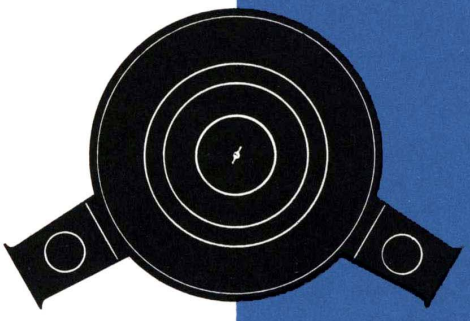
MASTER TECHNICIANS
SERVICE CONFERENCE

REFERENCE BOOK 70-6

HEATED AIR INTAKE AND "VAPOR SAVER"



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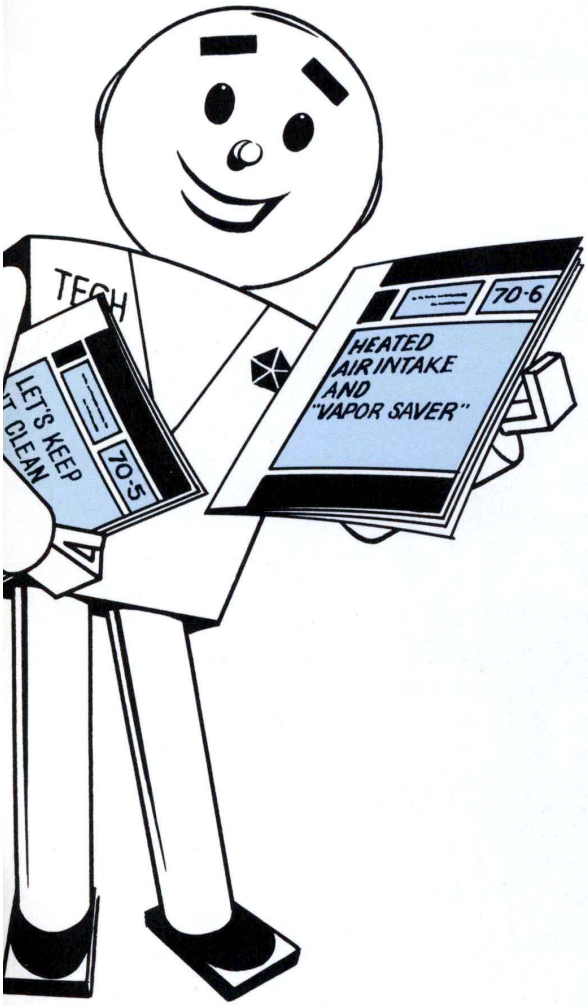

HERE'S THE REST OF THE STORY

Last month's session was all about design improvements in the 1970 engines to insure cleaner combustion and reduced exhaust emissions. Everything but the heated air intake and the evaporation control systems was covered. These two systems are a very important part of the overall effort Chrysler Corporation is making to control exhaust and fuel vapor emissions. So, along with last month's Reference Book, this month's will give you the complete story on cleaner air systems.

Since both the Heated Air Intake System and the Evaporation Control Systems are new this year, a large portion of this month's session deals with the operating principles of the systems. The Evaporation Control System shouldn't require any maintenance in normal service. There are no repairs or adjustments that can be made to components of the Heated Air Intake System; if they are faulty, they are simply replaced. However, testing the system is critical to determine which of the components is at fault.

As soon as you find the time, grab a cup of coffee or a Coke and read the Reference Book slowly and carefully. I'm sure you'll find it both informative and helpful.

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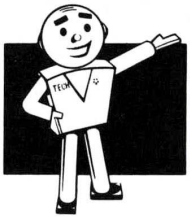


INTRODUCTION

The heated air intake system and the evaporation control system—or Vapor Saver—are two more steps forward by Chrysler Corporation to effectively reduce the emission of pollutants to the atmosphere. The heated air intake system works to lower exhaust emissions, whereas the evaporation control system prevents the loss of fuel vapors or liquid fuel prior to combustion. Without getting into specifics right now, let's see how each system gets the job done.

HEATED AIR INTAKE SYSTEM

The heated air intake system is not standard on all Chrysler Corporation engines. You'll find the heated air intake on all engines except the 340-cubic-inch, the 426 Hemi, and the 440's with three two-barrel carburetors. Of course, any engine equipped with the fresh-air scoop option won't have the heated air intake system.

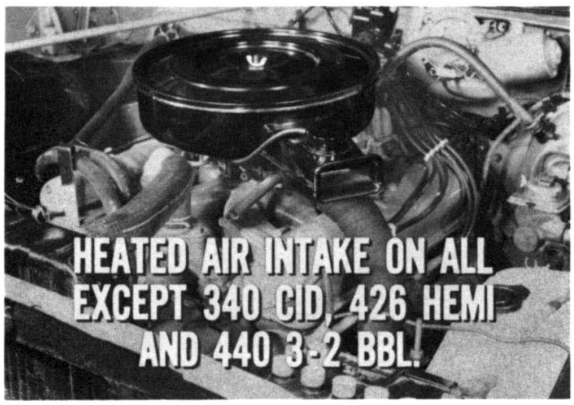


Fig. 1—Heated air intake system is not standard

TWO DIFFERENT SYSTEMS

There are two heated air intake systems—a single-snorkel system and a dual-snorkel system. I'm sure you all know that the air cleaner inlet is called the snorkel. Engines with two-barrel carburetors and the New Yorker and

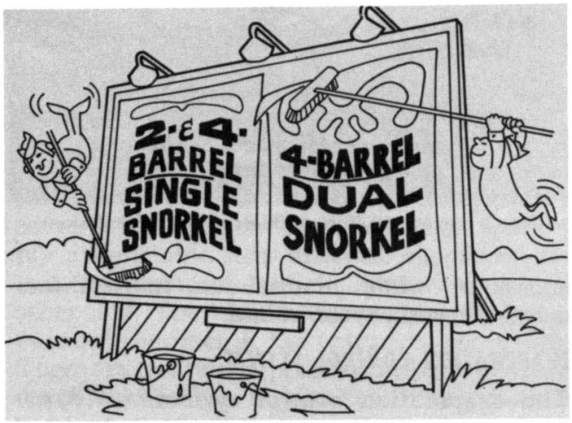


Fig. 2—"Snorkel" is the air cleaner inlet

Imperials with the standard 440 engine have the single-snorkel system. The 370-horse 440 and all other V-8's with four-barrels have the dual-snorkel system. The additional snorkel draws only underhood air and is operated by intake manifold vacuum only.

WHY HEATED AIR?

Some of you are probably wondering why the heated air intake system was developed for the 1970 engines. With the new air intake system, the air entering the carburetor is heated in cold weather to give warm-weather driveability. Use of this system is a step towards better fuel economy, particularly during winter driving. The reason for this is that the heated air intake system allows faster, more efficient engine warmup with better economy and reduced emissions during warmup.

