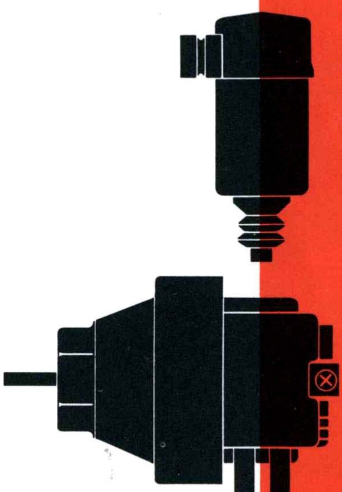
MASTER TECHNICIANS
SERVICE CONFERENCE

REFERENCE BOOK 70-5



LET'S KEEP IT CLEAN

CHRYSLER
MOTORS CORPORATION

PLYMOUTH • DODGE • CHRYSLER
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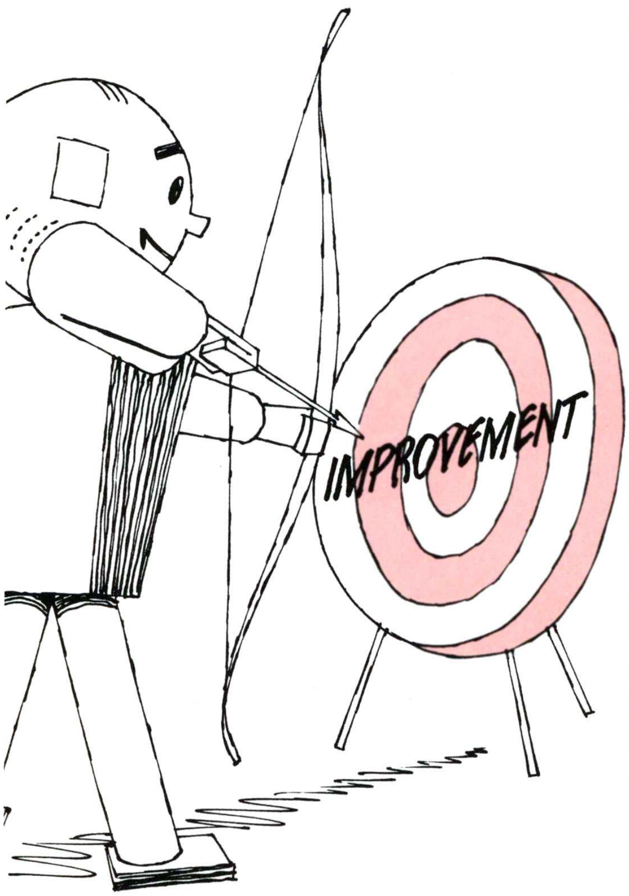

IMPROVEMENT IS THE GOAL...

Cleaner combustion and reduced exhaust emissions are back in the headlines again. Since vehicle emission control was introduced several years ago, each new model year has seen general improvements which have reduced undesirable emissions. As you probably know, many of these advances have been pioneered by Chrysler Corporation in keeping with its policy of continual product improvement.

Our 1970 models are no exceptions to this progression. In fact, you'll find that overall vehicle emission control is now more complete than ever before as a result of overall engine, ignition and carburetion refinements.

From past experience with these yearly improvements, you should expect changes both in servicing specifications and in servicing procedures. That's what this and the session to follow are all about, so here's your chance to learn how, why and the wherefor of 1970 model emission control.

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CONTROLLING VEHICLE EMISSIONS

A great deal has been written and said about the part automobiles and trucks play in air pollution. Whenever the subject is brought up, most people automatically think of the problem in terms of controlling the exhaust emissions of the internal combustion engine. Actually, vehicles equipped with a gasoline-burning internal combustion engine present three potential sources of air pollution: engine crankcase vapors, vapor loss from the fuel system, and engine exhaust emissions. Chrysler Corporation has stepped up to the challenge of eliminating or minimizing vehicle emissions from each of these sources.

CONTROLLING CRANKCASE VAPORS

The closed crankcase ventilation system has been on the job for some ten years now, preventing blow-by gases and other vapors from escaping to the atmosphere. In this system fresh air, picked up at the air cleaner, is drawn through the crankcase inlet air cleaner and into the crankcase. As this filtered air sweeps through the crankcase it picks up blow-by gases and other vapors. The flow path is then through the crankcase ventilator valve to the base of the carburetor, to the intake manifold and finally into the combustion chambers where the combustible material is burned.

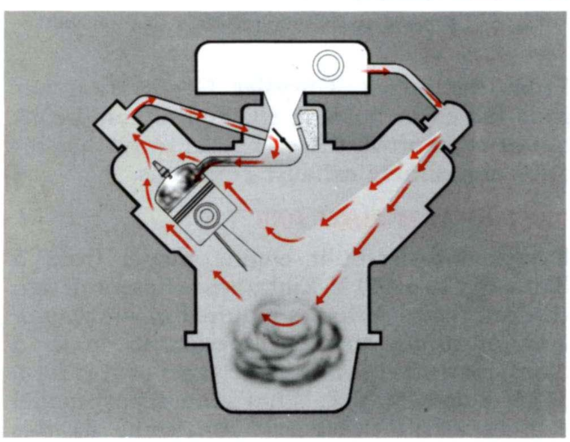


Fig. 1—The closed crankcase ventilation system

THE CHRYSLER "VAPOR SAVER"

The Vapor Saver installed on some models is designed to greatly reduce the escape into the atmosphere of fuel vapors from the fuel tank and carburetor. When the engine is not running, fuel vapors from the carburetor and fuel tank are vented through the crankcase inlet air cleaner and into the crankcase. When the engine is running, the vapors are drawn from the crankcase by the crankcase ventilation system and burned in the combustion chambers.

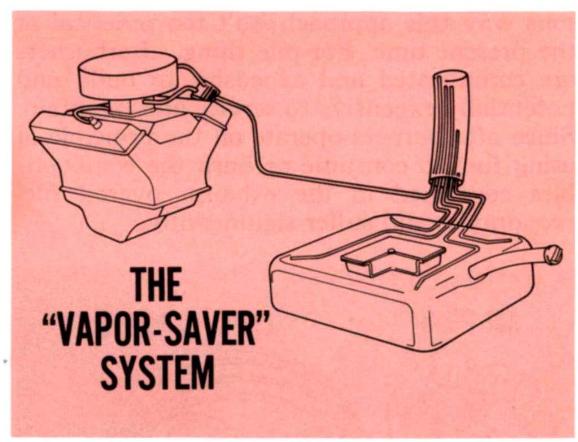


Fig. 2—Fuel vapors are vented to the engine crankcase

A detailed explanation of how the Vapor Saver works will be contained in next month's Film and Reference Book, Session 70-6. This session will also contain service information on the Vapor Saver system.

