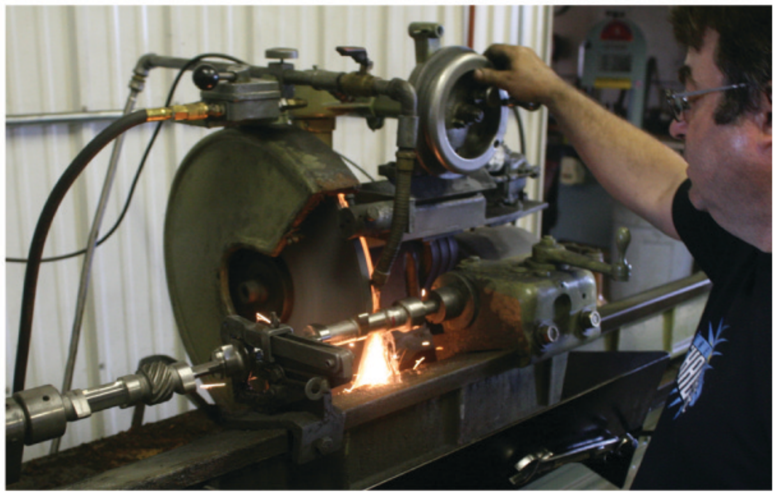
PULLER TECH BASICS: CHECKING CAMSHAFT TIMING

By Gary Baker and Bryan Lively

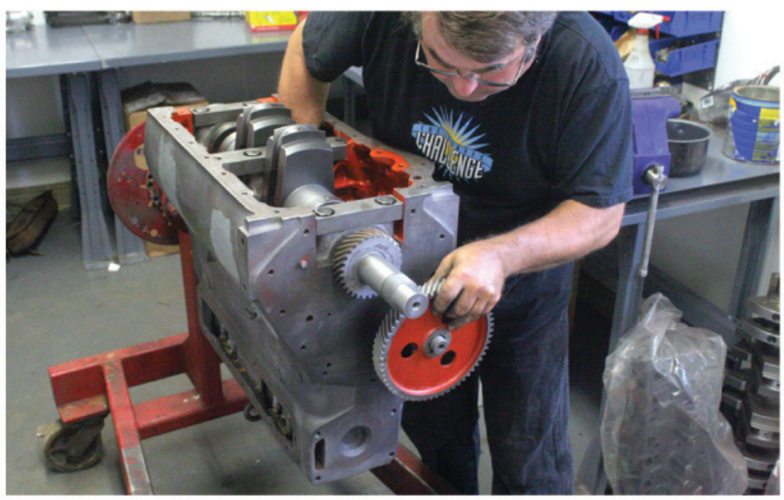
In the world of high performance engines, there are a number of tasks that go hand in hand with creating the best performing engine possible. Most of what is done is accomplished with increased cubic inches and extensive head work. Like has been stated before in this very magazine in past tech articles, the "little" details go a long way to make the best use of expensive internal upgrades. This tech article will address the process of verifying the timing of a camshaft based upon the specifications provided by the cam grinder.

While it would seem that a cam should be correct when sent out by your cam supplier, any number of factors come into play. Perhaps the most common instance where a cam grind needs to be verified is when a crankshaft has been welded and ground to provide increased stroke. In the process of producing new rod journals, it is possible that the journal, though perfectly round and measuring within the specifications needed, may be slightly offset from the ideal centerline of the journal. This negatively effects the position of Top Dead Center (TDC) and because the cam is ground based on the correct TDC, horsepower and torque will be effected.

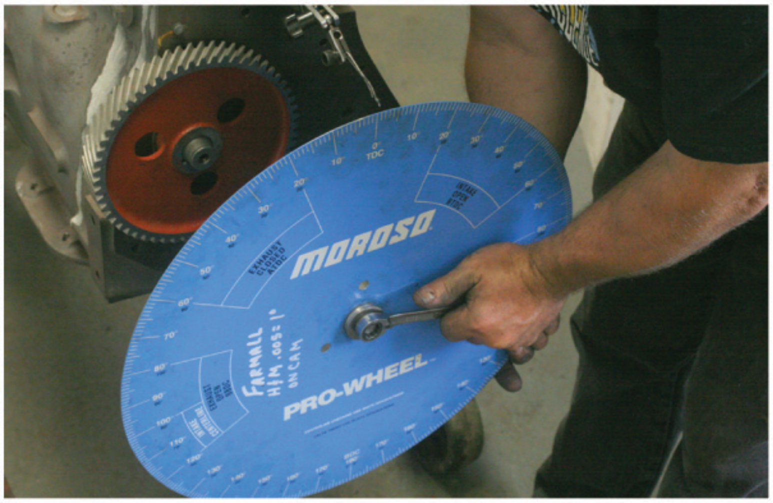
In the process of checking cam timing, we need to examine the tools needed to do the job correctly. A degree wheel, a magnetic pointer, lifter, pushrod, a 1" travel dial indicator on magnetic base, and a positive stop that consists of a flat bar with a bolt threaded into it for situations where the head is removed or a screw-in type that can be installed in a spark plug hole when the head is present on the block. For ease of demonstration, our example is a M block undergoing a rebuild and the head removed. Because this is