REDUCED EMISSIONS

By using the heated air intake system, it was possible to design the engine, establish ignition timing, and calibrate the carburetor to get good, clean, combustion at uniform temperatures instead of compromising to cover a wide range of temperature conditions. Therefore, the heated air intake system permits leaner air/fuel mixtures to control exhaust

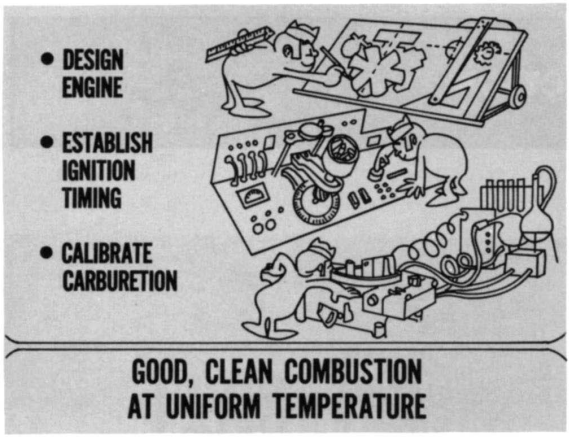


Fig. 3—Leaner air/fuel mixtures to control emissions

emissions, while maintaining mid-summer driveability the year round.

EVAPORATION CONTROL SYSTEM

The evaporation control system, or Vapor Saver, prevents the loss of liquid fuel or fuel vapors to the atmosphere from the fuel tank and the carburetor. By using vent lines, a vapor-liquid separator, overfill tank, and a special filler cap, loss of liquid fuel or vapors caused by expansion due to changing temperatures or maneuvering is eliminated.

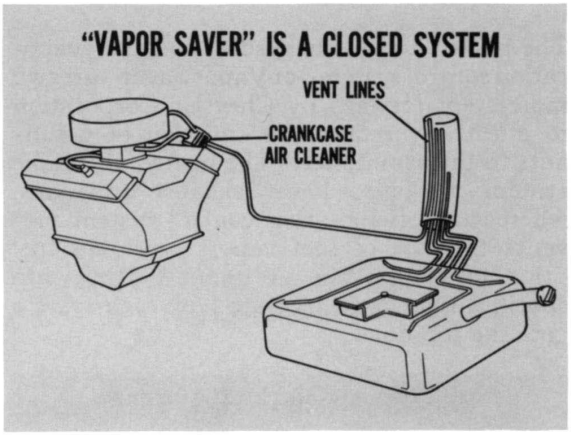
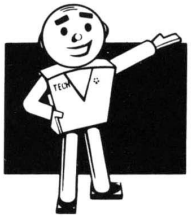


Fig. 4—Prevents loss of liquid fuel or fuel vapors



HERE'S HOW HEATED AIR INTAKE WORKS

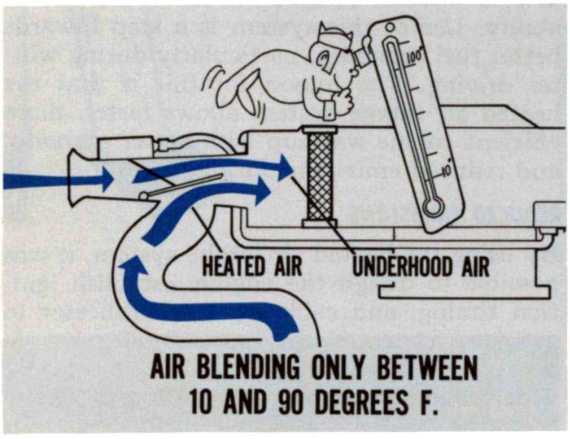


Fig. 5—There are two air flow circuits

You technicians may remember some of this from last month, but it's worth repeating. The heated air intake system operates as an air blending system, so it stands to reason that there are two air flow circuits. One circuit provides heated air and the other provides underhood air.

OVER NINETY—UNDER TEN

When the underhood temperature rises somewhere above ninety degrees, the heated air flow is shut off and the air flow is all underhood air. On the other hand, if underhood air entering the carburetor is below ten degrees, the air flow will be nothing but heated air. However, air blending occurs only when underhood temperatures are between ten and ninety degrees Fahrenheit.

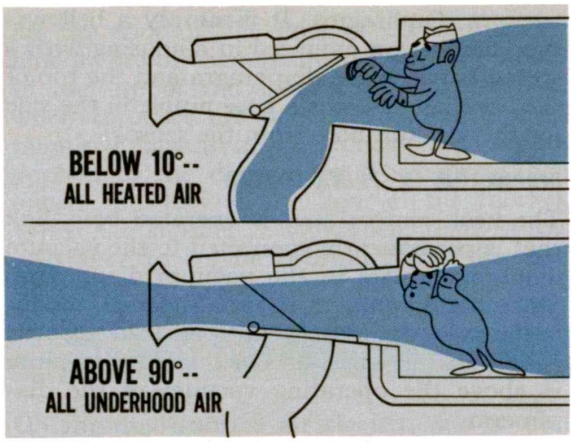


Fig. 6—No air blending under these conditions

AIR IS HEATED BY A STOVE

Attached to the exhaust manifold is a sheet-metal stove. Although it is called a stove, it is a duct or scoop to gather air for heating. Air entering the stove is heated as it passes over the hot exhaust manifold. As the air leaves the stove, it goes through a flexible duct into the snorkel, or air cleaner inlet.

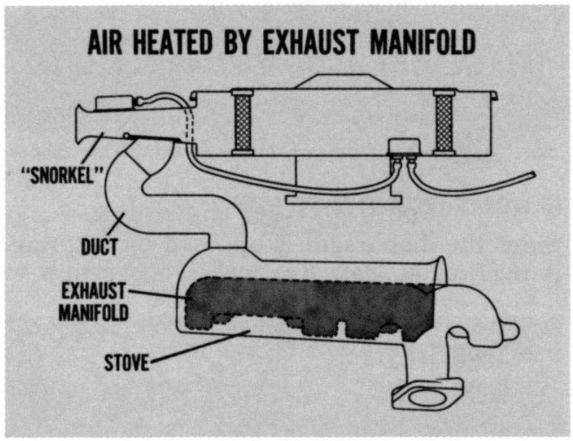


Fig. 7—"Stove" gathers air for heating

HEAT CONTROL DOOR

The amount of heated air flow is controlled by a heat control door in the snorkel. The heat control door is operated by a vacuum diaphragm which opens the door the proper amount to provide the right blend of heated and underhood air. Before we go any further, let's take a look at the control circuit for the heated air intake system.

TEMPERATURE AND VACUUM

The modulation of the induction air temperature is controlled by a temperature-sensitive vacuum valve. Intake manifold vacuum, acting on a diaphragm, operates the heat control door in the snorkel. Basically, the whole system is dependent on the temperature of the air entering the air cleaner to actuate the temperature-sensitive vacuum valve.

