# SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and decals on the machine itself to warn of the possibility of personal injury. Read these instructions carefully.
It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.

**DANGER** : Immediate hazards which WILL result in severe personal injury or death.

**WARNING** : Hazards or unsafe practices which COULD result in severe personal injury or death.

**CAUTION** : Hazards or unsafe practices which COULD result in minor personal injury.

■ **IMPORTANT** : Indicates that equipment or property damage could result if instructions are not followed.

■ **NOTE** : Gives helpful information.

## SAFETY SERVICING AND REPAIRING

(1) Before working on the machine :
- Park the machine on a firm and level ground, and set the parking brake.
- Lower the implement or mower to the ground.
- Stop the engine, and remove the spark plug cap and the key.
- Disconnect the battery's ground cable.
- Clean the work area and machine.

(2) Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
(3) Do not wear a necktie, scarf, necklace, loose or bulky clothing when you work near machine tools or moving parts.
(4) Use tools appropriate to the work. Makeshift tools, parts, and procedures will not make good repairs.
(5) When servicing is performed together by two or more persons, take care to perform all work safely.
(6) Do not work under the machine that is supported solely by a jack. Always support the machine by safety stands.

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## [OPERATION]

(1) Operate the machine only in daylight or in good artificial light.
(2) Do not run the engine in a closed area without adequate ventilation.
(3) Before starting the engine, make sure that all shift levers are in neutral positions or in disengaged positions.
(4) Never start the engine while standing on ground. Start the engine only from operator's seat.
(5) Be alert when operating. To prevent loss of control :
- Watch for holes in the terrain or other hidden hazards.
- Do not drive close to ditches, creeks, or other hazardous areas.
- Reduce speed when making sharp turns.
- Avoid sudden stops and starts.
- Before backing up, look to the rear to make sure no people or obstacles are behind you or the machine.

(6) Keep side discharge chute, mulching plate or grass catcher (option) in place.
(7) Do not discharge clippings toward people or objects.
(8) Do not put hands or feet near or under mower deck.
(9) Shut the engine off and wait for all movement to stop before removing grass catcher or unclogging discharge chute.
(10) Adjust cutting height only when engine is stopped and mower blades have stopped turning.
(11) Mow across the face of slopes — never up and down. Exercise extreme caution when changing direction on slopes. Do not mow excessively steep slopes.
(12) To reduce fire hazards, keep the engine exhaust area free of grass or leaves.
(13) Disengage power to the mower blades before crossing gravel drives, walks, or roads.
(14) If the machine should start to vibrate abnormally, stop the engine and check immediately for the cause. Vibration is generally a warning of trouble.
(15) After striking a foreign object, stop the engine immediately and thoroughly inspect the machine for any damage. Repair damage before restarting and operating the machine.
(16) Before leaving the operator's position :
- All shift levers are in neutral positions or in disengaged positions.
- Shut off engine, and remove the key.

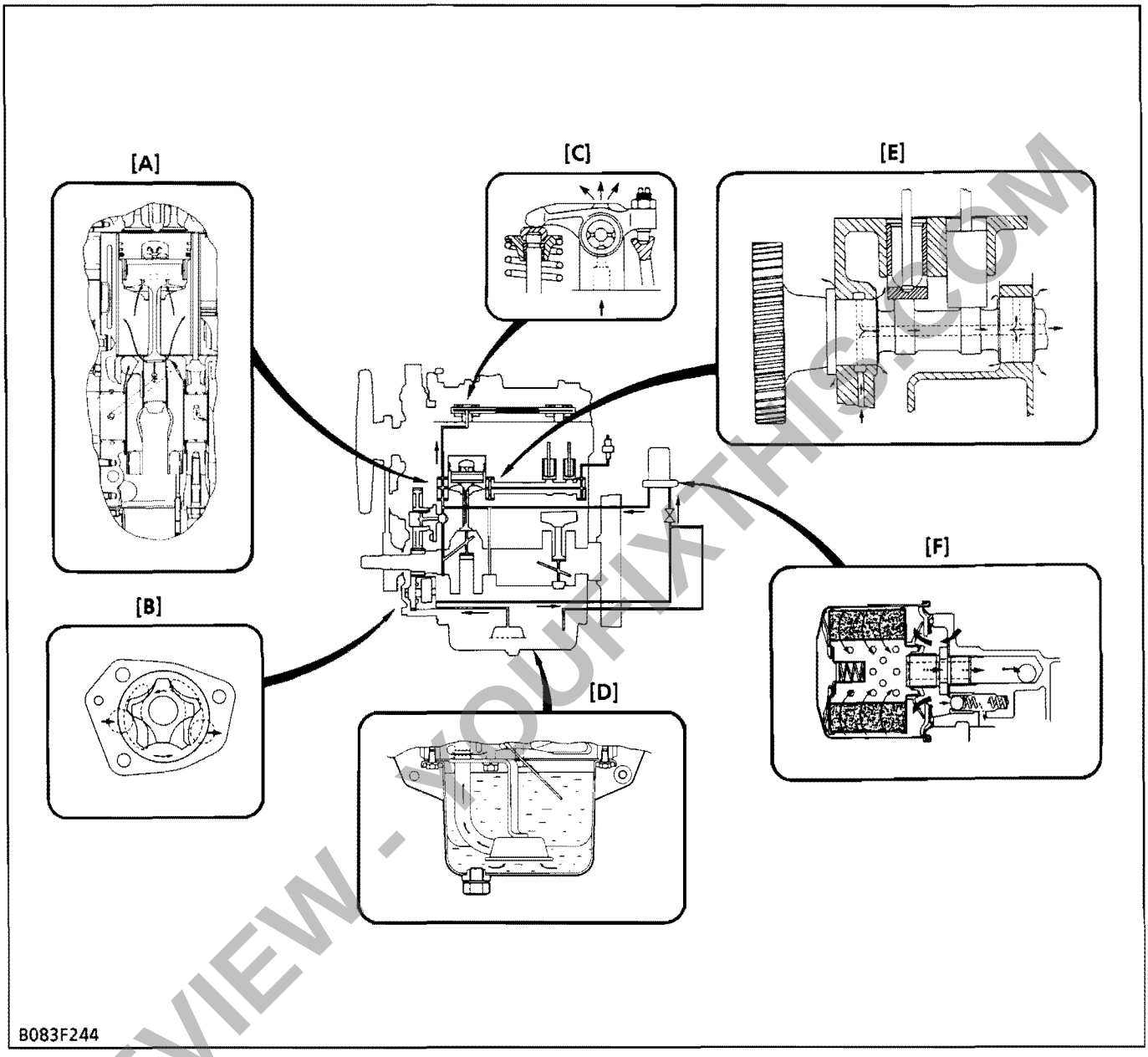
## [TRANSPORTING]

