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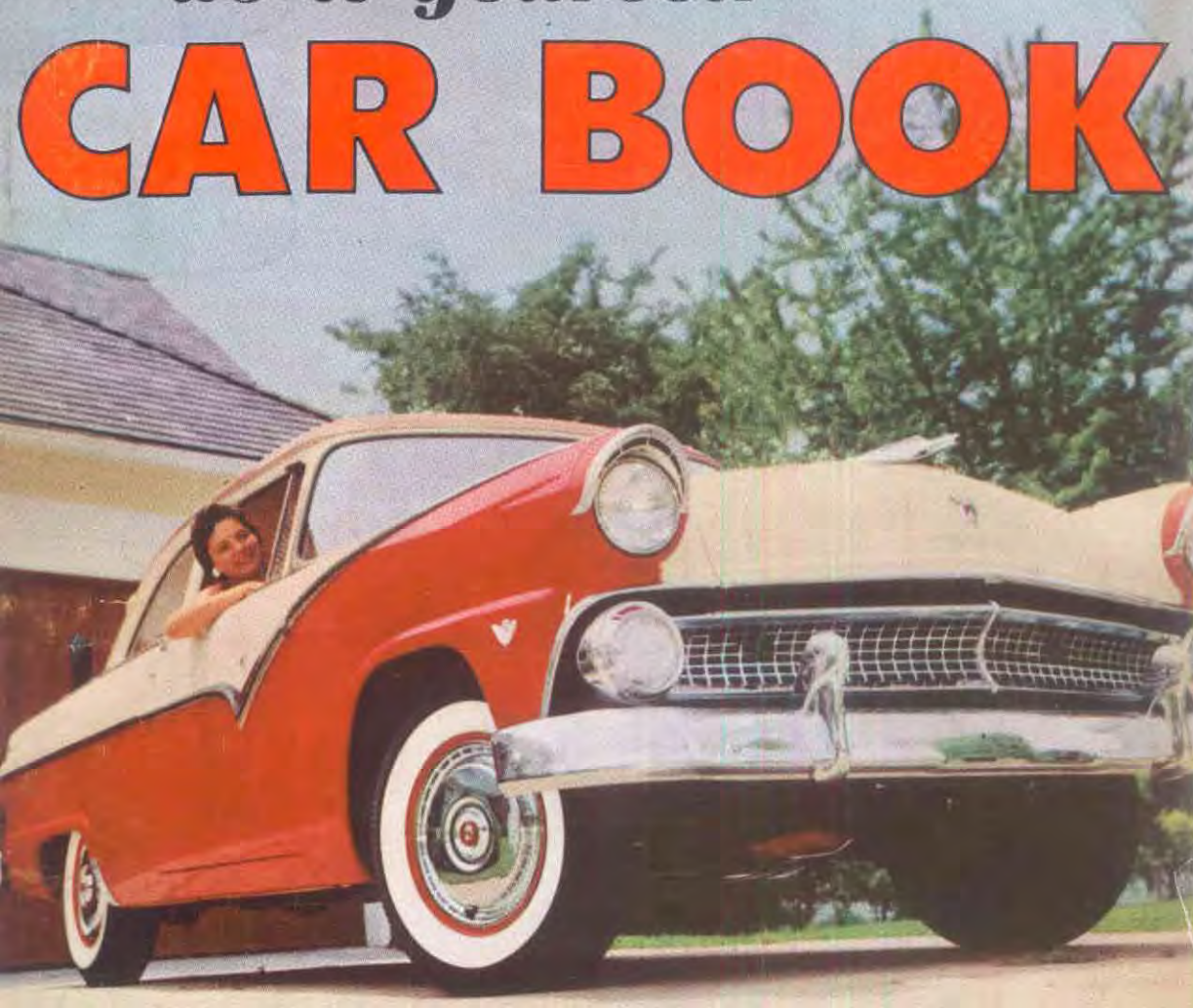
CAR BOOK



HOW TO ADJUST DISTRIBUTOR • SAVE GAS AND OIL • INSTALL NEW ENGINE • ALIGN FRONT END • REPAIR WIRING • INSTALL POWER BRAKES • ALIGN HEADLIGHTS • INSTALL NEW FRONT END • CLEAN AND PROTECT BODY • INSTALL TUBELESS TIRES . . . and much more!

Hundreds of Ways to Save Money on Your Car, Prolong Its Life, Get Top-Notch Performance

POPULAR SCIENCE *Monthly*

do-it-yourself

CAR BOOK

PREPARED BY
THE EDITORS OF
POPULAR SCIENCE MONTHLY

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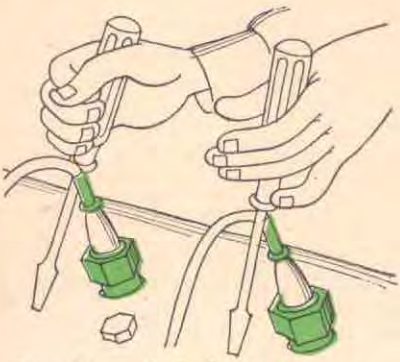
Spongy connections indicate hose decay



Screwdrivers check plug performance

How to siphon gas without sipping it

Direct action primes a parched carburetor

How to Escape

By Glen F. Stillwell

WHEN our car overheated on the climb to Clingmans Dome in the Great Smoky Mountains we missed half the scenery worrying about it. We were greatly puzzled because we had flushed the radiator, tightened the fan belt, tuned the motor and greased the chassis before starting out. Nevertheless, other cars were whizzing past while we plugged along nursing a sizzling engine. Then we were encouraged by the unpretentious sign: "Garage."

The lanky mechanic who worked there raised the hood and pinched the hose connections. "They're spongy. Bad sign."

"But they look good on the outside."

"That's the trouble. Hoses wear out on the inside. So do fan belts. Yours looks frayed and greasy where it hits the pulleys."

He was right. The interior of the hose had collapsed and the fan belt had lost much of its resilience. We thought we were all set when he installed new parts, but he detained us for a look at the spark plugs. "Sounds like you've got a miss."

Spotting a Bad Plug

With the engine running, he used two screwdrivers with insulated handles to short the plugs, two at a time. The tips of the screwdrivers were against the cylinder head, the shanks resting against the spark-plug terminals. When he lifted one screwdriver away, the engine picked up noticeably. "That one's all right," he said. "Notice how the engine picks up when I cut it in? On V-8 engines like this one it's hard to locate a bad plug by shorting them out one at a time."

It turned out, too, that the new spark plugs we had installed before starting on the trip were not properly adjusted. "New or old," he said, "spark plugs have to be gapped right before you install 'em. The points on these new ones are set too close. Causes overheating and power loss. Use a wire gauge to set the points."

While we made a note of this, he checked our

Car Troubles

oil. Then he crawled under the engine with a wrench. "Just want to make sure that the guy who changed your oil tightened the crankcase plug so it won't leak. Sometimes a guy gets in a hurry and a customer burns out a set of bearings."

"You should move to our town," we told him. "How about taking a look at the carburetor?"

He shook his head. "Don't bother it. Nothing much ever goes wrong with a carburetor, but it's generally blamed for everything from sticking brakes to water in the gas." He closed the hood. "You'd better fill your tank at the next stop. Gas runs short around here this time of year."

Mouth-Powered Vacuum Pump

We paid our bill with thanks and had no more trouble. But after we had filled up with gas we ran across another tourist who wasn't so lucky. However, he knew the trick of siphoning quickly without getting a mouthful.

He used ¼" rubber tube, about 4' long. He stuck one end of it into the tank and blew; he didn't suck. The sound of gasoline gurgling signaled that the tube was in it. Next, holding the tube between thumb and forefinger of the right hand, hand near mouth, he sucked gently but briefly. Then he pinched the hose shut before the gasoline could reach his mouth, lowered the free end of the tube into a clean container and waited a few seconds for the gasoline to start flowing.

This man's car wouldn't start because the fuel pump had lost its vacuum, and we couldn't push him because our bumper didn't match his. But he knew what to do.

He removed the air filter on his carburetor and squirted a little raw gas into the carburetor throat while his wife worked the starter button. The engine came to life with a roar.

The man thanked us and said that if we ever had trouble with a blocked fuel line to disconnect the line at the carburetor and try blowing through it with a tire pump. He told us also that he had trouble starting his car on cold or wet

To turn wheel nuts, right may be wrong

Simple surgery can unplug wiper tubing

What Makes Trouble on a Long Trip

Thirsty battery
Loose wiring
Dirty cooling system
Faulty spark plugs
Defective ignition
Dirty fuel system
Oil or fuel leaks
Faulty brakes
Defective steering
Slipping fan belt
Worn tires
Lack of lubrication
Gauge or accessory failure
Loose bolts or screws

mornings until he learned the trick of wiping off the spark-plug porcelains with a clean, dry rag before using the starter.

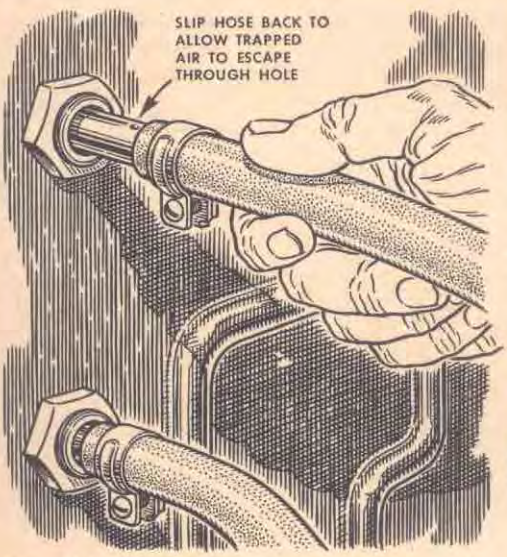
Before starting a trip west we rotated our tires as advised in the car manual: front to rear, left to right, spare to the right rear wheel. Nevertheless we had a flat, miles from a service station.

We hauled out the spare, removed the hub cap of the wheel with the flat and tried to loosen the wheel nuts before we jacked up the wheel. After a fruitless struggle we suddenly realized that while the wheel nuts on the right side had right-hand threads, those on the left side, like many other cars, had left-hand threads (turn counter-clockwise to tighten).