TEMPERATURE SENSOR

To make things easier, let's call the temperature-sensitive vacuum valve the "temperature sensor". The temperature-sensitive part is simply a bimetallic strip attached rigidly at one end that controls a small bleed valve at the other end. The bleed valve is connected to a vacuum chamber at the bottom of the sensor. There are two hose nipples at the bottom of the vacuum chamber. A vacuum hose connects one hose nipple—either one—to the base of the carburetor. The other hose is connected to the vacuum diaphragm on the snorkel.

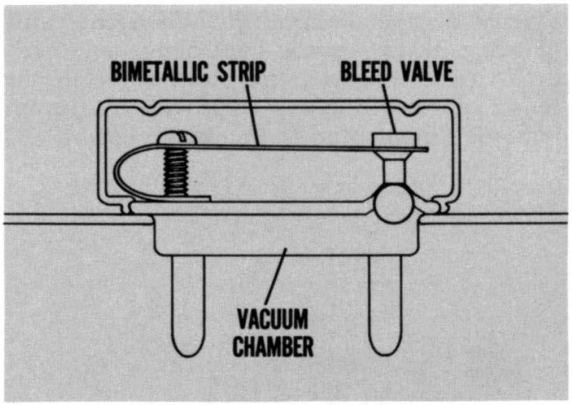


Fig. 8—Sensor controls vacuum to diaphragm

BELOW TEN DEGREES

When the temperature is lower than about ten degrees, the bleed valve is closed. Maximum intake manifold vacuum is applied to the vacuum diaphragm and the heat control door is all the way up in the "heat on" position.

AS THE SENSOR TEMPERATURE RISES...

. . . the bleed valve opens gradually. This vents the vacuum chamber and reduces the vacuum applied to the vacuum diaphragm. As

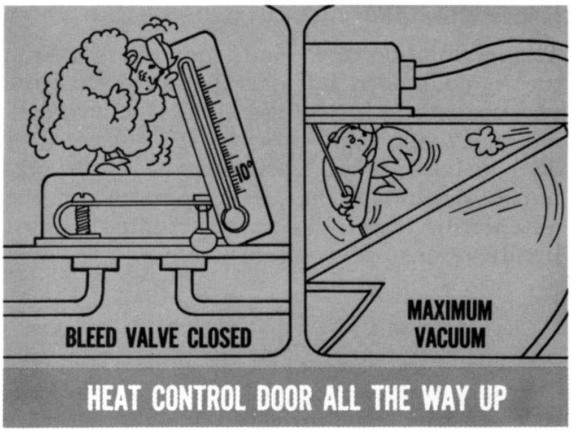


Fig. 9—When temperature is down, door is up

the vacuum decreases, the spring in the diaphragm housing pushes the control door down to *decrease* the heated air flow and *increase* the underhood air flow through the snorkel.

ABOVE 120 DEGREES

The object of the heated air intake system is to maintain the temperature inside the air cleaner between ninety and one-hundred-twenty degrees Fahrenheit. When the temperature at the sensor goes above one-hundred-twenty degrees, the bleed valve in the sensor opens all the way to provide maximum reduction in vacuum to the diaphragm.

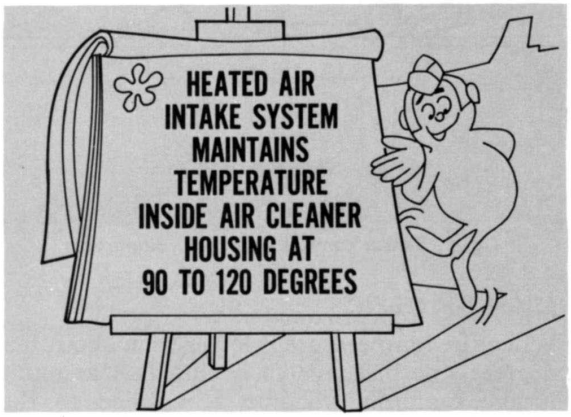


Fig. 10—The system takes a rest above 120 degrees

VACUUM DIAPHRAGM UNIT

The vacuum diaphragm that operates the heat control door works the same as many other vacuum diaphragms. It is simply a bellows-type diaphragm mounted in a housing with a spring between the diaphragm and the top of the housing. There is a hose nipple in the side for the vacuum hose from the sensor.

DIAPHRAGM IS SPRING LOADED

The heat control door is operated by a link that is permanently connected to the vacuum diaphragm plate in the vacuum diaphragm. Since the diaphragm is spring-loaded, modulation will occur only at road-load throttle conditions or when intake manifold vacuum is above the operating vacuum of the diaphragm.

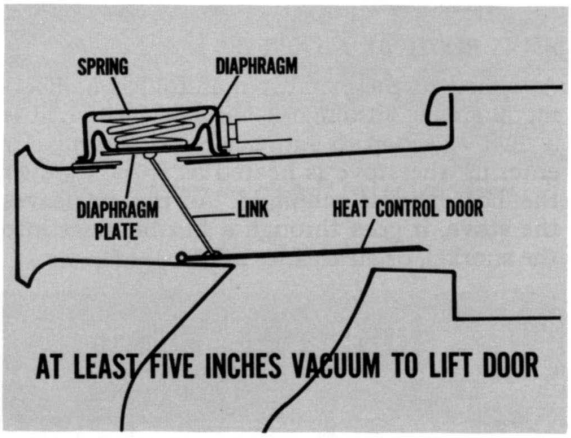


Fig. 11—Modulation only at road-load throttle conditions

IT WORKS FROM FIVE TO NINE

Since the diaphragm is opposed by a spring, it requires at least five inches of vacuum to

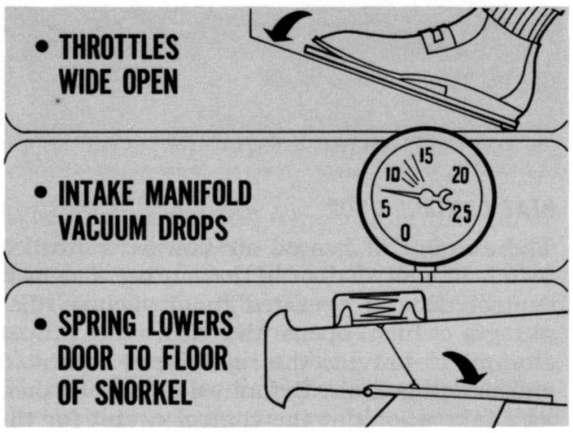


Fig. 12—Less resistance to engine breathing

lift the door off the floor of the snorkel. At nine inches of vacuum the door will be raised to the top of the snorkel. On acceleration, when throttles are opened wide, the intake manifold vacuum drops, reducing the vacuum applied to the diaphragm. The spring then lowers the door to the floor of the snorkel. When the snorkel is wide open, there is less resistance to engine breathing than through the heated air system.