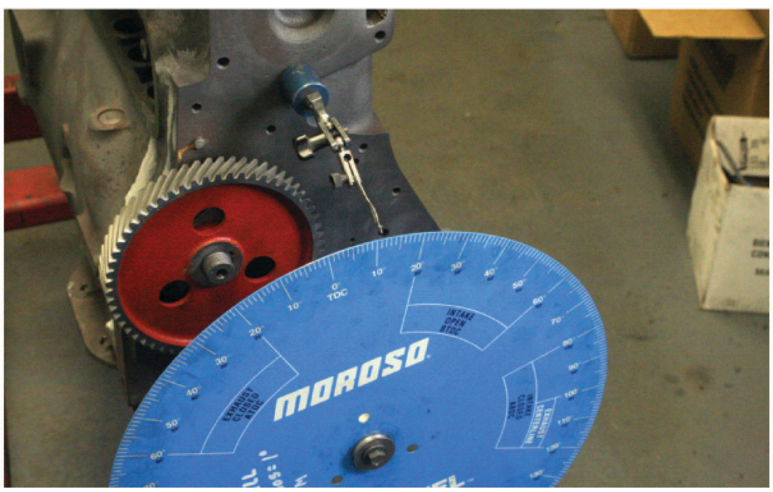
Gary utilizes a cam grinding machine to develop his own specific profiles for the engines he produces.



Baker carefully feeds the camshaft into the engine and aligns the cam and crank gears in proper sequence.



Having gotten the piston close to TDC, Gary tightens the degree wheel and aligns the pointer to zero "0."



The first measurement gave us 130 degrees when spinning the crank counterclockwise.

a task performed much easier with as few components mounted on the engine as needed, The crank, cam, and the number one piston/rod combination are bolted and the only components essential to the task.

At this point we proceed with the following steps:
1) We mount the degree wheel on the nose of the crankshaft and install the pointer on the block. Start with the piston near TDC and the pointer placed at 0 degrees.
2)Next, rotate the crankshaft so that the piston is an inch or two below TDC. Install the positive stop, then gently rotate the crankshaft (in either direction) until the piston comes into contact with the stop. Record the degree wheel reading at the pointer, then turn the crankshaft in the opposite direction until the piston again comes into contact with the stop. Record this reading also.
3) TDC is halfway between these two numbers. In our example engine (see photos), the degree wheel stopped at 11 degrees to the right of zero for the first measurement, and 14 degrees to the left of zero (written as -12) in our second measurement. Therefore, (-14) + 11 = (-3). Negative 3 is then divided by 2, giving us a measurement of -1.5 degrees. Rotate the crankshaft until the degree wheel is aligned at -1.5 degrees with the pointer. This is your true TDC.
4) Now move the pointer (careful not to move the crankshaft) so that it is aligned with zero degrees. This is also a good time to mark the front pulley or flywheel for ignition timing reference purposes. Having established true TDC, we can now move on to setting the dial indicator up to find the cam timing.
5) Before installation of the dial indicator, install a lifter into the #1 intake lifter hole in the block and place a pushrod on top of it. Install the dial indicator on the block so that it is seated in/on the center of the pushrod.
6) Rotate the crankshaft until you find the highest lift point of the camshaft intake lobe. At this point, the dial indicator is zeroed. Rotate the crankshaft in a counterclockwise direction until you move the dial indicator past 10 thousandths of an inch (shown as 0.010). Move the crank back until the indicator is on 10 thousandths and record this number. The reason for moving just past 10 thousandths and then back to the number is to remove any slop in the meshing of cam and crank gears. Record the measurement on the degree wheel. Continue moving the crankshaft in the clockwise direction until the dial indicator again reads 10 thousandths. This is the other side of high lift. On our test engine, measurement A was 130 degrees, and the second measurement is 98 degrees.
7) These two measurements are subtracted from one another (130-98=32) and the difference is divided by 2 (32/2 = 16) Since we are finding the exact middle of these two numbers, it is likely easiest to add 16 to 98, giving us 114 degrees. The spec sheet for this particular cam indicated that 108 degrees is the number indi-

cated for this camshaft. 114-108 indicates a need to offset the cam 6 degrees, correct? Yes, and no, and here's why:

Because the camshaft is moving half the speed of crank, a 2 degree change on the crank reflects only 1 degree of movement in the camshaft. Therefore, that six degree measurement is actually a 3 degree shift on the cam.

