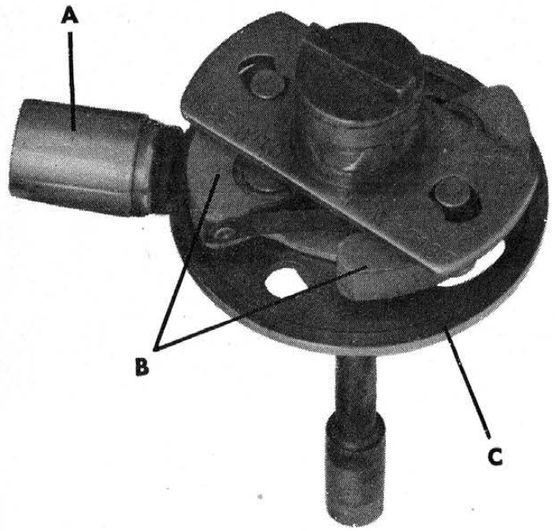
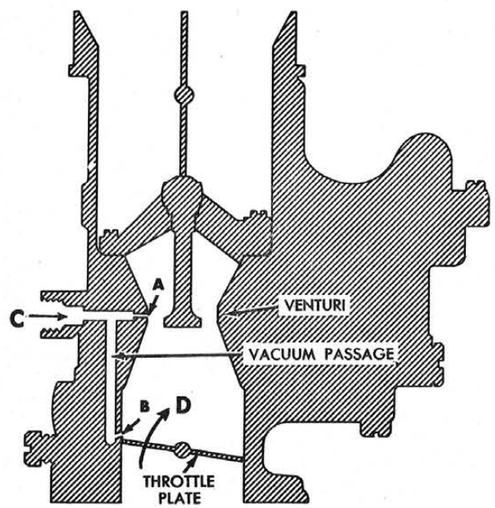
SPARK ADVANCE HOP UP TROUBLE SPOT



Spark advance mechanism of an early Ford distributor is shown above. The important points noted are: (A) Vacuum operated piston; (B) Flyweights; and (C) brake disc

Carburetor vacuum passages of 1949-53 Ford are illustrated below. Indicated are: (A) venturi vacuum port and (B) manifold vacuum. Butterfly (D) rotates thusly to open



BY BARNEY NAVARRO

AMONG the mistakes made in hopping up engines, few exceed in number the misapplication of spark advancing principles. The chief source of error is the limited information available on the subject of spark lead. That which is distributed, unfortunately, fails to cover some essential factors and very often is no more than a comment to the effect that fuel charges take a certain amount of time to burn so spark must be advanced enough to compensate for the time lapse.

Well informed engineers wish that the problem was really that simple.

Most ignition system purchasers overlook every factor except the amount of spark produced. The wrong system can cause plenty of trouble: plug fouling, poor gas mileage (even though the engine has no tendency to missfire), overheating in slow traffic, and other maladies.

Basically, engines require some means of advancing spark timing as rpm increases since the pistons, in effect, try to get ahead of the burning speed of the fuel charges. Combustion, which takes a definite length of time, must occur when pistons are at top dead center before the start of the downward power stroke. If burning finishes too early, energy is wasted because the resultant pressure rise produces a force in opposition to rotation. This is readily apparent when starting an engine that has too much spark lead; it will actually kick back against the starter's efforts.

Modern high compression engines, while under full load, audibly indicate spark that is too far advanced by pinging. So the popular method of setting spark timing for maximum horsepower is to set it just below the ping point under full throttle operation.

Distributors that employ flyweight governor advance mechanisms use a spark advance curve that conforms to the engine's requirements under full throttle at any point within the rpm range. At low rpm a lesser spark lead is required so the governor advances a small amount. As speed picks up, it advances more and more, always conforming to the full throttle full load requirements.

On a drag machine, where full throttle and full load conditions are maintained, the flyweight governor is all that is required. But for ordinary driving, which consists mainly of partial throttle operation with very light loads, it is not enough. Some other means of compensating for varying loads must be provided.

The load compensator is necessary because a light fuel mixture burns more slowly than a heavy charge since the concentration is less and the flame takes longer to travel from one fuel particle to the other. If the utmost energy is to be obtained from light charges, their burning should be completed at the same point that the heavy charges finish. So if they take longer, the only way to make them finish at the same point is to start them earlier. Consequently, partial throttle partial load operation requires more spark lead at any given speed than is required at full throttle full load.

Load compensation is most commonly achieved by using intake manifold vacuum to actuate a diaphragm. This diaphragm advances and retards the distributor breaker plate and in some cases the whole distributor case.

When the engine is operated with a very light throttle pressure, the manifold vacuum is high, so the diaphragm advances the spark timing to produce the most efficient combustion possible. As the throttle is depressed, the vacuum drops off and the diaphragm produces less and less advance until it reaches a point of being completely ineffective at wide open throttle. Thus the ideal load compensation is always maintained and results in more power from every drop of fuel.