CONTROLLING EXHAUST EMISSIONS

There are three basic ways to reduce or control

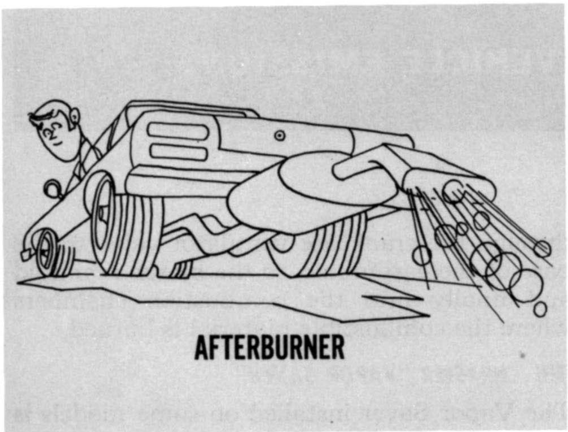


Fig. 3—Exhaust gas afterburners aren't very practical

undesirable exhaust emissions, those undesirable air pollutants that would come out of the tail pipe if we didn't do something about them.

One approach to exhaust emission control is to use a catalyst or exhaust gas afterburner to get rid of the unwanted gases before they reach the end of the tail pipe. There are several reasons why this approach isn't too practical at the present time. For one thing, afterburners are complicated and expensive to build and potentially expensive to service and maintain. Since afterburners operate on the principle of using fuel to consume or burn the combustibles contained in the exhaust, overall fuel economy would suffer significantly.

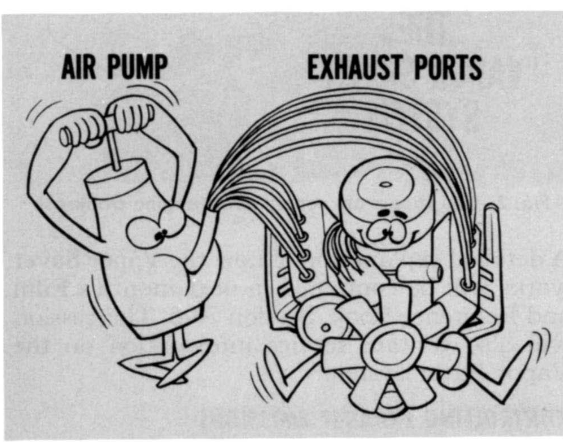


Fig. 4—The air pump system is an expensive add-on

Another way to clean up exhaust emissions is to pump extra air into the exhaust gas as it leaves the exhaust ports. The idea here is to complete the combustion process after the unburned portion of the mixture leaves the combustion chamber. Like the afterburner, the air pump system represents a relatively expensive add-on unit which contributes nothing to engine efficiency and actually consumes engine power in its operation. It, too, requires periodic service and maintenance over and above normal engine performance evaluation and engine tuneup.

A third, very practical approach to clean exhaust, is to refine and improve the entire engine so that all of the fuel fed into the cylinders is burned in the combustion chambers.

Fig. 5—Complete combustion results in clean exhaust

From the outset, Chrysler Corporation has gone the clean-burning engine route and continues to improve these engines to further reduce undesirable exhaust emissions.

DON'T LET LOOK-ALIKES FOOL YOU

Every Chrysler-built engine model from a Slant-Six to a 440 V-Eight has different design characteristics. What is required in the way of ignition timing and carburetion to make a Slant-Six run clean isn't the same as it is for a 318 V-8 or a 440 V-8. What's more, past model engines aren't necessarily the same as this year's engines even if the displacement or

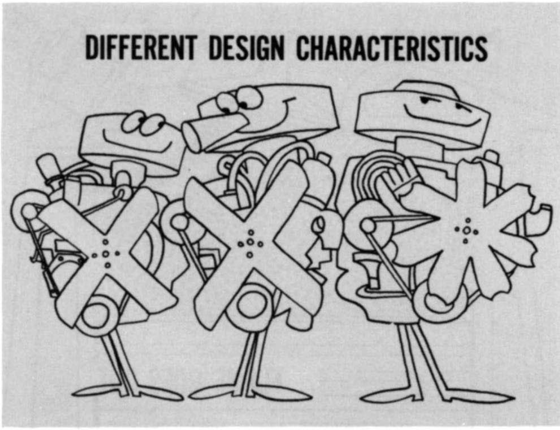


Fig. 6—Each engine has different characteristics

model designation happens to be the same. Since all of these engines are being constantly refined and improved, they undergo subtle but significant changes each model year. So don't try to service them from memory and apply past model service specifications to present model engines . . . or vice versa. Use the service instructions and specifications for the model you are servicing.

CLEAN COMBUSTION IS A DESIGNED-IN FEATURE

Complete combustion and clean exhaust is the result of many things like combustion chamber shape, compression ratio, camshaft design, manifolding, ignition timing, carburetion and even engine operating temperature. In other words, clean combustion is something that is designed into Chrysler-built engines . . . not added on.

THE PROBLEM'S GREATEST AT CLOSED THROTTLE

All Chrysler-built engines are inherently clean burning and efficient over a wide range of operating conditions. However, strange as it may seem, all engines tend to produce a higher concentration of undesirable exhaust products at closed throttle than they do under other operating conditions.

IT'S ALL A MATTER OF CONCENTRATION

The reason why the relatively small amount of fuel fed into the engine at closed throttle doesn't always burn completely is easy to

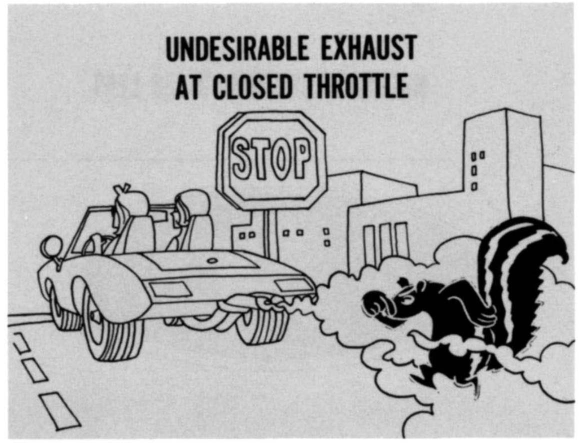


Fig. 7—Concentration is highest at closed throttle

understand. Just imagine that there are two circles of equal diameter on a sheet of asbestos with some flash powder spread out over the area of both circles. In one, the particles of powder are close together but in the other, they are spread out so the particles are much farther apart.

