PPH Screw
17	4	Tapped Plate
18	2	Blade Type Fuse

Ref. No.	Qty.	Description
19	1	Switch
20	2	Normally Open Switch
21	5	Plastic Tie
22	1	Seat Delay Module
23	1	Key Switch ASM
24	1	Hourmeter
25	1	Delta Switch
26	3	Loom Clip
27	1	Wire Harness
28	2	Plastic Tie
29	1	Starter Wire
30	1	Solenoid Insulator
31	2	Holddown Bolt
32	1	Tilt Switch
33	6	Lock Nut
34	2	Relay
37	1	Flat Washer

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