The second most popular method of obtaining load compensation, though further from perfection, is that employed in Ford V-8 distributors from 1932 through 1948. Instead of a diaphragm, there is a piston brake actuated by manifold vacuum. The flyweight governor mechanism is equipped with a braking disc which cancels five degrees of the governor's advance when pressure is brought to bear on its edge. At this edge a spring loaded piston is located in a small cylinder. The spring is on the side of the piston opposite the disc so it causes the piston to be pushed against the disc. Vacuum is introduced on the spring side to oppose its action and lift the piston off the disc.

In action, the high vacuum produced by operation with small throttle openings lifts the piston off the disc, allows the full action of the governor weights to take effect and gives the Ford engine five degrees more spark advance. By depressing the throttle further, the manifold vacuum drops off and the spring again pushes the piston against the disc to retard the spark.

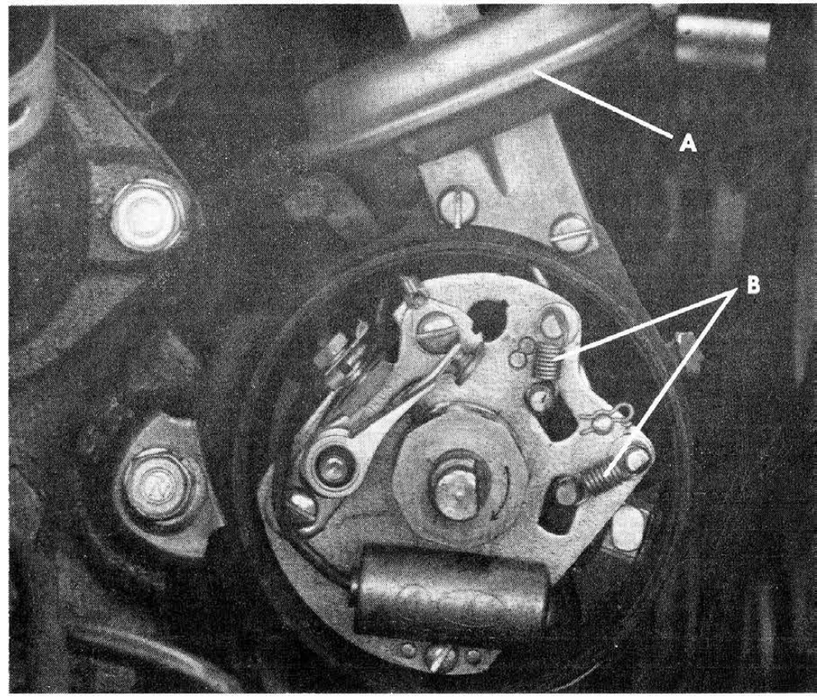
The flaw in the operation of this mechanism lies in the fact that it is either "full on or full off" and permits no gradual compensation like the diaphragm.

Ford's latest method of controlling spark advance employs an ingenious system of utilizing manifold vacuum and venturi vacuum. With this system, the flyweight governor is eliminated and in its place is nothing but a diaphragm. This diaphragm not only advances the spark to conform to rpm changes but it also makes load compensation adjustments.

All '49 through '54 Ford and Mercury carburetors have, in addition to the conventional manifold vacuum takeoff, such as is found in the throttle body of most passenger car carburetors, a connecting venturi vacuum passage.

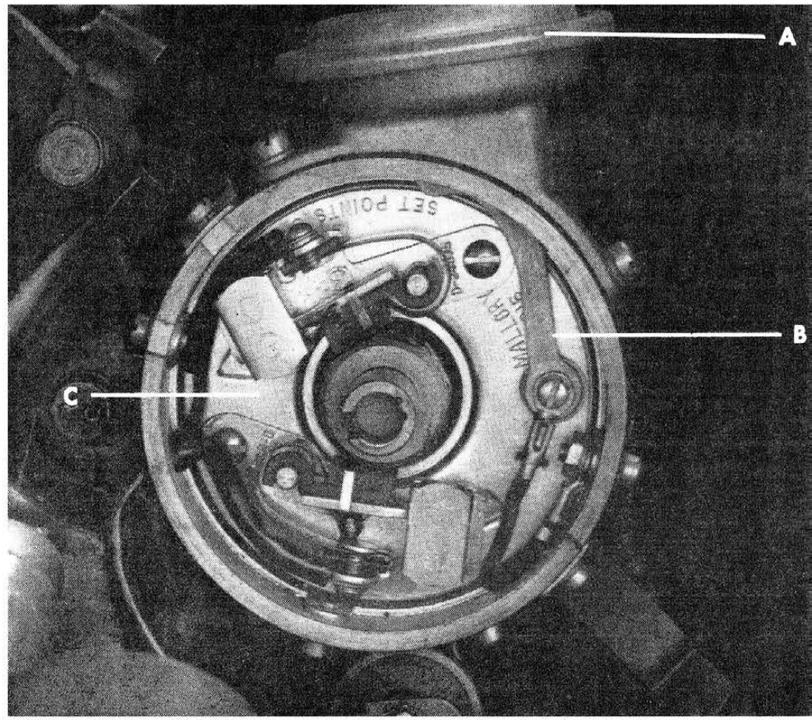
The manifold vacuum, as usual, is obtained from a small port in the throttle body located slightly above the butterfly's closed position, on the side where the butterfly swings upward to open. When the throttle is closed at idling, the vacuum port does not receive vacuum because it is on the opposite side of the butterfly. As the throttle is opened slightly, this port is uncovered and a vacuum is applied to the distributor diaphragm to advance the spark. If the throttle is fully depressed, the manifold vacuum is destroyed and no advance takes place.