(1) Disengage power to the mower blades, implements and attachments before transporting the machine.
(2) Do not tow this machine.
(3) Do not use this machine on public roads. If you must transport it, use a pick-up truck, trailer, or other suitable vehicle and ramp.
(4) Tie the machine down securely before transporting on public roads.

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## [3] LUBRICATING SYSTEM




[A] Crankshaft and Piston
[B] Oil Pump
[C] Rocker Arm and Rocker Arm Shaft
[D] Oil Strainer
[E] Camshaft
[F] Oil Filter Cartridge and Relief Valve

This engine lubricating system consists of oil strainer, oil pump, relief valve, oil filter cartridge and oil pressure switch.

The oil pump sucks lubricating oil from the oil pan through the oil strainer and the oil flows down to the filter cartridge, where it is further filtered.

Then the oil is force-fed to crankshaft, connecting rods, idle gear, camshaft and rocker arm shaft to lubricate each part.

Some part of oil, splashed by the crankshaft or leaking and dropping from gaps of each part, lubricates these parts: pistons, cylinders, small ends of connecting rods, tappets, push rods, intake and exhaust valves and timing gears.

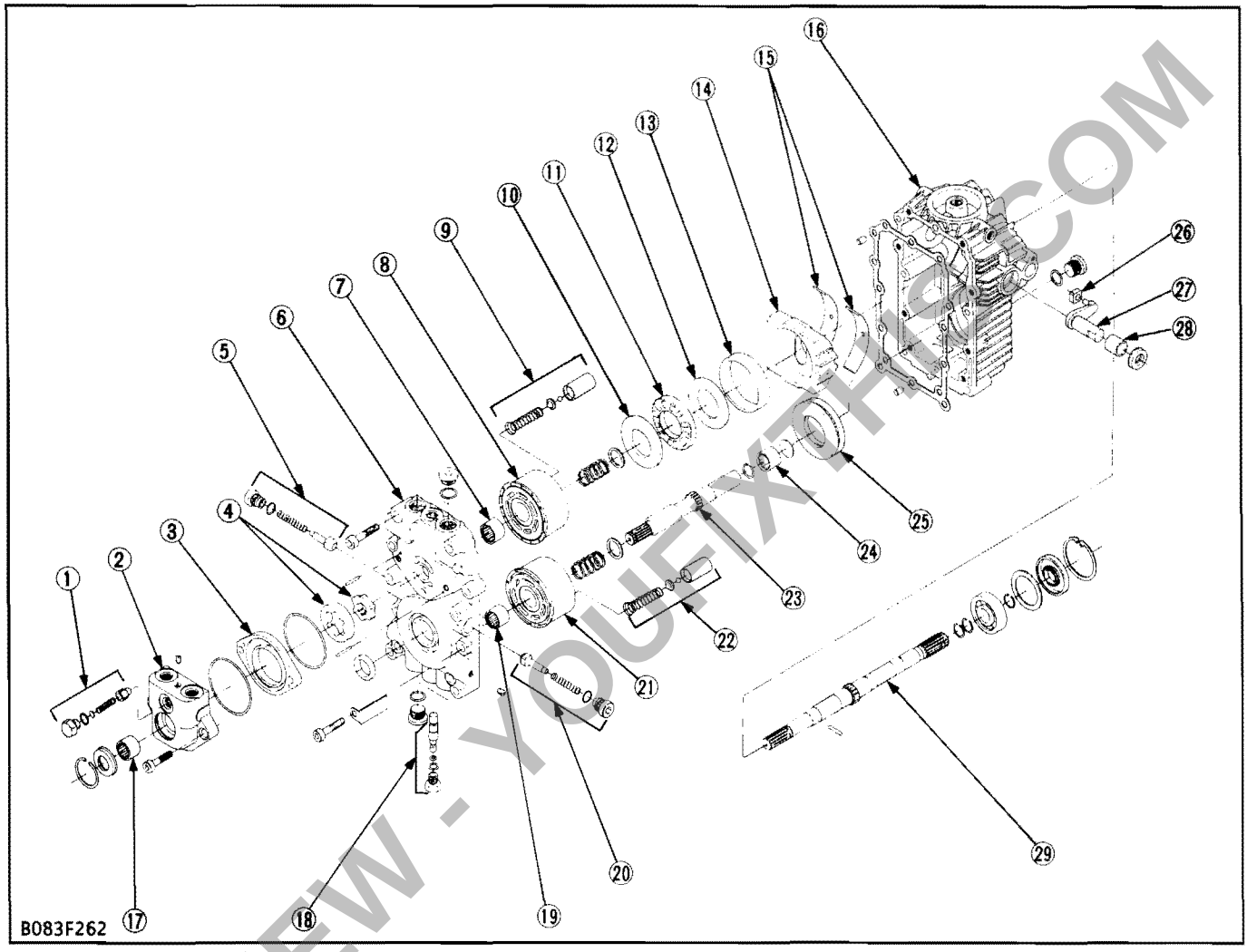
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# 2 TRANSMISSION AND FRONT AXLE