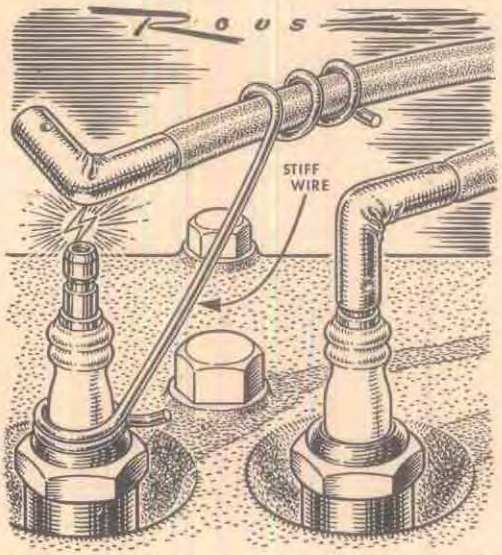
Scissors Snip Repairs Wipers

We hadn't figured on running into heavy rain in the California desert. But that's what happened and we were glad we had checked the windshield wipers before starting west. We were reminded of a friend who hadn't. He spent half a day of his vacation overhauling his wipers only to find, six naughty words later, that the rubber tubing was pinched shut where it was attached to the manifold. He repaired it easily by snipping off a short piece of this end and reattaching it.

Always suspect the obvious trouble. When the engine fails, look for an empty gasoline tank or a broken fuel line. Your overheating problem may be an empty radiator, bad hose connection or broken fan belt. When the electrical system fails, make sure that your battery isn't dead before you overhaul the wiring. Your loss of power might be due to a need of oil. Check at source the four essentials of car operation—gasoline, water, oil and electricity—before digging into the complicated units. END



Try this if your car heater becomes air-bound. Pull the hose connected to the upper heater tube back an inch and drill a 1/16" hole through the top of the tube. Move the hose forward to cover the hole. Uncover it briefly whenever air-binding occurs.



Having trouble with an oil-passing cylinder that fouls the spark plug every few miles? To help you get home, clean the plug, replace it, and anchor the ignition cable ¾" from the plug with wire. The resulting hot spark slows soot build-up.

Is your car pepless or hard to start? Maybe you can snap it up by learning

How to Keep an Automatic Choke Automatic

By E. F. Lindsley

TELL an English mechanic you suspect the strangler, and instead of calling a cop he will look at your automatic choke. If it is clogged with gum or carbon, the British name for this gadget is especially apt. It may be strangling the pep out of your engine.

Manual or automatic, a choke is basically a butterfly valve set in the air horn of the carburetor. Close it, and you get less air and more raw gas into the engine —fine for cold starting.

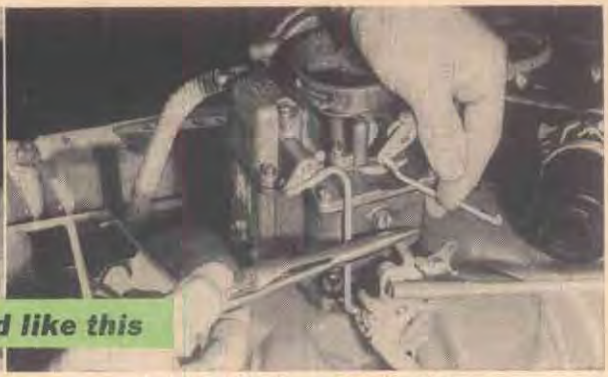
But once things are warm, this valve should open wide to let the engine breathe freely. If it doesn't, the pistons gulp gas; you'll get a rich mixture, a sluggish engine and a big gas bill.

That joke about the woman driver who complained of poor gas mileage but left the manual choke out to hang her pocketbook on is still good for a laugh—sometimes from the very fellow who drives around with a jammed automatic choke.

Heat turns the trick. What makes a choke automatic is a bimetallic thermostat wrapped like a coil spring around the shaft of the butterfly valve. The spring curls up tightly when cold, twisting the shaft around and closing the valve.

To keep it from shutting completely, the shaft isn't centered. This lets the air blast kick the valve open a bit against spring tension, like a barn door in the wind. It is helped along by a little piston that works on manifold vacuum. As soon as the engine takes off, the piston pulls against the thermostat spring, opening the choke part way.

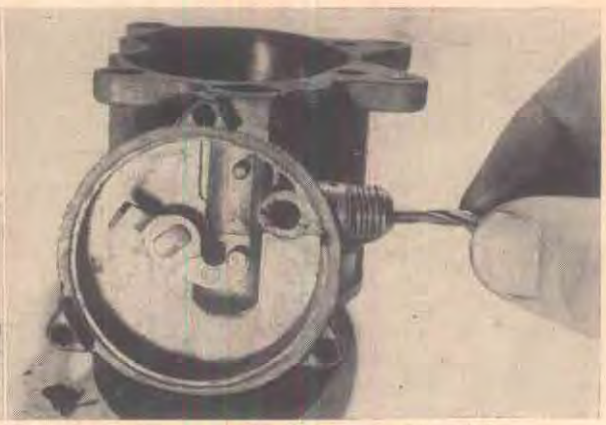
As the engine warms up, hot exhaust gases are sucked up into the thermostat casing through a tube. The thermostat



One standard make is cleaned like this

1 FIRST STEP in cleaning choke is to remove air cleaner. Next disconnect heat tube running from thermostat chamber to exhaust manifold. On this Carter automatic choke, tube is insulated against heat loss.

2 PULL OFF hairpin clip that holds the linkage arm connecting choke shaft to the fast-idle cam. Also take off unloader and high-speed-idle link. Then loosen the four screws holding the choke to the carburetor.



5 THIS MUCH DIRT in a thermostat casing indicates two things: it's high time to clean it, and the engine is probably burning oil. Above, knife points to clogged exhaust-heat passage that would delay choke opening.

6 WASH OUT as much dirt as possible with solvent. It will probably take a small drill to poke all hard carbon out of the passage. Don't forget to run the drill through mating passage in the carburetor, too.

relaxes in the heat, slacking off on the butterfly valve.

Choke trips the throttle. You'd think that would do it. But engineers, who seem to believe gadgets are better than people, have gone further by linking the choke to the throttle. Like it or not, this link is supposed to replace the old hand throttle you pulled out to keep the heater warm while you and the girl friend studied astronomy.

When the engine is cold and the choke closed, this link shoves a cam behind the throttle, so that it cannot close all the way. Thus your engine runs at a fast idle and won't stall readily.

When it warms up and the choke goes out of action, the link hauls the fast-idle cam around out of the way and the engine drops to normal idling speed.

There's another serious purpose for the fast-idle link. With the old hand choke, you shoved the button back in if the engine didn't catch pronto, and pulled it out slightly *after* starting. You knew that leaving the choke out too long would flood the engine. You're still expected to know that, but a lot of present-day drivers don't.

If the mill doesn't start promptly, the trick is to shove the foot throttle clear to the floor. A little gimmick called the un-

3 REMOVE COVER of thermostat casing and lay it aside (cleaning solvent may attack a plastic cover). Rinse choke body in lacquer thinner or spray-gun cleaner, using a brush to work the fluid into all tight spots.

4 RINSE AT LEAST TWICE in clean thinner, so that contaminated fluid will not redeposit fuel gum around shaft and vacuum piston as it dries. After last rinse, work piston to force fluid out of the passage.

7 NOW'S THE TIME to check the air cleaner. Replenish the oil if its level is low. If it is dirty, throw it out and replace with a heavy grade of fresh oil. A mark around the pot shows the correct filling level.

8 EASY DOES IT! Tighten the air-cleaner clamp snugly, but don't make it so tight that it cramps the choke valve in the air horn—an often unsuspected cause of automatic-choke trouble. Just clamp it securely.

loader trip then gives the fast-idle link a kick that opens the choke to clear the engine. Once it starts, you let up on the throttle and the choke goes back to work.

Like many simple things, the automatic choke gets complicated in practice. Spring tensions, clearances, cam contours and other details are carefully tailored to match carburetor and engine. So it's best not to monkey with choke adjustments unless you have a sporting attitude toward the whole thing, or the proper shop manual.

But you can clean it. Although engineered to a hair, an automatic choke can be put out of action by nothing more complex than fuel-gum and carbon deposits. Provided you don't try to redesign it with hacksaw and pliers, there is no reason why you can't keep it in working trim by cleaning it every 5,000 miles or so. This should pay off in better gas mileage and easier starting.

Probably the strategic times to check and clean the automatic choke are fall and spring. But if you didn't do it then, now is a good time, for in winter the choke has to do its stuff or you're going to be flagging someone for a push.

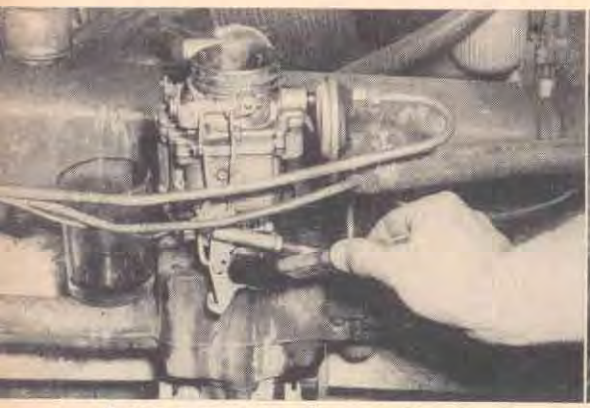
Fuel gum is stubborn stuff; gasoline and kerosene won't touch it. But it surrenders to ordinary lacquer thinner or

How unit can be cleaned on the car

1 ANOTHER TYPE OF CHOKE, the Stromberg, is shown here. Note position of choke valve as you take off air cleaner. If engine is cold, it should be closed or should snap shut when foot throttle is nudged.

2 EXHAUST-HEAT TUBE must be removed before thermostat cover of this unit can be taken off. While you're at it, blow into the tube. If it's clogged with carbon, clean it out with solvent and a piece of wire.

3 MAKE A NOTE of markings that show setting of cover against thermostat tension. Remove cover and wash casing out with solvent. Be sure choke valve is free. Replace cover at same tension setting as before.



4 USE A BRUSH to clean outside of carburetor and, more important, the fast-idle cam, throttle and various linkages. Lacquer thinner dissolves fuel gum, flushes away dirt. Leave parts clean and dry; they need no oil.

5 CHECK FAST IDLE. With engine cold, a touch on throttle should engage fast-idle cam. When gas is floorboarded, unloader tab (arrow) should snap choke partly open. If it doesn't, bend tab a little toward choke link.

