Cub Cadet Power Equipment

Service Bulletin CC-312

GARDEN AND SUPER GARDEN TRACTORS

Models: 1340, 1863, 1864, 2084, 2284

Date: November 14, 1995

Subject: Hydraulic Valve Lifters

Hydraulic Valve Lifters

Many technological advances that prove themselves in automotive engines, later find use in smaller engines, as well. The hydraulic lifter is one such component that we feel can be successfully adapted to the manufacture of air-cooled engines. The Command 11-25 HP engines incorporate hydraulic lifters to automatically maintain optimal valve lash.

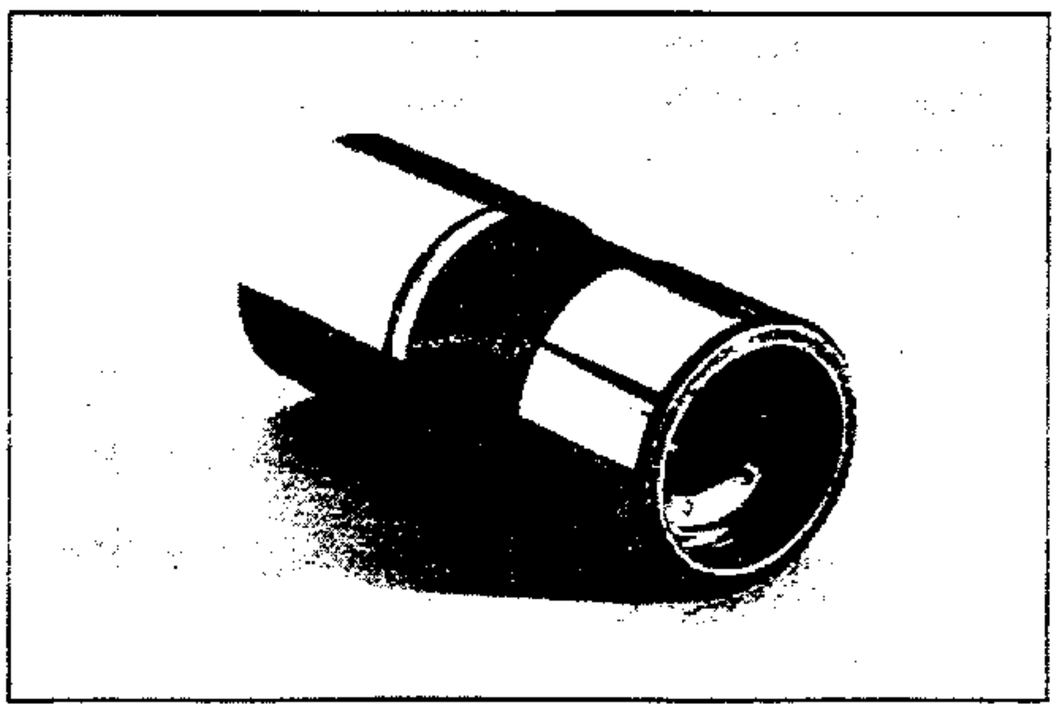

Figure 1. Hydraulic Lifter.

The purpose of the hydraulic lifter is to automatically eliminate all lash in the valve train, thus eliminating the noise. The lifter stays in constant contact with the valve stem or push rod regardless of thermal expansion or component wear. During valve opening, the lifter is already in contact with the stem or push rod, so the noise of contact is eliminated. During the closing process, the valve comes gradually to rest on its seat, instead of hitting it with a sharp, noisy blow. The hydraulic lifter also adjusts itself automatically to compensate for component wear, so the need for periodic lash adjustments is also eliminated.

