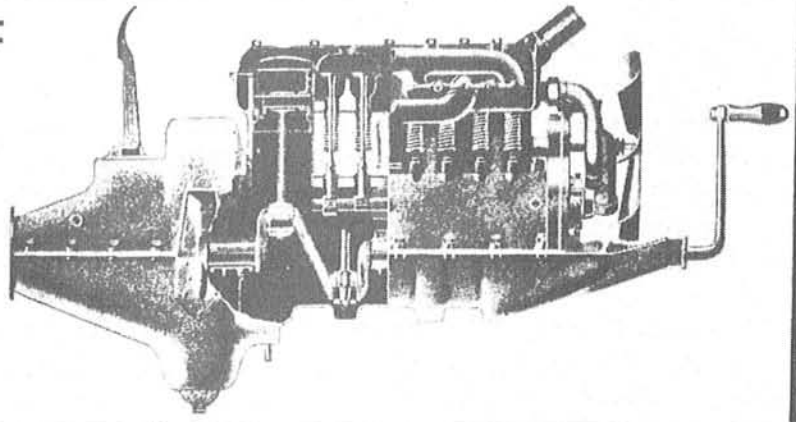
THE ANALYSIS OF ENGINE NOISES IN THREE PARTS



Ed. Note: This article is the third in a three-part series on the analysis and diagnosis of engine noises. The material is excerpted from a 1936 edition of the Automobile Digest Engine Service Manual.

PART 3 — NOISES WHICH ORIGINATE IN THE CAMSHAFT, PUSH RODS, VALVES, FAN AND DRIVE, GENERATOR, STARTING MOTOR, CARBURETOR, AND FUEL PUMP. PLUS MISCELLANEOUS NOISES.

The mechanic is cautioned that in noise analysis nothing is to be gained by jumping to conclusions based on a single clue, no matter how prominent it may be. The only successful method is to establish complete evidence as to the source and reason for the noise.

Camshaft

The camshaft may be responsible for noise due to excessive bearing clearance or end play. If the shaft is loose in its bearings, there will be a dull thump slightly sharper than a main bearing knock, and a loose front bearing may be accompanied by noise in the front end drive. The loose bearing may be located by sounding to determine the approximate location and then by applying downward pressure on the push rods riding the cams on each side of the suspected bearing. A method of accomplishing this operation is shown in Figure 1. Feeler gauge material or shim stock is inserted between the valve stems and push rods as shown. The stock should be of sufficient thickness to take up all the clearance and provide a constant pressure on the cam throughout its entire circumference. If insertion of the shims removes the knock, you have located the loose bearing. Usually when but one bearing is loose, the push rods on either side will also be noisy.

The tone of the noise due to excessive end play in the camshaft will vary depending on the engine, but it will usually be a sharp rap. It is a form of noise not often encountered. The period of the noise cannot be definitely stated, but it usually occurs one or more times each revolution of the camshaft. There is no simple way of testing end play and it may be necessary to remove the front end cover for inspection. If a push rod can be removed, end play may be detected by prying the shaft endwise. Push rods are often mounted in cluster brackets and, in this case, inspection is facilitated by removing one of these clusters.

Push Rods

Noisy push rods are often accompanied by loss of power as the valve timing may be affected.

The noise is most commonly due to excessive clearance between the valve stem and the push rod, and with the roller type may also be caused by a worn roller or pin. The noise produced is a sharp metallic knock or tapping sound and

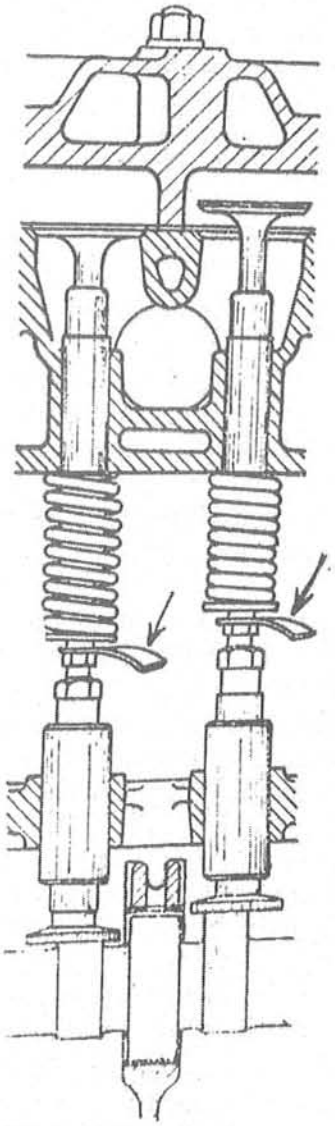


FIG. 1: Method of loading cams adjacent to suspected camshaft bearings using feeler stock to take up clearance.

