SERVICE MANUAL
MODEL LS-23 AND LS-24
INERTIA DRIVE
LUBE-FREE
AIR/GAS STARTER

POW-R-QUIK

EXCELLENCE IN AIR STARTING SYSTEMS

4540 West 160th Street - Cleveland, Ohio 44135-2628
Telephone: 216-362-0755 • Fax: 216-362-0799
A Division of Maradyne Corporation

P/N 6-55-007
APRIL 2005np

GENERAL INFORMATION

Purpose. This manual contains installation and service instructions for the POW-R-QUIK model LS-23 and LS-24 inertia drive air and gas starting systems.

Application. These systems are primarily utilized in petroleum drilling and production equipment, gas compressor engines, water well drilling rigs, highway vehicles, marine engines, construction equipment, diesel powered generator sets and cogeneration equipment. When in doubt regarding the proper starting system for a particular application, the detailed installation instructions should be reviewed or a POW-R-QUIK starting system specialist should be contacted.

The LS-23/LS-24 air starters are designed to operate without any lubrication supplied to the air motor; however, on applications involving severe service conditions such as unfiltered air supply, prolonged cranking, or in starting environments with excessive heat buildups, consult with a POW-R-QUIK starting system specialist.

Parts and Service. Parts and service are available through POW-R-QUIK's worldwide distributor network. Lubricators, operating valves and other STARTING SYSTEM COMPONENTS ARE AVAILABLE INDIVIDUALLY OR IN COMPLETELY PACKAGED INSTALLATION AND REBUILD KITS. For guaranteed reliability use only original Pow-R-Quik starting system components. For the name of the nearest Pow-R-Quik sales and service outlet contact the factory:

DESCRIPTION

Air/Gas Starting System. The POW-R-QUIK Model LS-23 and LS 24 inertia drive air and gas starting system consists of three basic components: The starter, operating valves and air or gas supply.

NOTE

Contact the Pow-R-Quik distributor nearest you for information on genuine Pow-R-Quik starting system components.

1. **The LS series can be operated without lubrication for short crank cycles only. Should the cranking time exceed ten (10) seconds, lubrication must be provided to the air motor.**

   It is recommended that lubrication is provided on all starters used with natural gas engines.

2. **Operation of the LS series without lubrication may result in loss of efficiency.**

Shown in Figures 1 and 2 are schematics of typical POW-R-QUIK air and gas starting systems.

NOTE: CAUTION - PROPER VENTILATION IS REQUIRED FOR ALL ENGINES STARTED BY NATURAL GAS

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POW-R-QUIK
LIMITED WARRANTY

Pow-R-Quik warrants its air starters (Starters) to be free of defects in material and workmanship for a period of 18 months from the date of shipment by Pow-R-Quik. Pow-R-Quik will repair, without cost, any Starter found to be defective, including parts and labor charges, or at its option, will replace such Starter or refund the purchase price, in exchange for the Starter. Repairs or replacements are warranted for the remainder of the original warranty period.

If any Starter proves defective within its original 18 month warranty period, it should be returned to any authorized Pow-R-Quik Service Distributor, or to Pow-R-Quik in Cleveland, Ohio, transportation prepaid. You must contact Pow-R-Quik to receive a factory Return Authorization Number. Do not return any product without first receiving authorization from Pow-R-Quik.

This warranty does not apply to Starters which Pow-R-Quik has determined to have been misused or abused, improperly applied, installed or maintained by the user, or where the malfunction or defect can be attributed to the use of non-genuine Pow-R-Quik repair parts.

Pow-R-Quik makes no other warranty, and all implied warranties including any warranty of merchantability or fitness for a particular purpose are hereby disclaimed. Pow-R-Quik's maximum liability is limited to the purchase price of the starter and in no event shall Pow-R-Quik be liable for any consequential, indirect, incidental, or special damages of any nature arising from the sale or use of the Starter, whether in contract, tort, or otherwise.

