

Service Dept. Bulletin

No. 65. February 8, 1918

Harley-Davidson Motor Co., Milwaukee

Directions for Timing Harley-Davidson Motors

The Valve Lift Adjustment Must be Accurate

The Timing of Inlet and Exhaust Valves
Spark Timing

To Time the 1918 Model 235 Generator for the First Time

Reasons for Advancing and Retarding the Spark.

Timing of Mechanical Relief Valve
Setting Twin Cylinder Motors According to Gear Marks

To Time the 1918 Model 235 Generator According to Gear Marks

Setting Single Cylinder Motors According to Gear Marks

Review of Timing of All Models

One of the important features to be considered in the operation of a four cycle gasoline motor is the proper timing of valves. This of course refers to the time of opening and closing of valves, or in other words, when they should start to lift and just close. The points of opening and closing are designated in two ways, either by degrees or piston positions. The timing of the Harley-Davidson motor is of course determined by piston position only, because the fly wheels are enclosed and cannot be referred to for marks.

The meaning of the term "four cycle" is as follows: A cycle is one-half revolution or 180° travel of the fly wheels. The fly wheels must make two complete revolutions to complete one power impulse

of the motor per cylinder, therefore the term "four cycle."

To time a motor accurately it is advisable to use a 6 inch scale graduated to at least $\frac{1}{32}$ inch, and to measure the motor positions from the head of the piston through the cylinder plug opening. To do this the motor must be removed from the frame. If it is not desired to remove the motor from the frame, the piston position can be determined by inserting the scale through the inlet housing chamber. However, since accuracy is essential to correct timing, we recommend the first means.

Piston positions are determined from either upper or lower dead center. Dead center is the point at the extreme upper or lower end of piston travel just before the piston begins to travel up or down, the point where the piston is "dead."

The Valve Lift Adjustment Must be Accurate

Before proceeding to retime the valves, see that the exhaust lifter pins and inlet push rods are adjusted as recommended here. On the twin cylinder models prior to 1915 and all single cylinder motors made to date, allow .004 inch clearance

between the exhaust lifter pins and exhaust valve stems or caps.

Allow .004 inch clearance between the inlet levers or rocker arms and the valve stems. This applies to all models. On

the 1916 and 1915 twin motors, allow .004 inch lifter pin clearance for the rear cylinder and .006 inch for the front cylinder. On the 1917 and 1918 motors allow from .008 inch to .010 inch clear-

ance for both cylinders. Whenever making any of these inspections or adjustments be sure that the motor is cold because expansion of the cylinders and lift mechanism vary when the motor gets hot.

The Timing of Inlet and Exhaust Valves

Assuming that the explosion has taken place, it can easily be understood that there must be an outlet at the proper time to get the full benefit of the energy obtained by the explosion, and to prevent possible injury to the motor. This point of opening is when the piston is between 3-4 inch and 9-16 inch before bottom center. The exhaust valve opens in this position and closes when the piston is 1-32 inch to 3-32 inch past top dead center.

Since the inlet cam is mounted on one gear with the exhaust cam on all twin cylinder motors, the inlet valves do not require independent timing.

All 1913 to 1918 single cylinder motors require independent timing of the inlet

valve, the inlet cam being mounted on a separate gear. The time of valve opening is when the piston is between 3-16 inch before top center and top center. The inlet valve should close when the piston is from 1-8 to 3-8 inch past bottom center. Single cylinder motors prior to 1913 have automatic inlet valves, therefore require no timing.

After the inlet valve closes, the charge is compressed, otherwise complete combustion will be very slow and little power or speed will be produced. In this connection the importance of having the valves seat properly can be appreciated. A poorly seating valve will let a great amount of compression leak by.