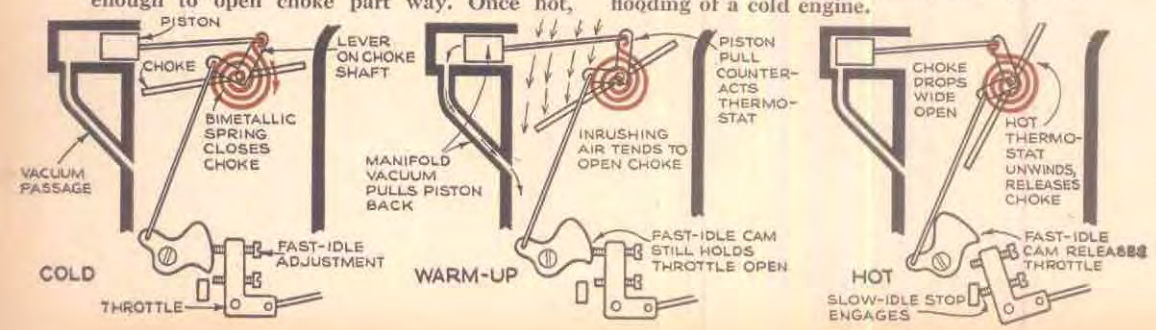
the spray-gun cleaner shown in one of the photos, which is even cheaper. Half a pint will clean a choke.

Cleaning must be done inside as well as out. Take care to get to the small vacuum piston and to both choke-shaft bearings. Wash away all red deposits. Then rinse and rerinse the parts, at the same time working them back and forth, until the thinner runs clear.

If your car has a Stromberg choke, you may not want to take off the whole top of the carburetor to get it loose.

Choke adapts itself to engine operating conditions

HERE'S WHAT HAPPENS after you get in the car. First touch on foot throttle lets fast-idle cam drop under its adjustment screw. It stays there during warm-up, while vacuum piston and air-horn draft buck thermostat tension enough to open choke part way. Once hot, thermostat relaxes, letting choke drop open and fast-idle cam ride off the throttle. Not shown here is the unloader tab, which forces choke open against thermostat tension when you push throttle down hard. This prevents flooding of a cold engine.



Wash it in place, and don't worry if thinner trickles down the intake. It evaporates and won't do any harm.

The choke linkage, high-idle cam and throttle parts should be washed until they gleam and no residue can be seen. These parts must move with perfect freedom. They work best when clean and dry; no lubricant is needed.

To wash the inside of the thermostat housing, remove the cover. A black plastic case identifies the Carter breed; a coinlike plate with degree markings, the Stromberg. How you reset the cover against thermostat tension determines choking. Wind it too tight and your engine will run choked all the time. Wind too little and, as a result, you'll have no choke action.

Setting is simple. Adjusting this is no harder than setting an alarm clock. There is a mark on the housing and a mark on the cover. Set mark to mark and you'll probably get by. However, most cars have specific settings a notch or so rich or lean. You can get this dope from a shop manual or dealer. In Wisconsin, I usually go about two notches rich for the winter and about the same toward the lean side for summer driving. Arrows on the covers tell you which way to turn.

Since you have to yank off the air cleaner anyway, you may as well check and clean it if necessary. If you've been on dry, dusty roads, you may find a fair chunk of real estate in the cleaner. This indicates the need for washing out the cleaner mesh and putting a fresh supply of heavy oil in the pot. END

What you should know about

Your Car's Wiring

You can avoid costly electrical failures by learning where and how to nip trouble in the bud.

By E. F. Lindsley

TAKE a complicated electrical hookup and a bunch of fairly delicate instruments, wrestle them into unlikely shapes and corners, shake the daylights out of them in all sorts of weather—and you've got the deal you give your car's electrical system in everyday driving. You also have an inkling of why electrical troubles rank so high on the service calls tallied up each year by the AAA.

Your chance of adding to these statistics will be reduced if you take a few simple precautions. These should include an electrical tightening-up and frazzled-

A CLEAN BATTERY with secure connections is first step in preventing an electrical breakdown in your car. Baking-soda-and-water paste will remove corrosion from terminals.

wire-hunting expedition twice a year—ideally at the fall and spring change-over. For the first check, however, the very best time is the day you bring the hack, new or old, from the shelter of the dealer's mothering wing to your own driveway.

If you were sharp enough to save a box of spare fuses in the trade-in, don't count on the cute little things too much. Fuses come in different ratings, lengths and diameters, so the old ones may be distinctly frustrating some dark night on the highway. The best check is in the car owner's guide, at the original dealer's, or in the fuse maker's index.

This is also a good opportunity to find out if your car has an automatic circuit breaker in one or more circuits. These don't call for fuses, but pop on and off, or simply buzz, until the short circuit or overload is located and repaired.

Nighttime Sport: "Finding the Fuse"

Most automobile fuses simply snap in and out of clips a lot less complicated than the snap on your wife's purse. But locating the fuse under the dashboard by the touch system in the dark will never grow into a popular sport. The smart operator takes the time on a bright sunshine-filled day to locate his fuses.

The usual spot for an important fuse is under the dash, often on or near the back end of the light switch. But many minor and accessory circuits have fuses inside the small barrel-type connectors, fairly close to the light or accessory. Look for these tricky beggars where wires have been tucked up into the inner bulkhead of a trunk deck, or look down under the edges of the trunk matting for wires running to accessory lights on the rear.

Never count on a long life for the first replacement fuse. The old one may have simply gotten tired and quit. But more likely a short or bare wire rubbing on the body or frame did the job, and will cause the new one to blow again. Here,

FUSES ARE WHERE YOU FIND 'EM. But most important ones are usually under dash. Buick (above) has a removable access panel that saves working in cramped under-dash space.

the writer prefers the nose method of investigation, smelling shorts out by substituting a piece of metal or a foil-wrapped fuse for the real thing and letting the bad wire get hot enough to make the insulation stink. A few quick whiffs in the trunk, or under the dash or hood, will probably spot the short in a hurry.

Naturally, this method lacks the highest technical approval and is not as safe as a continuity meter. So use some care not to start a fire.

If your car is suffering from hot flashes under the dash, you may have an octopus on the back of your ignition switch. This mare's-nest of meandering wires results from home-installed heaters, defrosters, radios and the like being hooked to the closest hot wire with the idea that when you chop the ignition and walk away nothing will be left cooking to run down the battery.

Taking the Wraps Off

Unfortunately, most ignition-switch screws just aren't big enough to digest all these wraps of wire. A better practice would be to clamp one husky strip of metal firmly under the screw and solder the extra leads to the strip so that they can be taped up as neatly as a mashed thumb.

ACCESSORY FUSES often are found inside connectors, like the tubular metal one shown above, which feeds radio juice. Look for such fuses under mats and metal panels in trunks.

THE RIGHT FUSE will fit and do its job. Wrong one may fail, cause damage, or drive you crazy because it won't slip into clip. Car manual or fuse makers' books list the right ones.

Snugging up an electrical hookup starts at the battery. Very often, this goes for roadside trouble-shooting as well, so the time you spend running down loose terminal screws is a good stand-by education for the time you may have to do it by the glimmer of a cigarette lighter.

No battery is likely to do its best job with an incrustation of corrosion and crud on it. A fast and reliable wash for this condition is easily made by puddling up a thin paste of water and baking soda. This will remove the whitish crusts and take the fight out of the acid accumulations causing the trouble. Rinse the battery clear when done.

Unless the terminals are obviously in

Jumpers Test Continuity

BOBBY PIN IS HANDY TEST JUMPER. Bulb can be tested across battery by grounding one terminal and jumping from other to hot side of battery. A pin shorted across stop-light leads (center photo) should light tail-end bulbs. If bulbs light on this check, but fail when brakes go on, a new switch is probably needed. Failure to light with the jumper means both bulbs bad (unlikely), or a broken wire or blown fuse.

PLIER HANDLES serve as jumper from hot terminal of battery to body ground. Sparks mean ground cable is at least connected and battery not completely dead. No sparks mean you'd better check woven ground strap in foreground for good connections. Next step: follow hot lead down to big terminals on starter.

first-class condition, you can't go wrong in disconnecting them and cleaning all the contact areas carefully with fine sandpaper.

Install new clamp bolts if needed, snuggle and clamp the connectors on the terminals securely, and coat the connectors and bolts with light grease or Vaseline.

From here on, a fast run-down with wrench and screwdriver, starting at the big terminals on the starter relays and working right out to the light junctions, will probably nip half a dozen loose connections in the harmless stage. Don't forget the connections under the dash, particularly at the back of the ammeter, ignition and light switches.

LOCATIONS OF TERMINAL CLUSTERS, like this one near radiator which feeds lights and horn, are handy to know. Some cars use plug-in connections which may sometimes be pulled loose accidentally.

When you're sure all the electrical connections are firmly attached at the proper places, you can pretty well dismiss from your mind the likelihood of serious failure on the road. Once in a while, however, breakdowns of the "everything went black" variety will stop you cold. If nothing works—lights, starter or any of the gauges—the battery has either fallen out of the car or one of the big cables to the ground, or feeding the system, is broken or disconnected.

Pliers Make Sparks Fly

Lacking a jumper lead and instruments, a pair of pliers with the handles spread wide can be compassed across from the ungrounded battery terminal to a bare spot on the metal of the car. A quick flash tells you the ground cable is making contact. No flash means no ground. Play around with the woven ground strap until you find what's loose. Blue sparks tell you to try another flash check at the next logical point—usually the big connection somewhere on or near the starter where the heavy cable from the battery latches on. Make a few tentative wiggles with the cable and see if any sparks look back at you or if your lights flicker. An all-out failure to produce any juice at all is usually easier and faster to find and fix yourself than it would be to call a repair truck.

Lesser electrical breakdowns such as a tail-light, headlight or accessory-light failure can, of course, always boil down to a bulb. As a first shot, make sure the light and its socket are firmly seated and grounded. If you tote a variety of junk in the trunk, wires or bulb holders can often get themselves entangled and jerked out by the roots. A next bet for a quick check of the bulb would be to use the pliers or a scrap of wire for a jumper. Touch one terminal of the bulb with the jumper from the battery or other hot terminal, while holding the second terminal, or base of the bulb, against a bare-metal ground.

Unless the bulb is a trick one with a shaky filament, lighting up means that the bulb is working. Now clean the end of the lead wire to the light and flash it against a ground. No flash probably means a loose wire or a short and a burned-out fuse.

Directional lights and tail-light stop signals both have an extra gimmick with which to amuse yourself. If directional lights flash on only one side, or not at all, and the wires and bulbs seem to pass inspection, borrow a new flasher unit and see what happens.

The tail-light switch ties in with the hydraulic-brake system. If you suspect its honesty, short across its terminals with a screwdriver. No flash from the screwdriver means no current getting to the switch. Check the wires. If the lights operate with the screwdriver but not with the brakes, you'd better buy a new switch. END

What You Should Know
About Spark Plugs

Too many drivers pay too little attention to the need for using the right plugs right, this expert declares.