## [1] HYDROSTATIC TRANSMISSION




(1) Charge Relief Valve
(2) Auxiliary Pump Housing
(3) Auxiliary Pump Spacer
(4) Gerotor
(5) Check Valve
(6) Center Section
(7) Needle Bearing
(8) Cylinder Block (Pump)
(9) Piston Assembly
(10) Thrust Plate
(11) Thrust Roller Bearing
(12) Thrust Washer
(13) Bearing Guide
(14) Swashplate
(15) Cradle Bearing
(16) Housing
(17) Needle Bearing
(18) By-pass Valve
(19) Needle Bearing
(20) Check Valve
(21) Cylinder Block (Motor)
(22) Piston Assembly
(23) Motor Shaft
(24) Needle Bearing
(25) Thrust Ball Bearing
(26) Slot Guide
(27) Trunnion Arm
(28) Journal Bearing
(29) Pump Shaft

The hydrostatic transmission consists of a variable displacement piston pump and a fixed displacement piston motor.

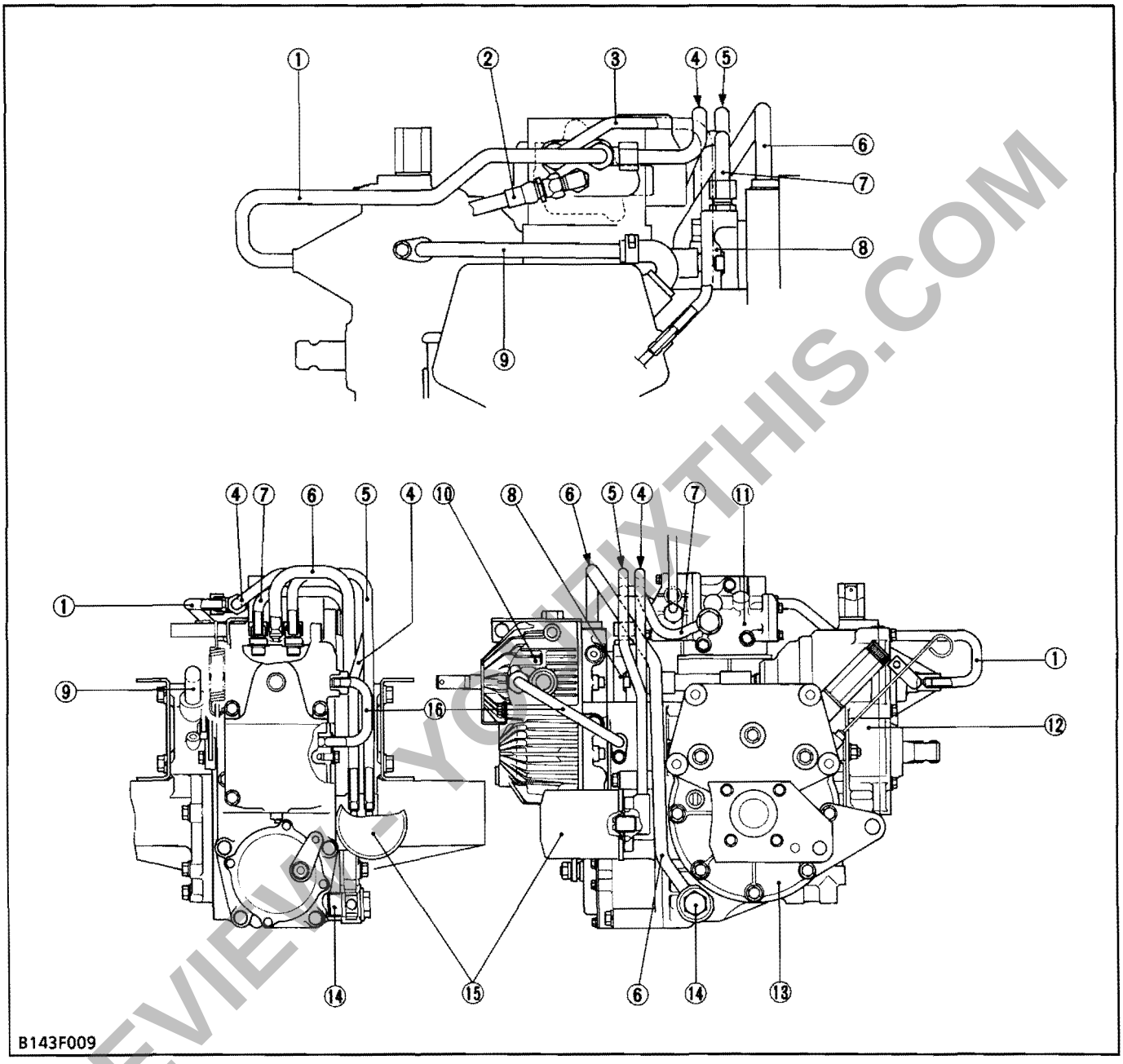
A fan is used to cool the hydrostatic transmission, eliminating the need for an oil cooler.