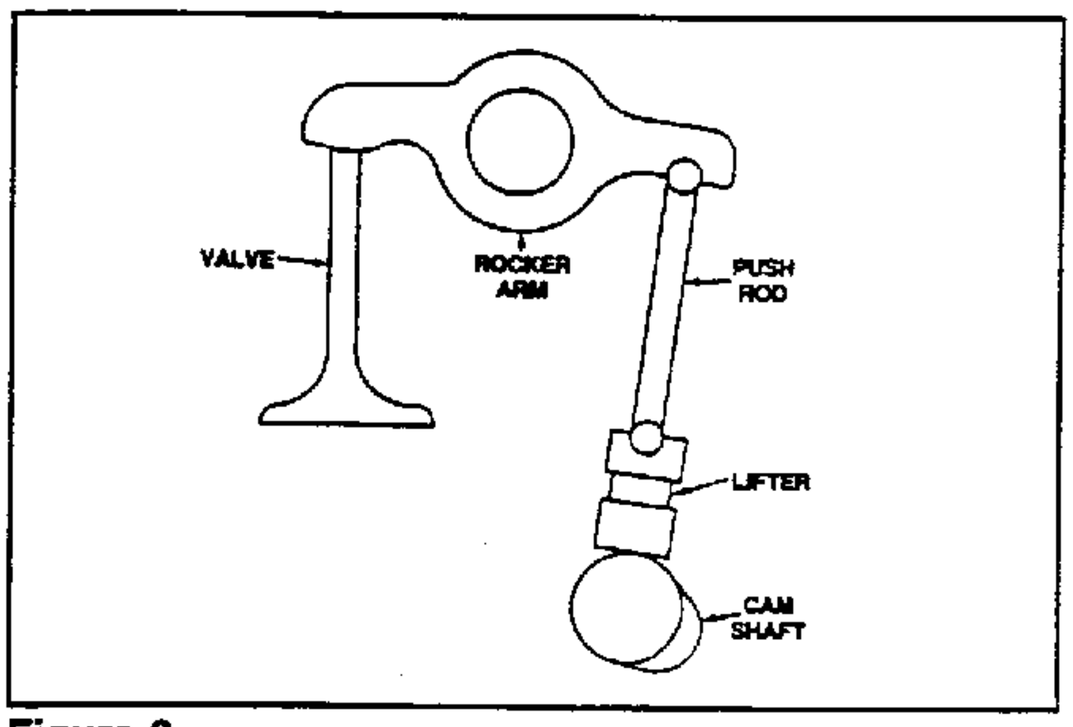

Figure 2.

Principle of Operation

The principle of the hydraulic lifter is quite simple. A cylindrical plunger is inserted into a matching recess in the end of the tappet. At the base of the plunger is a small chamber filled with oil. This high pressure chamber is virtually sealed by the close running tolerances between the plunger and tappet body. Since the oil cannot escape, and like all liquids is nearly incompressible, the lifter provides a solid drive between the camshaft and valve or push rod.