By Howard Vogel

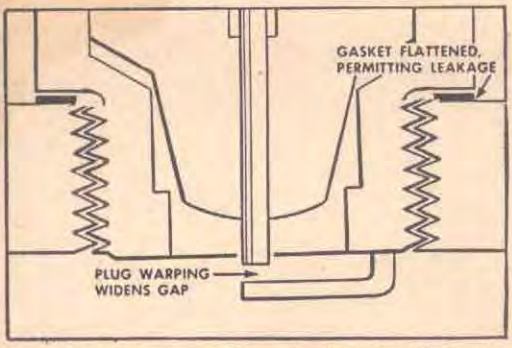
WITH compression and horsepower definitely on the way up, it's time all car owners learned the facts of life about spark plugs. And this goes not only for the average motorist, but for professional racers and sports-car enthusiasts as well.

Spark plugs aren't complex. But pick the wrong type for a high-speed engine, do a sloppy installation job and you may run up a whole string of complexities—including lost compression, horsepower and speed.

I have seen this happen surprisingly often while working with high-compression engines. A Champion crew began servicing racing engines at the Indianapolis Speedway back in the Twenties. Even then, compression ratios of better than 7-to-1 were commonplace. In the intervening years, our crew has serviced racing engines at most of the nation's top tracks and famous water raceways. We have seen a lot and learned more.

Use plugs of correct reach. First of all, if you want to get the most out of your engine, be sure to select the proper type of plug for your engine and your driving habits—not just one that happens to fit the hole. European cars, for example, use at least

THE AUTHOR, Howard Vogel, is one of America's top authorities on spark plugs. A graduate of Purdue in 1932, he went to work the same year as a draftsman for Champion, became chief engineer of that company in 1946 and director of engineering a year later. Several times each year he gets away from his desk to head up a crew that provides plug service at such races as Indianapolis and Daytona Beach. Below he checks a plug with a magnifying glass.



TOO MUCH TORQUE is as bad as too little in seating a spark plug. If the gasket is flattened so much that gases leak from the combustion chamber, you lose compression and overheat the plug, shortening its life. A heavy hand with the wrench also may warp the bottom shell, pulling the electrodes apart.

three different reaches (lengths of threaded sections) of plugs in the 14-mm. size. They are ⅜″, ½″ and ¾″.

We have found that you can't put the longer-reach plugs in an engine designed for a ⅜″ reach and expect efficiency. Neither should you put ⅜″-reach plugs into holes designed for longer ones. The same thing is true, incidentally, in most American passenger cars where we have both ⅜″- and 7/16″-reach plugs in the 14-mm. size.

Here's what can happen. The main trouble with installing a long-reach plug in a short-reach hole is that the bottom threads extend into the combustion chamber and can become coated with fuel deposits. Not only will the end of the plug overheat and cause a probable power loss but the threads in the cylinder head are very likely to be damaged when the plug is removed.

Conversely, when a short-reach plug is placed in a long-reach hole, it's the exposed cylinder-head threads that become fouled with carbon-like deposits. Later, when you install the proper-type plug, the end will hit those clogged threads and prevent proper seating of the plug on the gasket.

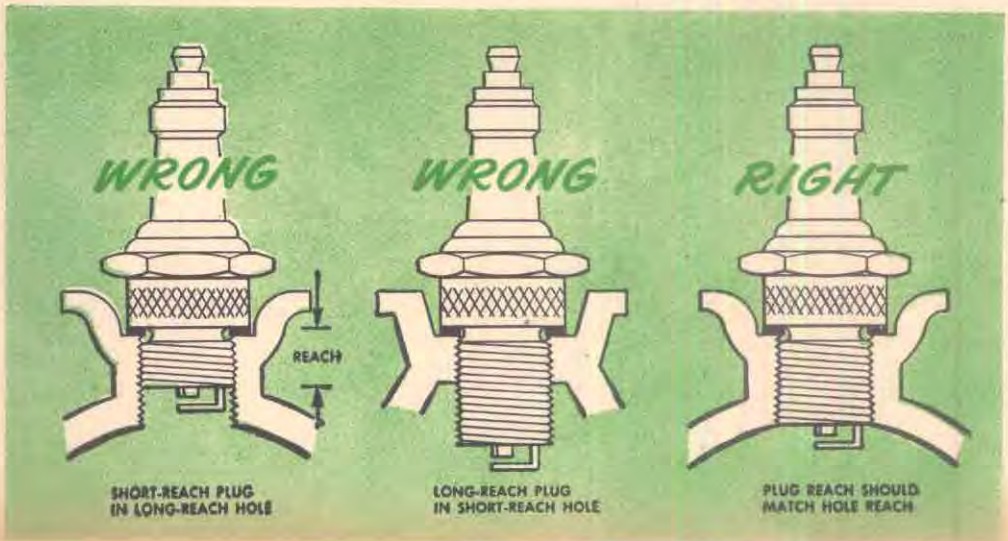
This situation of the too-short reach can pile up a number of troubles. The higher position of the firing end will tend to delay combustion, giving the same effect as a slightly retarded spark; the unfilled cylinder hole will increase the combustion-chamber area and may affect compression; and the plug undoubtedly will overheat.

Heat range. This is the next consideration in proper plug selection. Over the years spark plugs have been designed, laboratory- and road-tested in all types of equipment to check and rate their ability to dissipate heat from the firing end.

Selecting a plug in the right heat range depends largely on driving conditions. The car maker has tried, in the sports-car as well as the regular-car field, to specify a plug for all-around service. But in many cases the ordinary car driver will never drive at highest speeds; most of his driving will be in slower stop-and-go city traffic.

In city traffic, then, the plugs may run too cold and accumulate deposits which in time will short the firing end of the insulator and cause the engine to misfire. In this instance, it is our policy to install a plug one step hotter. On the other hand, if a plug operates too hot in an engine, the life of the electrodes will be shortened. And under some high-speed driving conditions, the plug may build up such heat in the combustion chamber that it will cause preignition and detonation.

Fuel can affect heat range. We know; we've had the headaches. More than once our crew has serviced a racing job, adjusting the gaps with Swiss-watch precision and installing the plugs in accordance with



the best practices. We've watched the car in a practice run, the cadence of the exhaust sheer perfection.

The next day things go wrong. The multi-thousand-dollar special sputters back into the pits with the plugs badly fouled. Once we were puzzled. Now we get the solution by asking "what've you got in the tank?" Racing engines are critical and switching from gasoline to cooler-running alcohol—or back—definitely can affect spark-plug heat range.

Proper installation. You'll note that in many garages a torque wrench is used to tighten down the head properly so that the head gasket doesn't burn out. This same problem arises in spark plugs as we are trying to dissipate heat from the spark plug through the little copper gasket.

Improperly installed plugs may indicate, when removed, that they are operating at too high a temperature—electrodes may be burned and the insulators very white in color. This appearance might seem to indicate need for a different type of plug. But just looking at the firing end doesn't always determine whether such a change should be made. First, examine the outside copper gasket to check proper installation. After that, if installation is satisfactory, is the time to determine whether the correct plug is being used.

Insufficient torque will fail to compress the copper gasket properly for a good seal. The resulting leak will cause some loss in compression and make the plug overheat. Too much torque may stretch the gap right out of adjustment or in the racing-type plugs may so warp the shell that the internal structure of the plug will be damaged.

Even the pros go wrong. We keep stressing correct installation because too few persons understand its importance from the standpoints of both efficiency and economy. And we're not referring merely to the average motorist, either. At the NASCAR meet in Daytona Beach last spring, we were amazed to find plugs that could be unscrewed with our fingers from engines sporting expensive special heads, cams, manifold and exhaust systems.

Furthermore, we found ignition cables cracked and deteriorated on some of these costly jobs. These conditions, of course, affect spark plugs because they're at the end of the line. As a result we organized an "ignition clinic" for several hundred drivers and mechanics and were gratified the next day to see them out on the line with wrenches and gauges checking their plugs.

YOU CAN MAKE A CLEAN-OUT TAP from an old plug by filing four square-edged notches across the threads. Turn the tap into the cylinder head without a gasket and it will clear out any carbon left on the bottom threads if old plug was short or loose.

Real evidence that spark plugs, properly selected and installed, can contribute to surprising engine performance was supplied by Bob Pronger, a Chicago driver in the Daytona strictly-stock race.

Bob reported that he had tuned his '53 Olds on a dynamometer in Chicago, testing various types of plugs. The right combination (Champion J-6's) was an eye-opener, he said. The engine revved up 300 r.p.m. faster.

It paid off. Bob set a new record in the prerace time trials—113.28 miles an hour for a two-way run over a measured mile. END

Plug Facts in a Nutshell

Select plugs with a reach to match the cylinder-head threads and a heat range to suit your driving conditions.

Gap them as recommended.

Turn a clean-out tap into the cylinder-head threads and clean the cylinder-head gasket seat.

Fit a new gasket to each plug.

Seat to the proper tightness.

What You Can Do with a

Spark-Plug Tester

Check your car plugs . . .

oil-burner ignition . . .

small engines.

Red flashes emitted by this little instrument will put you on the beam when you're tracking down ignition trouble.

By E. F. Lindsley

A SPARK-PLUG tester's keen nose can sniff out automobile plugs that waste enough gasoline every week to cover its original cost. Used to forestall trouble, it offers first-rate insurance against highway breakdowns. If trouble does show up, you can spot the source yourself—and perhaps reduce the repair bill. You'll use one most around a car, but it's also good for a power mower, outboard or spark-ignition oil burner.

Most testers look something like the pencils that are given away for advertising. The resemblance ends there, however, because the tube contains neon gas, and in place of lead at the tip some testers have a sharp needle to jab through the rubber insulating caps now commonly found on plug connectors. If the plugs lack insulators, you just leave the cap on the needle and hold it against the terminal to watch the fireworks.

What you see. You don't have to take a plug out to use a tester, nor are any wires or batteries required. Just bring the indicator against the plug terminal or near the high-voltage leads while the engine is running or being cranked and it will start

flashing its story of what is going on inside. A healthy plug and ignition system show up as nicely spaced red flashes. If yours are resistor plugs, the flashes won't be quite so bright, but they'll still be steady and even.

An indicator also gives out a pretty glow just from being in the vicinity of a high-voltage ignition system. This is important because spark-plug trouble may not come from plugs at all, but from a break in the wire insulation, chafing where the wire passes under a retaining clip, or a short to the spark-plug cover if the car has one. By passing the tip of the indicator along each wire from plug to distributor cap, you can sneak up on these little performance stealers. A sure clue is a bright flash that stands out against the dull glow you get elsewhere along the wire. Obviously, a new wire is cheaper than a new plug, and it cures the trouble.