DUAL-SNORKEL SYSTEM

On the dual-snorkel air cleaner, one snorkel is connected to the temperature sensor and draws heated air through the stove. It operates exactly the same as the single-snorkel air cleaner. The other snorkel draws only underhood air and operates strictly on manifold vacuum.

Fig. 13—Second snorkel operates on vacuum only

RIGHT SIDE CONTROL DOOR

The air control door is operated by a vacuum diaphragm that is identical to the one on the heat control door. The vacuum supply is drawn from a "tee" in the vacuum hose connected to the carburetor. During normal driving, intake vacuum is sufficient to keep the heat control door in the "up" position. So, most of the time, the right snorkel is closed to underhood air intake.

RIGHT DOOR OPENS ON HEAVY THROTTLE ACCELERATION

On heavy throttle acceleration, the intake manifold vacuum drops and the air door starts to open. The spring should start to push the door down when the vacuum drops to about nine inches. At five inches of vacuum, the door should be all the way down to the floor of the snorkel. At that time both snorkels are open to underhood air to provide maximum performance.

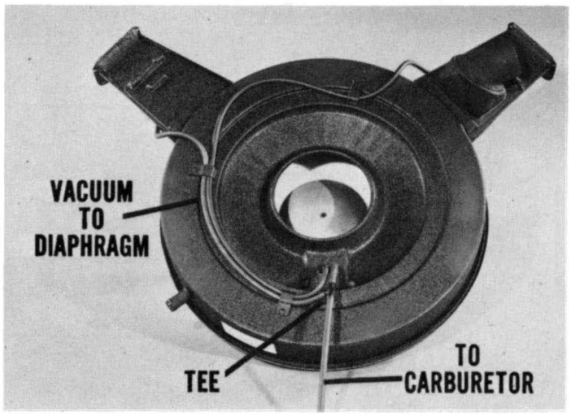


Fig. 14—Vacuum supply is drawn from carburetor

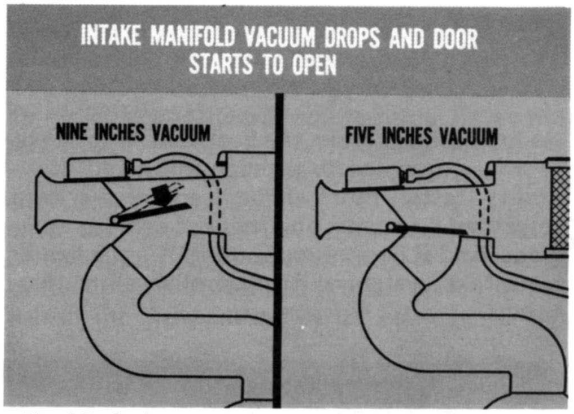


Fig. 15—On heavy acceleration, both snorkels are open

HIGH SPEED AND HIGH VACUUM

Don't get the false impression that at high speeds when manifold vacuum is still above nine inches that only one snorkel is open. Here's why. At high engine speeds, air velocity will create a pressure drop inside the air cleaner. So, you have *higher* pressure on one side of the control door and *lower* pressure on the other side. This pressure differential tends to open *both* doors regardless of manifold vacuum.

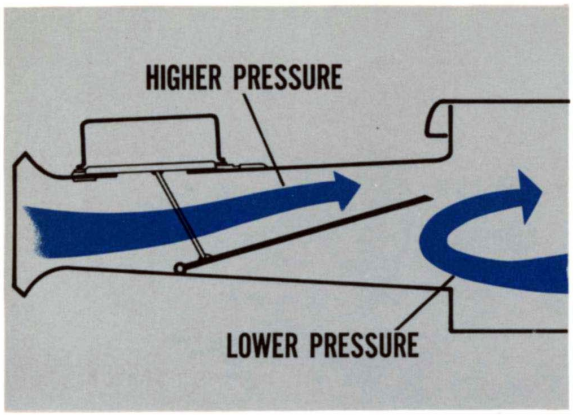
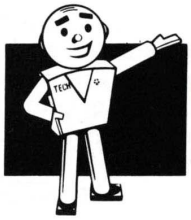


Fig. 16—Pressure differential tends to open both doors



TESTING AND SERVICE

As mentioned before, the heated air intake system was designed to provide improved driveability, faster, more efficient engine warmup, improved economy, and reduced exhaust emissions. And if everything is "A-OK", the heated air intake system will accomplish all of these things.

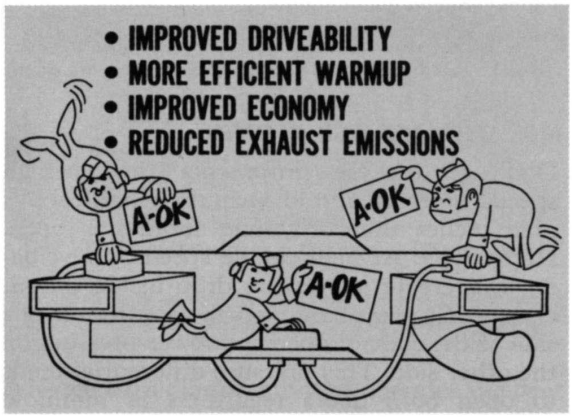


Fig. 17—Advantages of heated air intake

CHECK THE SYSTEM ON THE CAR FIRST

If the heated air intake system is not functioning properly, general performance, and especially efficiency and economy during warmup will be affected. And, of course, vehicle exhaust emissions are likely to be increased. The first checks that you make will be with the system on the car.

VACUUM HOSE CONNECTIONS

The first thing to check is to make sure that

Fig. 18—Make this check first

all the vacuum hoses and the flexible duct from the stove to the snorkel are properly attached and in good condition. Make sure that the vacuum hoses are not pinched at any place and that they are fully seated on the nipples.

COLD ENGINE CHECK

You will probably never get to check a cold engine in the service garage. But if you do, with the engine cold and an ambient temperature under ninety degrees, the door in the snorkel should be all the way up, or open to full heated air. Remember, the engine has to be running to provide vacuum at the diaphragm. Have someone else start the car while you look into the snorkel to watch the heat control door.

KEEP WATCHING

The exhaust manifold starts to heat the air almost immediately, so keep watching the heat control door to see if it starts to modulate the amount of heated or underhood air. Close the hood and warm up the engine, including the cooling system, to operating temperature. At this point, the door should be all the way down for full underhood air.

