Feb 2021

February 2021 MDE

2. With reference to a diesel engine chain driven camshaft:

   (a) state the important checks that must be made during the drive inspection; (6)

   (b) explain why the checks described in part (a) are necessary. (4)

Chain-Driven Camshaft in Diesel Engines: Inspection

(a) Important Checks During Inspection:

1. **Chain Tension:** This is the most crucial check. A loose chain can cause the camshaft timing to be inaccurate, leading to engine performance issues and potential damage.
2. **Chain Wear:** Over time, the chain links and sprockets wear, causing the chain to stretch. Excessive wear can lead to chain skipping teeth on the sprockets, resulting in catastrophic engine failure.
3. **Chain Guide Wear:** The chain guides keep the chain aligned and prevent excessive movement. Worn guides can contribute to chain slack and potential jumping.
4. **Tensioner Function:** The tensioner automatically adjusts to maintain proper chain tension. A malfunctioning tensioner could lead to either a loose or overly tight chain.

(b) Why These Checks Are Necessary:

- **Accurate Timing:** The camshaft controls the opening and closing of valves for intake, compression, combustion, and exhaust. A mistimed camshaft disrupts this precise sequence, affecting engine performance and potentially causing valve-to-piston contact (expensive damage).
- **Durability and Reliability:** A worn chain or malfunctioning tensioner can lead to chain breakage, which can cause severe internal engine damage. Early detection of wear allows for preventative maintenance and avoids costly repairs.
- **Noise Reduction:** Excessive chain slack or a worn chain can generate increased noise during engine operation. Regular checks help maintain a smooth and quiet operation.

By performing these checks, you ensure the proper function of the camshaft timing system, leading to optimal engine performance, longevity, and reduced risk of catastrophic failure.

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2. (a) With reference to the section of timing chain shown in the figure below, identify the component parts A-E. (5)

(b) Explain the reasons why chains may elongate or slacken in service and the areas that may wear. (5)

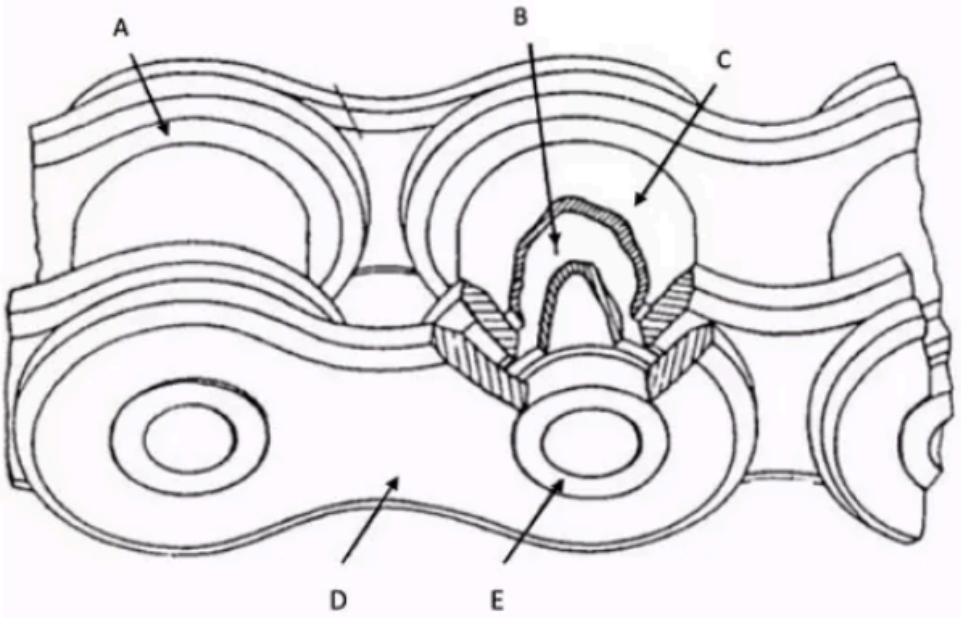

Fig Q2

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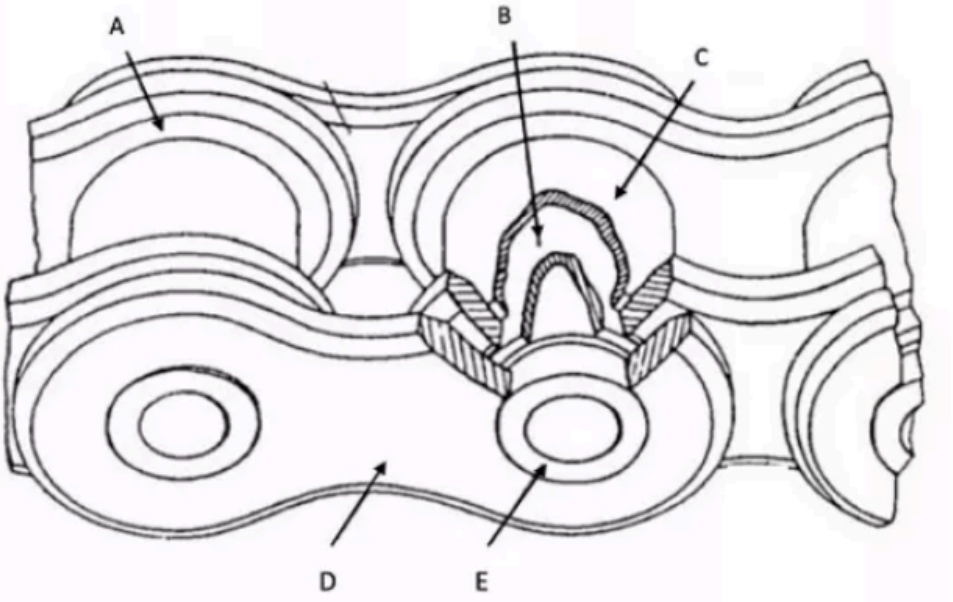
3. (a) With reference to the section of timing chain shown in the figure below, identify the component parts A-E. (5)

