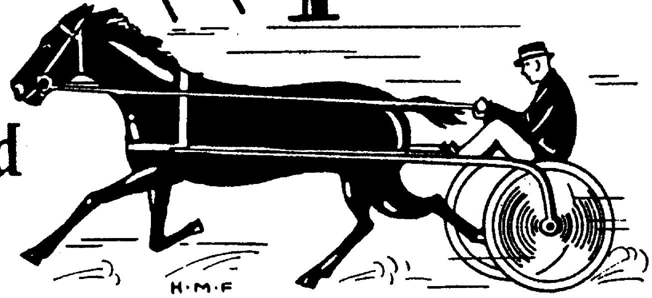
ACCURATE SPARK TIMING

It's Vital Importance to Ford Power and Speed



WHEN Man-O-War, that splendid horse, steps out to strut his stuff—notice with what cool precision he moves his legs. It is not muscle that gives him speed—every cart horse has more. What is the secret of his speed? It is the accuracy with which he *times* the swing of his legs! Suppose that something happened to his nerves, so that he moved one leg a fraction of a second late. Gone would be the smooth speed and power—and the race would be lost!

The four cylinders of the Ford engine correspond to the four legs of the race-horse and need to be *timed* with equal accuracy, if the Ford engine is to develop race-horse speed and efficiency. While the ignition system of the Ford engine corresponds to the nerves of the horse, so we have to adjust the Ford ignition to time the spark to each of the four cylinders with perfect accuracy.

If we were told to divide a second into forty parts, we would feel that we had been given quite a job. Yet that is what the timer, or commutator, on a Ford engine has to do when the car is travelling at 30 miles per hour!

Forty times each second, the small steel roller in the timer has to make perfect contact with the segment inserted in the raceway, or what is usually called the fibre ring.

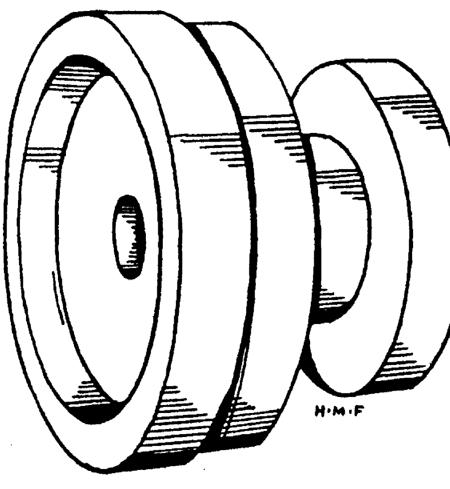
You can hold it in the palm of your hand! Yet the Ford timer is one of the most important parts of the car and upon its proper performance largely depends the quality of the performance of the engine.

Much of the trouble with timers is due to neglect. If regularly and properly oiled, the timer is remarkably durable, functioning perfectly for thousands of miles, and giving fair warning before requiring replacement.

Timer troubles are not so difficult to detect, though some mechanics confuse them with carburetion troubles. Hard starting, skipping, misfiring when under load, popping and muffler explosions at high speeds, are often symptoms of a defective timer.

The Ford Motor Company says "It is very important that the timer case recess in cylinder front cover lines up accurately with cam shaft. If these parts are not in exact alignment, the roller brush will not revolve centrally in the timer case and, as a result, will cause an uneven spark and possible damage to the engine." Note the "possible damage."

To check the alignment of the front cover with cam shaft, place a cylinder front cover gauge (see cut) in recess in cover provided for timer case. With the gauge in position, insert and tightly draw down the three cap screws No. 1, No. 2 and No. 3 which hold cover to cylinder. The gauge is then removed and the remaining cap screws and bolts (which hold cover to crank case and cylinder) are entered and drawn down tightly. After assembly is completed, it is advisable to again insert gauge into recess to make sure that front cover has not been forced out of alignment, in drawing down the cylinder cover to crank case bolts.