Convenient single lever control permits simple operation of the vehicle, starting, stopping, increasing or decreasing speeds, changing direction of travel, and even going up or down hills.

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## (1) Oil Flow



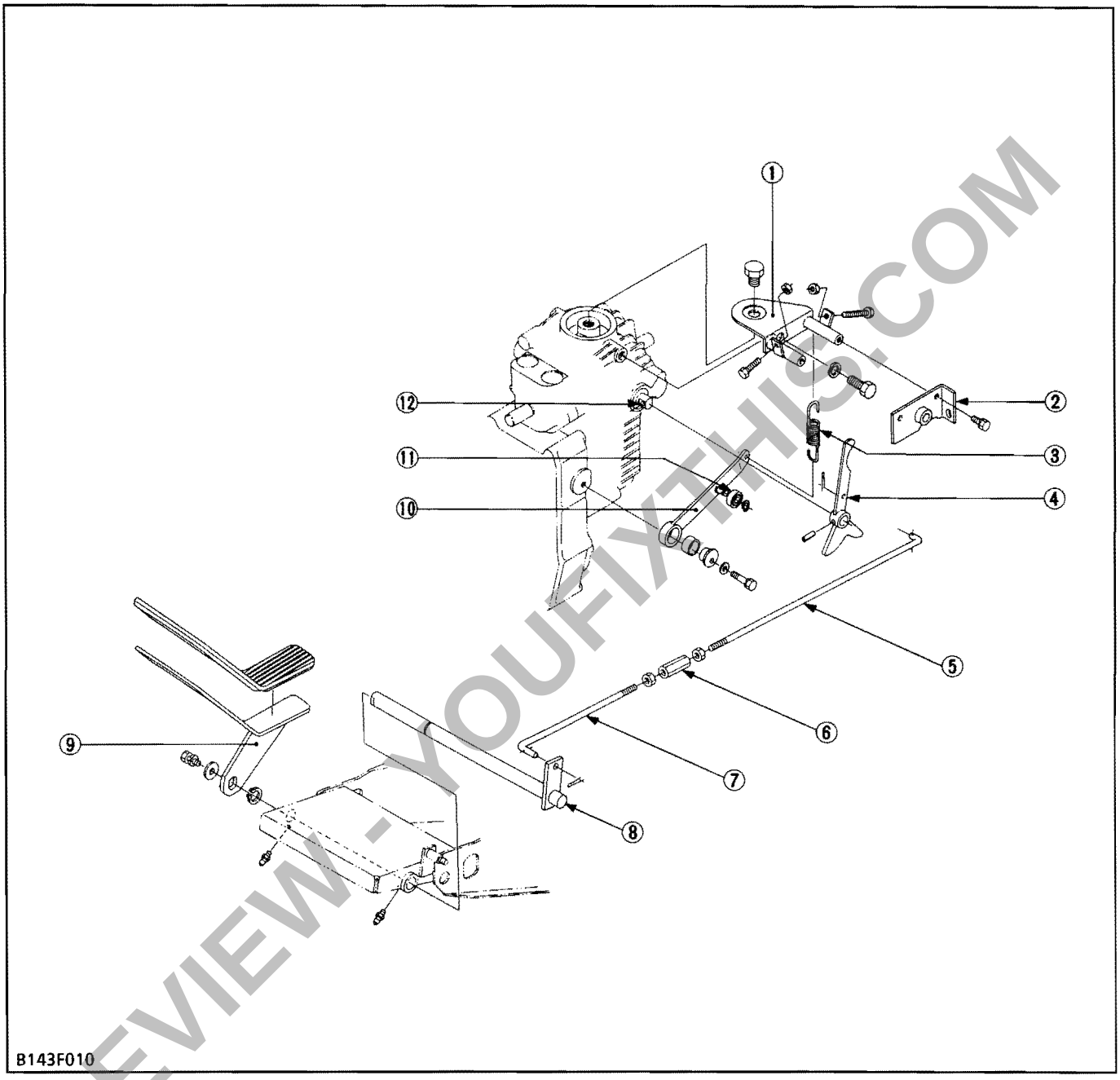

(1) PTO Pipe
(2) Cylinder Hose
(3) Return Pipe 1
(4) HST Pipe 1
(5) HST Pipe 2
(6) Suction Pipe
(7) Delivery Pipe
(8) Auxiliary Pump
(9) Return Pipe 2
(10) HST
(11) Control Valve
(12) PTO Gear Case
(13) Transmission Case
(14) Oil Strainer
(15) Oil Filter Cartridge
(16) Drain Pipe