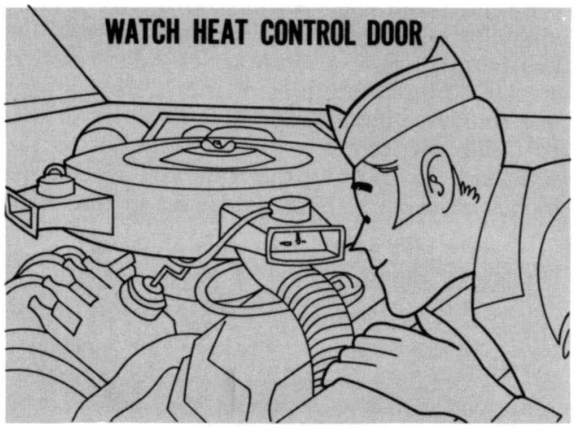


Fig. 19—Manifold starts to heat air almost immediately

GET READY FOR BENCH TESTING

Further testing of the heated air intake system will have to be done with the air cleaner on the bench. Disconnect the flex duct from the stove and remove the air cleaner from the engine. To avoid damaging the flex duct while you're testing, remove the duct from the air cleaner at the snorkel. Here's a little warning. Whenever you remove or install the flex duct at the snorkel, *never pull it off* or *force it on*. The snorkel inlet has a retaining ridge that acts as a threading device. Always thread the flex duct *on* or *off*. It takes at least two full turns to properly install it.

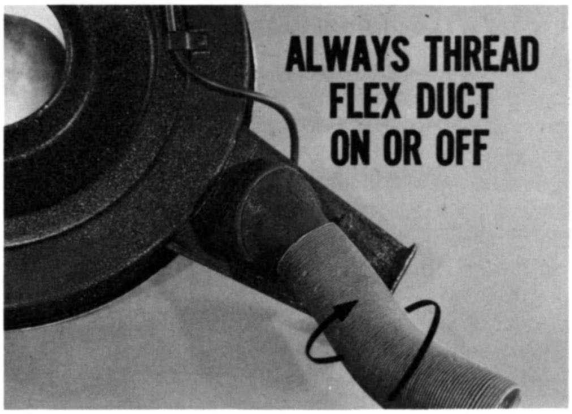


Fig. 20—Remove flex duct to avoid damage

COOL IT, MAN!

With the air cleaner on the bench, cool the temperature sensor to below ninety degrees. The quickest and easiest way to do this is with an air hose and nozzle pointed directly at the sensor. However, keep the nozzle at least eight to ten inches away from the sensor to avoid upsetting the calibration of the bimetallic strip and bleed valve. Remember, without any vacuum, the heat control door will move to the down position and remain there regardless of the temperature at the sensor.

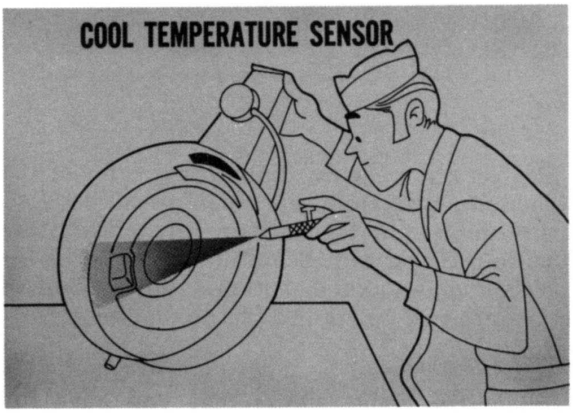


Fig. 21—Quickest and easiest way is with an air hose

USE INTAKE MANIFOLD VACUUM

Use a long piece of hose to connect the sensor to intake manifold vacuum. Although the Service Manual says to use a vacuum pump, most engines at an idle will provide ample vacuum. If you have a vacuum pump, go ahead and use it. With intake vacuum applied to the sensor, the heat control door should move to the "up" position as when open to heated air. If the door does not rise to the "heated air" position, the next step is to check the vacuum diaphragm to make sure it is operating properly.

GET READY

The Service Manual also calls for a vacuum pump to test the diaphragm. However, as mentioned earlier, if a vacuum pump is not available, use the intake manifold vacuum as in the previous test. For a complete test, you'll also need a shut-off device, a bleed valve, and a vacuum gauge connected in that order.

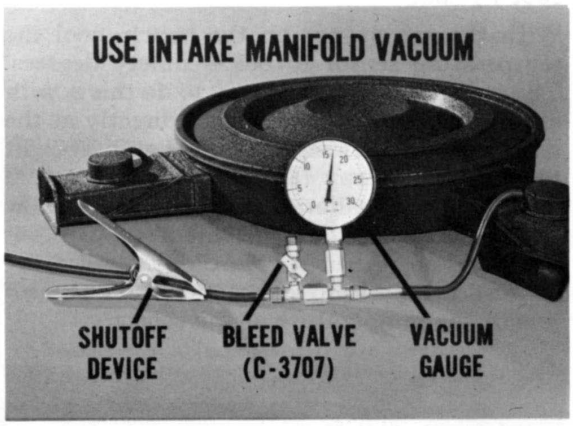


Fig. 22—Here's what you need for complete test

GET SET

To test the vacuum diaphragm, connect the vacuum hose from the manifold directly to the diaphragm rather than the temperature sensor. Be sure the shutoff is open and the bleed valve closed so that full manifold vacuum can be applied to the diaphragm.

TEST FOR LEAKS

When the gauge shows that you have full manifold vacuum, close off the vacuum line.

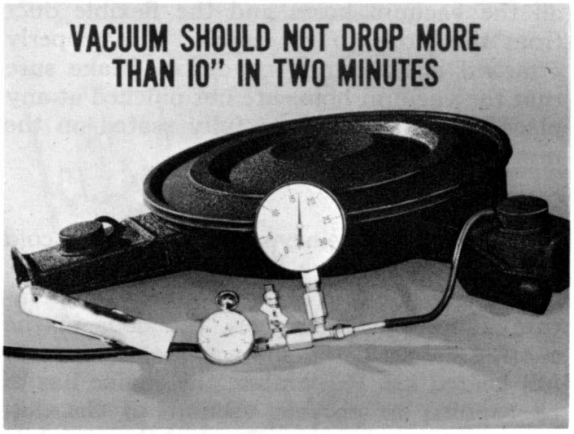


Fig. 23—Use full manifold vacuum for this test

Of course, if you can't register full manifold vacuum on the gauge, it's a pretty good indication that you have a bad diaphragm. After you have full vacuum, the diaphragm vacuum should not drop more than ten inches vacuum in two minutes. After checking for leaks, open the shutoff device and release the vacuum by opening the bleed valve.

CHECK HEAT CONTROL DOOR OPERATION

To check the modulation of the vacuum diaphragm, build the vacuum slowly by gradually closing the bleed valve and observe the heat control door operation. The door should start to lift off the floor of the snorkel at not less than five inches vacuum. As you continue to build vacuum, the door should lift to the full "up" position by the time you reach nine inches of vacuum. The right side, or non-heat

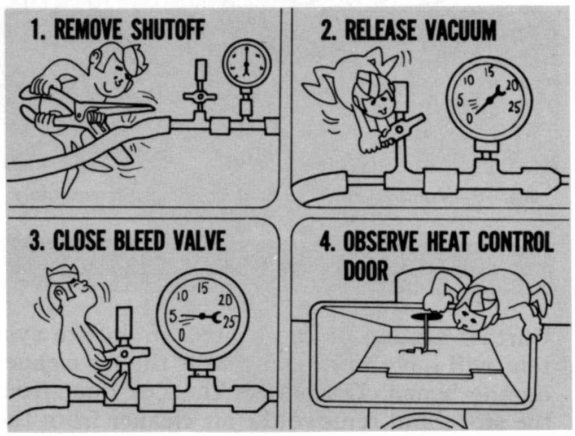


Fig. 24—This test is good for both snorkels

side, of the dual snorkel air cleaner is checked the same way as the left side except that there is no temperature sensor to check.