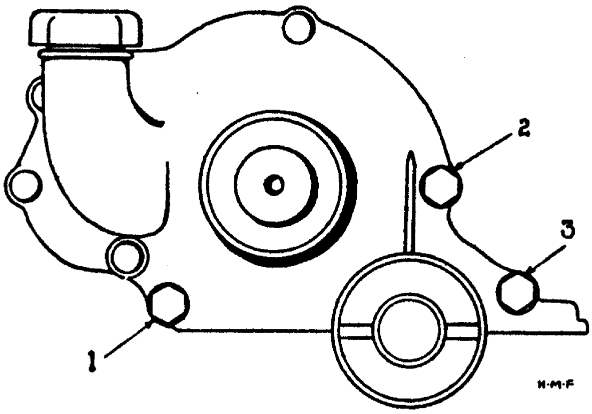
Necessary Cylinder Cover Gauge

Importance of Centering Timer

TO show the effect of a slight, off-center misplacement of the regular Ford timer, the makers of the Milwaukee timer arranged a fixture by means of which the timer could be moved slightly off center, while the engine is in operation. Instead of being connected to the Ford coil units the four terminals of the timer were connected to small electric lights.

When centered accurately, the lights flashed regularly with the proper equal intervals between the flashes of the different lights. But when the timer was shifted slightly to one side or the other —My Ford! What a difference in the regularity! The lights would flash closely together—then far apart. In fact, everywhich way. This was a conclusive demonstration to us as to the effect produced on a Ford engine by a slight off-center misplacement.

No wonder a correctly centered timer makes such a difference in Ford engine performance.



Using Cylinder Cover Gauge

When the timer case is off-center, with relation to the cam shaft; the roller brush must be constantly on the move, towards and away from the cam shaft, in order to compensate for the constantly changing distance between cam shaft and raceway. This tends to cause wear of the bearing between the roller arm and hub. But it also has a much more serious effect than this.

As the roller brush moves in and out on the off-center raceway, the tension of the spring is constantly changing, so that the roller tends to wear the raceway unevenly—often to a *wavy* surface. This is apt to result in misfiring at high engine speeds, and is probably an important factor in timer wear. The Ford timer can stand a lot of *evenly* distributed wear, without impairing its accuracy. It is the *uneven* wear that causes trouble.

When Timer Is Off-Center

LET'S make a diagram, and work out how "off-center" position affects the timing. To lay this out, we shall assume that the roller makes contact on the segment for about 42-degrees (which is 84-degrees of crank shaft rotation, owing to the two-to-one gear ratio between cam shaft gear and crank shaft gear.)

When the roller first makes contact with the segment, the current flows through the coil unit and the spark occurs. Consequently, it is this *first* edge of each segment, which *times* the spark. Let's move our timer shell ⅛ inch to the left (or move the roller brush ⅛ inch to the right). What happens?

The contact for No. 1 cylinder is practically ⅛ inch late!

Let's assume that ⅛ inch late means 5 degrees late. But that's just the half of it! We have to consider the two-to-one ratio between the cam shaft gear and the crank shaft gear, which means that 5 degrees late on the cam shaft is 10 degrees late on the crank shaft! WOW!

It needs no argument to convince mechanics, who have learned the importance of timing valves by piston position, that 10 degrees late on one cylinder will make a whale of a difference in the power and speed of the engine.

But why not advance the timer that much?

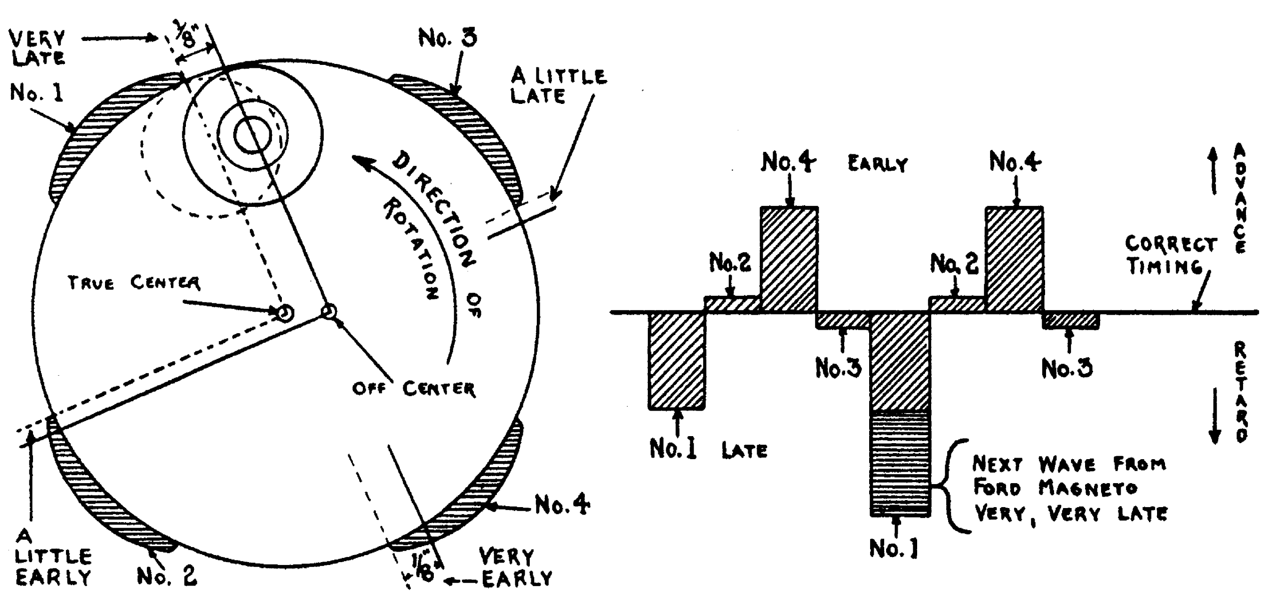
The worst is yet to come!