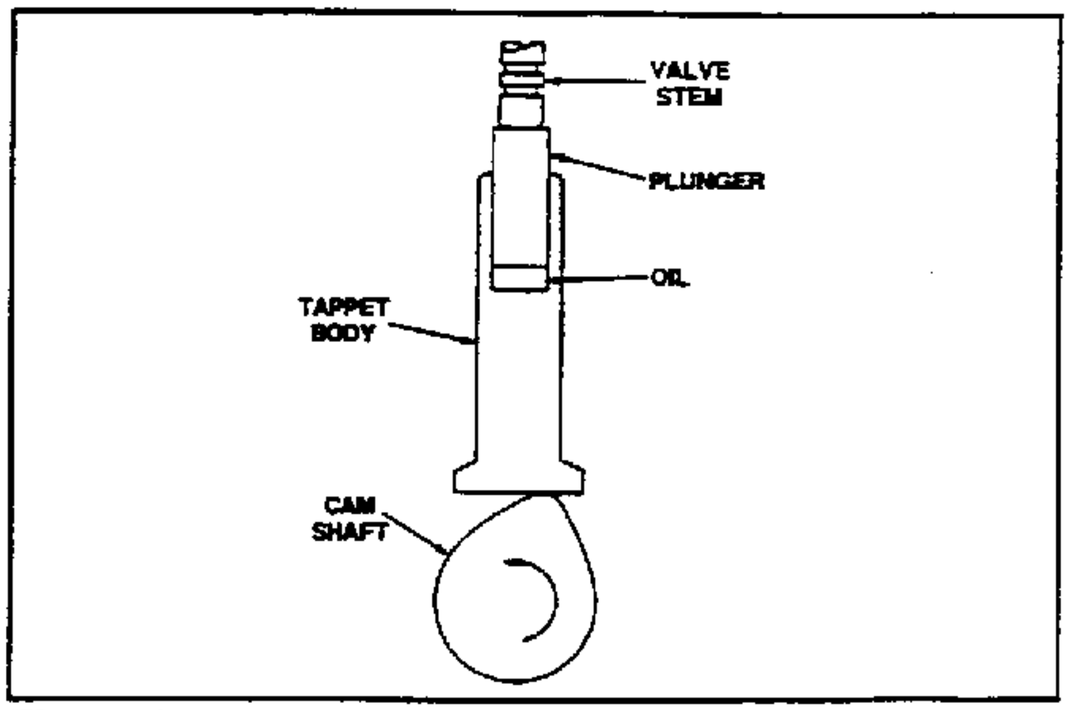

Figure 3.

The plunger diameter has a tightly controlled clearance which allows a slight leakage of oil whenever the valve is open and because of the high pressure of the valve spring acting on the plunger. To compensate for this leakage, the high pressure chamber must be replenished following each opening and closing of the valve. After the valve has closed and the valve spring is no longer putting pressure on the plunger, the oil pressure in the reservoir and gallery is greater than the pressure in the high pressure chamber. The check ball opens and allows oil to flow from the reservoir into the high pressure chamber. The oil pressure and the plunger spring force the plunger upward to keep the socket in contact with the push rod (zero lash). When the cam comes around again to open the valve, the force of the valve spring against the plunger causes a rapid pressure increase in the high pressure chamber. The check ball will be forced against its seat and the hydraulic lock will again allow the lifter to perform as a solid drive.