POW-R-QUIK

Performance · Reliability · Quality

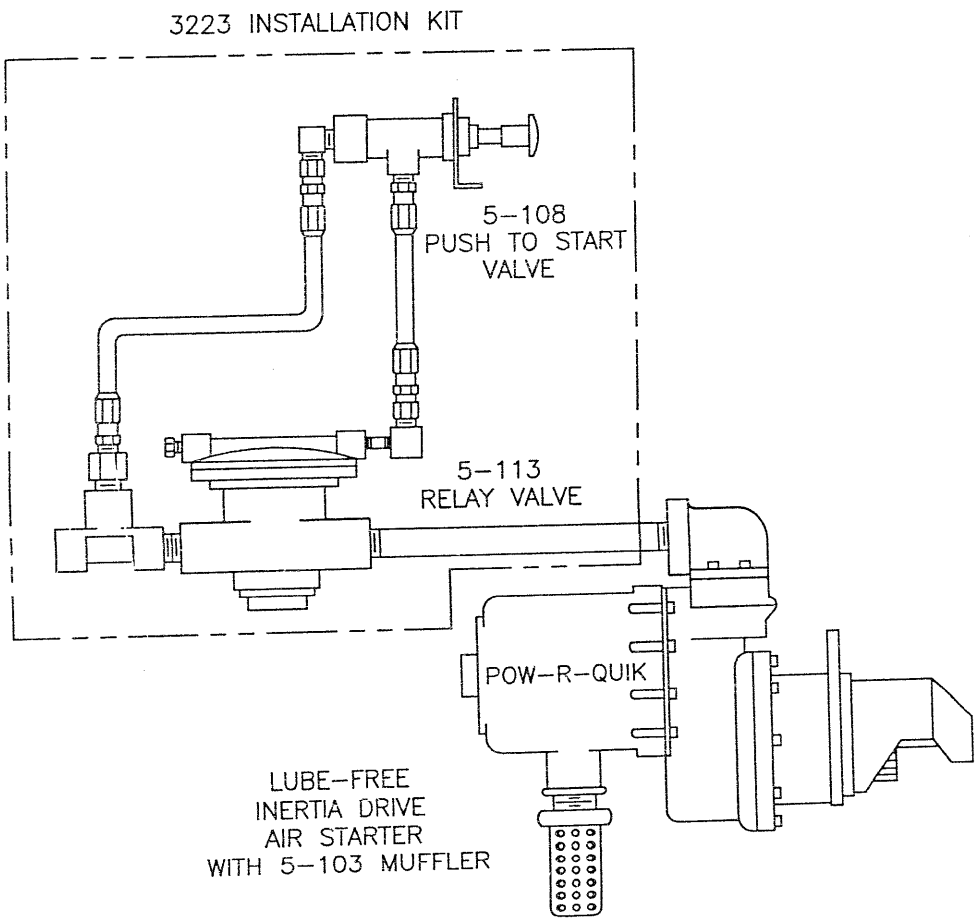

FIGURE 1. TYPICAL DIESEL ENGINE INSTALLATION

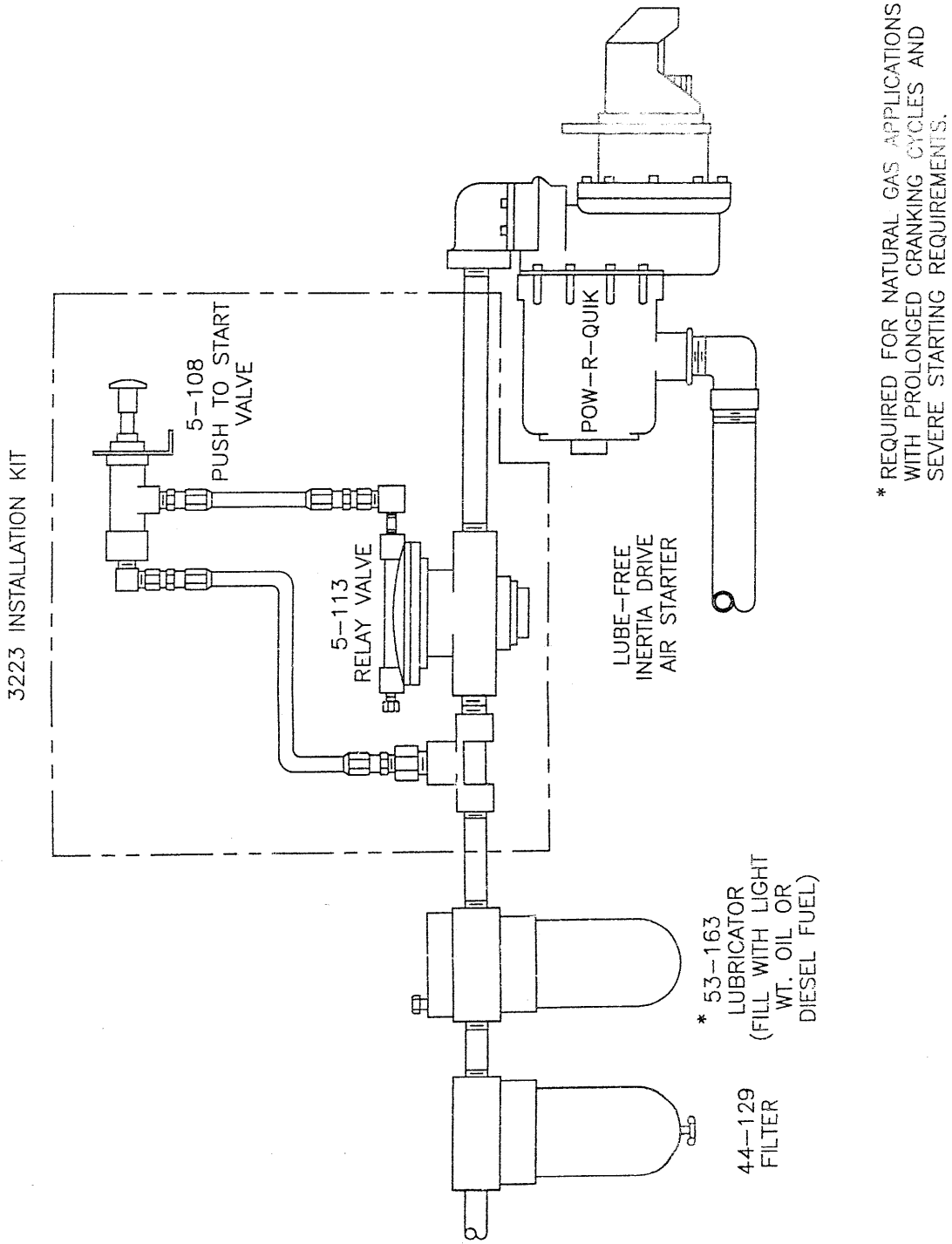

FIGURE 2. TYPICAL GAS ENGINE INSTALLATION

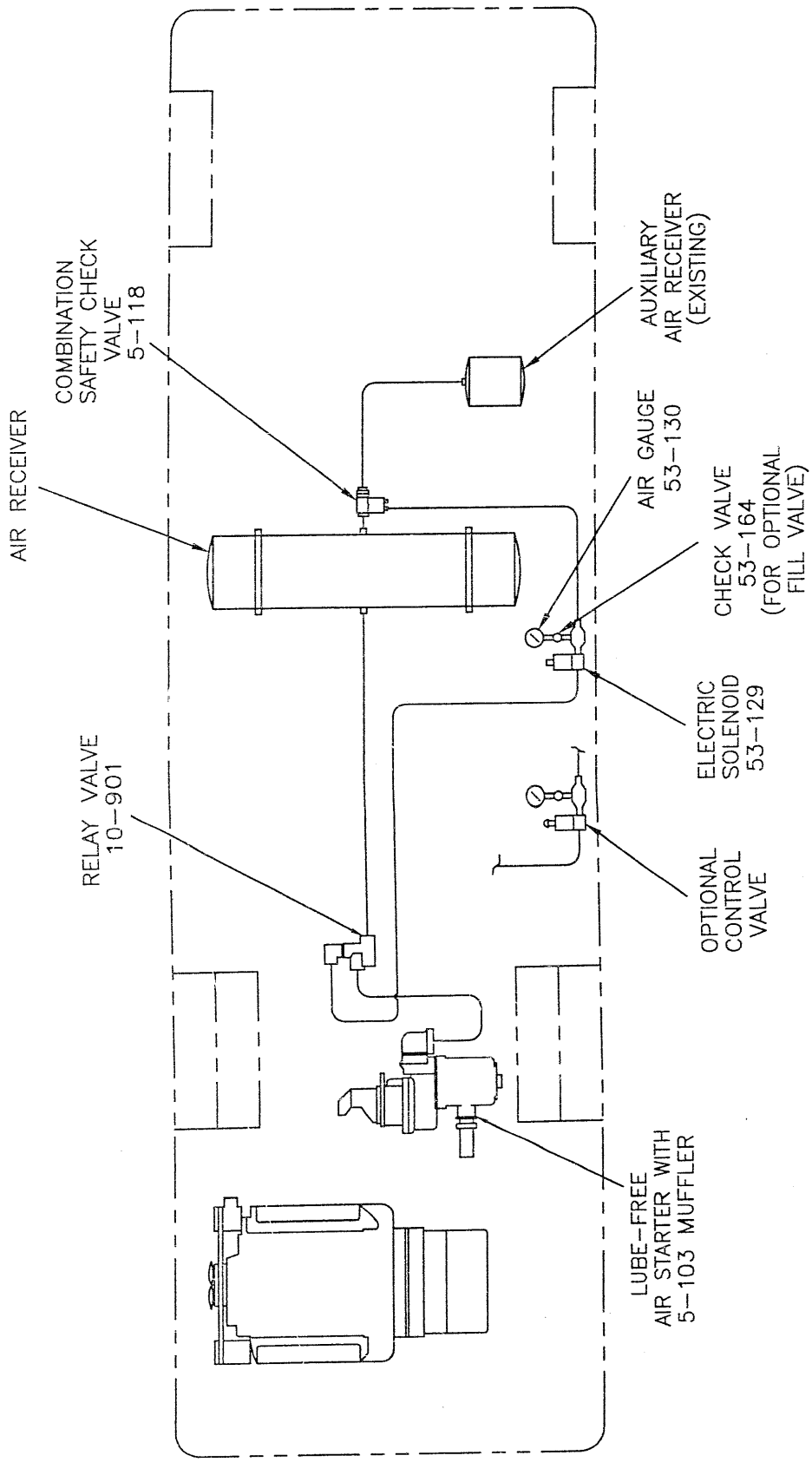

FIGURE 3. TYPICAL TRANSIT BUS AIR STARTING SYSTEM

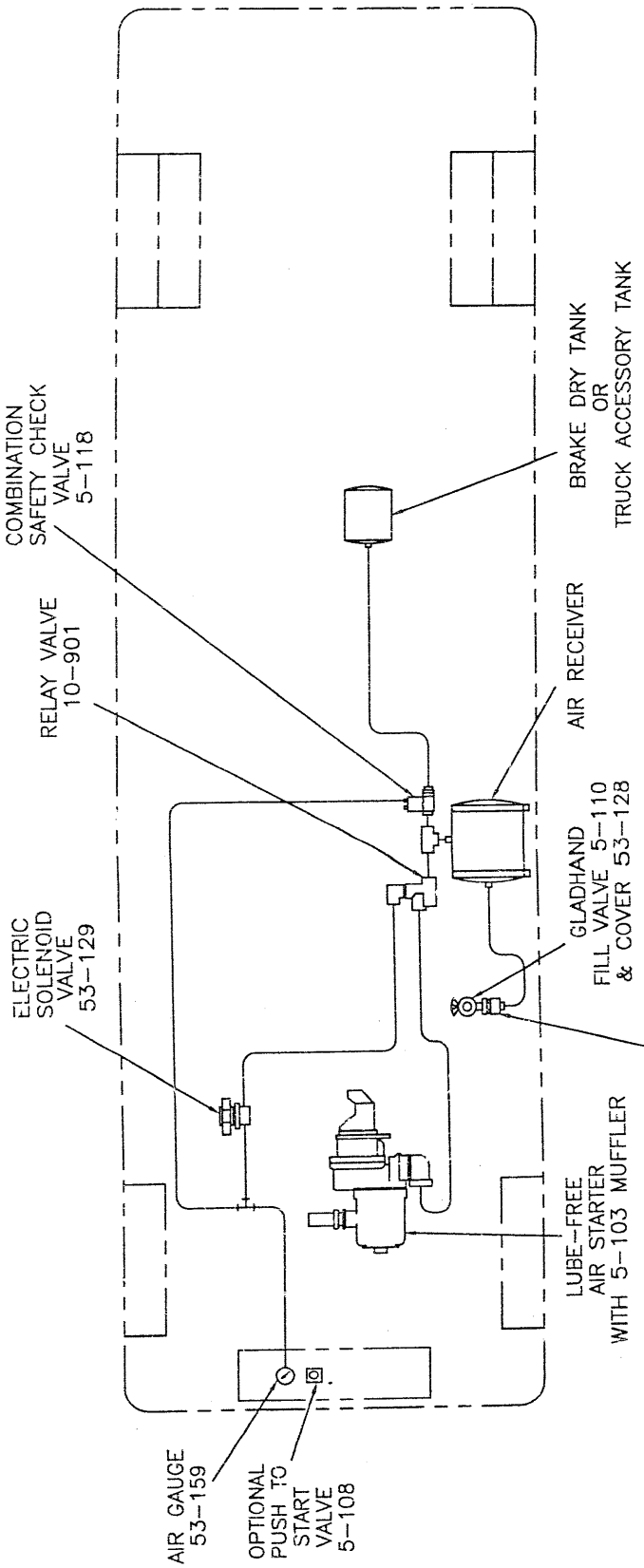

FIGURE 4. TYPICAL TRUCK AIR STARTING SYSTEM

Starter Installation.

NOTE

Before installing the starter, it should be noted that the three (3) major housings of the starter may be rotated a full 360°. Refer to Figure 3.

1. Position the starter on the engine flywheel housing with the starter drive housing properly positioned in the flywheel.

2. Align the three (3) bolt holes in the mounting flange with the proper bolt holes in the flywheel housing. Install and properly torque the three bolts.