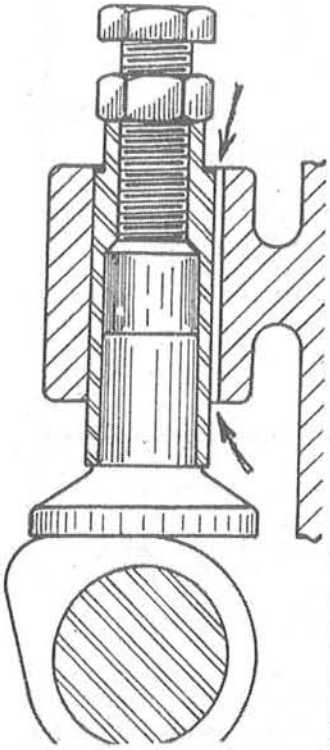


FIG. 2: Section of push rod showing excessive clearance in guide, which causes noise when cam lifts push rod.

approaches a rap when the parts are badly worn.

The noise will invariably occur at regular intervals at camshaft speed and may be located in several ways. If clearance is excessive, it can be taken up by a strip of feeler gauge held between the valve stem and push rod. If this quiets the valve, then it has excessive clearance.

Another method is to grip the push rod and the end of the valve stem with the forefinger at the same time using the sense of "feel" to locate the noisy push rod. In this method, the noise is located by identifying the push rod in which sound and feel are synchronized. It may be necessary to use both methods if both valves of one cylinder are noisy, quieting one with a feeler gauge to eliminate that source while testing the other.

If the clearance for all valves has been taken up and the noise still persists, it is safe to assume that it is not due to excessive push rod to valve stem clearance. In that case look for excessive clearance of the push rod in its guide, which can cause noise as the push rod slaps against the side of its guide as shown in Figure 2.

Another source of noise is a worn push rod adjusting screw and poor alignment of the end of the valve stem as shown in Figure 3. With the tapered surfaces not in alignment as at the right, the clearance is a minimum, but when aligned as shown at the left it is a maximum, and noise results.

Properly adjusted valves will almost always produce some noise, and the main thing is to stick

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Ed. Note: Terminology is a little loose in this area, but what are called "push rods" in this article are usually referred to today as "valve lifters" or "tappets." The term push rods was used 40 or 50 years ago and is used here for the sake of consistency as it was employed in the original article. No confusion should ensue. Push rods today usually refer to the rods which actuate the rocker arms on overhead valve engines.

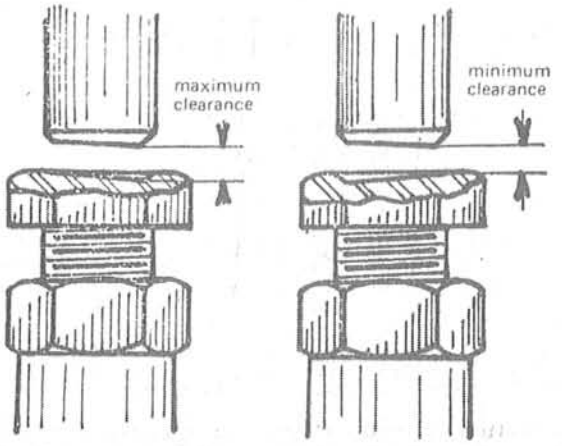

FIG. 3: Effect of misalignment between worn push rod and valve stem, which results in varying clearance.

to accepted manufacturers' tolerances rather than to achieve maximum quietness in valve operation. When the clearance is adjusted so that all valves have the proper clearance, the resulting rhythmic noise is not objectionable, but should the clearance of one valve vary, even slightly, from the others, the rhythm is destroyed and the noise may be objectionable.

Valves

Valves themselves can cause a variety of noises which are difficult to categorize. An intake valve which sticks in its guide due to a bent stem or corrosion may cause a knock due to delayed closure, which at the same time may result in backfiring or popping in the carburetor. Badly worn guides may cause clicks or rattles, also popping in the carburetor if the valves do not seat properly.

If there is a ridge on the valve seat as shown in Figure 4, due either to wear or improperly ground valves, a light tapping sound may occur at all speeds.

A weak, broken, or cocked valve spring may result in a knock and also popping in the carburetor due to slow closure of the valve. A broken or cocked spring will be evident on inspection, while the tension in a weak spring can be increased with a screwdriver blade inserted between the coils. On valves equipped with double springs, a jingling noise usually indicates a broken inner spring.