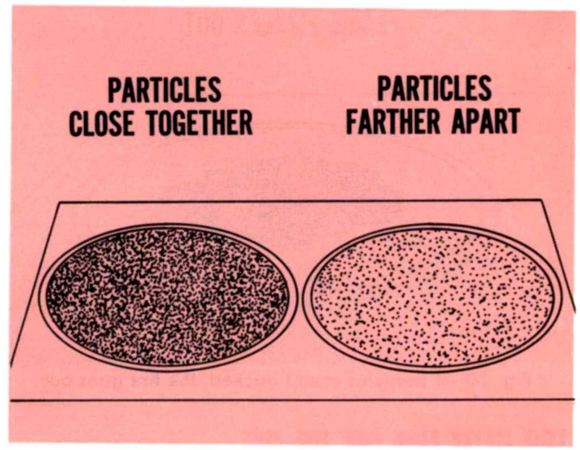


Fig. 8—Comparison of combustible particle dispersion

IT ALL BURNS UP IN A FLASH

Flame can travel quickly from one powder particle to the next where they are close together, with a "POOF" the flash powder burns completely. There are no unburned or partly burned particles remaining.

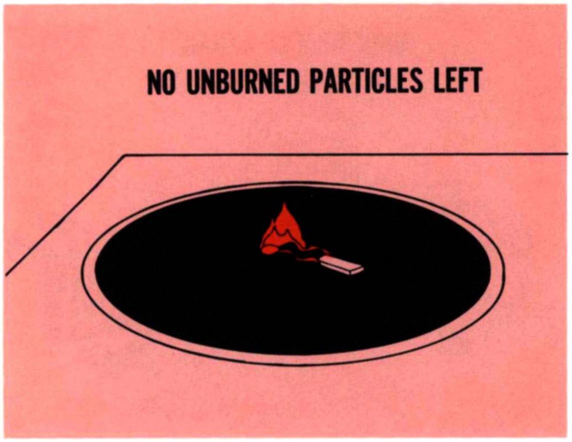


Fig. 9—Closely packed particles burn completely

In the circle where the powder is spread out, the flame fizzles out before all of the particles are burned. That's because they aren't close enough together to keep the fire going.

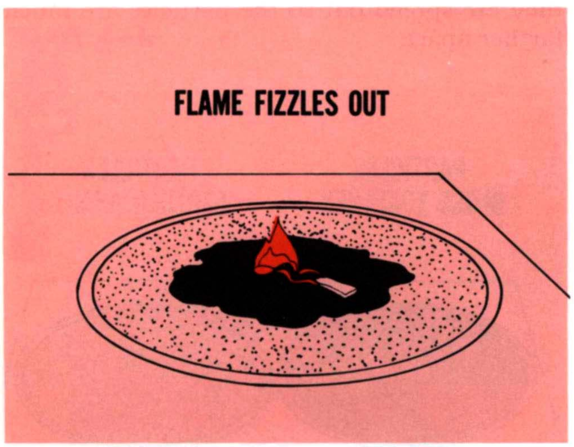


Fig. 10—If particles aren't packed, the fire goes out

TOO LITTLE FUEL FOR THE FIRE

This flame-out condition can also take place in the engine's combustion chamber at idle and when decelerating with closed throttle. If the throttle closes so far that only a small amount of air/fuel mixture is drawn into the combustion chambers, the fuel particles won't be packed closely and the flame will go out before all of the fuel is burned.

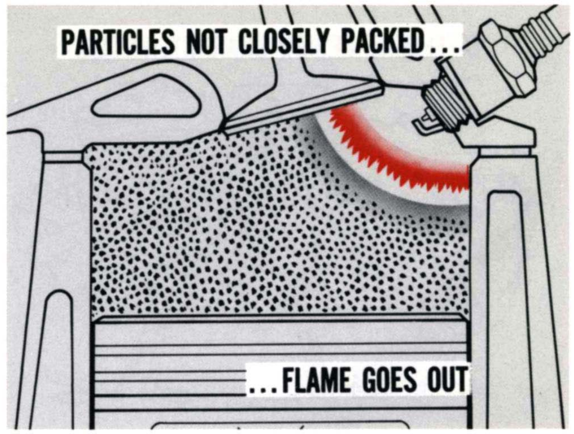


Fig. 11—Not enough mixture to support combustion

MORE MIXTURE BURNS BETTER

One way to prevent the flame-out condition is to keep the throttle open a bit wider in the closed throttle position so that more mixture is pulled in on the intake stroke. Then, on the compression stroke the fuel particles will pack close together and keep burning on the power stroke. As a result, combustion will be much more complete and the exhaust will be cleaner.

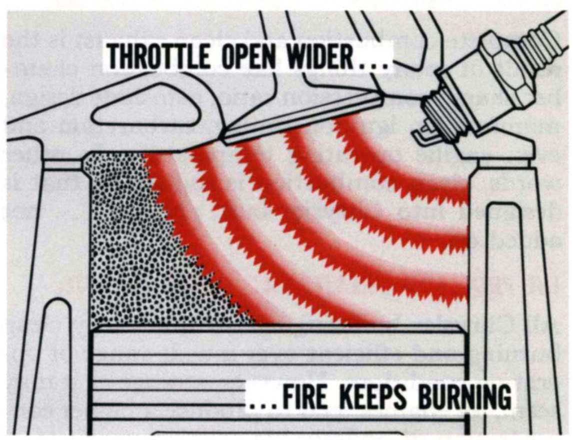


Fig. 12—More mixture for more complete combustion

MORE MIXTURE MEANS MORE SPEED

There is one little catch to opening the throttle at idle to insure more complete combustion. More mixture could result in objectionably high idle speed on some of our engines.

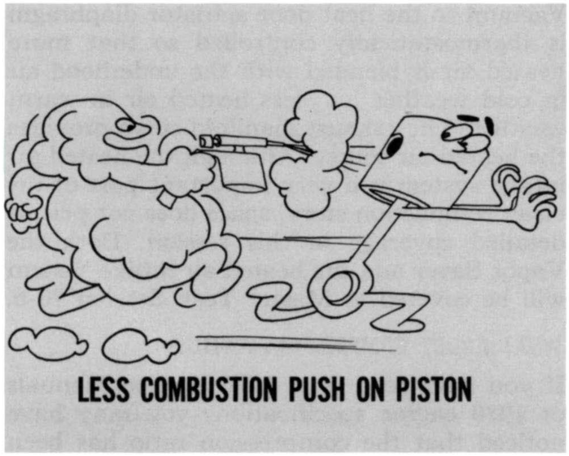


Fig. 13—The piston literally runs away from the push

To compensate for the increased idle mixture, a special distributor equipped with a solenoid is used on some engines to retard the timing at closed throttle. By igniting the mixture later, the piston is literally running away from the expanding gas in the combustion chamber on the power stroke. As a result, there is less push on the piston. This is a very effective way to reduce engine idle speed.