Spark Timing

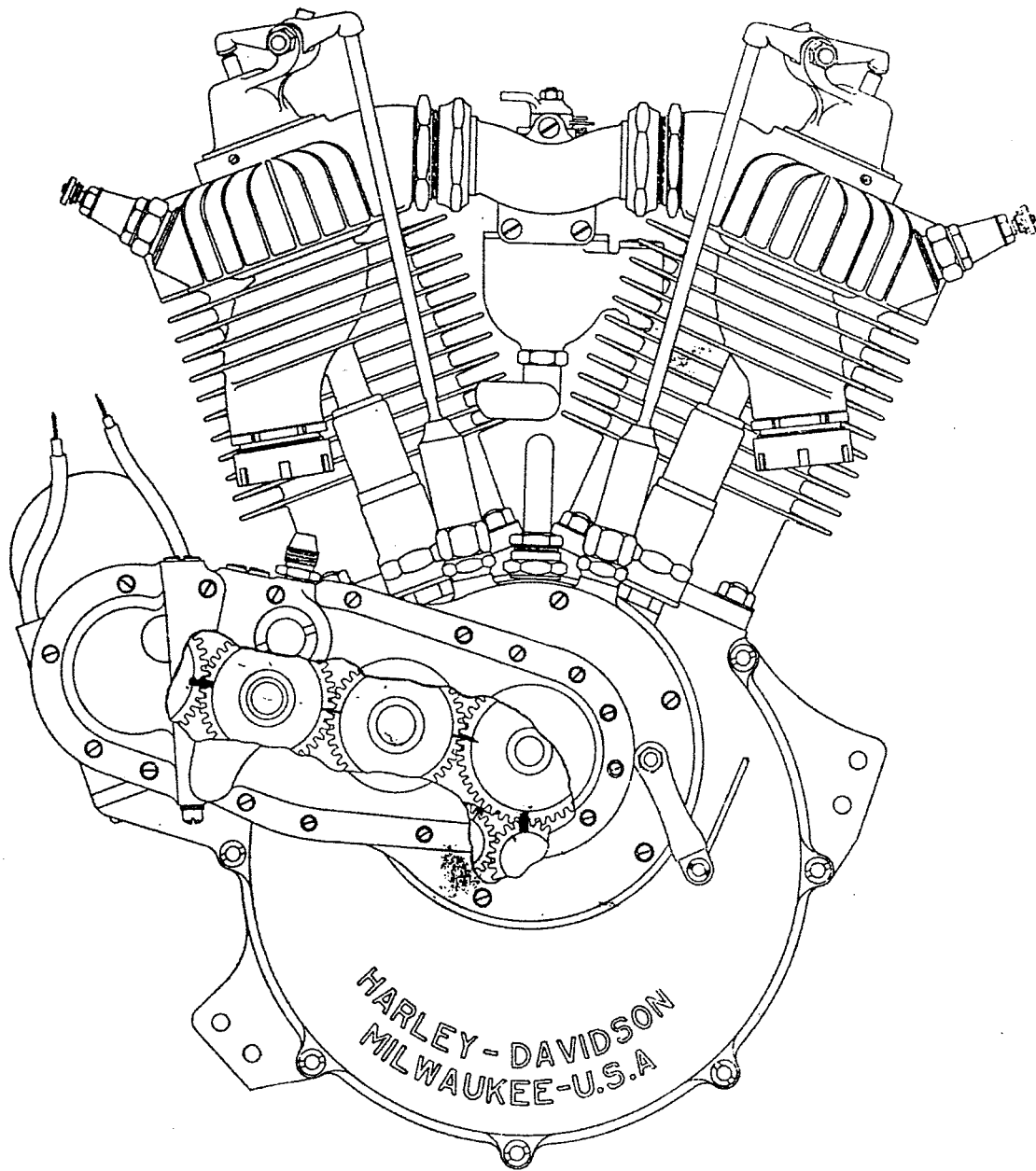
When the charge is properly compressed it must be ignited. On the twin magneto equipped machine the point of ignition is when the piston is between 1-4 inch and 5-16 inch before top center on the compression stroke, with the interrupter fully advanced. Ignition occurs when the circuit breaker points are just breaking. On the electrically equipped models, the

spark should be set with a 7-32 inch to 9-32 inch advance. The circuit breaker must be fully advanced. On all single cylinder models, the spark should be set with 3-16 inch to 1-4 inch advance. Before proceeding to set the time of ignition on any model, be sure that the circuit breaker is fully advanced and that the points are properly adjusted.

To Time the 1918 Model 235 Generator for the First Time

When a model 235 generator is fitted to a motor for the first time, gear marks cannot be referred to, to get the timing correct, because the interrupter cam is loose on the shaft and must be set for that

particular motor. Proceed to time the generator by first placing all the gears with marks in line on their respective studs. Turn the motor to the firing position which is when either piston is between



7-32 inch to 9-32 inch before top center on the compression stroke. Remove the bakelite distributor cap and the high tension distributor segment. Remove the hexagon nut clamping the circuit breaker cam, advance the circuit breaker as far as it will go by pushing it forward and moving the cam on the shaft in the direction that it runs so that the circuit breaker points are just starting to break contact. Then tighten the cam clamp nut securely.