(b) Explain the reasons why chains may elongate or slacken in service and the areas that may wear. (5)



However, based on a generic timing chain design, here are the possible components:

- **Link Plate (Chain Body):** The main body of the chain, consisting of alternating flat plates that connect the side plates. (Not labeled in the image)
- **Inner Link Plate:** The inner plate that connects the side plates on the inside of the chain. (Not labeled in the image)
- **Outer Link Plate:** The outer plate that connects the side plates on the outside of the chain. (Not labeled in the image)
- **Side Plate:** The side plates that fit between the link plates and form the chain's sides. They interlock with the sprocket teeth. (Labeled in the image as A and C)
- **Roller:** A cylindrical roller between the side plates that reduces friction as the chain travels over the sprocket teeth. (Labeled in the image as B and D)
- **Bush Pin:** The pin that connects the side plates at each link. (Labeled in the image as E)

It's important to note that the terminology may vary depending on the specific manufacturer or design.

There are several reasons why chains, including timing chains in diesel engines, may elongate or slacken in service:

1. Wear and Stretch:

- **Metal Fatigue:** Over time, the constant cyclical loading and unloading of the chain as it rotates causes metal fatigue. This weakens the metal in the chain links, causing them to elongate slightly.

- **Roller and Bush Pin Wear:** The rollers and bush pins that reduce friction between the chain and sprocket teeth wear down over time. This wear increases the space between links, effectively lengthening the chain.

2. Improper Tension:

- **Incorrect Initial Tension:** If the chain is not tensioned properly during installation, it can be too loose from the start. This allows for additional slack to develop as the chain wears.
- **Tensioner Failure:** The automatic tensioner maintains appropriate chain tension. A malfunctioning tensioner could allow the chain to become too loose.

Areas that may wear:

- **Chain Links:** As mentioned earlier, the link plates themselves experience metal fatigue and can elongate slightly.
- **Rollers and Bush Pins:** These components directly contact the sprocket teeth and are prone to wear. Worn rollers and bush pins increase the space between links, effectively lengthening the chain.
- **Sprocket Teeth:** While less common, the sprocket teeth can also wear down. This wear can cause the chain to ride higher on the teeth, which can contribute to chain slack.
- **Chain Guides:** Worn guides can allow the chain to move excessively, increasing wear on the chain and sprockets.

By understanding these reasons for chain elongation and the areas that wear, mechanics can perform regular inspections to identify potential problems early on. This allows for preventative maintenance such as chain and sprocket replacement before they wear excessively and cause engine performance issues or potential failure.

Feb 2020

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3. With reference to engine timing belts or chains:

(a) state the cause of loss of timing drive tension; (2)

(b) state how this will affect the engine; (6)

(c) explain how slight loss of tension can be corrected. (2)

Engine Timing Drive Tension Loss

(a) Causes of Loss of Timing Drive Tension

There are several factors that can contribute to a loss of timing drive tension:

- **Natural Stretch:** Timing belts are made of rubber and synthetic fibers. Over time, these materials can stretch slightly, even under normal operating conditions.

- **Chain Wear:** In chain-driven systems, the chain links and sprockets wear as they rotate. This wear increases the space between links, effectively lengthening the chain and reducing tension.
- **Tensioner Failure:** The automatic tensioner maintains proper belt or chain tension. A malfunctioning tensioner, either mechanical or hydraulic, can fail to maintain the appropriate pressure, allowing the timing drive to become loose.
- **Improper Installation:** If the timing belt or chain is not tensioned correctly during installation, it can be too loose from the start. This allows for additional slack to develop as the drive components wear.

(b) Effects of Loss of Timing Drive Tension

A loose timing drive can have several negative consequences for the engine:

- **Valve Timing Misalignment:** The timing belt or chain synchronizes the rotation of the crankshaft and camshaft, ensuring valves open and close at precise moments. A loose drive can cause these components to be slightly out of sync.
- **Loss of Power and Efficiency:** Incorrect valve timing disrupts the optimal intake, compression, combustion, and exhaust cycles. This can lead to a decrease in engine power output and reduced fuel efficiency.
- **Increased Engine Noise:** A loose timing belt or chain may slap against the sprockets, creating a rattling noise during engine operation.
- **Engine Damage:** In severe cases, a very loose timing drive can cause the camshaft and crankshaft to be significantly out of sync. This can lead to valve-to-piston contact, causing serious internal engine damage and potentially a complete engine failure.

(c) Correcting Slight Loss of Tension

The method for correcting a slight loss of tension depends on the type of timing drive system:

- **Timing Belt:** Most timing belts do not have an integrated tensioning mechanism. In these cases, a slight loss of tension may necessitate replacing the entire timing belt and tensioner pulley (if applicable) as a preventative measure.
- **Timing Chain:** Many chain-driven systems have an automatic tensioner. If a slight loss of tension is detected, some tensioners may have an adjustment mechanism to restore proper tension. However, it's important to consult the engine's service manual for specific instructions on tensioner adjustment.

Important Note: It's crucial to emphasize that attempting to adjust timing drive tension yourself is not recommended unless you have the proper tools, knowledge, and experience. A slight misadjustment can have severe consequences for the engine. If you suspect a loss of timing drive tension, it's best to consult a qualified mechanic for inspection and any necessary repairs.