3. Install the air hose on the inlet adaptor. Use minimum 1" air line.

4. Install exhaust piping or muffler, if applicable.

Starter Removal.

1. Remove the air hose from the starter's inlet adaptor. If applicable, remove any exhaust piping or muffler and any lubricator hose that may be attached to the starter.

2. Loosen, but do not remove, the three (3) starter mounting bolts.

3. Support the starter with one hand and remove the three (3) mounting bolts with the other.

4. Remove the starter from the engine.

Vane Kit Installation.

Disassembly For Vane Kit Installation.

NOTE

Prior to any disassembly operation, use a center punch and mark the starter housings at each side of all parting lines.

1. Disconnect all starter air lines.

NOTE

Refer to Figure 5. for parts identification.

2. Remove six (6) screws (#26) and lockwashers (#27) from the rotor housing (#1) and separate it from the gear housing (#21). Discard the screws, lockwashers and the o-ring (#20).

3. Remove the retaining ring (#8), end plate (#4) and thrust bearing assembly (#6) from the rotor assembly (#5). Discard the retaining ring (#8) and thrust bearing assembly (#6).

4. Remove and discard all vanes (#12) from the rotor assembly.

5. Disconnect and remove the rotor casing assembly (#2) from the inlet end plate (#3) and the gear housing (#21).

Inspection.

1. Check all rotor slots for burrs or foreign matter. Clean rotor and remove burrs.

2. Inspect the rotor casing (#2), rotor assembly (#5), end plate (#4) and rotor housing (#1) for damage. Replace damaged parts. Clean all parts that are going to be used again.

Assembly.

1. Install a new o-ring (#20) on the gear housing (#21).

