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These instructions are a guide to assist in the installation of your new Crane camshaft in your "Big Twin®" Harley-Davidson®. This instruction guide is not designed to perform as a complete service manual. If you are not sure about dimensions, torques, timing setting, etc. not included in this material, refer to your service manual for your model of motorcycle.

It is important to remember that the concept of a "bolt-in" camshaft with no inspection from the engine builder does not really exist. It is the engine builder's responsibility to be sure that the component parts that he is using will be compatible with one another and provide proper running clearance. It is generally accepted that camshafts with valve lifts greater than .455" may require modifications to either the valve spring assembly, valve guides, valves, and/or pistons to provide proper clearance. The increase in lift may be itself not cause a problem, but is used with other components (such as new "thick margin" valves with new valve seats in the head) in combination may not provide the clearance necessary. Mocking up of the parts with careful inspection is always advised. For example, some engines may require that the crankcase be ground in order to clear the innermost lobe on a high lift camshaft.

If you feel that you do not have the knowledge or experience for this inspection and possible modification of component parts, then seek assistance from a qualified dealer.

### REMOVING THE OLD CAMSHAFT - ALL MODELS

1. Disconnect the battery. Secure the motorcycle on a suitable stand with the rear wheel off the ground if no kickstarter is on the model. Remove components necessary for easy access to pushrod covers an gear case cover, i.e., exhaust system (Fig. 1), right footrest (Fig. 2) brake pedal (Fig. 3), and air cleaner.
2. Remove pushrod cover keepers and lift covers (Fig. 4 & 5). Remove spark plugs and rotate engine with kicker, or by moving rear wheel with motorcycle in gear. Turn engine until both valves are closed on the front cylinder. This is found when you can see both front cylinder tappets in the down position and see the piston at the top through the spark plug hole. Loosen the locknuts on each pushrod adjuster and adjust shorter until pushrod can be lifted out (Fig. 6). Repeat this same procedure

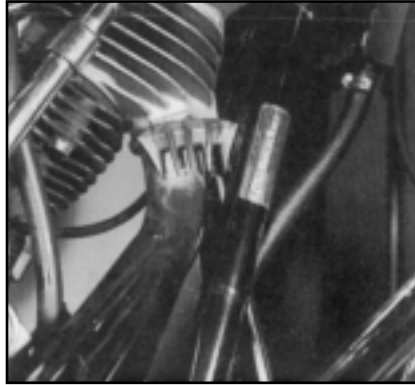


Fig. 1

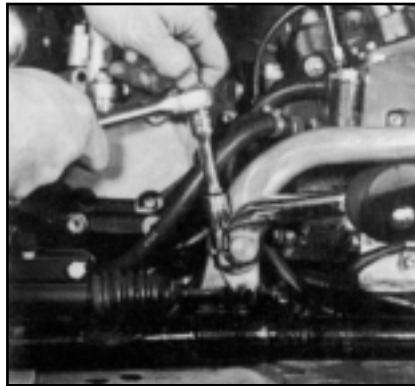


Fig. 2



Fig. 3

for the rear cylinder. (Keep pushrods in order for re-assembly.)

3. Remove ignition cover on gear case cover. (Drilling out of two rivets may be necessary.) Remove adjusting plate. Remove bolt and rotor. (Figs. 7 & 8 - Your model

may have point ignition.)

4. Remove the gear case cover screws and remove cover and gasket (Fig. 9).
5. Remove tappet guide screws and lift out tappet guide assemblies. Be careful not to drop the tappets out of the bottom of guides (Fig. 10 & 11).
6. Remove camshaft assembly, spacing washer, and thrust washer (Fig.12). Save the spacing washer and thrust washer for re-assembly on new camshaft.

### IMPORTANT NOTES FOR 1948 THROUGH 1969 MODEL ENGINES

1. The 1948 through 1957 engines used a "bushing" in the crankcase to align the camshaft in position. The 1958 and later engines used a "needle bearing". All Crane camshafts are ground for the needle-bearing dimension and can not be used with a bushing. If your engine has the crankcase bushing, it must be converted to the needle bearing by a qualified dealer.
2. The earlier model engines (1948 through 1969) drive the ignition system by use of a series of gears. These engines require a camshaft with a short nose (approximately 3/4" long). The "circuit breaker" gear is positioned very close to the front lobe of the camshaft. It is possible that this gear can hit the lobe of a high lift camshaft. You must inspect the clearance between the lobe and the circuit breaker gear to be sure it's at least .030" or more. If not, this gear must be removed and modified in a lathe to provide the proper clearance. In a lathe, the teeth can be machined down and narrowed only in the area where the lobe is hitting, in order to allow for the necessary clearance, and still keep enough width for the gear to drive the ignition system. The 1970 and later engines drove the ignition off the end of the camshaft and used a long nose (approximately 1 5/16" long) camshaft.