1. When the engine is started, the auxiliary pump (8) is rotated to suck oil from the transmission case (13) through the suction pipe (6).
2. When the oil is sucked, it is filtered by the oil strainer (14).
3. Filtered oil is forced out by the auxiliary pump (8) to the control valve (11) through the delivery pipe (7).
4. With the control valve in neutral position, the oil is delivered to the HST pipe 1 (4), oil filter cartridge (15) and HST pipe 2 (5).
5. The oil used to charge a leak of the closed circuit in the hydrostatic transmission.
   A portion of oil is drained into the transmission case (13) through the drain pipe (16) after flushing and cooling the HST cylinder blocks.

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## (8) Control Linkage




(1) Control Panel Plate
(2) Cruise Control Plate
(3) Neutral Arm Return Spring
(4) Speed Change Arm
(5) Speed Change Rod 1
(6) Turnbuckle
(7) Speed Change Rod 2
(8) HST Pedal Shaft
(9) Speed Change Pedal
(10) Neutral Arm
(11) Ball Bearing
(12) Trunnion Arm

The speed change pedal (9) and the trunnion arm (12) are linked with speed change rod 2 (7), turnbuckle (6), speed change rod 1 (5) and speed change arm (4).

As the front footrest of the pedal is depressed, the swashplate rotates and forward traveling speed increases. Depressing the rear footrest increases reverse speed.

The ball bearing (11) on the neutral arm (10) hanged with the return spring (3) seats the detent of the speed change arm (4) so that the speed change arm returns to neutral.

Then, the swashplate is returned to neutral with the speed change arm, when the pedal is released.

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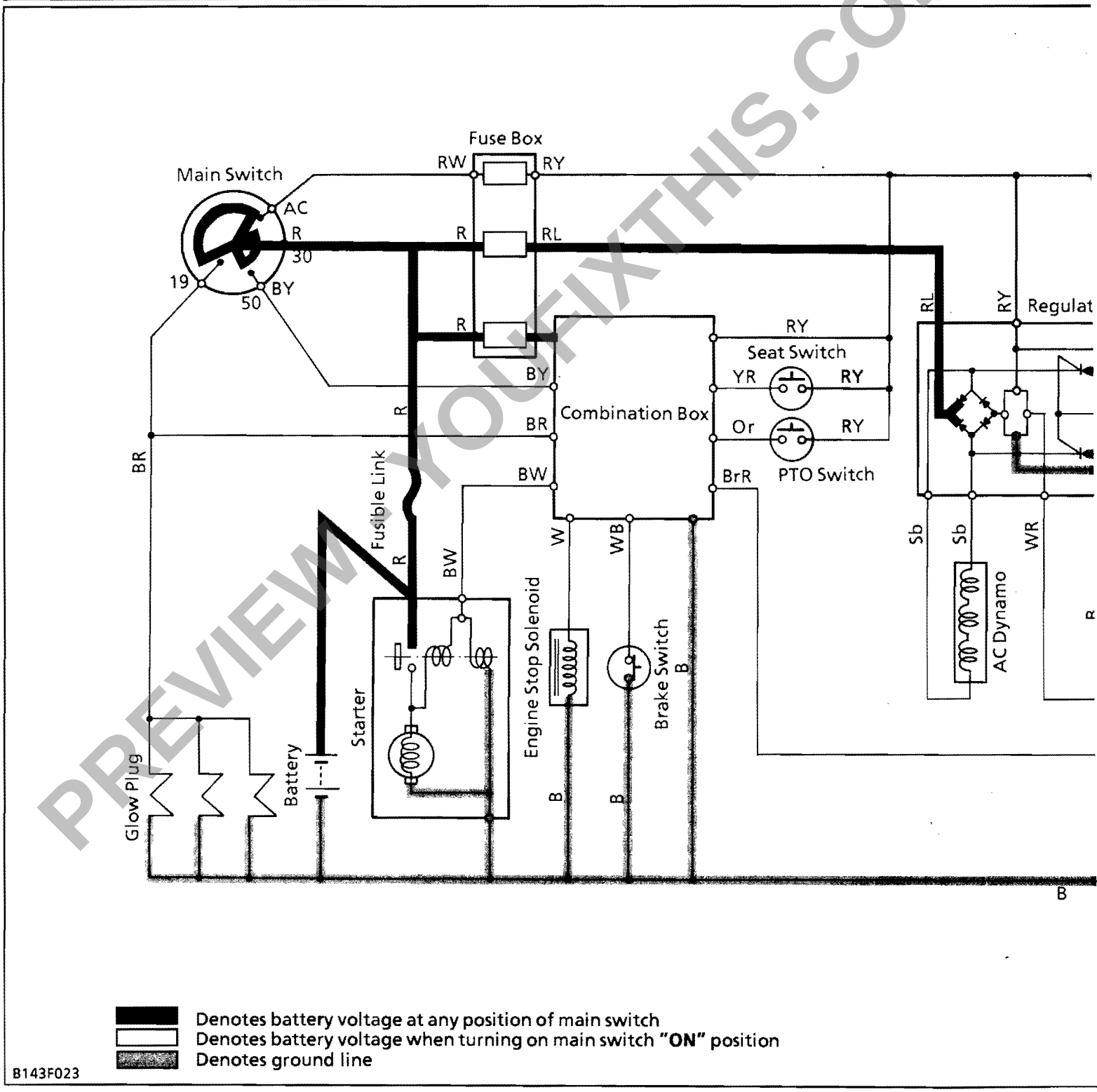