2. Install the rotor casing assembly (#2) with the long roll pin extended through the inlet end plate (#3) and into the gear housing (#21).

NOTE

Be sure that the inlet air passage or baffle on the rotor casing assembly A(#2) properly aligns with the air passage on the inlet end plate (#3) and gear housing (#21).

3. Insert the vanes (#12) into the rotor slots on the rotor assembly (#5) as shown in Figure 4.

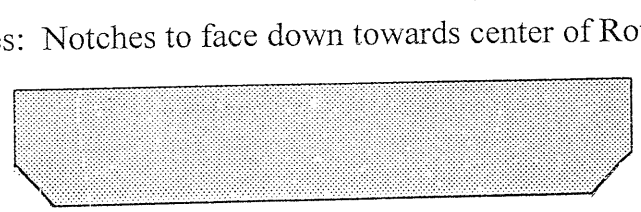

Figure #4

4. Make sure bearing assembly (#6) is packed with bearing grease.

5. Position the new thrust bearing assembly (#6) on the end of the rotor assembly (#5).

6. Install the end plate (#4) on the rotor casing (#2), making certain that the short roll pin on the rotor casing is properly insterted into the end plate (#4).

7. Install the retaining ring (#8) on the rotor assembly (#5), making certain that the snap ring seats properly into the appropriate groove.