LESS POWER FROM MORE MIXTURE

To summarize emission control at idle, here's what happens: More mixture is fed into the engine at idle to insure complete burning but late ignition is used to reduce mechanical power input and engine idle speed. The net result is cleaner combustion and acceptable idle speed.

A WORD ABOUT CLOSED THROTTLE DECELERATION

Increased mixture flow at closed throttle packs the combustibles closer together during deceleration just as it does at idle, thereby insuring continuous combustion. In addition, the solenoid retards ignition and this results in higher exhaust gas temperatures. Actually, burning continues during the exhaust stroke so that combustion is completed in the exhaust system. This combination of conditions insures excellent combustion and cleaner exhaust during closed throttle deceleration.

SOME ENGINES DON'T NEED A SOLENOID

Ignition timing at closed throttle is retarded as much as 10 degrees from what it was a few years ago. But the ignition distributor solenoid is just one way of retarding timing at idle to reduce engine idle speed. On most of our smaller engines, it was practical to tailor the distributor advance curve and basic ignition timing to obtain satisfactory engine idle speeds without using a distributor solenoid.

THE HEATED AIR INTAKE SYSTEM

For 1970, most engine models have a heated air intake system. This is a very important improvement from the standpoint of performance during warmup and reduced exhaust emissions.

Fig. 14—Most 1970 engines have heated air intake

By feeding the engine heated air in cold weather, it is possible to calibrate carburetion and establish ignition timing for good clean combustion at moderate temperatures instead of compromising to cover a wide range of temperatures. The net result is that the engine performs as though it were summer even in winter weather.

The heated air intake is an air blending system. A vacuum-actuated heat control door in the air cleaner inlet controls the flow of unheated underhood air and manifold heated air in the right proportion to maintain correct minimum intake air temperature.

Fig. 15—Heated air intake minimizes design compromise

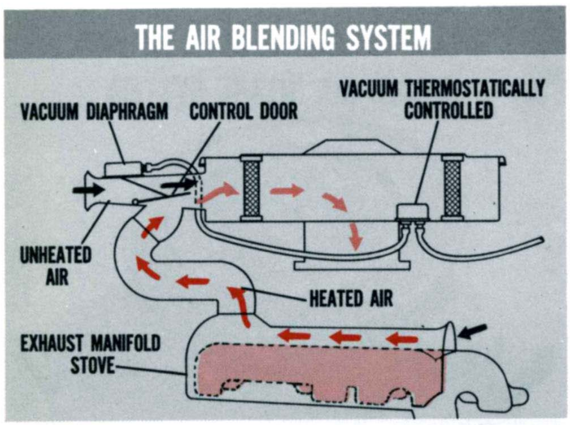


Fig. 16—A heated air blending system is used

Vacuum to the heat door actuator diaphragm is thermostatically controlled so that more heated air is blended with the underhood air in cold weather . . . less heated air in warm weather. The exhaust manifold stove provides the heated air source. Although the heated air intake system is a very important part of the clean combustion story, space does not permit detailed coverage in this session. Both the Vapor Saver and the heated air intake system will be covered in Master Tech Session 70-6.

WHAT ABOUT COMPRESSION RATIO?

If you have read your 1970 Service Manuals or 1970 engine specifications you may have noticed that the compression ratio has been reduced on all V-8's except high-performance models. This has prompted some questions which certainly deserve an answer.

As was pointed out earlier, compression ratio is only one of the many factors affecting engine efficiency, power output and exhaust cleanliness. Within a reasonable range, it isn't even the most important factor. The important thing to remember is that the net result of recent improvements in combustion chamber shape, camshaft design, manifolding, ignition and carburetion is more complete combustion and cleaner-running engines. So, the fractional decrease in compression ratio is not a step backward but is simply part of the total engine improvement story.

THE DISTRIBUTOR AND CARBURETOR SOLENOIDS

THE DISTRIBUTOR SOLENOID

The use of retarded ignition timing at idle has resulted in significant reductions in exhaust emissions during idle and closed-throttle deceleration. As was pointed out earlier, relatively late ignition timing at idle has been provided on some engines by modifying the distributor advance curve to permit comparatively late basic ignition timing. Some engines, particularly the bigger V-8's, have somewhat more critical timing and ignition advance requirements. On these engines it is desirable to have ignition timing somewhat more advanced (earlier) for ease of starting, greatly retarded at idle for minimum emissions, plus immediate advance for good driveaway performance from engine idle. The solenoid-type distributor makes it possible to satisfy these requirements.

COMPARE IGNITION ADVANCE CURVES

The best way to understand what the solenoid does is to compare the advance curve of a distributor without solenoid, with the curve for a distributor with solenoid. In the accompanying illustration, notice that a conventional distributor without solenoid provides no ignition advance during starting and idle. By comparison, the distributor solenoid provides more advanced ignition timing to facilitate starting. It also provides immediate ignition retard for clean exhaust at idle and then immediate advance when the throttle is opened.

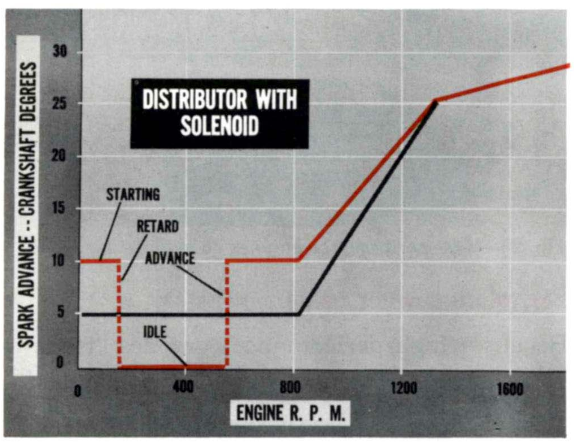


Fig. 17—Ignition advance curve comparison

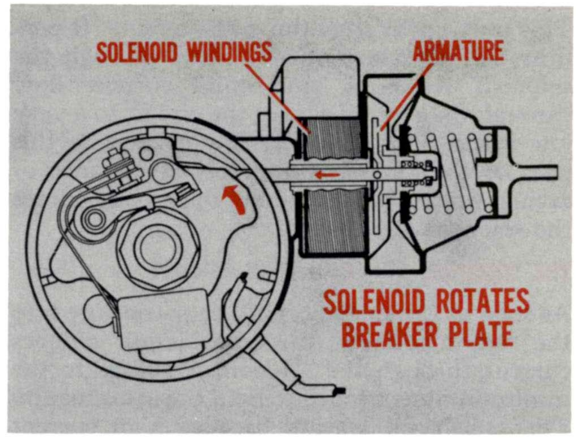


Fig. 18—The solenoid is built into the vacuum unit

THE SOLENOID IS BUILT IN

The distributor solenoid is built into the vacuum advance unit. When the solenoid windings are energized, they pull the armature in against the solenoid core. This moves the distributor breaker plate in the direction of distributor cam rotation to retard timing.