Moving the roller brush around our circle, we find that the contact is made for No. 2 cylinder a little early! Not much, but a little.

Now comes the Heck of it!

Continuing the counter-clockwise rotation of the roller brush, the roller next reaches the segment which fires the No. 4 cylinder. See what happens! Since the roller brush has been moved over in the direction of the segments, it makes contact ⅛ inch EARLY.

Comparing No. 1 cylinder (which was ⅛ inch *late*) with No. 4 cylinder (which is ⅛ inch *early*), and we have a DIFFERENCE of ¼ inch. Since ⅛ inch means 5 degrees or more of cam shaft rotation, and 10 degrees or more of crank shaft rotation; we see that ¼ inch means a difference in the timing between No.



Showing Effect of Off-Center Case in Timing Spark to Each Cylinder

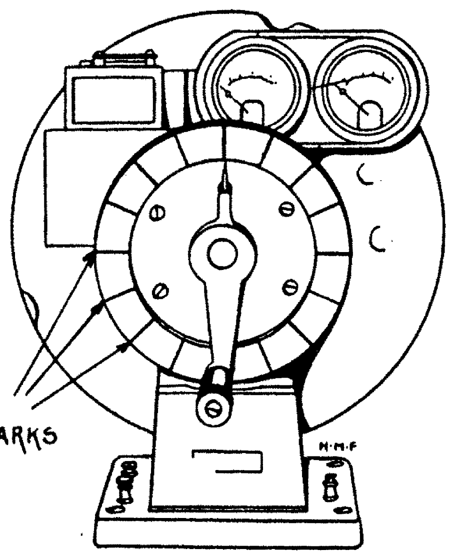
1 and No. 4 cylinders of more than 20 degrees! Can you imagine that?

Continuing the rotation of the roller brush, the final contact is made with the segment which fires the No. 3 cylinder and it is a little late. We cannot advance the spark to suit No. 1 cylinder, or we shall have the spark twice as far off for No. 4 cylinder. This means that even the best possible position for the spark lever is "all wrong" for *all* four cylinders!

Now ordinarily, the Ford timer will not be ⅛ inch off-center. Usually, it will be much less. But when we remember that any inaccuracy, however slight, is first *doubled* by moving from No. 1 to No. 4 cylinder, and that this result is then *doubled again* by the timing gears, we can realize the importance of exact centering of the Ford timer.

Vibration and Noise

LET'S make another chart on which we can represent the spark more-advanced-than-normal above the line, while the spark more-retarded-than-normal is shown below the line. Since the spark for No. 1 cylinder occurs about ⅛ inch late, or more than 10 degrees, we shall show this as *below* the normal line. The No. 2 cylinder fires next, and just a little early. (Not so bad—yet not so good either.) But now, Hot Zowie! we have to put the next cylinder, No. 4, away *above* the line. While No. 3 cylinder, which fires last, is shown a little below the normal line.



Spark Occurs Only at Crest of Current Wave

With such inaccurate timing, it is no wonder that the engine runs unevenly, with *surges* or waves of vibration—until it is speeded up enough to drown out a Northeaster horn in a general all around clatter.