Fan and Belt

Fan noise is usually in the form of a clicking or rattling at operating speed. Sometimes it may be due to vibration caused by loose blades, or it may be caused by a bent blade striking an obstacle, in which case a brightly polished spot should be evident on the blade or blades responsible. A broken bearing will produce a clicking or grinding

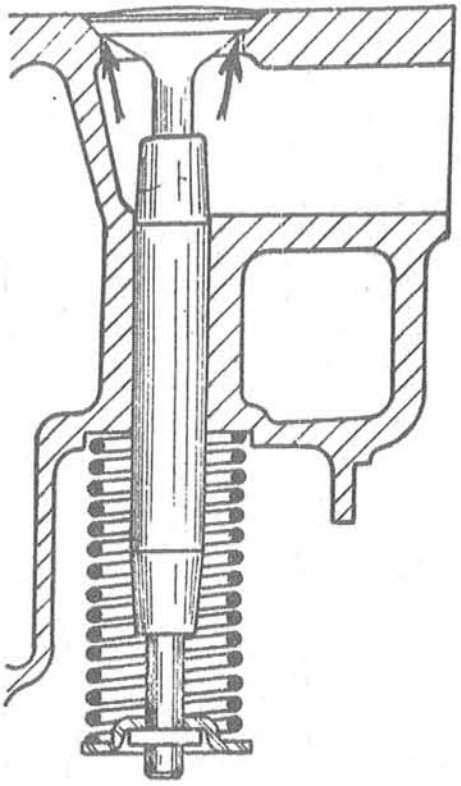

FIG. 4: Arrows show ridge on valve seat, which is responsible for one type of valve noise.

noise and will probably be felt as the fan is rotated by hand with the belt disconnected. On a few engines, the design is such that the fan operates in close proximity to the belt, which results in a humming noise. Little can be done to correct this condition and it does no harm.

Too tight a fan belt overloads the bearings and may cause a squeak, while a fan belt too loose may slip and squeak during rapid acceleration. The obvious solution is correct adjustment.

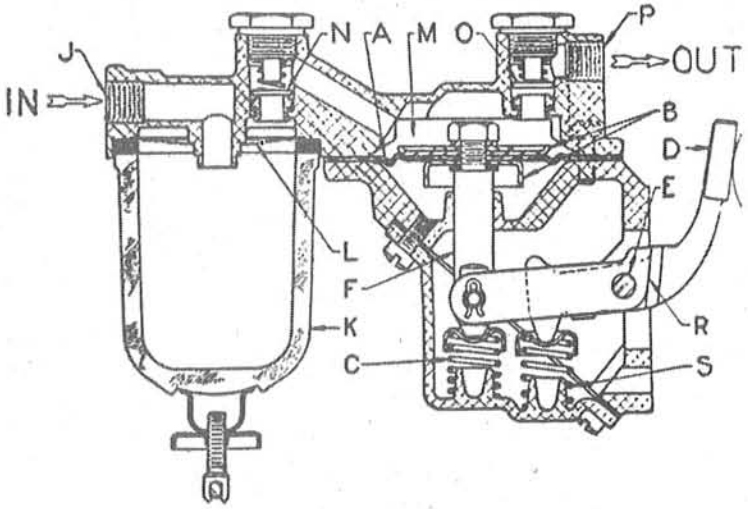

FIG. 5: Sectional view of fuel pump. Noise originates between cam eccentric lever "D" and diaphragm "A."

Generator

Noise will result in this unit if the armature does not rotate freely. The bearings may be worn or the shaft bent so the armature is permitted to rub on the pole pieces. This latter condition is evident by scored places on the armature core. If the bearings bind on the shaft, a squeaking noise will usually be the result; however, if ball bearings are employed, more of a grating sound is likely to be heard. Noise may often be caused by particles of dirt left in the bearings — a result of careless handling during assembly.

Excessive end play in the armature may result in a knock which may sound like an engine bearing knock; however, proper sounding will identify the source of the noise.

Noisy brushes are fairly common and are due to poorly seated brushes, improper brush spring tension, hard spots on the brush, or worn commutator.

Starting Motor

What has been said with reference to the generator also applies to the starting motor. In addition there are other noise sources in the meshing gears and Bendix drive. Starting motors equipped with reduction gears may be noisy if the gears are worn or improperly lubricated. Operation will also be noisy if the starting motor is loose or not in alignment with the flywheel ring gear, and the same is true if the gears are worn, battered, or burred.

With the Bendix type drive, a backfire from the engine during starting may break the drive spring, in which case only a whirring sound is heard when an attempt is made to start the car. A periodic click or rasping sound emanating from the vicinity of the Bendix drive is usually indicative of a faulty retarder pin which allows the pinion to move into contact with the ring gear.