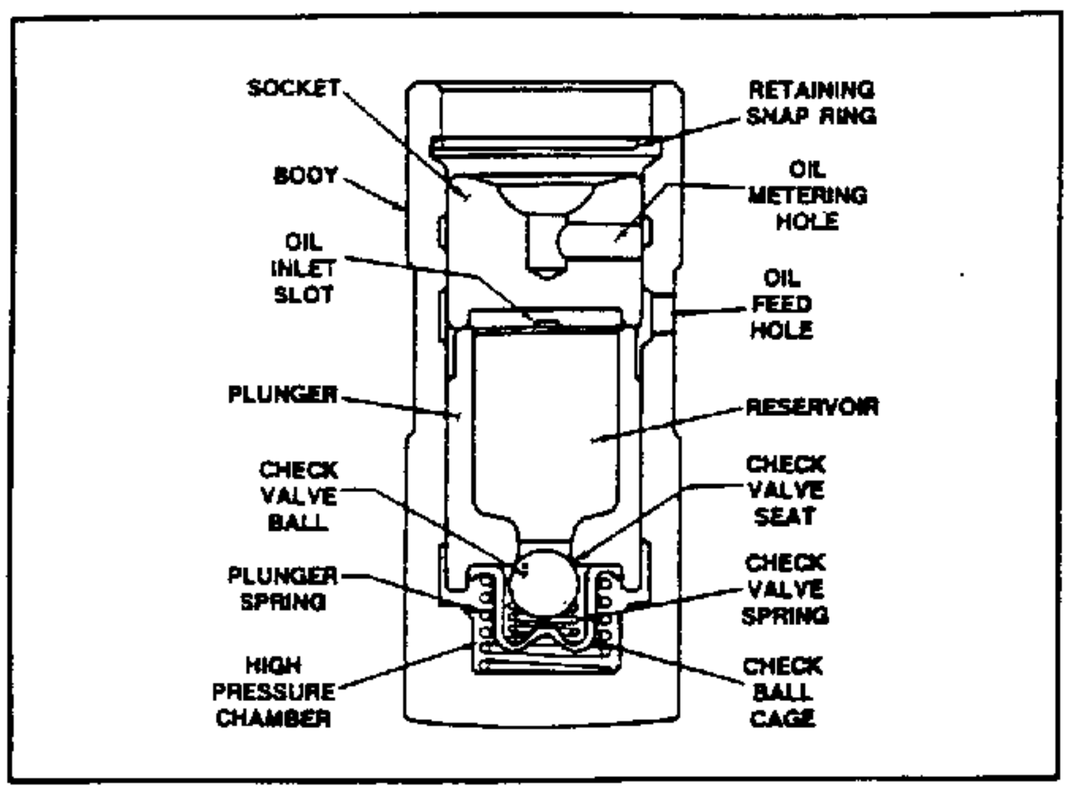

Figure 4.

The leakage which occurs in the lifter allows it to automatically compensate for thermal expansion and wear of the valve face and seat. As the engine heats up, the valve stems and push rods expand lengthwise. The leakage will allow the volume of the high pressure chamber to gradually decrease in response to the expansion. The same compensation also occurs in response to valve face and seat wear.

The leakage rate is very critical, it must be sufficient for compensation, but it cannot be excessive, or the lifter will be noisy.

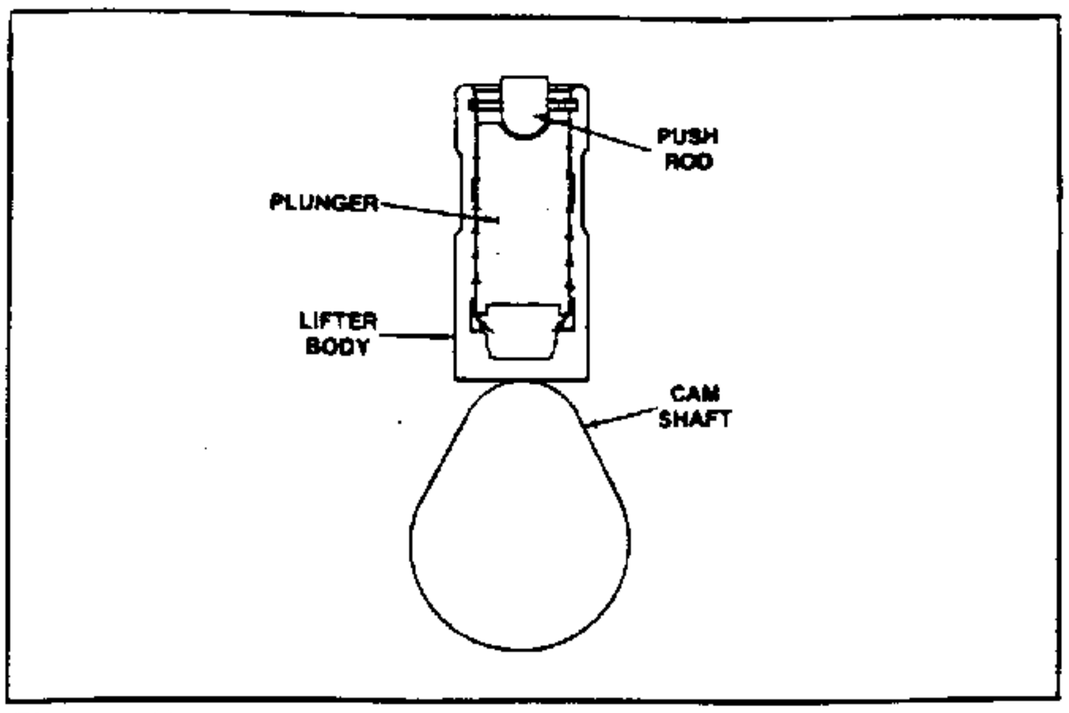

Figure 5.

Troubleshooting Reported Problems

The most common or frequently received complaint relating to hydraulic lifters is that they are "noisy". In some cases, the complaint will say the engine is noisy when first started. Other times, the noise may be more pronounced after the engine gets warm, or it may appear rather suddenly after a period of running.