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## (2) Electrical Circuit

- **Color of Wiring**

| | | | | |
|---|---|---|---|---|
| B ---------- Black | R ---------- Red | BW --------- Black / White | RB --------- Red / Black | WB --------- White / Black |
| Br ---------- Brown | Sb ---------- Sky blue | BY --------- Black / Yellow | RL --------- Red / Bule | WR --------- White / Red |
| L ---------- Blue | W ---------- White | BrR --------- Brown / Red | RW --------- Red / White | YL ---------- Yellow / Blue |
| Or ---------- Orange | BR ---------- Black / Red | LW --------- Blue / White | RY --------- Red / Yellow | YR ---------- Yellow / Red |




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# [5] TIGHTENING TORQUES (GENERAL USE SCREWS, BOLTS AND NUTS)

Screws, bolts and nuts whose tightening torques are not specified in this Workshop Manual should be tightened according to the table below.

| Grade / Unit / Nominal Diameter | No-grade or 4T * ( ⬡ or ④ ) | | | 7T * ( ⑦ ) | | |
|---|---|---|---|---|---|---|
| | N·m | kgf·m | ft-lbs | N·m | kgf·m | ft-lbs |
| M 6 | 7.85 to 9.32 | 0.80 to 0.95 | 5.79 to 6.87 | 9.81 to 11.28 | 1.00 to 1.15 | 7.23 to 8.32 |
| M 8 | 17.65 to 20.59 | 1.80 to 2.10 | 13.02 to 15.19 | 23.54 to 27.46 | 2.40 to 2.80 | 17.36 to 20.25 |
| M10 | 39.23 to 45.11 | 4.00 to 4.60 | 28.93 to 33.27 | 48.05 to 55.90 | 4.90 to 5.70 | 35.44 to 41.23 |
| M12 | 62.76 to 72.57 | 6.40 to 7.40 | 46.29 to 53.52 | 77.47 to 90.22 | 7.90 to 9.20 | 57.14 to 66.54 |
| M14 | 107.9 to 125.5 | 11.0 to 12.8 | 79.56 to 92.58 | 123.6 to 147.1 | 12.6 to 15.0 | 91.1 to 108.5 |
| M16 | 166.7 to 191.2 | 17.0 to 19.5 | 123.0 to 141.0 | 196.1 to 225.6 | 20.0 to 23.0 | 144.7 to 166.4 |
| M18 | 245.2 to 284.4 | 25.0 to 29.0 | 180.8 to 209.8 | 274.6 to 318.7 | 28.0 to 32.5 | 202.5 to 235.1 |
| M20 | 333.4 to 392.3 | 34.0 to 40.0 | 245.9 to 289.3 | 367.7 to 431.5 | 37.5 to 44.0 | 271.2 to 318.3 |

* The figures on the table above are indicated the top of screw or bolt.

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## [6] MAINTENANCE CHECK LIST

To keep the machine working in good condition as well as to avoid any accident and trouble, carry out periodic inspection and maintenance. Check the following points before use.