(*Continued on page 54*)



The stock 1949 through 1953 Ford distributor uses vacuum control to advance spark. A flywheel governor is not employed. The principal items pointed out above are (A) diaphragm and (B) return springs to oppose the action of the diaphragm

Distributor with flyweight governor advance and diaphragm load control. This is for use with Mallory Magspark transformer and ball bearing breaker plate. Units are: (A) Diaphragm; (B) Diaphragm link to breaker plate; (C) breaker plate



SPARK ADVANCE

(*Continued from page 44*)

As speed increases, however, the venturi vacuum increases gradually and advances the spark to conform to the rpm. Letting up on the throttle increases the manifold vacuum (provided it isn't let up all the way) and the spark receives load compensation. A balance is always maintained so that the correct amount of spark advance is supplied for all speed and load conditions.

The greatest installation errors center around the misunderstanding of the late Ford distributors. A distressingly large number of mechanics are unaware of the difference between manifold vacuum and venturi vacuum. In fact, many attempt to operate Ford and Mercury distributors by connecting the vacuum line to the windshield wiper connection on dual intake manifolds. This sometimes results from a desire to use the old Ford Stromberg carburetors which are not equipped with a vacuum takeoff. So the simple solution seems to be connecting the distributor vacuum line to the handiest apparent source of vacuum.

Such a practice is worse than having no spark control at all for when the engine idles the spark advances fully and retards as the throttle is depressed. There is no venturi vacuum available to advance the spark as speed picks up and it remains retarded until the throttle is let up. So if the old style carburetors are preferred, the stock Ford distributor must be discarded on the late models. However, Stromberg has resumed production of the old "97" and is now fitting it with a venturi vacuum takeoff to make its use feasible.

Four-throat carburetion installations also have had their share of improper distributors. Early articles in certain publications gave the impression that no vacuum control whatsoever could be tolerated. It wasn't pointed out that the only forbidden type is that of the stock '49 through '54 Ford and Mercury distributor. This caused many to purchase distributors and magnetos that were equipped with flyweight governors only.

Such installations get very poor gas mileage, so the car owners blame the four-throat carburetor. Even more irritating, is the tendency for spark plugs to foul. Having no load compensation, the spark is never far enough advanced under partial throttle to fire the fuel mixture charges at the most opportune time. In effect, the engine is being operated with a lower effective compression ratio because burning is completed as the pistons travel *down* the cylinder bores. And since the plugs never receive a hot flame, soot collects on them.

Furthermore, the condition cannot be remedied by using hotter plugs because they will burn up under full throttle operation. The only real cure is the installation of a flyweight governor dis-

tributor with a vacuum-operated load compensating device.

In practice, the installation of dual intake manifolds on Fords and Mercurys of the '49 through '54 series should be accompanied by a change in distributors such as prescribed in the preceding paragraph. The addition of two carburetors divides the air flow so only half as much air flows through one carburetor as previously at normal operating speeds. Venturi vacuum is dependent upon the air velocity through the venturi so any reduction in velocity will result in less spark advance. And connecting a line to each venturi vacuum takeoff of a dual set up will not increase the vacuum—such a practice is just a waste of copper tubing.

The best advice to keep in mind when purchasing a distributor is not to pinch pennies. An inexpensive unit, if it doesn't do the job correctly, can prove to be the most costly. The best way to avoid mistakes is to study the problems involved and learn enough about them so that you can select a distributor that matches your engine requirements.

'54 FORD ENGINE

(*Continued from page 19*)

port interference, found in the L-head Fords and Mercs and some overheads, has been avoided in the '54 engine. This interference is not a matter of back pressure, but is one of conflict between the intake and exhaust strokes of the center cylinders of each bank. There is a point where both exhaust valves and one intake valve of the center cylinders are open simultaneously. The practice of Siamesing the two center exhaust valves to one port causes exhaust of one cylinder to interfere with the scavenge of the one that has its intake valve open. The separate ports of the '54 Ford will allow regrinding the cams to timing specifications with more overlap, because interference is impossible.

Head milling to increase the compression ratio and boring to raise displacement will be standard possibilities with the new engine, as in the past, so it is unnecessary to dwell on these operations. However, the wonderful coincidence of crankshaft interchangeability that Ford enthusiasts enjoyed in the past has reached a disappointing finish. Previously, it was possible to increase the stroke of an L-head Ford one-eighth of an inch by the inexpensive installation of a Mercury crankshaft. If three-eighths of an inch increase is desired, the Mercury crank can be stroked one-eighth of an inch and early Ford rods installed to take up the difference in bearing size.

Now, however, both the '54 Fords and Mercurys have the same size cranks and have the same length strokes, so nothing can be gained by an interchange or substitution. Stroking will necessarily be limited to the process which employs metal spraying, an inferior method which weakens the crank considerably.