SERVICE PROCEDURES

Once you have determined that there is a faulty temperature sensor or vacuum diaphragm, it will be necessary to replace either with a new unit. There are no adjustments that can be made on either of the components, nor can they be repaired.

REMOVE VACUUM DIAPHRAGM

First, remove the vacuum hose. Then bend the forward lock tab straight down. Lift the diaphragm until the lock tab clears the slot. Slide the unit forward to disengage the rear lock tab. Then move it to the right to unhook the operating link from the control door.

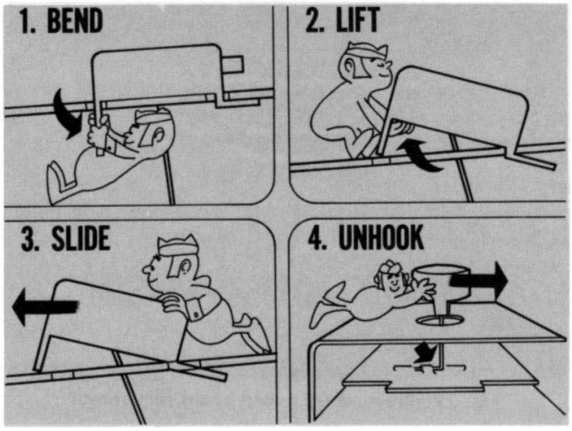


Fig. 25—To make it easy, follow these steps

CHECK HEAT CONTROL DOOR

With the diaphragm removed, check the heat control door for freedom of travel. Lift the door to the "up" position, or top of the snorkel. When you let go of it, it should fall freely to the floor of the snorkel. If it doesn't, check the snorkel side walls for interference or deposits of foreign matter, and check the hinge pin for deposits.

CHECK THE OUTSIDE, TOO

On the outside of the snorkel, make sure there is no physical damage in the area of the hinge pin. If necessary, remove any foreign matter

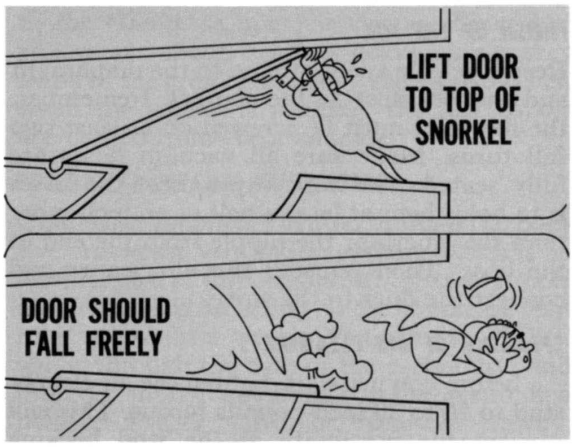


Fig. 26—Check door with diaphragm removed

such as paint blobs, burrs, or whatever, from snorkel side walls or door edges. Also, make sure that the door works freely without binding at the hinge.

INSTALLATION

To install the vacuum diaphragm, reverse the removal procedure. But, before you bend the front lock tab, apply manifold vacuum to the diaphragm while holding it against the snorkel and bend the front lock tab toward the end of the snorkel. Make sure the door operates freely by applying and releasing vacuum. It isn't a good idea to move the heat control door by hand. You might cock the rod or diaphragm and restrict the operation of the door. If the diaphragm has been cocked, it can be recentered by applying vacuum.

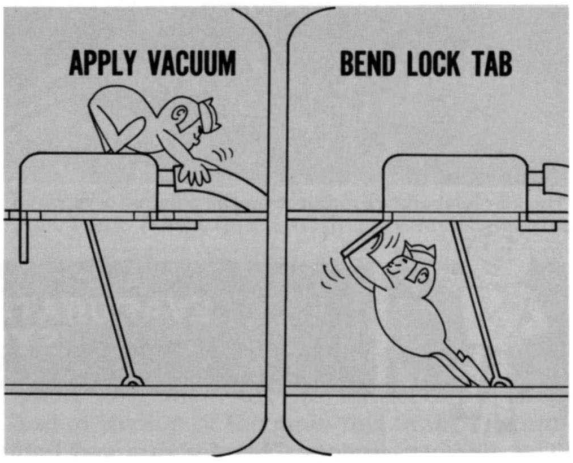


Fig. 27—Applying vacuum fully seats diaphragm

FINISH UP THE JOB

Reconnect the vacuum hose to the diaphragm and the flex duct to the snorkel. Remember, the flex duct must be screwed on at least two full turns. Make sure all vacuum hoses are fully seated. The best way to seat the hoses is to hold them at least a half of an inch more than the length of the nipple from the end of the hose. Then reinstall the air cleaner and connect the duct to the stove.

SPEAKING OF AIR CLEANERS...

. . . before you install it, tighten the air cleaner stud to 20 to 30 inch-pounds torque. This will prevent the possibility of the stud backing out; which finger-tightening will not do. Another thing—the air cleaner and carburetor are a matched set. So, if you replace the air cleaner for any reason, make sure that you use the right type to avoid upsetting the balance in the carburetor.

TEMPERATURE SENSOR REPLACEMENT

Replacement of the temperature sensor is relatively simple. Disconnect the vacuum hoses and remove the retainer clips. Remove the temperature sensor with the gasket and discard both. To install the new sensor, position a new gasket on the sensor and install it. When installing the sensor, push against the vacuum chamber, or bottom, of the sensor, and not the guard. Install new retainer clips securely to compress the gasket and form an air seal between the sensor and the air cleaner.

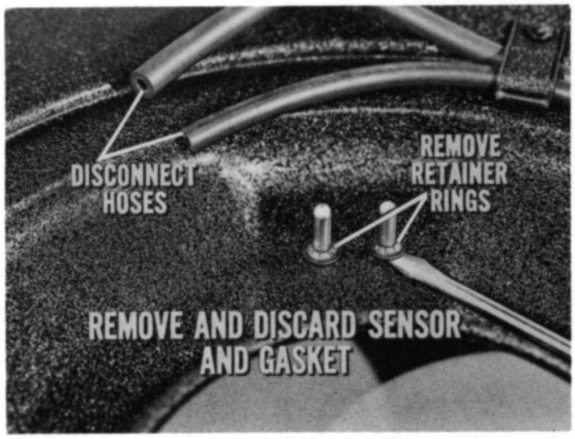


Fig. 28—Temperature sensor cannot be adjusted or repaired

A COUPLE OF SMALL WARNINGS

There are a couple of things you should be careful of when installing the sensor. Don't *ever* put any pressure on the guard, or top, of the sensor. Enough pressure on the guard could separate the guard from the vacuum chamber and ruin the sensor. The other thing is—don't attempt to adjust the temperature sensor; you'll only foul up the calibration.