### IMPORTANT NOTE CONCERNING CAMSHAFT GEARS

Harley-Davidson® used two different style cam gears in the engines between 1948 through 1984. These gears (and matching pinion and breather gears) are NOT INTERCHANGEABLE. You must be sure that your cam gear is

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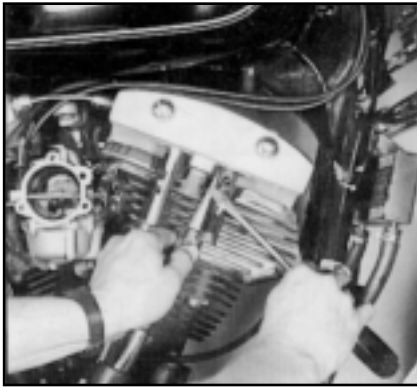


Fig. 4

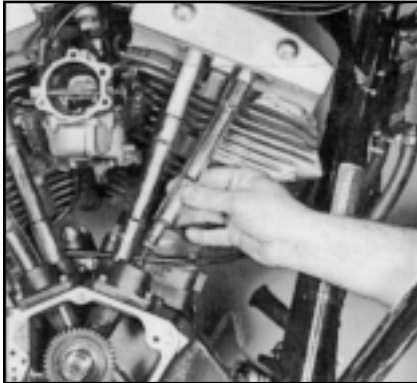


Fig. 5



Fig. 6

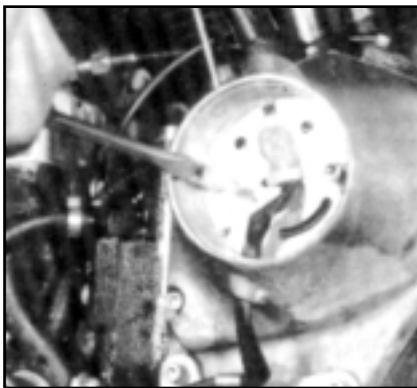
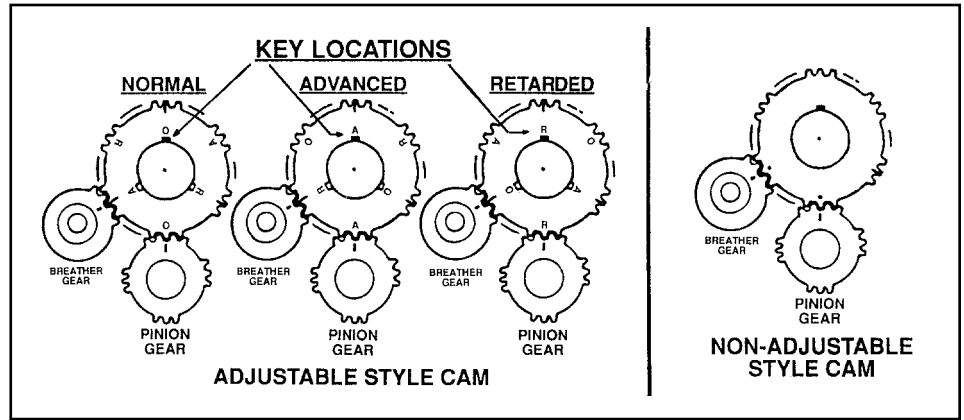


Fig. 7

properly mated to the other components for compatibility.

The 1948 through early 1977 engines use a cam gear with a "straight cut tooth". This gear is plain in appearance with no identification



marks required by Harley-Davidson®. Its matching pinion gear has teeth across the full width of the pinion gear body. The matching breather gear has a "slash mark" ( / ) to identify its timing position.