Checking an oil burner. As a sidelight to this, my oil burner (furnace, not car) had been erratic about igniting. I ran the tester along the wires leading from the high-voltage transformer to the terminals of the ignition points which touch off the

oil. Sure enough, a very bright glow picked out a cracked wire. This had been vibrating enough to snuggle over against the housing and short out the burner ignition now and then. A new wire saved a call to a serviceman.

An item you'll want to check occasionally is the possibility of induced firing. This results from the plug wires being grapevined around each other too closely. You may get intermittent engine roughness because induced firing can touch off a cylinder before the correct time. Your indicator will show the trouble by extra flashes in between the main firing shots.

Hunting bad plugs. Maybe your car has been acting up as mine did some time ago. Ordinarily, she'd run smooth. Then I'd tramp on it a bit for a hill and a ragged miss and buck would crop up. You can hunt all day for this deceptive sort of trouble if you do your checking at idle speeds. The problem usually results from the high engine load that boosts the dielectric across the plug gap and causes some weakness in one or two plugs to show up even though the plugs appear good at idle loads.

My tester didn't pick out the two bum plugs at idle. So I pulled the wires off four alternate cylinders and gunned the engine. One bad plug showed up right away. I had to swap wires and try the other four to spot the second. The four dead cylinders were just a way of simulating a load on the engine. (Never prolong this test. It can dump a lot of raw fuel on the cylinder walls and destroy the oil film.)

Signs of bad points. You may find, however, that the trouble seems to show up over the entire set of plugs. If the flashes are regular, but of uneven intensity, it's time to have a go at your distributor points. Maybe just careful filing and regapping will solve your problem. Even if it does, count on getting some new points pretty soon. Other general troubles with the same symptoms are, in order of increasing meanness, corroded rotor tip and cap electrodes, cracked or oil-and-dust-shorted distributor cap, and finally, a sick condenser or coil.

The last two are less common than replacement coil and condenser sales might suggest. If you need 'em, you need 'em bad. But first make a mighty thorough check for shorts in primary connections, bum grounds, bad connections and terminals and oil-film shorting.

Spotting a fouled plug. An easy trouble to spot with a tester is plug fouling. Instructions with my tester describe the symptoms as "weak flashing, becoming intermittent when speed is increased." On a hunch, I tried this on my power mower. They were right; the plug in the little two-cycle was coked a bit.

The tester can also be used on a balky outboard. It has a pocket clip and doesn't take much room even on a fishing trip. But remember that in a shaded garage under a car hood the tester flashes are brilliant; in bright sunshine, they are less so.

The man on the job
Whose work gives most pride,
Is the one who at home
Has a hobby to ride.

If you play around with a distributor, you should retime the spark. The makers never intended a spark-plug tester to be used as a timing light. But running a spare length of high-tension wire from No. 1 plug to the tip of the indicator will turn it into a fair excuse for a timing light if the garage is quite dark and you hold the flasher close to the timing marks. END

Added Spring Holds Trunk Open

THE springs that hold open the trunk lid of a car may weaken enough to let the lid drop without warning. If they are spiral springs, operating around the hinged joint of a folding brace, adding a screen-door coil spring will make the lid safer.

S-shaped connectors in each end of the spring are dropped in ¼" holes drilled in the upper arm of the brace and the metal lining of the lid.—*O. A. Nelson, Seattle.*

How to Cure Noisy Valves

Hydraulic lifters in some of the new cars may set up a clatter unless kept oiled. Here's what to do to shush them.

By Basil Hoover

"HYDRAULIC valve lifters are fine as long as they work the way they're supposed to," said a friend of mine the other day. He had just taken his car to a repair shop to have a clicking valve fixed, and was complaining because he thought the labor charge was too high. "Valves used to get noisy on my old Chevvy," he grumbled, "but it took only about 30 minutes to adjust them."

I felt like telling him that he should have changed the oil before it got dirty enough to cause trouble; but I'd often told him that. So I merely made some vague remark about everything having disadvantages.

The hydraulic valve lifter has become widely used during the past few years. Buick, Olds, Lincoln and Cadillac use it, for example; and when Chevrolet offered the Power-Glide model in 1950 the engine was equipped with hydraulic valve lifters. Perhaps the lifter is most appreciated by Power-Glide owners because it has hushed Chevvy's notoriously noisy valves.

A properly functioning hydraulic valve system is practically noiseless. Noise is a sign of trouble. Fortunately the trouble can be corrected by anyone who is moderately skillful at working on an engine.

Cleaning may stop noise. A noisy hydraulic valve lifter is usually dirty. The regular motor oil circulates through the lifter and dirt and gum from the oil tend to collect in it. While the cleaning process is not difficult it is time-consuming. If you are a car owner who keeps an eye on the pocketbook you may prefer to consume your own time instead of your money.

With the exception of one adjustment, the same procedure can be used in servicing hydraulic lifters on both the Power-Glide Chevrolet and the Dyna-flow Buick.

The valve-in-head V-8 engine used by Olds and Cadillac has a hydraulic valve lifter that is fundamentally the same as that used by Chevrolet and Buick. The method of removing valve lifters from the V-8 motor is different, but not difficult.

THESE ARE THE PARTS of a typical hydraulic valve lifter. Used like a stethoscope as in the photo above, a rubber hose will help you locate a noisy lifter.

If you want to work on Chevrolet valve lifters simply follow the method described and illustrated here. If you have a Buick, Olds, or Cadillac, note the variations that apply to your particular car.

Locating a noisy lifter. One quick and easy way to locate a troublesome valve lifter is with a piece of rubber hose, used stethoscope fashion. With the motor idling hold one end of the hose to the ear and place the other end against the rocker arm. If the lifter is functioning properly a dull, scarcely audible click will be heard, combined with the cushioning sound caused by the oil in the lifter. If the lifter is faulty a hard, sharp click will be heard through the hose. Some experienced mechanics can locate bad lifters by putting their fingers on the rocker arms while the motor is running. The amateur mechanic, however, can do better with the makeshift stethoscope.

The hydraulic valve lifters are located at the lower end of the push rods and operate directly off the camshaft. They can be reached by removing the push-rod cover plate from the side of the motor.

Removing the lifter. After the noisy lifter has been located and the push-rod cover removed, the next step is to take out the push rod. The easiest and quickest way is to slide the rocker arm to one side and lift the push rod out beside it. In doing this, first make sure that the rocker arm is not holding the valve open. Then loosen the adjusting screw all the way. The arm can then be moved sideways and the rod lifted out. Another method is to unbolt and remove the entire rocker-arm assembly.

When the push rod has been taken out insert a hooked wire in the top of the lifter unit and lift it out of the engine block.

The lifter is made up of seven parts. Disassemble the unit by removing the small spring at the top—but before this can be removed the plunger must be depressed slightly. If you try to push the plunger down with a small screwdriver handle or any other blunt object you will find it practically impossible because of the oil pressure within the lifter.

The secret is to insert a small object about two inches long through the hole in the top of the plunger. A pin punch, small Allen wrench, or even a piece of stiff wire may be used. Pushing down on the small tool releases the oil pressure by holding open the ball-check valve at the bottom of the plunger.

Checking a lifter. After taking the unit apart clean it thoroughly. Then inspect the various parts for defects. The plunger should move freely in the body but should not be so loose that it wobbles. The most important thing is the ball-check valve. Make sure the ball doesn't have a flat side and that it is seating properly. If any of the parts are defective you will save time and trouble by buying a new lifter unit. When reassembling the lifter, line up the

FIRST STEP in having a look at a Chevvy lifter is to slide rocker arm to one side and lift the push rod out beside it, as is being done above.

TO LIFT THE LIFTER from the engine block so you can work on it, bend a hook in a piece of wire and insert the hook in the top of the lifter.

TAKE LIFTER APART by inserting a small Allen wrench through hole in top as at left to depress plunger and free the retaining spring. After cleaning, reassemble the lifter by inserting the wrench through aligned holes to hold down the plunger while the spring is being replaced.

hole in the side of the plunger with that in the body. Push the plunger down until the two holes are aligned and put a small Allen wrench through the holes to keep the plunger down while the retaining spring is being replaced. After the lifter is reassembled fill it with the same oil that you are using in the motor.

Lifter parts are not interchangeable, and to avoid the danger of getting parts of different lifters mixed it is best to disassemble only one unit at a time.

Making final adjustments. In finishing up the job the rocker-arm screws must be readjusted. This adjustment is extremely simple—much simpler than with nonhydraulic valves.

First make sure the camshaft is in the closed-valve position. If a lifter on cylinder number three, for example, is being adjusted remove the distributor cap and crank the motor until the rotor points to the number three high-voltage contact and the breaker points are open. The piston is then at the top of the cylinder and both valves are closed.

Next, take hold of the push rod with one hand and gently jiggle it back and forth sideways as you screw down the rocker-arm adjustment. By jiggling the rod slightly you will be able to tell when the adjusting screw makes firm contact with it. As soon as this occurs—when you can't jiggle the rod any more—stop. Then carefully screw the adjustment down exactly one and one-half turns more. That's all.

FINAL ADJUSTMENT on a Chevvy rocker arm is a one and one-half turn of the screw. For a Buick adjustment allow two full turns.

The valve-lifter plunger can travel a distance in the body cylinder equivalent to three turns of the adjusting screw. One and one-half turns places the plunger in the midpoint of its travel.

The Chevrolet adjustment is one and one-half turns; but on the Buick the correct adjustment is two turns of the screw after it makes contact with the push rod. Otherwise Buick valve lifters can be removed and serviced according to the procedure described for Chevrolet.

Working on other cars. On the new valve-in-head V-8 engine used by Olds and Cadillac the lifters are located in the V between the two cylinder banks. Before the lifters can be reached the intake manifold must be removed. Under the manifold is a valve-compartment cover plate. The disassembly job sounds more difficult than it actually is because the manifold can be taken off rather quickly and the compartment cover presents no problem.

The rocker arms on the V-8 engine have no adjusting screws. All parts of the assembly are fitted to close tolerances and it is extremely important not to interchange any parts of the valve system whatsoever.

Push rods on the V-8 engine can be removed singly without unbolting the entire rocker-arm assembly. Since there is no adjusting screw the valve spring must be depressed before the rocker can be slid to one side.