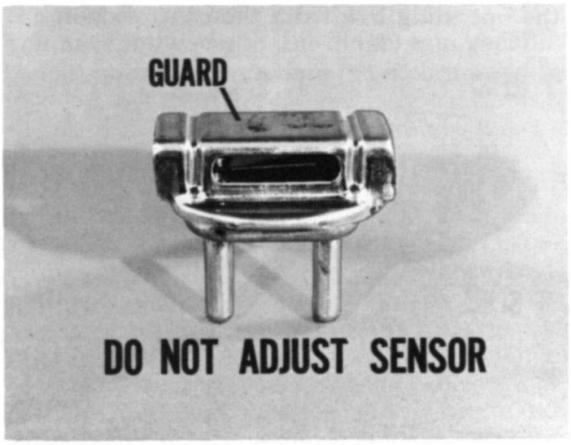
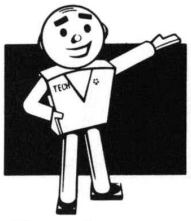


Fig. 29—Pressure on guard could ruin sensor

BUTTON IT UP

Install the air cleaner on the car and check to make sure that the door opens as the engine warms up. Again make sure that the vacuum hoses and the flex duct from the stove are fully seated.



EVAPORATION CONTROL SYSTEM

The nineteen-seventy Chrysler cars and light trucks sold in the State of California have the evaporation control system. And it's a good bet that in the near future it will be standard production on all Chrysler products.

IT'S BEEN DUBBED "VAPOR SAVER"

The evaporation control system reduces loss of fuel or fuel vapors to the atmosphere. The system has been dubbed, and is commonly referred to as the "Vapor Saver"; and that's what we'll call it from here on.

Fig. 30—Vapor Saver will be on all cars in near future

VAPORS TO CRANKCASE, LIQUID TO TANK

The Vapor Saver is a closed ventilation system that prevents loss of fuel vapors or liquid fuel from the fuel tank or carburetor through evaporation, expansion, or spillage. Fuel vapors pass through vents to the crankcase. Liquid fuel is returned to the tank.

VAPORS ONLY PAY A BRIEF VISIT

Vapors pass through vent lines from the tank to the crankcase inlet air cleaner. Since fuel vapors are about twice as heavy as air, they settle in the crankcase above the oil. However, when the engine is running, the fuel vapors are purged from the crankcase.

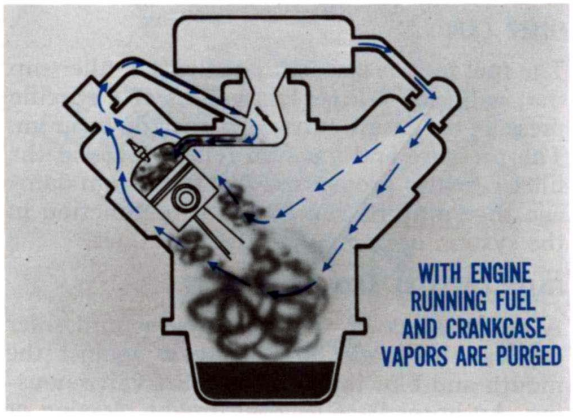


Fig. 31—Fuel vapors settle in crankcase

POSITIVE CRANKCASE VENTILATION

Crankcase vapors are vented through the positive crankcase ventilation system, which is an existing part of the Cleaner Air System. Intake manifold vacuum acting on the crankcase vent tube, draws the vapors through the P-C-V valve, through the base of the carburetor, and into the intake manifold. In the event of a plugged P-C-V valve, or excessive blowby, crankcase vapors are vented into the air cleaner. This way, *all* crankcase vapors are burned by engine combustion.

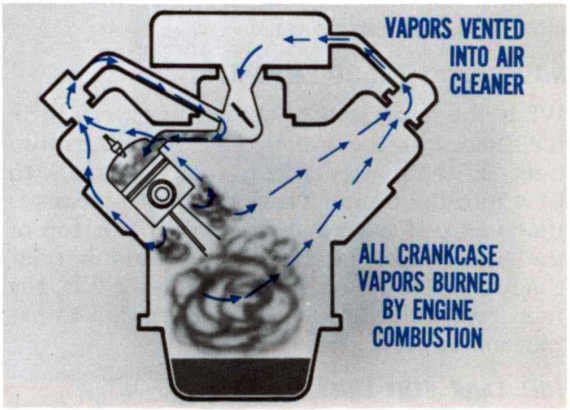


Fig. 32—Manifold vacuum draws vapors from crankcase

"VAPOR SAVER" FUEL TANK

Since the fuel tank is the largest storehouse of liquid fuel on the car, it stands to reason that vapor or liquid loss is more likely to occur from the tank than any other place. To prevent loss of liquid fuel or fuel vapors, the fuel tank is equipped with an overfill limiter tank, pressure-vacuum relief filler cap, and vent lines and separator. Let's take a look at them one by one.

OVERFILL LIMITER TANK

There is a small overfill limiter tank inside and at the top of the main fuel tank. The limiter tank holds approximately one and four-tenths gallons. The passage entering the lim-

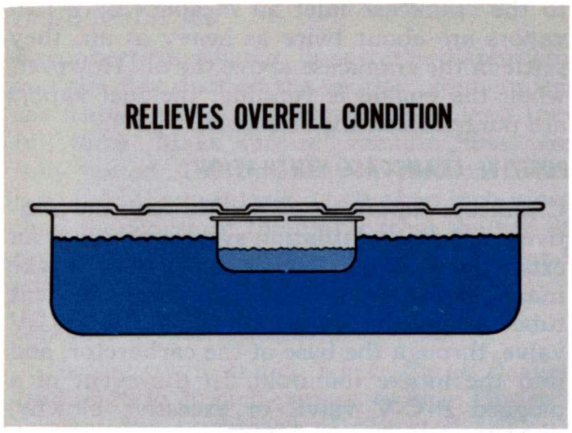


Fig. 33—Limiter tank fills slower than main tank

iter tank from the main tank is very small. Because of this, the limiter tank fills much slower than the main tank.

NO FUEL LOSS DUE TO EXPANSION

While the main tank is being filled, very little fuel flows into the limiter tank. After the main tank is completely filled, fuel continues to flow into the limiter tank. What this means is that you can fill the main tank to the top of the filler neck and the limiter tank is relatively empty. When the limiter tank fills, the fuel level is lowered and fuel loss due to expansion is prevented.