The vibration of the engine makes the car unpleasant to drive, and is destructive of engine and chassis parts. The fact that the cylinders are trying to run at *different speeds* means that they are "working against each other", resulting in a lack of power and speed and, of course, wasting fuel and tending to cause overheating.

When No Spark Occurs

HOW little can the Ford spark timing be advanced or retarded by spark lever? There's a question for you!

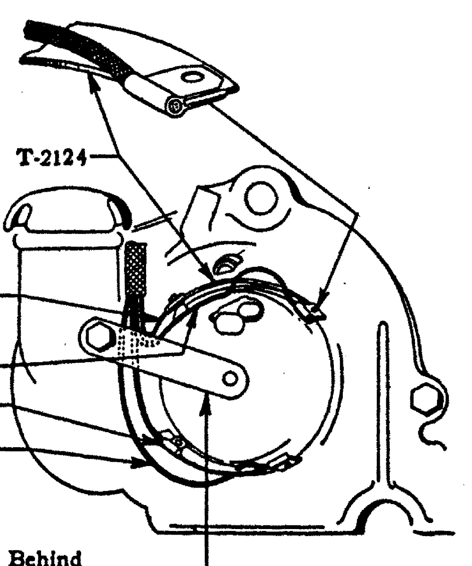
There is another peculiarity of the Ford ignition system, which will interest those Ford mechanics who like "deep stuff". On earlier than 1914 Ford cars, there were certain positions of the spark lever called "dead spots", at which the engine would not fire properly. On later Fords, this is not noticeable—what causes the difference?

Earlier than 1914 Ford cars had small, round bobbins on the magneto coil assembly—with considerable space between adjacent bobbins. When the Ford magneto was changed to allow the operation of head lights from the magneto, the bobbins were made larger and of oblong shape, so that there is now little space between adjacent bobbins. Also the magnets were changed from the ½ inch size to the ¾ inch size now used, making a notable increase in the intensity and size of the magnetic field. Consequently, the Ford magneto now delivers much more current (with less space between waves), reducing the dead spots which previously existed.

However, these dead spots still exist, though much subdued. The Ford coil units only fire on the *crest* of the current wave from the Ford magneto. Consequently when the spark lever is advanced to use one wave ahead, it advances the spark about 20 degrees. This is the least the spark can be advanced on a Ford car. We figure this from the fact that 16 poles on the magneto produce 16 impulses for each revolution, or 360 degrees. You can see this demonstrated very clearly as the 16 sparks around the ring of a coil unit testing machine.

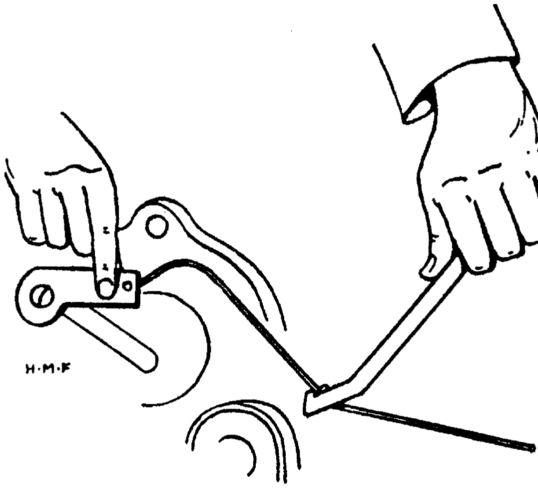
Well, what has all this to do with an off-center timer?

Just this, if the timer is off-center, so that one cylinder is just enough later than another to



Sketch Showing Method of Assembling Wires to Commutator Case

Wiring the Timer



Using Timer Gauge

miss the "crest" of one of the current waves from the Ford magneto, it will not fire until the next wave — or 20 degrees late. If the contact for that cylinder was already 20 degrees late on the timer, this means that the spark would be 20 degrees plus 20 degrees, or 40 degrees late. This would mean that the cylinder, in many cases, would not fire at all!