THE CARBURETOR CONTROLS THE DISTRIBUTOR

The switch that controls the distributor solenoid is located at the carburetor. It consists of the carburetor throttle stop and the curb idle adjusting screw. Closing the throttle completes the solenoid ground circuit.

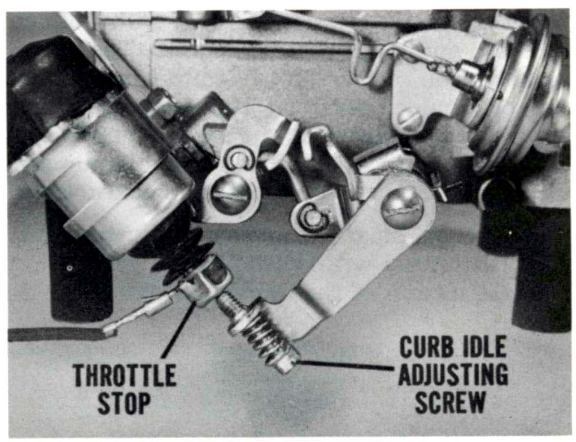


Fig. 19—Carburetor controls the distributor solenoid

The solenoid circuit is quite simple. One of the solenoid terminals is connected to the ignition circuit. The other solenoid terminal is connected to the stop for the curb idle screw at the carburetor. The solenoid is immediately de-energized when the throttle is opened . . . energized when the throttle is closed.

DISTRIBUTOR SOLENOID CONTROL UNIT

The vacuum advance and solenoid assembly is equipped with an electronic control unit.

This unit works something like a relay. It permits the necessary current flow through the solenoid windings but limits current flow through the ground side of the circuit to a very low value. The relatively low current in this part of the circuit eliminates any chance of arcing when the idle screw opens and closes the solenoid control circuit.

THE SOLENOID CONTROL KEEPS IT COOL

As soon as the solenoid pulls the armature into the retard position, the control unit reduces current through the solenoid windings to the minimum flow needed to hold the armature in. This is a good feature because high current flow through the solenoid windings at closed throttle would overheat the solenoid windings during prolonged engine idling. Reducing the hold-in current eliminates this possibility.

SERVICE TIPS COME LATER

Since the vacuum advance unit with built-in solenoid and control unit is serviced as an assembly, you really don't have to worry about the internal circuitry of the solenoid or the control unit. However, a good understanding of what they do will help you understand some of the new service precautions and instructions.

Incidentally, diagnosis and service instructions for distributors with solenoids are included in the last section of this reference book.

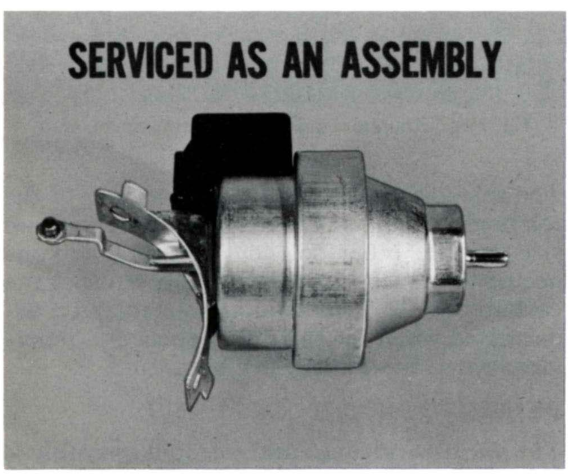


Fig. 20—Distributor vacuum advance with solenoid

THE THROTTLE STOP SOLENOID

Cars equipped with a 426 Hemi, a 340 V-8 or a high-performance 440 V-8 are outstanding performance and highway machines. However, these spirited power plants are designed to idle at relatively high speeds . . . 800 r.p.m. or higher. This is okay with the people who buy these cars because they don't plan on spending a lot of time driving in heavy traffic or standing with the engine idling in a rush-hour traffic jam.

Fig. 21—High-performance engines have high idle speeds

"AFTER-RUNNING" CAN BE A PROBLEM

Because high-performance engines require

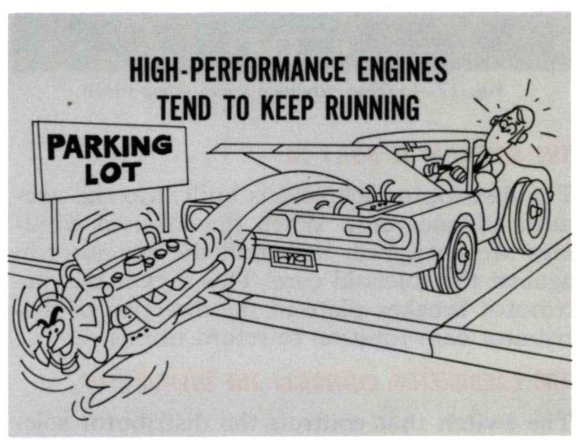


Fig. 22—High idle speed contributes to after-running

much higher engine idle speeds, they tend to keep on running after the ignition is turned off. This is called "after-running" and one of the best ways to prevent it is to reduce the flow of air/fuel mixture at closed throttle. But we learned earlier that closing the throttle more at idle tends to increase emissions, so the solution here is one throttle position for idling and another for stopping the engine. Here's how that is accomplished.

THE ADJUSTABLE THROTTLE STOP

The stem of the carburetor solenoid is used as a throttle stop for the *fast* curb idle screw. (Bear with us a paragraph or two and we'll explain why "fast curb idle screw" really means engine idle speed screw.) When the ignition is on, the solenoid is energized and the stem of the idle adjusting screw seats against it to provide the specified curb idle speed.