FUEL TANK VENT LINES

Internal vent lines at the upper corners of the fuel tank are connected to a vapor liquid separator by rubber hoses. The vent lines are at different heights so that the tank will always be vented regardless of vehicle attitude. The C-body station wagon fuel tanks have only one vent line and do not use a separator. A high loop in the vent line limits transfer of liquid fuel to the crankcase air cleaner.

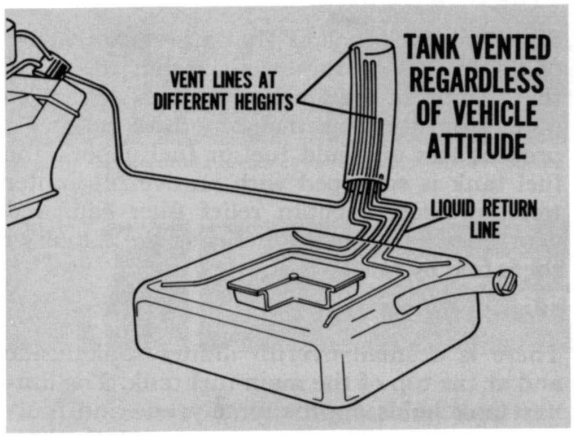


Fig. 34—Station wagon fuel tanks are slightly different

VAPOR-LIQUID SEPARATOR

The vapor-liquid separator is simply a piece of two-inch tubing that holds the four vent lines from the tank and a vent line which leads to the crankcase inlet air cleaner. Because liquids are heavier than vapors they will settle to the bottom of the separator. The shortest vent line in the separator is to return any liquid fuel that may enter the separator during maneuvering or incline parking. The vent line to the crankcase is at the top of the separator to minimize liquid transfer to the crankcase.

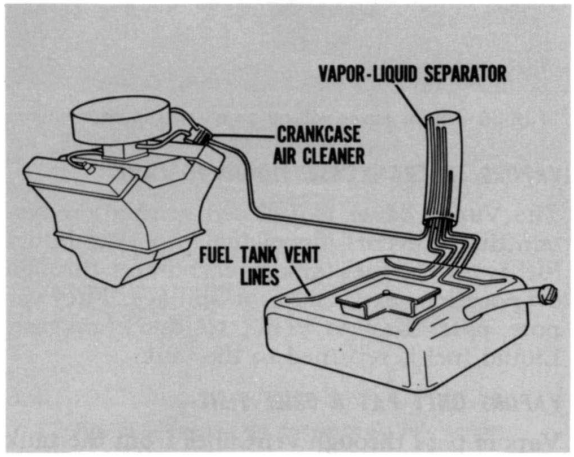


Fig. 35—Vapor Saver controls evaporation

FILLER CAP

The fuel tank is also equipped with a filler cap that will only release fuel vapors at a specific pressure or let air enter at a specific vacuum. The pressure and vacuum relief valves in the filler cap also protect the fuel tank from damage that may be caused by a malfunction in the system or damage to the vent lines.

FILLER CAP TEST AND REPLACEMENT

A quick check of the pressure-vacuum filler cap can be made by placing it against the mouth and blowing into the relief valve housing. An immediate leak with light blowing or lack of release with hard blowing indicates a

Fig. 36—Relief valves in filler cap protect fuel tank

defective or incorrect unit. The cap is identified by the words "pressure" and "vacuum", and for the system to remain effective, must be replaced by the same type filler cap.

CARBURETOR VENTILATION

The Vapor Saver also includes ventilation of fuel vapors from the carburetor fuel bowls. When the engine is shut down, the carburetor temperature usually rises and some fuel is evaporated from the fuel bowls. These fuel vapors travel by gravity from the carburetor into the crankcase for storage and are later burned during normal combustion.

SIX'S ARE DIFFERENT

On eight-cylinder engines, the fuel bowls are vented to the crankcase air cleaner along with the tank vent lines. On the six-cylinder models, the fuel bowl is vented to the crankcase through a passage in the fuel pump.

BLEED DEVICE IMPROVES HOT STARTING

The six-cylinder fuel pump also has a bleed device that prevents pressure buildup between the fuel pump and the carburetor. This bleed device improves hot starting. The six-cylinder engines without the Vapor Saver system use a fuel pump that has a bleed device but does not have the vapor passage. If it is necessary to replace a fuel pump, make sure that you install the correct one.

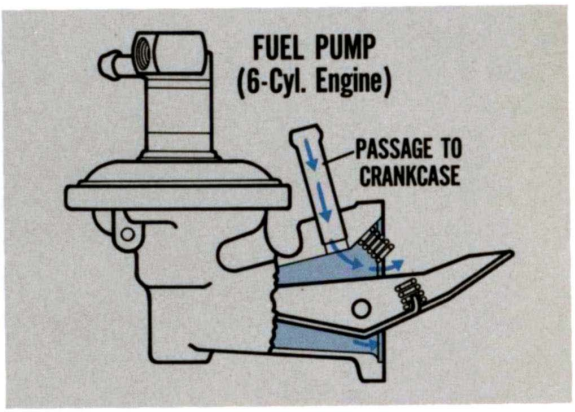
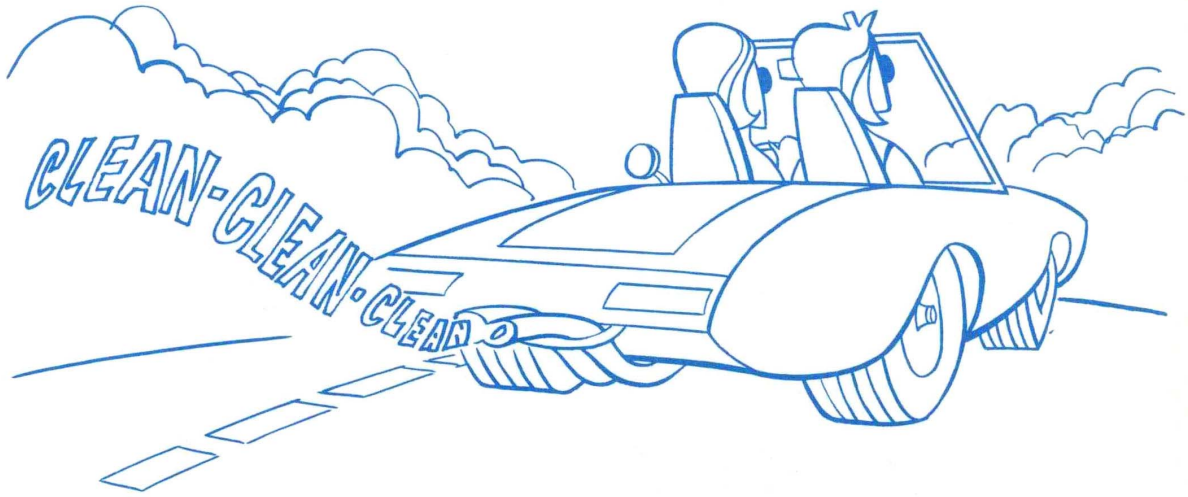


Fig. 37—Use correct pump when replacing



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