Carburetor

A properly adjusted carburetor will produce a hissing sound, and this is nothing to be concerned about. A low pitched roaring sound emanating from the carburetor air intake — usually more noticeable on eight cylinder cars — is also a natural phenomenon due to a pipe organ effect in the intake manifold. Most cars from about 1930 and later used air intake cleaners and silencers which eliminated or reduced intake roar. About the only other likely source of noise around a carburetor would be loose parts such as

an air intake cleaner which could rattle.

Fuel Pump

Fuel pump noise results from a broken rocker arm spring, bent rocker arm, worn pull rod linkage, or anything which prevents the rocker arm from following the cam eccentric. See Figure 5. Fuel pump noises can quickly be located by sounding the fuel pump. Conditions which cause fuel pump noise will usually result in the fuel pump supplying insufficient fuel to the carburetor.

Electric fuel pumps when in operation produce a clicking or pulsating noise almost akin to a vibration, but this is entirely normal.

Lubrication System

Gear or vane type oil pumps rarely cause noise, because by the time they get to a worn condition where noise could develop, the oil pressure will have fallen off and other trouble develops. Of course, low oil pressure or restricted oil lines can accentuate bearing knocks.

Vibration Dampener

A faulty vibration dampener may cause a vibration and rattle which is most noticeable at or above a certain engine speed. A check may be made by removing the dampener and operating the vehicle at a speed slightly above that at which the noise was most apparent before. Some units have a test procedure which measures movement accompanying a specific tangential pull; however, special test equipment and specifications are needed to perform the test. Most vibration dampeners have no means of adjustment so any faults require replacement or rebuilding.

Miscellaneous

Under this heading we list other troubles which may have a bearing on development of noise in the engine. Thus, overheating due to a faulty cooling system will probably result in the development of knocks in the engine, particularly if the bearings are slightly on the loose side.

Popping in the carburetor, which was mentioned earlier, may be due to defects in the carburetor which cause too lean a mixture, dirt or water in the fuel, insufficient fuel due to faulty fuel pump or clogged fuel lines, air leaks, valves or ignition out of time, or spark plug wires hooked up incorrectly. All of these possible faults must be checked in turn.

A shriek or whistle at part open throttle is probably due to a sharp edge or restriction in the path of the incoming fuel charge or exhaust gas. It is often caused by a damaged or improperly installed manifold gasket or a damaged heat riser.

A loose or damaged manifold heat control valve (see Figure 6) will sometimes result in a peculiar knock, the sound of which is often diagnosed as a knock inside the engine, so watch out for this unit.

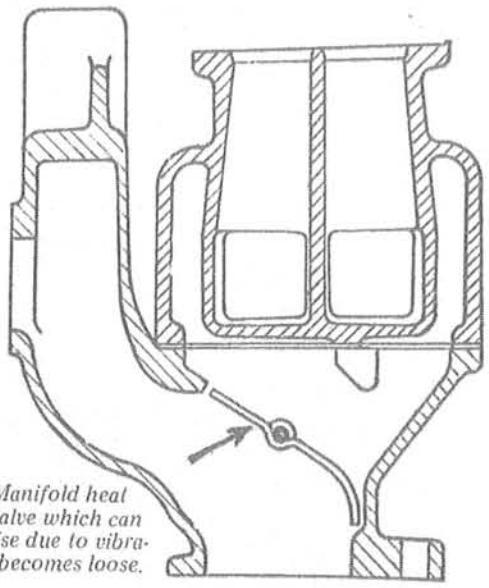

FIG. 6: Manifold heat control valve which can cause noise due to vibration if it becomes loose.

Loose exhaust manifold gaskets may cause a dull, muffled vibration or pulsation. Explosions in the muffler are due to improper fuel mixture, burnt or leaking exhaust valves, or improper ignition timing.

A sharp, snapping noise under the hood, particularly under heavy pull, indicates leakage of high tension current due to loose connections, defective insulation, or a cracked distributor cap. It may also be caused by a cracked or dirty spark plug insulator, wet insulation, or a broken electrode.

Loose engine support bolts or improperly adjusted engine mounts can sometimes result in a knock which may be mistaken for a main bearing knock or a loose flywheel. Usually such a knock is irregular and not in unison with the crankshaft speed.

There may be many other noises under the hood which are set up by vibration of parts which are loose in their mountings or lack rigidity. Control rods which are long and slender may vibrate at certain periods. Likewise, springs have a habit of emitting a high pitched tone due to vibration under certain conditions. These conditions may usually be diagnosed by careful inspection.

Ed. Note: This concludes the series on the analysis of engine noises. Since the article on which this series was based was written over eighty years ago, it did not dwell on noises peculiar to more modern engines built since that time with features such as overhead valves and hydraulic valve lifters. However, the perceptive amateur mechanic should have little difficulty in extending the principles outlined to his more modern problems.

S.K.