8. Properly pack bearing (#11) with lithium and molybdenum disulfide based grease.

9. With the new o-ring (#20) properly positioned on the gear housing (#21), work the rotor housing (#1) over the rotor casing (#2) until the rotor assmbly's shaft is seated in the bearing (#11) and the two housings make contact.

10. Rotate the rotor housing (#1) until its center punch mark lines up with the punch mark on the gear housing (#21).

11. Install the six screws (#26) and lockwashers (#27) that hold the rotor housing (#1). Alternately tighten these screws to 6-8 ft. lbs. (8.16 - 10.88 NM) of torque.

12. Pour a small amount of light weight oil (SAE #10 lube oil) or diesel fuel into the starter air inlet (#25).

WARNING:
PENETRATING OIL WILL ATTACK
ROTOR VANES AND CAUSE
MOTOR FAILURE
USE DIESEL FUEL OR
SAE#10 LUBE OIL ONLY

13. Bench test the reassembled starter, using a 1" air hose, or install the starter on the engine for testing.

14. Install the air lines.

15. Engine test the starter.

Rebuild Kit Installation.

NOTE

Refer to Figure 5. for parts identification.

Disassembly For Rebuild.

1. Perform steps outlined in "Disassembly For Vane Kit Installation".

2. Remove rotor shaft section including the rotor shaft (#5), inlet end plate (#3), sealing spacer (#14), bearing (#17), and gear (#18). This should be removed manually by pulling straight away from the gear housing (#21).

3. Disassemble the rotor shaft section by removing retaining ring (#19) from the gear end of the shaft.

4. Lift gear (#18) off the shaft splines and remove bearing (#17) with bearing pullers.

5. Remove sealing spacer (#14) with o-rings (#15 & #16). Remove inlet end plate (#3) and thrust bearing assembly (#6).

6. Discard bearing (#17), o-rings (#15 & #16), thrust bearing assembly (#6), and retaining ring (#19).

7. Remove three screws (#40) and grease cap (#39) from rotor housing (#1). Discard o-ring (#38).

8. Remove and discard old bearing (#11) from rotor housing (#1).

9. Remove fours screws (#26) with lockwashers (#27) from inlet adaptor (#25).

10. After removing inlet adaptor (#25), remove and discard o-ring (#24).

11. Remove inlet screen (#23) from gear housing (#21).

12. Remove ten screws (#26) with lockwashers (#27) from drive housing (#37). Remove the drive housing.

13. Remove and discard bearing (#36) from the drive housing (#37).

14. Pull starter drive (#35) from arbor shaft (#30), then pull the arbor shaft subassembly out of gear housing (#21).

15. Disassemble the arbor shaft subassembly by removing thrust washer (#29), gear (#32), and bearing spacer (#34). Remove and discard "O" Rings (#45, 46).

16. Using a gear puller or press, separate bearing (#33) from arbor shaft (#30).

17. Inspect and, if necessary, remove and discard needle bearing (#28), located in gear housing (#21).

Inspection.

1. Inspect the starter drive for visible damage or clutch slippage. Replace if necessary.

NOTE

A replacement starter drive is not included in the LS-23 and LS-24 rebuild kit.

2. Inspect all Parts. Clean all re-usable parts (except the starter drive) in a good commercial cleaning solvent, and dry with compressed air. Replace any parts that cannot be re-used.

CAUTION

Do not apply solvent to the starter drive, as it may remove the factory applied lubricant.

Assembly.

1. Position thrust bearing assembly (#6), then inlet end plate (#3) on the splined end of rotor shaft assembly (#5). The smaller outside diameter on the end plate should be facing the slotted rotor body and the small counterbore should fit over the thrust bearing assembly (#6).

2. Position new o-rings (#15 & #16) on sealing spacer (#14) and place on the rotor shaft assembly adjacent to inlet and end plate (#3).

3. Press new bearing (#17) on the shaft until it bottoms lightly against sealing spacer (#14). Make certain that the end plate will rotate freely.

4. Mount rotor spur gear (#18) on splined end of rotor shaft assembly and install retaining ring (#19) with the use of snap ring pliers.

5. Install the rotor casing assembly (#2) with the long roll pin placed through the inlet end plate (#3). Make certain that the air passage (baffle) on the rotor casing assembly (#2) is properly aligned with the air passage on the inlet end plate (#3).