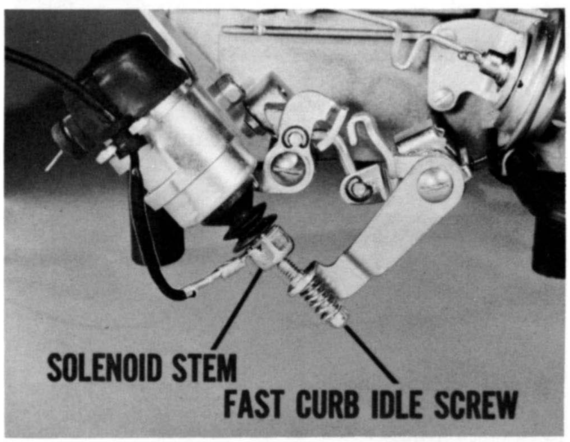


Fig. 23—The solenoid stem is the idle screw stop

When the ignition is turned off, the solenoid is de-energized and the stem retracts. This allows the throttle blades to close more, reducing the air/fuel flow. As soon as this happens, the temerature in the combustion chamber drops below the self-ignition point and the engine stops instead of after-running.

THREE IDLE SCREWS HATH THIS CARBURETOR

There is nothing complicated about the idle speed solenoid or its circuit. However, carburetors with an idle speed solenoid have three idle speed screws instead of the usual two. The new names for these screws have caused some misunderstandings, so let's clear the air on that score before we proceed.

THE FAST IDLE IS THE SAME

The fast idle speed cam, linkage and screw are essentially the same as for past models. This screw is called the "fast idle speed adjusting screw" and the procedure for adjusting it is the same as for past models.

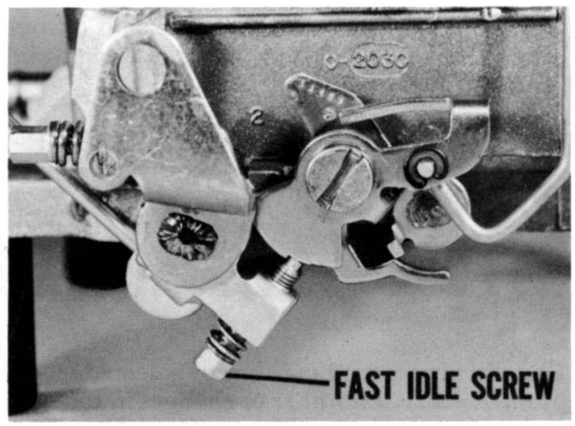


Fig. 24—The fast idle system's unchanged

THE FAST CURB IDLE SCREW IS NEW

The "fast curb idle speed screw" is the one that has been added on carburetors with a solenoid.

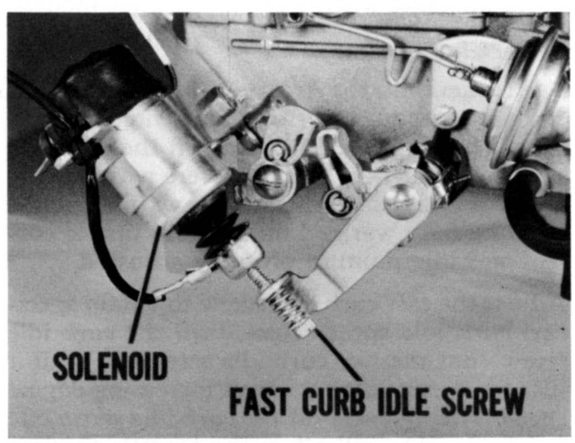


Fig. 25—They added a solenoid and changed a name

This screw is the one which rests against the stem of the idle speed solenoid when the ignition is on and is used to obtain specified warm engine, idle speed. In other words, fast curb idle is simply a new name for curb idle.

THE SCREW THAT STOPS THE ENGINE

On carburetors with a solenoid, the curb-idle screw doesn't really have anything to do with engine idle speed specifications or with keeping the engine running at idle. On the contrary, this is really the engine shutdown screw. It lets the throttle valves close far enough to prevent after-running when the ignition is shut off but keeps them from closing all of the way and jamming in the throttle bores.

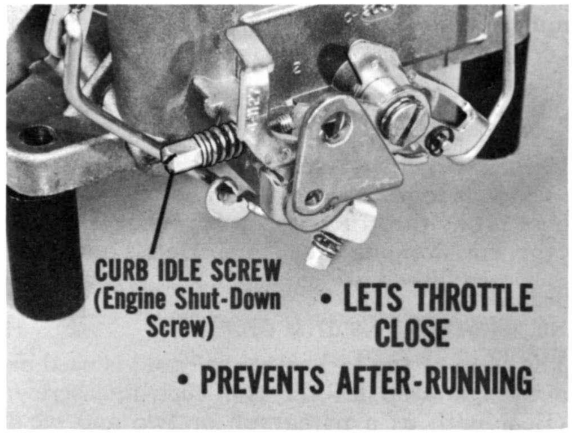
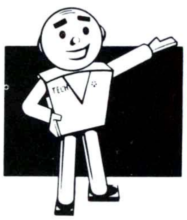


Fig. 26—It's really the engine shutdown screw



SERVICE TIPS AND SUGGESTIONS

The distributor and carburetor solenoids have brought about a number of changes in tune-up and adjustment procedures. The best advice for anyone servicing models equipped with either or both of these solenoids is, "Use your 1970 Service Manuals". The information which follows will help you understand some of the changes in service procedures and help you avoid mistakes when working on these models.

IDLE SPEED ADJUSTMENT

Adjustment of the two idle screws used on carburetors equipped with a solenoid is quite easy. The first step is to back off the curb idle screw so that it does not interfere with adjustment of the fast curb idle screw. The engine must be fully warmed up, ignition timing correct and idle mixture properly adjusted.

Adjust the *fast* curb idle screw to obtain specified curb idle speed. Next, turn the *curb* idle screw (not the *fast* curb idle screw) in until it just touches its stop without increasing engine speed. Finally, back off the *curb* idle screw one full turn. This will allow the throttle to close far enough to prevent after-running when the ignition is turned off.