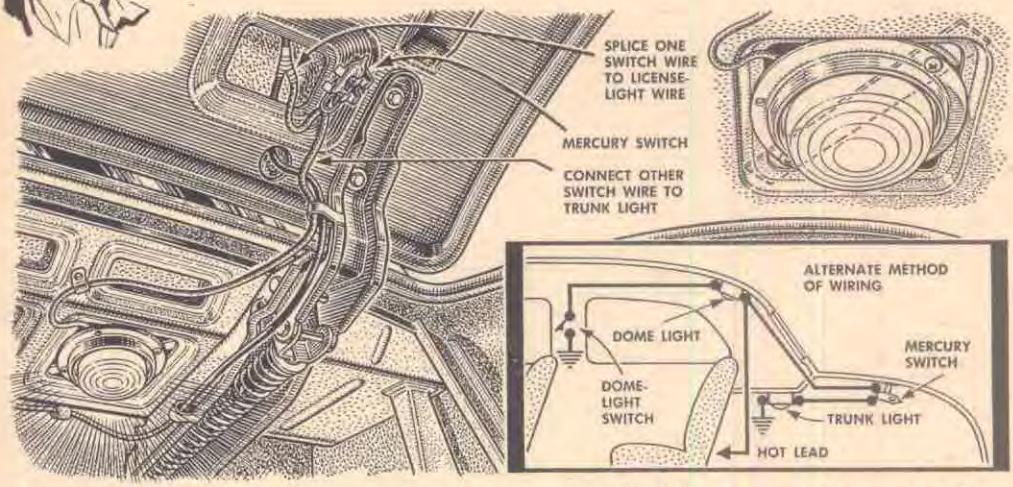
Hydraulic lifter units on Olds and Cadillac are smaller than those on Buick and Chevrolet, but the basic design is the same.

Are lifters getting oil? When servicing the V-8 engine be sure to inspect the passages that feed oil to the lifters, for oil starvation will cause noisy operation. If you remove a lifter and find no oil in it, the short passage leading from the longitudinal oil header to the lifter bore is clogged. This passage is a visible opening in the side of the lifter bore. A clogged oil passage is a common trouble on the V-8 engine.

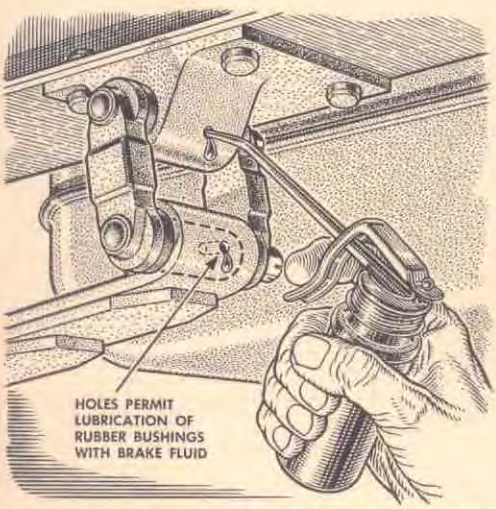
When you've finished servicing the lifters on an Olds or Cadillac, merely put the motor back together. There is no valve adjustment to make.

Where hydraulic valve lifters are concerned, an ounce of prevention is worth a pound of cure. The prevention is simply clean oil. But once the lifters start clicking it is too late for prevention. END

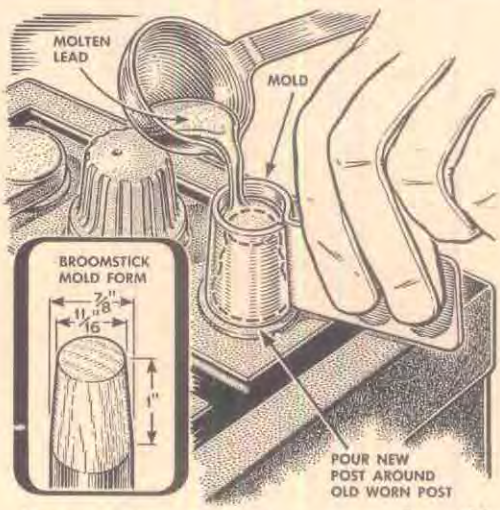
Hints FROM THE MODEL GARAGE



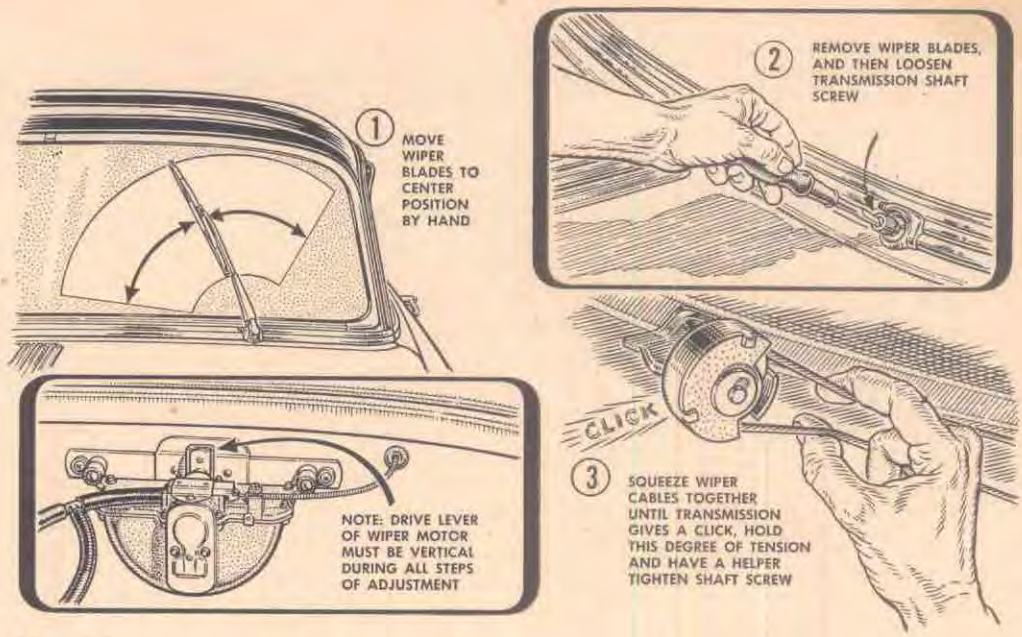
A lamp that lights automatically when you lift the trunk lid can be installed with parts that cost around a dollar. A mercury switch will take care of turning the light on and off. A flush-mounted clearance lamp with a clear lens is a good choice for the light. It usually can be set into a recess in the lid or body bracing by placing a metal strip back of the opening and running sheet-metal screws through the holes in the flange. The strip or lamp must contact bare metal for a good circuit. If it is connected to the license-light wire, the lamp will come on only when the car lights are on. In the alternate method, the lamp will operate independently.



A persistent squeak in a rubber-bushed spring shackle usually can be eliminated by drilling a hole into the bushing and forcing in brake fluid with a pump oiler.

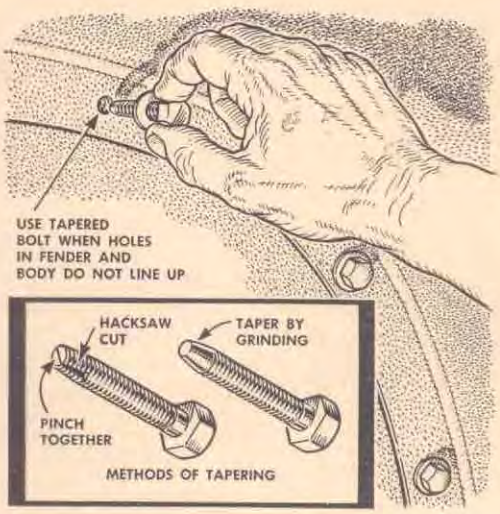


If a battery post is so worn the cable won't hold, cast a new post around the old one. Make a form by shaping aluminum around a broom handle tapered as shown.



Sluggish wipers can often be traced to cable drives that are too tight. The remedy is to slack off the cables a trifle.

Center the wiper arms by hand (upper left), bringing drive lever to vertical position (lower left above). Remove wiper arms and loosen screw at end of wiper shaft about ¾ turn (upper right). Pinch the cables together (lower right above) until you hear the serrations in the wiper drive slip one notch. Tighten the shaft screw and repeat this operation on the opposite shaft.



If one or more of the fender holes do not line up with those in the body when a fender is being installed, taper the ends of the bolts by one of the methods shown. When the bolt is pulled tight, the taper will force the holes into matching position.

An annoying squeak often develops in the molding that fits between the instrument panel and windshield. You usually can get rid of it by loosening the screws and squirting penetrating oil containing graphite on the screws and under the molding.

How to Patch Tubeless Tires

Kits make it easy. They include a gun that you can also use to repair small punctures in regular tires.

SOON you may find yourself out on the road face to face with a punctured tubeless tire. They will be standard equipment on many 1955 cars.

A tubeless tire isn't necessarily punctureproof. Some makes have no special inner layer of sealing compound to "heal over" small punctures. And even those makes that do have an inner sealer can be punctured in such a way that they may develop a leak.

The tire makers have brought out two kinds of repair kits: professional kits, containing materials for various repairs, and smaller kits designed for motorists and intended only for fixing small punctures. The latter sell for less than three bucks.

Although the kits vary as to contents, and the step-by-step instructions that are included differ slightly, the basic procedures are similar.

Small punctures, like those you get from a small nail (no bigger than 1/16-inch diameter), usually can be repaired without removing the wheel or the tire. A special tire-sealer gun that looks like a screw-type grease gun is used to force a tire-sealing compound into the puncture hole. All kits contain one of these guns.

You jack up the car until the wheel can spin. Then you locate the leak by turning the wheel and watching for bubbles while water flows over the tire. Mark the puncture and wipe the tire dry.

Reduce the tire pressure to five pounds. Remove whatever caused the puncture and clean out the hole, taking care not to enlarge it. Then, following instructions provided with your gun, turn the screw handle to force the tire-sealing compound into the puncture hole.

After about 20 minutes you can re-

Small punctures can be fixed by using a tire-sealer gun to force sealing compound into hole.

LARGE PROFESSIONAL KIT for the repair of tubeless tires contains a large tire-sealer gun, two cartridges of sealing compound for the gun, sealant patches, rubber solvent, rat-tail file, plug-threading needle, six rubber repair plugs and a knife. Kits of this type, intended primarily for commercial tire repairmen but available to any motorist, cost less than $10.

inflate the tire to the standard pressure, lower the jack and drive off.