6. Install new vanes (#12) into the slots on the rotor assembly (#5). Refer to Figure 4. Make sure bearing assembly (#6) is packed with bearing grease.

7. Position the new thrust bearing assembly (#6) on the short end of the rotor assembly shaft.

8. Install the end plate (#4) on the rotor casing, making certain that the thrust bearing assembly (#6) is in place and that the short roll pin on the rotor casing (#2) is properly inserted into the end plate (#4).

9. Properly set the retaining ring (#8) into the appropriate groove on the rotor assembly (#5).

10. Install the new bearing (#11) in the rotor housing (#1) with the bearing end surface flush with the inside surface of the rotor housing.

11. Properly packed the bearing (#11) with lithium and molybdenum disulfide based grease.

12. Slip the rotor housing (#1) over the rotor casing assembly with the exhaust port pointing as necessary for punch marks to align properly at assembly.

13. Check to see that the rotor is free to rotate by turning the spur gear (#18).

14. Check for freeness of vanes by rotating rotor slowly and observing vanes through exhaust port.

15. Press the needle bearing (#28) into the gear box housing (#21).

16. Install new o-ring (#20) on gear housing (#21).

17. Align the long roll pin in the rotor casing assembly (#2) with the role in the gear housing (#21) and attach the gear housing (#21) to the rotor housing (#2) with six screws (#26) and lockwashers (#27) (Refer to marks made during disassembly). The gear housing may be rotated 360° in 36° increments, with respect to the rotor housing. Torque the six screws (#26) to 6-8 ft. lbs. (8.16 - 10.88 NM).

NOTE

Be sure that the inlet air passage or baffle on the rotor casing assembly (#2) properly aligns with the air passage on the inlet end plate (#3) and gear housing (#21).

18. Press the starter drive gear (#32) onto the arbor (#30). Make sure the key (#31) is in place.

19. Press the radial ball bearing (#33) onto the arbor (#30) until it seats against the shoulder. Apply pressure to the inner race only, and keep the sealing side of the bearing toward the splined portion of the arbor (#30).

20. Install O'Rings (#45 & #46) onto bearing spacer (#34). Press the bearing spacer (#34) over the bearing (#33) until flush with bearing.

21. Place about one-fourth pint of lithium and molybdenum disulfied based grease into the gear box housing (#21).

22. Place the thrust washer (#29) on the arbor shaft against the gear and insert the arbor with parts attached, into the housing (#21).

23. Slide the starter drive (#35) over the arbor spline (#30).

24. Lubricate the needle bearing (#36) with lithium and molybdenum disulfide based grease and press it into the drive housing (#37) until it is flush with the inside of the housing.

25. The drive housing (#37) may be located 360° in 18° increments with respect to the gear housing (#21). (Refer to marks made during disassembly for proper orientation).

26. Attach the drive housing (#37) to the gear housing (#21) with ten screws (#26) and lockwashers (#27). Torque these screws to 6-8 ft. lbs. (8.16 - 10.88 NM).

27. Pour a small amount of light weight oil or diesel fuel into the starter air inlet.

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MOTOR FAILURE
USE DIESEL FUEL OR
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28. Position new o-ring (#24) and inlet strainer (#23) on the gear housing (#21).

29. Align inlet adapter (#25) with punch marks on gear housing and install four screws (#26) and lockwashers (#27). Alternately tighten screws to 6-8 ft. lbs. (13.6 - 16.3 NM) of torque.

30. Remove the starter from the vise or fixture.

31. Install the grease cap (#39) with a new o-ring (#38) and three screws (#40). Tighten screws to 10 - 12 in. lbs. (1.13NM - 1.36NM).

32. Bench test the rebuilt starter, using a 1" air hose and/or install on the engine for test.

33. Install the air lines.

34. Engine test the starter.

LS/DS-23/24 STARTER PARTS LIST (INERTIA)