| Service Interval | Check Points | Reference Page |
|---|---|---|
| Daily (Each use) | ● Check battery electrolyte level<br>● Check engine oil level<br>● Check transmission oil level<br>● Check cooling water level<br>● Clean radiator screen<br>● Check tire pressure<br>● Check brake pedal play | S.G-5<br>S.G-5<br>S.G-5<br>S.G-6<br>S.G-6<br>S.G-6<br>S.3-2 |
| Initial 50 hours | ● Change engine oil<br>● Change engine oil filter cartridge<br>● Change transmission oil filter cartridge | S.G-7<br>S.G-7<br>S.G-8 |
| Every 50 hours | ● Check and readjust fan belt tension<br>● Clean air cleaner element<br>● Lubricate moving parts | S.1-16, 41<br>S.G-8<br>S.G-9 |
| Every 100 hours | ● Change engine oil<br>● Check fuel line<br>● Check fuel filter<br>● Clean radiator core<br>● Check rear axle end play | S.G-7<br>S.G-10<br>S.G-10<br>S.G-10<br>S.G-10 |
| Initial 200 hours | ● Change transmission oil and PTO gear case oil<br>● Clean transmission oil strainer | S.G-11<br>S.G-11 |
| Every 200 hours | ● Check radiator hose and clamp<br>● Change engine oil filter cartridge<br>● Grease PTO drive shaft | S.G-12<br>S.G-7<br>S.G-12 |
| Every 300 hours | ● Change transmission oil filter cartridge<br>● Change transmission oil and PTO gear case oil<br>● Clean transmission oil strainer | S.G-8<br>S.G-11<br>S.G-12 |
| Every 500 hours | ● Change fuel filter | S.G-13 |
| Every 800 hours | ● Check and readjust valve clearance | S.1-15 |
| Every year | ● Change air cleaner element<br>● Change anti-freeze and coolant<br>● Clean cooling system | S.G-13<br>S.G-14<br>S.G-14 |
| Every 2 years | ● Change fuel line<br>● Change radiator hose and clamp<br>● Change cylinder hose | S.G-15<br>S.G-15<br>S.G-15 |

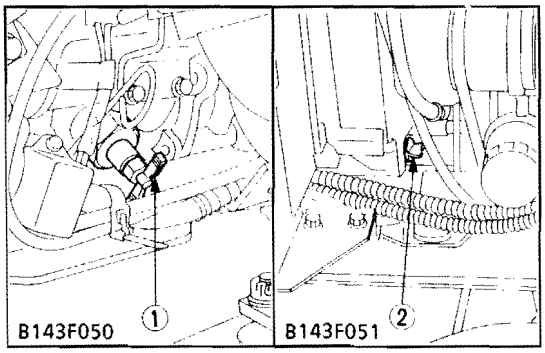
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# CHECKING, DISASSEMBLING AND SERVICING

## [1] SEPARATING ENGINE

## DISASSEMBLING AND ASSEMBLING



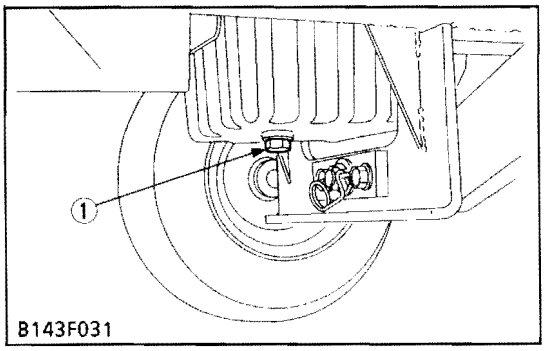

(1) Drain Cock (2) Drain Cock

### Draining Cooling Water

**CAUTION**

- **Never remove the radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**

1. Remove the radiator cap.
2. Open the drain cock (1), (2) and drain cooling water.




(1) Drain Plug

### Draining Engine Oil

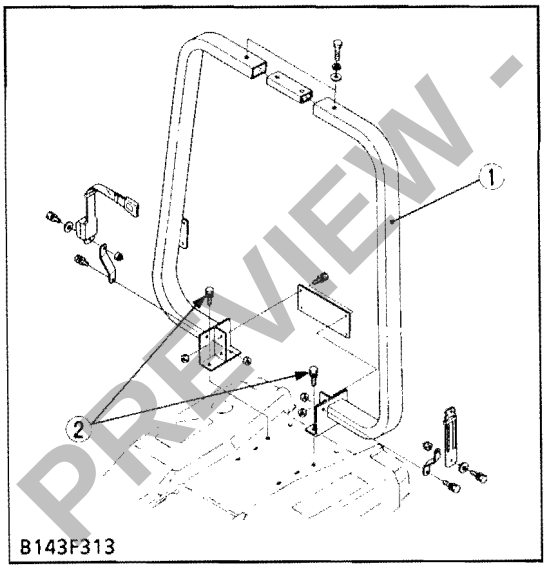
1. Place an oil pan underneath the drain plug.
2. Unscrew the drain plug (1), and drain engine oil.

**(When reassembling)**

| | | |
|---|---|---|
| Tightening torque | Drain plug | 32.4 to 37.3 N·m<br>3.3 to 3.8 kgf·m<br>23.9 to 27.5 ft-lbs |

**■ IMPORTANT**

- **Use the specified engine oil.**
  **Refer to "LUBRICANTS, FUEL AND COOLING WATER". (See page S.G-2)**




### ROPS

1. Support the ROPS with an hoist.
2. Unscrew the ROPS mounting screws (2), and remove the ROPS (1).

**(When reassembling)**

- Be sure to tighten the ROPS mounting screws (2) to the specified torque.

| | | |
|---|---|---|
| Tightening torque | ROPS mounting screw | 78.5 to 90.2 N·m<br>8.0 to 9.2 kgf·m<br>57.9 to 66.5 ft-lbs |