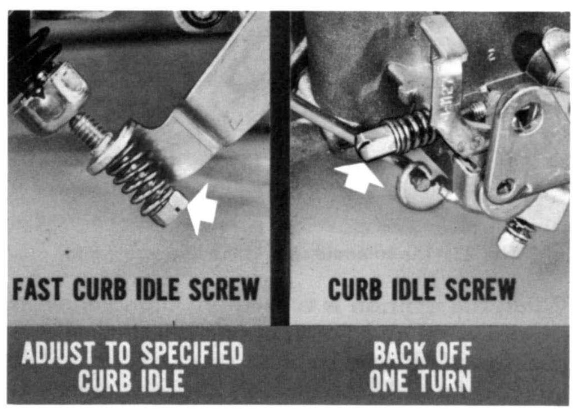


Fig. 27—Adjust both of the curb idle screws

CHECKING OR ADJUSTING IGNITION TIMING

Timing specifications are based on a fully retarded distributor . . . no vacuum advance and the breaker plate pushed into the fully retarded position by the distributor solenoid.

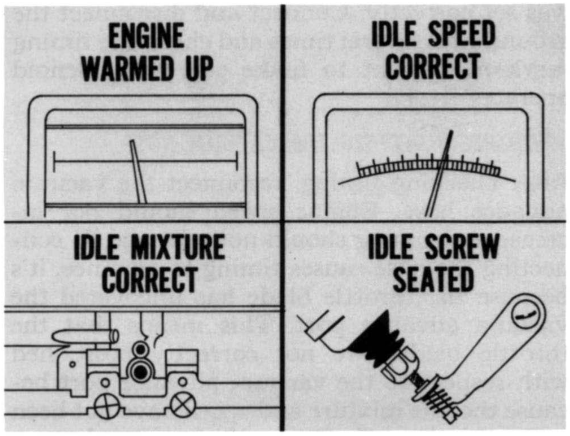


Fig. 28—To check or adjust ignition timing

The usual precautions, plus a few new ones, prevail when checking ignition timing. The engine should be fully warmed up so the fast idle cam is off and the engine is running at warm-engine idle. The idle speed and mixture adjustment must be correct and the solenoid ground circuit closed so the distributor solenoid is energized.

Before checking timing, disconnect the distributor vacuum advance hose and plug it to make sure there is no vacuum applied to the vacuum advance diaphragm. Be careful, when removing the vacuum advance hose, so that you do not disturb the vacuum advance unit. If the vacuum hose fits tightly and if you are careless, you could upset vacuum advance calibration when removing vacuum advance line from the carburetor and then cap the vacuum hose nipple at the carburetor. Others use a spring clamp to pinch off the vacuum advance line. If a spring clamp is used, it must be strong enough to completely close the line to vacuum but must not damage or collapse the vacuum hose permanently.

DON'T DISCONNECT THE SOLENOID

The distributor solenoid must be connected and energized when checking or setting timing. Incidentally, never try to disconnect either of the solenoid leads from the control unit. Some early production connectors looked like the removable type but they were not designed to be removed and pulling or prying them off will damage the solenoid control unit.

THE VACUUM ADVANCE ISN'T A HANDLE

It is easier to control timing adjustment if the distributor clamp screw is fairly snug so that distributor movement can be accomplished in very small steps. If you have difficulty moving the distributor, don't make the mistake of using the vacuum advance unit for a turning handle in order to gain a little extra leverage. This is a sure way of upsetting vacuum advance calibration. Instead, grasp the distributor housing itself. Where a very fine timing adustment is desirable, some technicians use a very blunt screwdriver or drift to tap on the

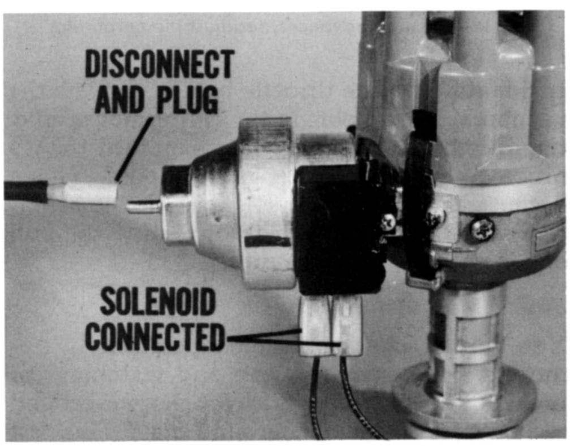


Fig. 29—Do not disconnect the distributor solenoid

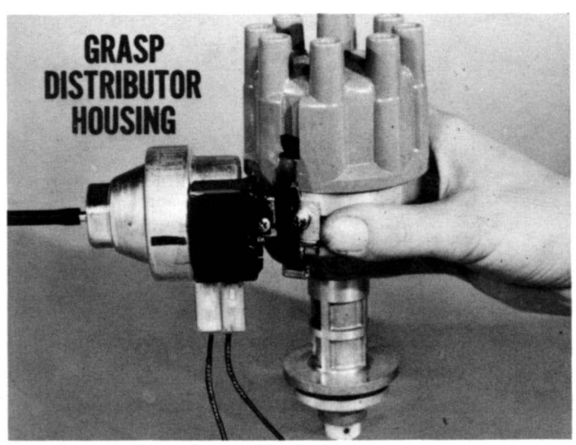


Fig. 30—Don't use the vacuum unit as a turning handle

head of one of the distributor cap hold-down clamp screws. This works fine *providing* you are very careful and use a lot of good judgment instead of too much force.

On engines where you can't watch the timing marks while adjusting the distributor, a tachometer provides a good clue to timing change. A degree or two advance in timing will register a noticeable increase in engine speed . . . retarding the timing will cause a drop in engine speed. With experience, you can judge timing change fairly well by noting engine speed change. Make the final check with the timing light and recheck timing after tightening the distributor clamp screw to make sure it has not changed.

CHECKING THE DISTRIBUTOR SOLENOID

While the timing light is connected, you can use it to check distributor solenoid operation. Simply disconnect the solenoid ground lead, located near the carburetor, so that the solenoid is no longer energized. This should cause timing to advance at least five degrees and engine speed should increase noticeably. This shows that the solenoid is working and capable of holding the breaker plate in the fully retarded position.

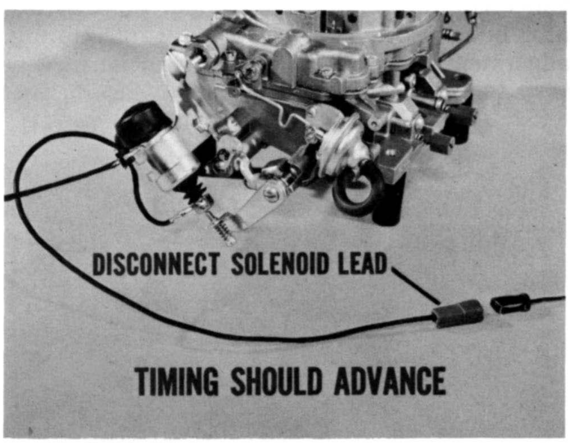


Fig. 31—To check distributor solenoid operation

When the solenoid ground lead is reconnected, engine speed should decrease and the timing should move back to the specified mark if it was set correctly. Connect and disconnect the ground lead several times and check the timing mark movement to make sure the solenoid operates freely.