The late 1977 through 1984 (non-Evolution®) engines used a cam gear with a "curved tooth". This gear is identified by a "groove" cut into the face of the gear. The matching pinion gear had teeth across only half of the width of the pinion gear body. The matching breather gear had a "cross" (+) to identify its timing position.

### SETTING GEAR LASH

In order to establish the proper gear lash, cam gears and pinion gears are made in different pitch diameters. The different sizes of gears are identified by "color codes" on both gears. (Check the color code chart in your Harley-Davidson® manual for the exact sizes.) It is advisable to match the color code of the cam gear (if available) to the color code of the original pinion gear. Crane offers three cam gear sizes which are .001" difference in pitch diameter. They are identified as color code "yellow" (smaller size), "red" (medium size), and "blue" (larger size). If the gears are not matched properly, you may witness some gear noise. If the gears are too loose, you will hear a "gear clatter" (much like a lifter noise), if the gears are too tight, you will hear a gear "whine". When the gears are properly fitted, you will hear a very slight gear whine when the engine is hot. You can also fine tune the gear lash by changing the stock pinion gear to the next size larger, or smaller, as necessary.

### ADJUSTABLE CAM GEAR.

Crane offers many of its camshafts with multi-index cam gears. This allows you to install the cam in either the original "straight up" zero degree ("0") position, 4 degrees advanced ("A"), or 4 degrees retarded ("R"). Advance the cam pulls the power range down a few hundred RPM, creating better bottom-end power. Retarding the cam raises the power band up, creating better top-end power. A small arbor press and a simple holding fixture will be required to remove the gear and to relocate it to your desired keyway position.

NOTE: When the gear is off the camshaft, double check the keyways for burrs or raised areas. Deburr keyways and lightly hand finish face of gear with fine emery cloth on a flat surface.

### CHECKING FOR "VALVE TO VALVE" CLEARANCE

The design of the Harley-Davidson® hemispherical cylinder head, with its existing valve angles, can cause the edge of the intake and exhaust valves to touch one another during the "overlap period" on certain camshafts. You must check to be sure that the valves are not touching.

There are many sophisticated tools and methods for checking this clearance, but what we will describe here is the basic way.

Since the valve spring tension could cause a hydraulic tappet to "bleed down" during the test, and give you a false reading, we recommend using "solid tappets" when performing this inspection. If you do not have solid tappets available, then you must disassemble your hydraulic tappets, drain the oil, and clean them. Replace the tappets in the guide and lengthen the pushrods to the full extent of the hydraulic tappet's plunger travel. With the hydraulic tappet completely compressed, it will act as a solid tappet and allow you to do the test properly.

You must make yourself a tool out of .030" diameter wire then put a 90-degree bend approximately 3/8" long on any convenient length of wire. Now rotate the engine so the piston is at T.D.C. during the "overlap period". (This is when the exhaust valve is closing and the intake valve is opening, and both valves are off the seat at the same time.) We want to check to be sure there is at least .030" clearance between the valves as they pass by one another. Put the checking wire through the spark plug hole and position it between the valves. Use a flashlight to shine into either the intake or exhaust port, while looking into the other port. If the wire will not pass between the valves, the valves and/or the valve seats must be modified to provide this clearance.

If necessary, the valves can be modified by reducing their head diameter, or by machining a 45-degree angle on the portion of the valve head that faces into the combustion chamber. If this does not correct the situation, then the valve seats in the heads will need to be ground deeper. This will "sink" the valves into the heads providing extra clearance at overlap.

### CHECKING "VALVE TO PISTON" CLEARANCE

There must be at least .080" clearance between the valve and piston.