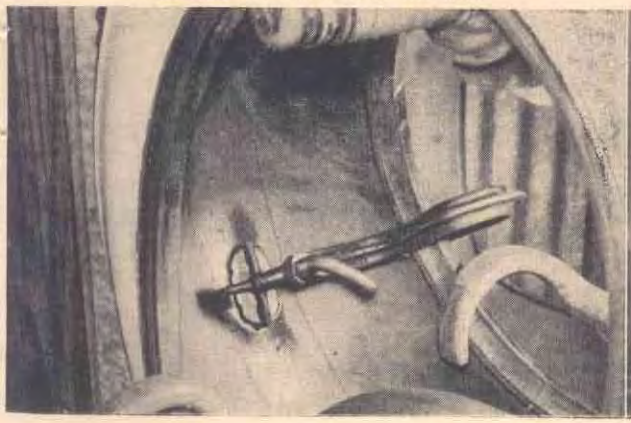
The tire-sealer gun also can be used in the same way, one manufacturer claims, to repair small punctures in conventional tires with tubes right on the road, without removing the tire or the wheel. The tire-sealing compound does its job on both tire and tube.

Medium-size punctures (no larger than 3/16 or ¼ inch) can be repaired with tire-sealing plugs that are provided in the professional kits. Since this work is done from the inside, the tire must be removed from the wheel.

Cold-patch repair. An ordinary cold patch also can be used to repair a puncture in a tubeless tire that doesn't have the inner layer of sealing compound, or in an unprotected area of a self-sealing tire. After the tire is removed, the puncture hole is cleaned, then filled with sealing compound from the tire-sealer gun. The cold patch then is applied to the inner wall in the regular way.

A hot-patch repair can be used on

HOT-PATCH REPAIR requires the use of a special hot-patch clamp designed for use with tubeless tires. The clamp's jaws are elongated to fit around the sidewall of the tire.



TIRE-SEALER GUNS FOR MOTORISTS are smaller versions of the large professional guns. This one, made of plastic, comes filled with sealing compound and sells for less than $1.50.

HOW TO USE A RUBBER REPAIR PLUG. First, plug-threading needle is inserted in puncture from inside (1). After stem of plug is attached to needle by squeezing metal fingers together, plug is coated with solvent (2). Then needle and stem are pulled through from outside (3) until plug's head is tight against tire's inner wall (4). Finally, stem is trimmed flush.

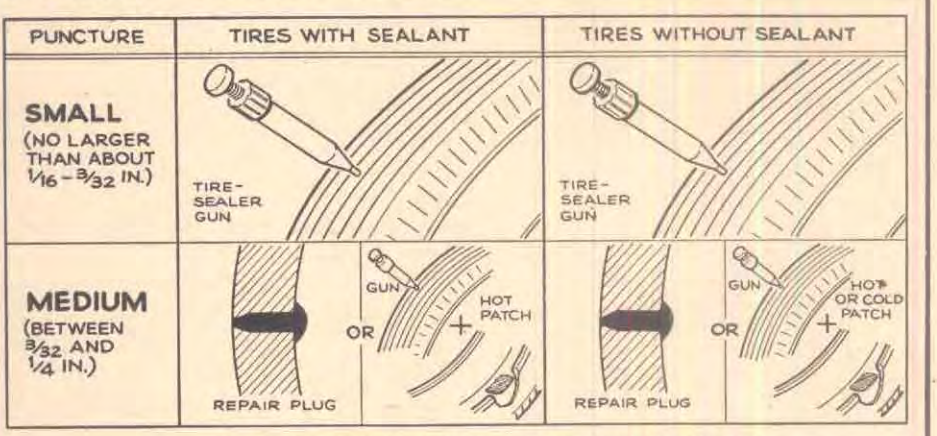
both types of tubeless tires—those with the inner layer of sealer and those without it. The tire-sealer gun is first used to fill the puncture hole and then the conventional hot patch is applied. But a special hot-patch clamp designed for use with tubeless tires is required to hold the patch in place.

Warning: Any puncture that doesn't "heal itself" in a tire having an inner self-sealing layer may indicate internal injuries that should be repaired. This can be done by carefully cutting away the injured portion and applying a patch of special sealer material.

Leaks can also be caused by loose rim rivets. They should be tightened by peening over their heads with a hammer. If this doesn't cure the leak, each rivet should be coated with rim-rivet cement.

Some tubeless tires are fitted with a safety diaphragm. This does not quite fill the tire. After repairing a puncture, inspect this diaphragm. If it shows any kind of a cut or bruise, it should be replaced by a new one. END

REPAIRING TUBELESS TIRES



FOR YOUR *POPULAR SCIENCE MONTHLY* INFORMATION FILE

Synthetic fibers have made it possible to banish the nightmare fear of sudden tire failure and sudden death on the road.

What every driver should know about

Tubeless Tires

By Devon Francis

WHILE going 95 m.p.h. on a country road a few years ago, Frank Herzegh lost control of his car. Before he came to a shuddering stop, he had barrel-rolled ten times!

When Herzegh crawled out of the wreckage, he looked first at his tires.

"Hm," he remarked to himself, "it was a tube."

Herzegh had designed a tire without a tube for Army trucks in 1941. An ardent home-workshopper, he never permits any mechanic but himself to touch his personal car. Employed by Goodrich as a tire engineer, he even did most of his preliminary work on his firm's tubeless passenger-car tires at home.

When his car crashed, it was shoed with two tubeless tires and two conventional tires with tubes. That accident convinced him that he and others who were working on tubeless tires were on the right track.

Tire troubles figured in about a third of the fatal auto accidents in 1953 in which "some unsafe condition" of the vehicles was reported. The tubeless tires that Detroit now puts on all new cars, unless the buyer specifies that he wants tubes, may increase highway safety. They go down more slowly when punctured and are less liable to blow out.

The fibers are synthetic: Wreck the fibers in a tire and you wreck the tire. These fibers go into the "plies" that tire men talk about. (A four-ply tire has four layers of rubber-impregnated fabric.) Cotton was used for more than 50 years, but it wouldn't do for tubeless tires, which must be leakproof.

Cotton fibers are short and hollow. They lack the strength needed to seal off compressed air for tens of thousands of miles of flexing on the road, and the natural oils in them resist absorption of the plastic conditioners needed to make a tire carcass airtight.

Rayon and Nylon Have What It Takes

Two synthetic fibers, rayon and nylon, made tubeless tires practical. One or the other of these fibers is woven into the fabric of all tubeless tires. No company has a monopoly on fabrics.

Both rayon—used in tire-making since 1935—and nylon are continuous filaments. They are solid, and strong. Try breaking cotton, rayon and nylon threads of equal diameter. The cotton will part. The rayon will sear your hands. And you'll probably give up on the nylon. Both of these synthetics are dry and absorb the resin conditioners used by tire manufacturers.

These synthetics made it possible to

How to Put Tubeless Tires on Your Old Rims

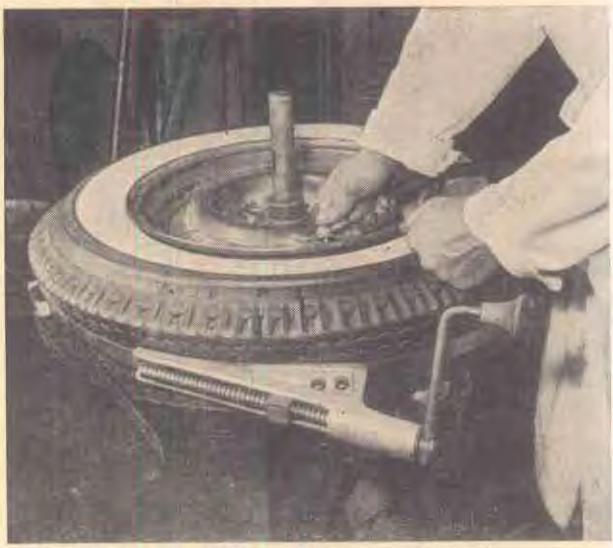
introduce tubeless tires for passenger cars, at a premium price, seven years ago. Now reductions in the cost of rayon and a simplification of processing have made possible the production of tubeless tires as non-premium, original equipment on the new cars. Nylon tires still cost more because nylon fabric is more expensive.

Similar but different: The tire industry's Big Four—Goodrich, Goodyear, Firestone and U.S. Rubber—supply the bulk of the original tires put on new cars. All four are making tubeless tires that contain synthetic cords.

All but Goodyear have thin artificial rubber "liners" adhered to the inside of their tires. These liners are known as a "butyl blend" and consist principally of natural rubber and reclaimed butyl. Goodyear does not consider such a liner necessary in its tire.

Although superficially similar, there are differences between various makes and types of tubeless tires. Goodrich puts a soft butyl sealant on the liner of its premium tires as added insurance against loss of air in case of a puncture. Goodyear sells an accessory tubeless tire "shield," a sort of tubeless-tire-within-a-tire, as added protection against blowouts. Firestone has a premium nylon puncture-sealing butyl adhered liner and a two-ply nylon-laced diaphragm, or shield. Other companies have other variations.

1 HOW LONG does it take to put tubeless tires on old rims? "About 20 minutes," said the man at Mohawk Service in Stamford, Conn.



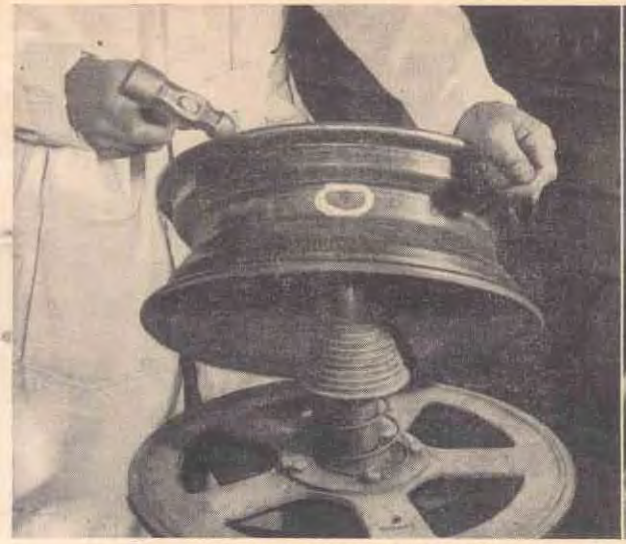
4 ONLY SPECIAL TOOL used is a "constrictor," which works like a tourniquet to snug the tire beads tightly against the rims.

No More Nightmares

What you gain: The tubeless tire should earn its keep on your car if for only one reason—it virtually does away with most of the nightmare of that sudden, thumping, crunching flat and the frightening loss of control at high speeds. It serves you just as well if you collect a nail at 20 miles an hour on your way to the grocery.