To determine our key offset the following steps need to be taken:

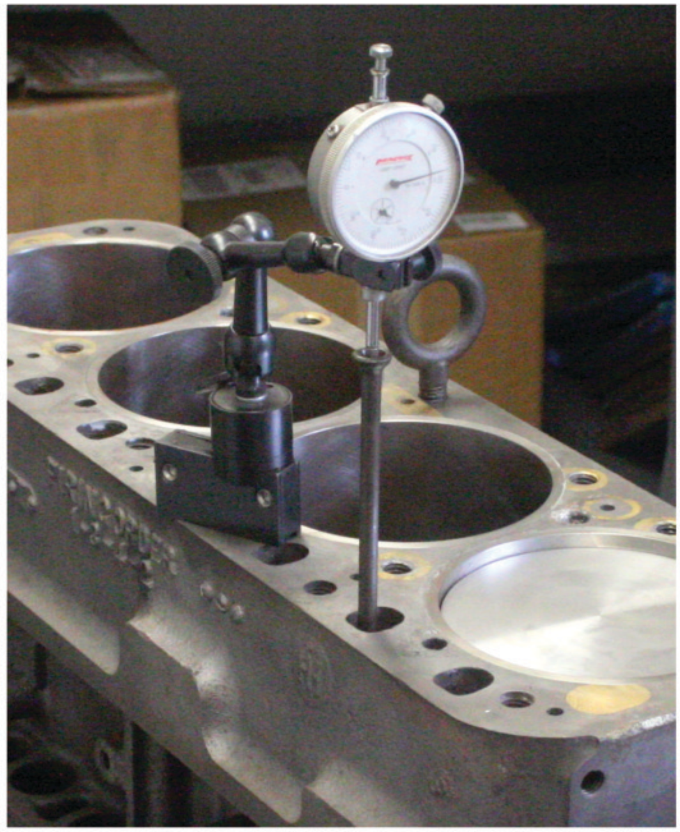
1) Measure the diameter of the camshaft where the keyway is. On our test M engine, as it is also on H cams, the diameter is 1.125. Having determined the diameter, we divide 1.125 by 2 to find the number we need, .5625, or the radius.

2) Because we're shifting 3 degrees in a circular pattern, we need to use the sine function on a scientific calculator to determine the amount of offset needed in the key. The sine of 1 degree of movement is .01745. .01745 is then multiplied by the radius (0.01745 x .5625 = 0.0098 or .010). Therefore, a 1 degree offset is .005, 2 degrees = .010 and 3 degrees (our measurement) is .015.

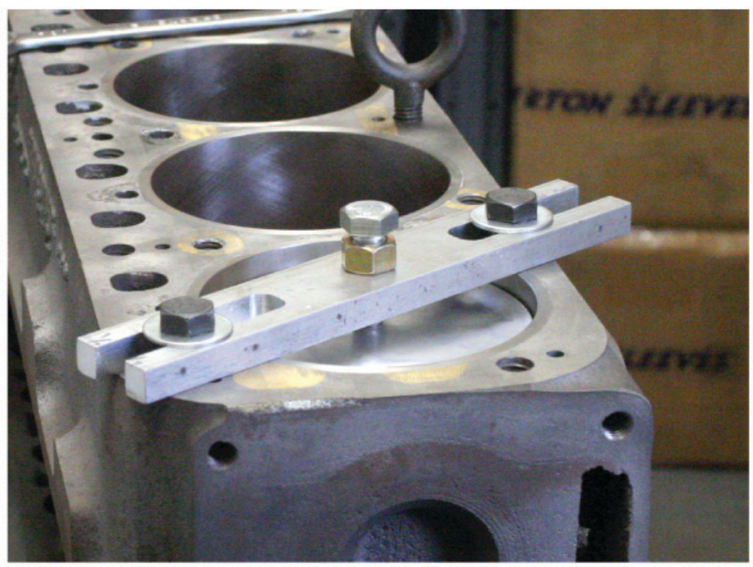
3) Once a key has been cut to the specifications needed, you will have to be mindful of the way the offset need to go. When standing in front of your engine, the crank turns clockwise and the cam counter clockwise. So, if you need to advance your camshaft, the key is installed inside the gear offset to the left, or counterclockwise. To retard the camshaft to place it in the correct position the key is placed to the right, or clockwise.

Ed note-Having watched Gary check a cam once, these steps are much easier once you've done it that first time. Like any other engine assembly function, it is VERY important to walk through the steps as much as needed to make sure it's done properly. Follow the photos and associated captions to help you through the process. Obviously, we're testing a Farmall cam but nearly everything here can be translated to any other tractor engine. Bottom line: take your time!

Need Filler!!!



The piston stop installed to assist in determining true TDC.



A dial indicator with a magnetic base is placed on the block with a lifter and pushrod installed in number one intake bore on the engine. The crank is then turned counterclockwise and clockwise with measurements taken at 0.010" on both sides of the highest lift point on the cam.