WHEN RECONNECTING THE VACUUM HOSE

After checking timing, reconnect the vacuum advance hose. Engine speed should *not* increase and timing should not advance. If connecting the hose causes timing to advance, it's because the throttle blade has uncovered the vacuum advance port. This means that the throttle blades are not correctly positioned with respect to the vacuum advance port because the idle mixture and speed have not been correctly adjusted. This condition must be corrected to obtain satisfactory engine operation.

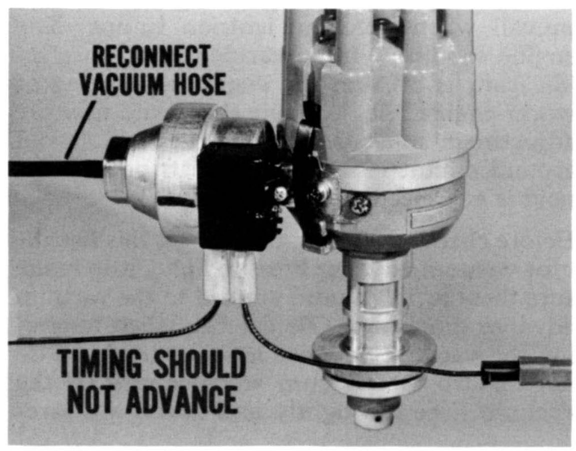


Fig. 32—If timing advances, readjust the carburetor

Incidentally, if the throttle blade uncovers the vacuum advance port in the carburetor at idle, the distributor solenoid will *not* retard the ignition at closed throttle as it should. That's because the pull of the solenoid on the armature is not great enough to overcome the pull of the vacuum advance unit.

YOU CAN'T DO IT THIS WAY

You cannot check solenoid operation by removing the distributor cap and watching for breaker plate movement as you disconnect and reconnect the solenoid ground lead. This test is not reliable for a couple of reasons.

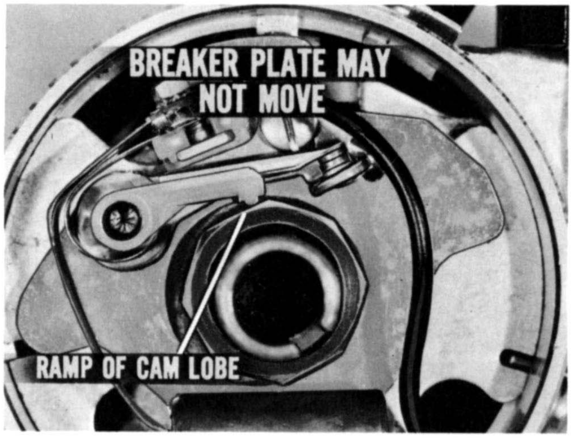


Fig. 33—This is not a valid solenoid test

The breaker plate may not be moved by the solenoid if the ignition point rubbing block happens to be on one of the cam lobe ramps. That's because the ramp angle plus the resistance of the movable breaker point spring may be too great to be overcome by the pull of the solenoid. Even if the breaker plate does move, it isn't easily detected because total movement is less than 1/16 of an inch.

DON'T SET TIMING THIS WAY

A few technicians have made the mistake of disconnecting both the vacuum advance unit and the solenoid ground lead and then setting timing ten or twelve degrees before top dead center. The reasoning seems to be that timing would be pulled back to correct basic timing when the solenoid lead was reconnected. DON'T TRY IT! You just might blow an engine.

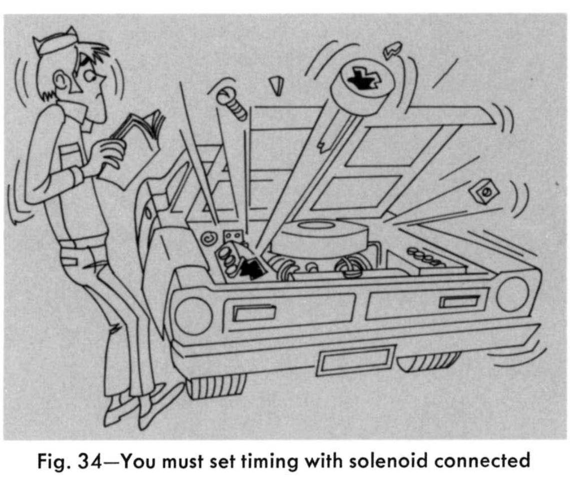


Fig. 34—You must set timing with solenoid connected

If timing were set ten degrees before TDC with the solenoid disconnected and the solenoid armature happened to be stuck in the retarded position, timing could advance as much as an additional ten degrees when the solenoid got "unstuck". This would result in a basic timing in the neighborhood of twenty degrees before TDC. Needless to say, that could knock the heads out of pistons and cause other serious damage.

A PARTING WORD ABOUT IGNITION TIMING & DWELL

Breaker plate movement affects dwell readings. Since dwell specifications are based on "no vacuum advance" and "no solenoid retard", both the vacuum advance hose and the solenoid lead at the carburetor *must be disconnected* before checking dwell. So remember that ignition timing is set with vacuum disconnected and solenoid connected, but dwell is checked with both vacuum and solenoid disconnected.

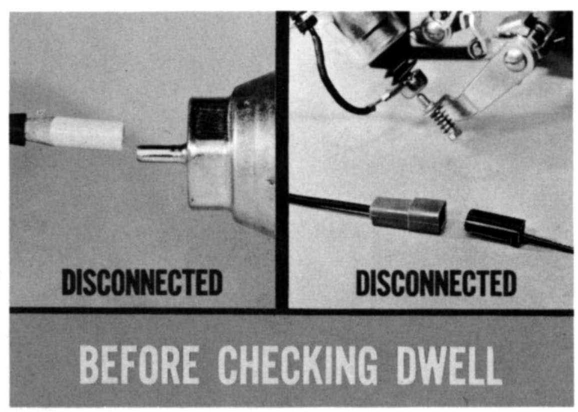


Fig. 35—Disconnect both the solenoid and the vacuum

It is most important to have dwell exactly correct for all off-idle driving conditions when the solenoid is not energized. If dwell is set with the solenoid connected, it would be incorrect under off-idle driving conditions and performance would suffer.

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