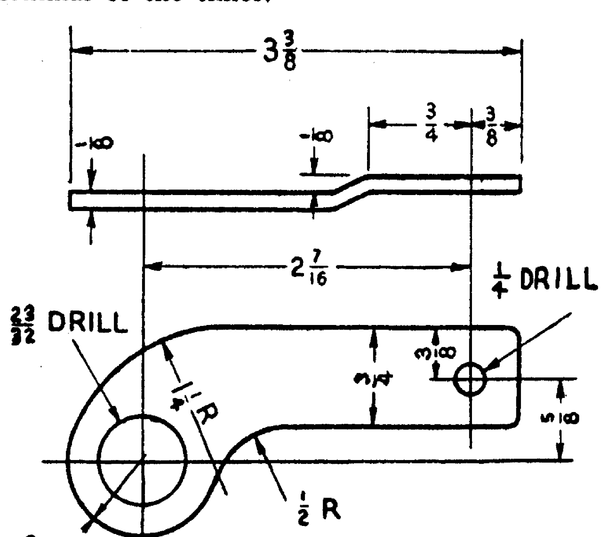
Installing the Timer

In wiring the Ford timer, we face the timer from the front of the car. We know that, viewed from this position, the upper left-hand terminal should fire the front or No. 1 cylinder. This is the *black* wire.

Since the cam shaft rotates in the opposite direction from the crank shaft, we know the roller brush rotates in a counter-clockwise direction, and so moves down to the lower left-hand terminal of the timer, to which the *red* wire, which fires No. 2 cylinder, should be attached.

Since the firing order of the Ford engine is 1-2-4-3, the roller brush moves to the lower right-hand terminal, to which the *green* wire, to fire No. 4 cylinder, should be attached.

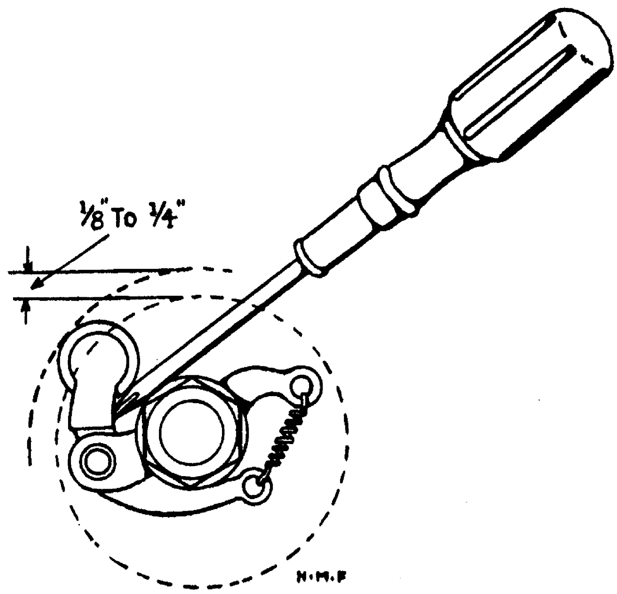
This leaves the *blue* wire, which fires No. 3 cylinder, to be connected to the upper right-hand terminal of the timer.



Gauge for Timer Setting

Good lubrication is an important factor in the performance of the Ford timer. When installed, the timer shell and roller brush should be flushed with light engine oil. From then on, the car owner should oil the timer every hundred miles or so. It is good practice to oil the timer a little every day—or at least once a week. A little and regularly is the big idea.

Every 500 or a thousand miles the timer should be lifted out and cleaned with gasoline or kerosene, and then oiled and replaced. If allowed to run dry, more rapid wear of moving parts is apt to occur. For winter use (to ensure easier starting), the timer may be oiled with a half-and-half mixture of light engine oil and kerosene. The importance of regular timer oiling will be



Bending Roller Arm

realized, when we remember that the roller is making 2440 contacts per minute when the car is travelling 30 miles an hour.

Setting Spark Advance

The importance of properly setting the timer must not be overlooked, as a poorly set spark will inevitably result in burned valves, knocks, etc.

When properly set, the distance from the center of the timer case spring cap screw to the center of the timer case pull rod (with spark fully retarded) is 2½ inches. Dealers can make up in their shops a gauge which will quickly and accurately check this setting. A dimension drawing of the gauge is given.

To use this gauge it is merely necessary to place the large hole over the cap screw and then bend the pull rod until the end of the rod fits freely in the small hole in the gauge.

If the spark advance is not correctly set or, in other words, if the angular position of the timer shell, with relation to the cam shaft is not correct; then the spark will occur either too late or too early, with regard to the position of the spark control lever on the steering column.