## GENERAL INSTRUCTIONS

1. Install spacing washer and thrust washer on camshaft (Fig. 13). Install camshaft. Check to make sure the innermost lobe clears the engine case (Fig. 14). If not, clearance must be made by removing case material with a cutter or grinding wheel. Care must be taken to keep chips, or grindings, out of the cam bearing. The inside of the gear case must be thoroughly cleaned after any grinding process.
2. Camshaft must be installed with the timing marks lined up on both the pinion gear and the breather gear. To install in a 4-degree advance, or a 4-degree retard position, the gear must be pressed off of the camshaft and key lined up with the respective mark. The camshaft is then pressed back into the gear. Make sure the camshaft is lined up straight during the pressing operation. Use of an arbor press is recommended. The timing marks on the camshaft gear are then lined up with the marks on the pinion and breather gears.
3. Camshaft end play must be checked at this point. With camshaft and original thrust washers installed in the crankcase, install the gear case cover with a gasket and tighten down the screws. Reach through the tappet guide hole (Fig. 15) and slide the camshaft back and forth. There should be a "slight drag" indicating proper fit of the nose of the cam and the bushing in the gear case cover. Try to rotate the camshaft to see if there is too much lash in the cam and pinion gears. (See "setting gear lash" section.) If you have a dial indicator available, measure the amount of movement (end play) at the nose of the camshaft as you slide it back and forth in the case. If no indicator is available, insert a feeler gauge between the hardened thrust washer and the thrust face of the camshaft. (Do NOT measure between the case itself and the thrust washer.) Depending on the year of the engine, the end play can be between .001" to .016", with an ideal situation of .003" to .005". If using a point-type ignition system, you must maintain the cam end play between .003 to .008". To arrive at the proper end play, different thickness spacing washers are available from a Harley-Davidson® dealer. Also, be sure the thrust washer is installed properly with the "ears" facing down and the cutoff portion of the washer towards the rear cylinder.

## SETTING PRELOAD USING STOCK HYDRAULIC TAPPETS AND PUSHRODS

1. Remove tappets from guide, drain oil and clean one at a time, then reassemble. Replace tappets in guide with "oil hole flats" (on the side of the tappet body) facing towards the center of the guide block. Install guides into case, being careful not to drop the tappets into the gear case. Install new tappet block gasket, and for engine models 1977 and later, use an aligning tool (Crane part #9-0021 or

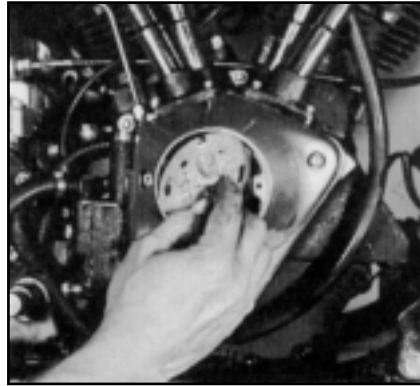


Fig. 8

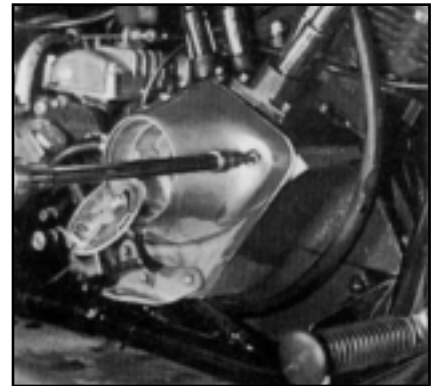


Fig. 9

#H.D.-33443) to position the tappet guide block in the case, and tighten all the screws.

2. The engine must be rotated so that the tappet you are adjusting is riding on the "heel" of the cam lobe (no lift involved). To determine this, you will watch the same valve (intake or exhaust) on the opposite cylinder (the cylinder opposite the one you're working on). If the same valve on the opposite cylinder is at full lift (tappet all the way up in the guide block), then the one you're adjusting will be all the way down and riding on the "heel" of the lobe. For example: When the exhaust tappet on the rear cylinder is at full lift (all the way up in the guide block), you will then adjust the exhaust tappet on the front cylinder, which will be all the way down. Do one tappet at a time to avoid confusion.
3. Install the pushrod and adjust. (Be sure to use new gaskets and seals on the pushrod tubes.) REMEMBER, THE STOCK TAPPETS MUST BE CLEAN AND DRAINED OF OIL TO DO THE ADJUSTING PROCEDURE. Turn one pushrod adjusting screw down until the hydraulic unit is completely compressed. Then turn it back up 1 & 1/2 turns (nine flats on the adjusting hex). Lock it in place by tightening the locknut. An adjusting gauge (part #HD-94438-79) could be used at this point to double check the tappet adjustment.
4. Follow this procedure of rotating the engine and adjusting the tappets until all four are adjusted properly.
5. Extend pushrod tubes and insert keepers in place.

Note: Improper lifter preload is probably the most common cause of hydraulic tappet noise. Different manufacturers of hydraulic tappets may have their own method for arriving at the desired "reload" for their particular tappet design. Therefore, you must follow the methods that the manufacturer of your tappets recommends.