Troubleshooting a "noise" complaint should follow the same pattern as any other complaint; do not overlook the simple causes and start with the least complicated possibilities first. The noise may be from the lifters, but it could also be from worn valve guides, loose rocker arms, and some of the other easily checked possibilities. If you have properly narrowed it down to the lifters, try to determine when the noise appears or is most noticeable. This can often give you clues to the most likely cause(s).

Lifter noise immediately after start up is usually due to contraction and/or leakdown. If the engine was worked hard at last use, the valve stems, push rods, etc., would have been at maximum expansion and the volume of oil in the high pressure chamber would be reduced. As the engine cools and the parts contract, the plunger spring will push the plunger up leaving the high pressure chamber partially empty. Also if one of the valves is open when the engine comes to rest, the pressure of the valve spring will squeeze oil out of the high pressure chamber, leaving it nearly empty. In either case, there will be some noise when the engine is first restarted, until the high pressure chamber is replenished. Normally, this will occur rather quickly, from a few seconds to a few minutes.

If the lifter is still noisy after 5 minutes of running, it could be from aeration (air trapped in the lifter). Stop the engine and check the oil level. Adjust as necessary and run the engine for an additional 20 minutes at half throttle.

If the noise persists after 20 minutes of running, it is probably an indication of contamination or dirt in the lifter preventing the check ball from seating. Corrective action would be to replace the lifter.

A lifter which suddenly gets noisy while the engine is running would probably be from contamination or aeration. Corrective measures would be the same as those already discussed.

ifter noise which appears or worsens as the engine eats up is usually due to wear in the lifter, especially if ne engine has considerable running hours or has not had regular oil changes.

A situation where the lifter seems to pump up too much; where it is holding a valve open, causing a loss of compression or hard starting; could be due to insufficient clearances between the plunger and body.

Servicing and Installing Hydraulic Lifters

Whenever an engine has been disassembled, before reassembly of the engine, the hydraulic lifters should be primed. Use the following procedure.

Priming Procedure

1. Place the lifter in a small can or container. A 6 oz. can from juice or tomato paste works well. If you expect to be priming lifters regularly, use a small plastic container with a snap-on lid. Following the priming operation, you can replace the lid and leave the oil stored in the container until the next time it's needed.

2. Pour 10W-30 oil into the container until the oil is level with the top of the lifter.

3. Place the end of one of the push rods into the socket on the top of the lifter and "pump" the lifter with the push rod until it feels solid.

4. Lift the lifter out of the oil, let it drip off for a moment, and install it into the appropriate bore in the engine.

CAUTION: Proper care and procedure must be taken to avoid damage to lifters or push rods. Refer to the "Reassembly" section of the appropriate service manual to assemble and install the cylinder head(s). On twin cylinder engines, install only the #1 cylinder head, then refer to the following procedure to "bleed down" the lifters.

"Bleeding" the Lifters

Because the lifters were "pumped up" outside the engine, there is a good possibility that they are extended beyond the requirements of the engine. To prevent a possible bent push rod or broken rocker arm, it is important to "bleed" any excess oil out of the lifters before attempting to start or run the engine.

1. After the first (or only) cylinder head has been installed, rotate the flywheel so the cylinder with the head is at TDC between the exhaust and intake strokes. The crankshaft keyway will be in line with the cylinder, and the rocker arms will move alternately if the flywheel is rocked. Leave the engine in this position for at least 10 minutes.

2. On a single cylinder engine, proceed to reassemble the rest of the engine.

   On a twin cylinder engine, follow the service manual to install the #2 cylinder head. After it is installed, check whether the #1 side has had at least 10 minutes to bleed down. If so, rotate the flywheel 3/4 turn clockwise, so #2 cylinder is at TDC between exhaust and intake. Check the position as in step 1. Then proceed to reassemble the rest of the engine.

3. When the reassembly is completed, turn the engine over slowly by hand. If the engine turns over completely and has good compression, it is ok to fill the crankcase to the proper level with the recommended oil and test run. If the engine does not turn over completely (locks up at some point), stop turning at the point of lockup and allow 10 more minutes for the lifters to bleed down. Then try rotating by hand again.