(1) ROPS (2) ROPS Mounting Screw

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# TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Excessive Vibration** | • Loosen engine mounting nuts | Retighten mounting nuts | – |
| **Engine Will Not Crank** | • Battery discharged | Check battery specific gravity, and charge or replace battery | S.8-5, 6 |
| | • Wiring harness disconnected | Connect | – |
| | • Fuse or fusible link blown | Replace fuse and fusible link | – |
| | • Starter malfunctioning | Repair or replace starter | S.8-9, 10<br>S.8-11, 12 |
| | • Main switch defective | Replace main switch | S.8-6, 7 |
| | • Engine jammed | Check engine to find trouble and repair | – |
| **Engine Cranks Slowly but Does Not Start** | • Battery charge low | Check battery specific gravity, and charge or replace battery | S.8-5, 6 |
| | • Battery cables loose, corroded or worn | Repair or replace cables | – |
| | • Increased resistance of moving parts | Repair or replace moving parts | – |
| | • Excessively high viscosity of fuel or engine oil at low temperature | Use specified fuel or engine oil | S.G-2 |
| **Engine Cranks at Normal Speed but Does Not Start** | • No fuel | Replenish fuel | – |
| | • Air in fuel system | Bleed air | S.G-13 |
| | • Water in fuel system | Replace fuel and repair | – |
| | • Fuel pipe or fuel filter clogged or damaged | Clean or replace | S.G-13, 15 |
| | • Compression leak from cylinder (Compression pressure too low) | Replace head gasket and tighten cylinder head screw, glow plug and injection nozzle, or check cylinder and piston ring | S.1-14, 15<br>S.1-17, 18<br>S.1-39 |
| | • Piston ring and cylinder worn | Replace piston ring and correct cylinder | S.1-31, 39 |
| | • Improper valve clearance | Adjust valve clearance | S.1-15 |
| | • Fuel leak due to loose injection pipe nut | Retighten nut | S.1-17 |
| | • Incorrect injection timing | Adjust | S.1-45 |
| | • Fuel camshaft worn | Replace | – |
| | • Injection nozzle clogged | Clean or replace | S.1-44 |
| | • Injection pump defective | Repair or replace | S.1-45, 46 |
| | • Fuel pump defective | Replace | S.8-15 |
| | • Improper valve timing | Check timing gear alignment | S.1-20 |
| | • Improper valve seat alignment, valve spring broken, valve seized | Repair or replace | S.1-26, 27<br>S.1-28 |

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# SPECIFICATIONS

| Model | | | GF1800E |
|---|---|---|---|
| Engine | Model | | D722-FM |
| | Type | | Vertical, liquid cooled, 4-cycle, diesel |
| | Gross power | | 13.4 kW / 3200 rpm (18 HP / 3200 rpm) |
| | Number of cylinders | | 3 |
| | Bore and stroke | | 67 mm × 68 mm (2.64 in. × 2.68 in.) |
| | Total displacement | | 719 $cm^3$ (43.88 cu.in.) |
| | Rated engine speed | | 3200 rpm |
| | Combustion chamber | | NTVCS |
| | Fuel injection pump | | Bosch MD mini pump |
| | Governor | | Centrifugal ball mechanical governor |
| | Injection nozzle | | Throttle type (DN4PD62) |
| | Injection timing | | 0.33 to 0.37 rad. (19 to 21°) before T.D.C. |
| | Injection pressure | | 13.73 MPa (140 kgf/$cm^2$, 1991 psi) |
| | Direction of rotation | | Counterclockwise (viewed from flywheel) |
| | Compression ratio | | 23 : 1 |
| | Lubricating system | | Forced lubrication by trochoid pump |
| | Cooling system | | Pressurized radiator, forced circulation with water pump |
| | Starting system | | Electric starter (12 V, 1.0 kW) |
| | Charging system | | AC dynamo (12 V, 150 W) |
| | Battery | | 12 V, 45 AH |
| | Engine stop system | | Key stop |
| Capacities | Fuel tank | | 20.0 ℓ (5.3 U.S.gals.) |
| | Engine crankcase | | 3.0 ℓ (3.17 U.S.qts.) |
| | Transmission case | | 5.7 ℓ (6.02 U.S.qts.) |
| | PTO gear case | | 0.6 ℓ (0.63 U.S.qts.) |
| | Radiator | | 3.3 ℓ (3.49 U.S.qts.) |
| Dimensions | Overall length | | 1950 mm (76.8 in.) |
| | Overall width | | 970 mm (38.2 in.) |
| | Overall height | | 1200 mm (47.2 in.) |
| | Wheel base | | 850 mm (33.5 in.) |
| | Tread | Front | 718 mm (28.3 in.) |
| | | Rear | 775 mm (30.5 in.) |
| | Min. ground clearance | | 102 mm (4.0 in.) |
| Weight (without mower) | | | 390 kg (859.8 lbs) |
| Tire size | Front | | 20 × 10.00 - 8 |
| | Rear | | 16 × 6.50 - 8 |
| Steering system | | | Manual |
| Transmission | | | Hydrostatic transmission |
| Brake | | | Internal expanding shoe type |
| Traveling speed | Forward | | 0 to 13.5 km / h (0 to 8.4 mph) |
| | Reverse | | 0 to 6.5 km / h (0 to 4.1 mph) |
| Mower drive system | | | Shaft drive |
| Mower clutch type | | | Wet multi plates |
| Mower PTO brake | | | Wet single plate |
| Mower lift system | | | Hydraulic |

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