Be careful when setting this cam, not to use the wrong cam for the cylinder that is being timed. The small cam times the front cylinder while the large cam times the rear cylinder. After the cam has been properly set and securely

clamped, check over the timing and if it is O. K., place the high tension distributor segment over the end of the shaft in such a position that the driving pin on the cam lines up with the provided hole in the distributor segment. The bakelite distributor cap can then be placed over the circuit breaker assembly, it being only necessary to line up the stop of this cap with the slot in the upper edge of the timer head and securing it by means of the springs. When placing the ignition cables into the distributor cap, be sure to place the short cable which is for the rear cylinder into the extreme left boss. The long front cylinder cable should be placed into the extreme right boss of the distributor cover.

Reasons for Advancing and Retarding the Spark

Theoretically the proper time for exploding the charge is at top dead center on the compression stroke, when the charge is compressed as much as it can be. However, there is a slight lapse of time between the sparking and exploding. When the spark occurs it first ignites the charge around the spark plug points. This flame then spreads through the rest of the mixture, forcing the piston downward. The time between the spark and complete explosion of the mixture is very short, but it can easily be understood that as the speed of the motor is increased, the spark should be advanced. For this reason the time of ignition is made adjustable with the use of the left grip.

If the motor is run at high speed with a retarded spark, the spark will occur when the piston is 1-16 inch to 1-8 inch past top center on the power stroke, and considerable energy will be lost on account of the lapse of time between the spark and complete explosion. Then again, running the motor at slow speed with an open throttle and fully advanced spark will result in injury to the motor in time, because

complete combustion of the charge will take place before the piston has reached top dead center on the compression stroke. The effects of this can more easily be noticed in the form of a knock, when driving at low motor speed with an open throttle on a hard pull. Therefore, to get the full effect of the explosion, the spark should occur slightly before top center on the compression stroke.

The time of sparking is controlled by turning the left grip to the right or to the left, depending on the speed of the motor and whether or not under a hard pull. If the above is understood, the left grip will always be carried in the proper position. Running the motor accordingly will mean added life, because the explosion is taking place when the piston is in the proper position.

Do not form the impression from the above explanation that it is necessary to carry the spark in retarded position whenever driving slowly. Do not do this unless the motor is pulling hard at a low motor speed.

Timing of Mechanical Relief Valve

To assure releasing the exact volume of crank case compression at the proper time, all motors are fitted with a relief or breather valve. All twin motors beginning with the 1914 but excluding the EH model are fitted with a mechanically operated rotary relief valve. The port in the sleeve of the relief valve must be open between 1-16 inch and 3-32 inch when the front piston is on top dead center. This port opens gradually when the motor is

turned in the direction it runs and closes when the piston has reached bottom dead center. Correct timing of this valve will allow the vacuum, which is formed when the pistons are on their upward stroke, to draw the oil and oil vapor to all bearing and cylinder surfaces exposed, insuring proper lubrication. All single cylinder motors, the EH model and all twin motors prior to 1914, are fitted with an automatic relief or breather valve which of course requires no timing.

Setting Twin Cylinder Motors According to Gear Marks

Assuming that all of the gears have been removed but that no new gears are to be fitted, it is a simple matter to retime the motor correctly according to the following:

Place the pinion gear on the fly wheel shaft, then fit the key and the pinion lock screw. Then fit the relief valve. On 1914 and 1915 motors, line up the marks of the relief valve pinion and pinion gear. On 1916, 1917 and 1918 motors, line up the mark of the relief valve pinion with the "U" mark stamped in the crank case. Before fitting this gear, be sure that the motor is in such a position that the mark on the driving pinion is in perfect alignment with the secondary gear stud and lifter arm stud. It is always advisable to check over the timing after a gear has been set according to marks. We therefore urge that the timing of the relief valve be checked over to see whether it corresponds with the timing mentioned previously in this article.

After the relief valve has been properly fitted, place the secondary gear on the stud in such a manner that the mark will line up with the mark on the pinion gear. In order to get this result with the 1914

and 1915 motors, the motor must first be turned until the mark on the pinion gear is in an upward position. The secondary gears on all 1915, 1916, 1917 and 1918 motors have two marks. Be sure to place the gear on the stud in such a position that the other mark will be toward the intermediate drive gear.