INDEX NO.		PART NO.	DESCRIPTION	QTY	6-3-136 Repair Kit	6-3-133 Vane Kit	6-3-236 LS-DS Kit	6-3-237 LS-DS Kit
-1		6-26-106	Rotor Housing	1				
-2		6-34-101R	Rotor Casing Assembly (RH)					
		6-34-101L	Rotor Casing Assembly (LH)	1				
-3		6-29-503RX	Inlet End Plate (LS Right Hand)				X	
		6-29-503LX	Inlet End Plate (LS Left Hand)	1				X
-3		6-29-501R	Inlet End Plate (DS Right Hand)					
		6-29-501L	Inlet End Plate (DS Left Hand)	1				
-4		6-29-502RX	End Plate (LS Right Hand)				X	
		6-29-502LX	End Plate (LS Left Hand)	1				X
-4		6-29-500R	End Plate (DS Right Hand)					
		6-29-500L	End Plate (DS Left Hand)	1				
-5		6-30-101	Rotor Assembly- Standard	1				
-6		6-38-114	Thrust bearing (DS)	2	X	X	X	X
-6		6-38-123	Thrust Bearing Assembly (LS)	2				
	-9	6-21-722	Thrust Bearing	2	X	X	X	X
	-7	6-21-723	Thrust Washer	2	X	X	X	X
	-10	6-21-744	Sealing Race	2	X	X	X	X
	-44	6-25-123	O' Ring	2	X	X	X	X
	-43	6-25-122	O' Ring	4	X	X	X	X
	-47	6-50-135	Backup Ring	1	X	X	X	X
-8		6-25-117	Retaining Ring, Rotor	1	X	X	X	X
-11		5-19322	Bearing, Needle	1	X	X	X	X
-12		6-14-105	Rotor Vanes- Standard	5	X	X	X	X
-14		6-68-107	Sealing Spacer	1				
-15		6-25-127	O-ring, Outer	1	X	X	X	X
-16		6-25-131	O-ring, Inner	1	X	X	X	X
-17		6-24-106	Bearing, Ball	1	X	X	X	X
-18		6-28-102	Gear, Starter Spur- LS-23 (16 Tooth)	1				
		6-28-108	Gear, Starter Spur- LS-24 (14 Tooth)	1				
-19		6-25-115	Retaining Ring, Gear	1	X	X	X	X
-20		6-50-128	O-ring, Gear Housing	1	X	X	X	X
-21		6-26-508	Gear Housing, LS-24	1				
-22		5-20038	Pipe Plug	1	X		X	X
-23		6-24-120	Screen, Inlet	1	X		X	X
-24		6-25-126	O-ring, Inlet	1	X		X	X
-25		6-44-119	Adaptor, Inlet	1				
-26		6-18-117	Screw	20	X	X	X	X
-27		6-38-112	Lockwasher	20	X	X	X	X
-28		6-24-103	Bearing, Needle	1	X		X	X
-29		6-38-115	Thrust Washer	1	X		X	X
-30		6-23-103	Arbor Shaft 6/8 Pitch	1				
		6-23-500	Arbor Shaft 8/10 Pitch	1				
-31		6-33-101	Key, Woodruff	1	X		X	X
-32		6-28-103	Gear, Starter Drive- LS-23 (45 Tooth)	1				
		6-28-109	Gear, Starter Drive- LS-24 (47 Tooth)	1	X		X	X
-33		6-24-119	Bearing, Ball	1				
-34		6-68-103	Spacer, Bearing	1				
-35		6-8-100	Drive, Model LS-23/LS-24 RH1	1				
		6-8-100S	Drive, Model LS-23/LS-24 RH1 PQS79	1				
		6-8-101	Drive, Model LS-23/LS-24 LH1	1				
		6-8-102	Drive, Model LS-23/LS-24 RH2	1				
		6-8-102S*	Drive, Model LS-23/LS-24 RH2-1	1				
		6-8-095	Drive, Model LS-23/LS-24 RH2 PQS79	1				
-36		6-24-109	Needle Bearing	1	X		X	X
		6-24-109D	Needle Bearing (PQS79 Series)	1				
-37		6-26-108	Drive Housing SAE# 3					
		6-26-121	Drive Housing SAE# 3 (PQS79 Series)					
		6-26-123	Drive Housing SAE # 1					
-38		6-53-160	Grease Cap O-ring	1	X	X	X	X
-39		6-26-115	Grease Cap O-ring	1				
-40		6-18-121	Screw	3	X	X	X	X
-41		6-6-107	Nipple (Optional)	1				
-42		6-5-103	Muffler (Optional)	1				
-45		6-25-148	O-ring	1	X		X	X
-46		6-25-149	O-ring	1	X		X	X

LS-23 AND LS-24 INERTIA DRIVE STARTER COMPONENTS