## SOLID LIFTERS

Follow the procedures already described in the preceding sections, but naturally since you will be using a "solid tappet", there will be no oil in the tappet to drain, and no pre-loading. Instead, you will run a slight amount of clearance between the tappet and pushrod.



Fig. 10

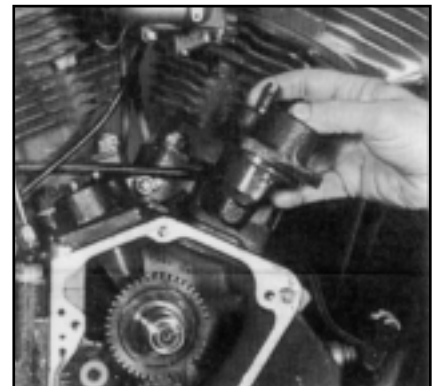


Fig. 11

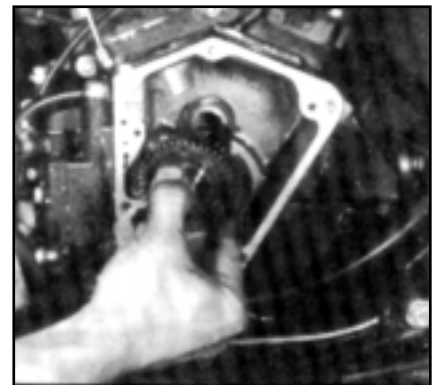


Fig. 12

When the engine is properly rotated so that the tappet is riding on the heel of the cam, lengthen the adjusting end of the pushrod until the slack is taken up. When the engine is cold, you should be able to spin the pushrod with your

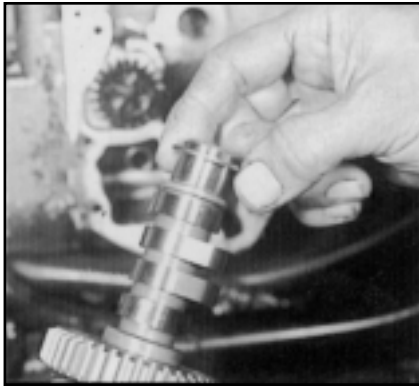


Fig. 13

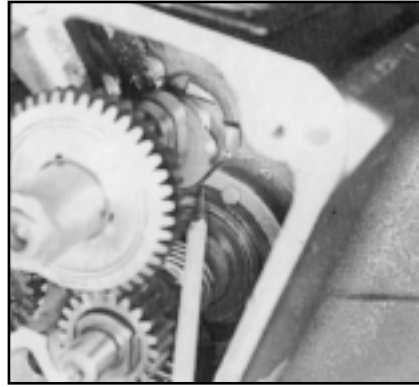


Fig. 14

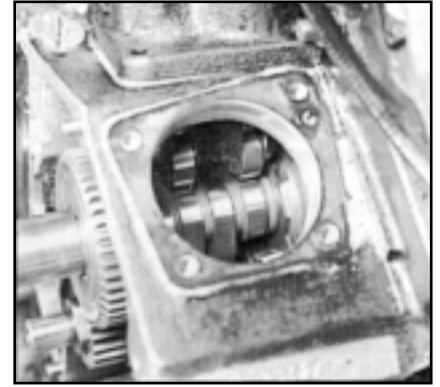


Fig. 15

fingers, but not be able to move it up or down by more than .002". (When the engine heats up the cylinders will grow approximately .040" in length, due to heat expansion. This will increase the valve lash clearance, and create the "ticking" sound of a solid lifter engine.) Tighten the pushrod locking nut and recheck by spinning the pushrod with your fingers. A slight drag, but no up and down play, is acceptable on a cold engine

### FINISHING THE INSTALLATION

1. Replace ignition components in the reverse order of disassembly. Refer to your service manual for proper setting. If your ignition cover was fastened with rivets, replacement rivets are available at your Harley-Davidson® dealer.
2. Reinstall air cleaner assembly, brake pedal and footrest assembly, the exhaust

system, and any other components you may have removed during the camshaft installation.

3. You are now ready to start your motorcycle. Run the engine before riding and check for any oil or fuel leaks, loose screws or bolts, etc.