The exhaust valve timing can now be checked over and must correspond within the limits already mentioned. Fit the drive case after being sure that the marks of the pinion and secondary gear are in line. Then place the intermediate gear so that the mark of this gear and the other mark on the secondary gear line up. After the intermediate gear has been placed in position, the motor should not be turned again. The intermediate worm gear is then placed on the stud in such a way that one of the marks of this gear and intermediate gear line up.

The magneto or generator drive gear with the exception of the model 235 generator is then lined up with the intermediate worm gear after the key has been properly placed in the keyway of the shaft. If the keyway of the shaft and gear are not in line, the shaft only may be

turned, because gear marks must be in line to have the timing right. Fit the lock washer and draw the clamp nut tight.

After completing these operations the gear marks will be in line as shown in illustration on page 3.

To Time the 1918 Model 235 Generator According to Gear Marks

Assuming that the pinion, relief, secondary, intermediate and intermediate worm gears have been set according to marks as is covered under Setting Twin Cylinder Motors According to Gear Marks, only the generator intermediate and generator gears remain to be set.

Place the generator gear and key on the generator shaft, fit the washer and draw up the left hand clamp nut temporarily. Remove the distributor cap from the generator. Turn the generator drive gear backward or to the left until the small cam just touches the fibre block on the circuit breaker lever. This is very important because the generator drive gear and circuit breaker cam are geared three

to one respectively. Place the intermediate generator gear on the stud so that the marks on the generator gear, intermediate generator gear and intermediate worm gear line up exactly true. Pay special attention to this because if one of these gears is just one tooth from the proper position, the point of ignition will vary about 1-4 inch of piston travel which has a decided effect on the running of the motor. After having the gears lined up properly, securely tighten the generator gear clamp nut and fit the split rings and collars on the gear studs.

As a matter of safety check over the timing of the ignition with previous instructions.

Setting Single Cylinder Models According to Gear Marks

Place the pinion gear on the fly wheel shaft and replace the pinion nut. Turn the motor until the mark on this gear is upward. Then place the secondary gear on the stud so that the marks of this gear and the pinion gear line up. Replace the drive case, turn the motor until the mark on the gear which is mounted on the secondary gear will be toward the intermediate cam gear stud. Place the intermediate or intake cam gear on the stud so that the proper mark will line up with

the mark on the gear mounted on the secondary gear. Fit the other intermediate gear and then the magneto gear according to marks also. When the gears are set according to marks, all marks visible will be in line.

These instructions, as already mentioned, apply to retiming a motor when a new gear is not fitted. If a new gear is fitted, time the motor according to piston positions only as previously explained.

Review of Timing of All Models

Twin and Single Exhaust Valve Timing

1. Exhaust valves must start to open 3-4 inch to 9-16 inch before bottom center. Exhaust valves must close 1-32 inch to 3-32 inch after top center. Inlet valves do not require independent timing.

Single Inlet Valve Timing

2. Inlet valves must start to open 3-16 inch before top center, to top center. Inlet valves must close 1-8 inch to 3-8 inch past bottom center.

Spark Timing

3. All twin magneto models must fire 1-4 inch to 5-16 inch before top center with spark fully advanced.

All twin electrically equipped models must fire 7-32 inch to 9-32 inch before top center with spark fully advanced.

All single cylinder models must fire 3-16 inch to 1-4 inch before top center with spark fully advanced.

Mechanical Relief Valves

4. Ports on all models must be open 1-16 inch to 3-32 inch when the front piston is at top center.

Time of valve lifting and closing can best be determined at the point where the

push rods or lifter pins begin to get tight or loosen up. This can easily be ascertained by turning them while the motor is being turned.

The spark occurs at the point where the contact points come apart.

Twin Berling Magneto

Lower cam (or shoe) in interrupter housing times ignition for front cylinder.

Upper cam (or shoe) in interrupter housing times ignition for rear cylinder.

Twin Dixie Magneto

Cam No. 2 times ignition for front cylinder.

Cam No. 1 times ignition for rear cylinder.

Twin Bosch Magneto

Interrupter shoe No. 2 times ignition for front cylinder.

Interrupter shoe No. 1 times ignition for rear cylinder.

Remy Generator

Small cam times ignition for front cylinder.

Large cam times ignition for rear cylinder.

Cam Puller

Due to the location and size of the circuit breaker cam on the model 235 generator, a puller is necessary for quick and satisfactory removal. This cam puller sells for \$1.00 net. Order by No. GK833.