Here's why: When a tubed tire is badly punctured, the air escapes into the casing almost instantly, then comes out through the valve hole in the rim. That can't happen with a tubeless. The valve is sealed in the rim.

Tubeless tires also give considerably more mileage. That's largely because they run cooler. They're lighter, there's no tube to create friction heat against



2 RIMS ARE SMOOTHED DOWN with steel wool. Then loose rivets are tightened with a ball-peen hammer to make the rims airtight.

3 VALVES GO THROUGH RIM like this. A flange-type rubber washer, a flat rubber washer and a metal washer keep air from escaping.

5 SOAPY WATER is used to check for leaks. Bubbles show that this valve is loose. Tightening it made the tubeless tire airtight.

6 TIRES SHOWN HERE cost $33.79 each. Allowance on old casings toward this set was $4 apiece. Shoeing the car took 19 minutes.

the casing, and the metal rim readily radiates heat.

Tubeless tires provide fewer puncture emergencies. Taxi fleets report an average of one-third as many flats for each 100,000 miles of operation.

At least one automobile manufacturer has inquired seriously of Akron whether that fifth rim and tire can't be discarded as part of a car's original equipment.

Replacing tubed tires with tubeless poses no problem. They can be bought one at a time. They are interchangeable with the tubed product. Don't worry about shimmy on account of the difference in weight—there is a greater disparity between the weight of a new tubed

tire and a worn one than there is between a new tubeless tire and one with a tube.

Inspect them regularly! It takes know-how to install them—they can be injured in the process. And it takes know-how to repair them.

To take tubeless tires, rims must be perfect. That's because retention of the air depends on a perfect seal between tire bead and rim. Damage a rim, and your tire probably will go flat.

Because tubeless tires will "absorb" a nail, it's possible to drive several thousand miles without realizing your tire is punctured, and thus do permanent damage to it. For this reason, tubeless tires should be carefully examined at least every 3,000 miles.

Prices on tubeless tires as original equipment are the same as those of comparable tubed tires. Replacement tires in some instances run a little higher. Here are some sample factory-recommended retail replacement prices on the 6.70-by-15 tire, the most-used size, as produced by Goodyear:

Plain black, rayon—$27.20; white sidewalls, rayon—$32.55; black, nylon—$33.85; white sidewalls, nylon—$40.65; an extra-heavy, deep-tread nylon available only in white sidewalls—$56.55; black, rayon, snow tread—$29.60; white sidewalls, rayon, snow tread—$35.50. Add $1.24 as federal tax.

The extreme range in prices on tubeless tires sized 6.70-by-15 made by U.S. Rubber is $27.20 to $32.55; that by Goodrich, $27.20 to $52.53, and by Firestone, $27.20 to $62. Prices on tires made by other companies are about the same.

The five percent boost in tire prices by the industry last November applied to tubed and tubeless tires alike. END

Lift Eases Auto Wheel Off

CHANGING a wheel on your car is made easier with this forked lift. Leverage does the work. Bend a four-foot length of ⅜" rod in the middle, making a vee with the ends 16" apart. Place it under the jacked-up wheel, raise and ease it off.—*Ivan Grosvenor, Indian Rocks, Fla.*

Motorist Uses Head in Pinch

MILES from nowhere, with a flat tire, I found the locknut on the spare wheel frozen to the stud *and the stud loose in the bracket*. Both parts turned when I tried to loosen the nut. I placed the jack against the spare wheel and forced it up until the side pressure jammed the stud in its hole. Then I removed the nut with the only other tool I had—the lug wrench.—*William B. Askew, Norfolk, Va.*

Winter Driving Tips

An old blanket hung on a wire stretched across the rear of your garage will help warm up your engine in the morning. With the radiator snug against it, the fan will be less effective.

Two pieces of metal lath rolled up and stored in the trunk are good insurance against staying stuck in the snow or mud. Wedged in front of the rear wheels, they'll give good traction.

Calking the air duct shut may be the solution for cold feet on the driver's side of cars fitted with twin ducts. Left duct usually isn't needed during the winter. Disconnect valve and apply calking around it.

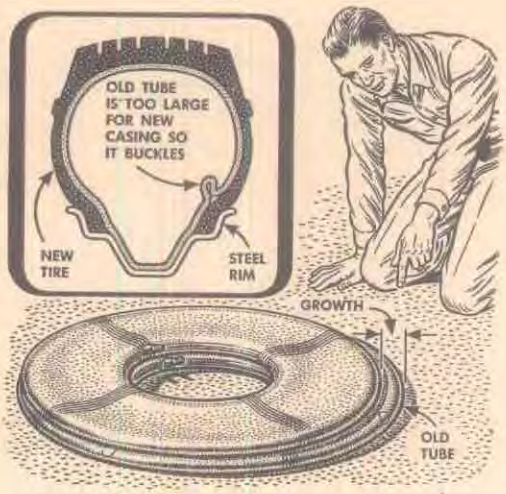
Locks freeze? Rubber tips for chair legs will slip over push-button locks, keeping out the rain and snow. Such protective tips can be found in most hardware stores.

Under-seat heaters can usually be made more efficient by removing the seat and cleaning out the lint, dust, and other material in the core. Use an air hose to blow out the dirt.

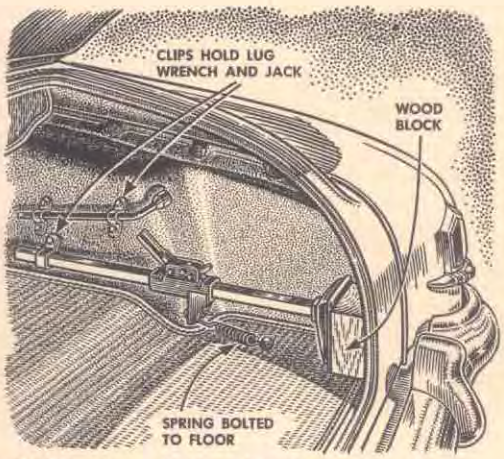
Slip pieces of corrugated cardboard under the wipers if you expect an ice or sleet storm while you are parked in the open. Removed, cardboard leaves windshield clear and dry.

Hints FROM THE MODEL GARAGE

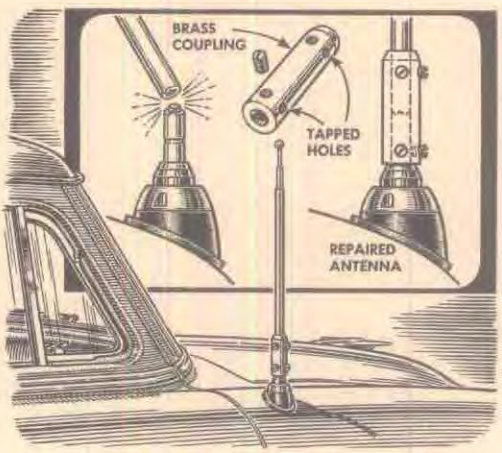
A small dent in the top of a car can often be pushed out by pressing a blunt ice pick or knitting needle through the headlining and tapping up. Then scratch the material around the hole in the headlining and fuzz it up to remove traces of the hole.



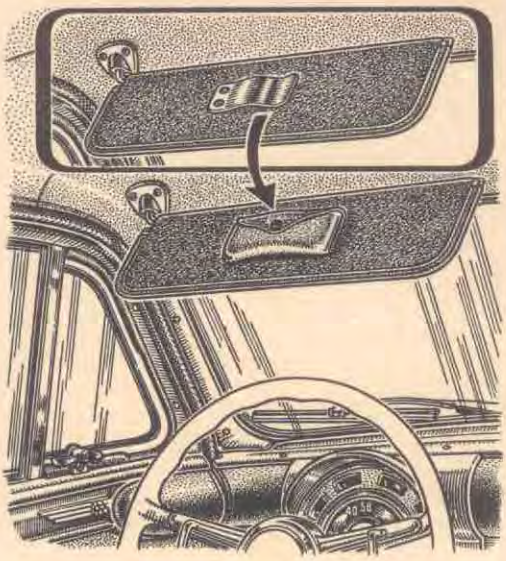
Because rubber grows in use, putting an old tube in a new tire may not be a good idea. New tubes usually are smaller in cross section than the same size casing to allow the tube to stretch into place inside the tire. An old tube may become pinched.



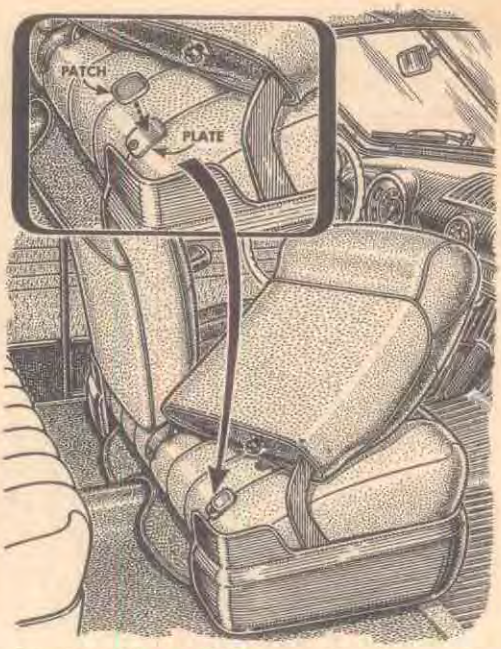
Rattle-free jack storage is easily provided. Attach two pipe straps to the trunk side with self-tapping screws, canting one in relation to the other so you'll have to press the wrench in place. Mount a spring to keep the jack butted against a wood block, with the shaft resting in a metal clip. Use the block as a wheel chock.



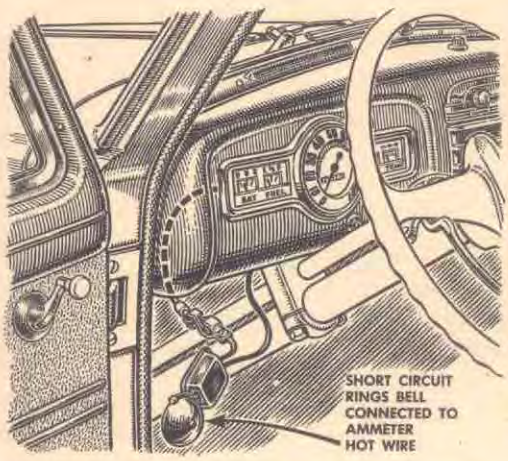
If an antenna is broken by mischievous children or overhanging tree limbs, it can sometimes be put back into service by making the repair illustrated here. The coupling might be made from a piece of brass, which makes a good electrical connection. Setscrews turned into the tapped holes will keep the two aerial sections together.



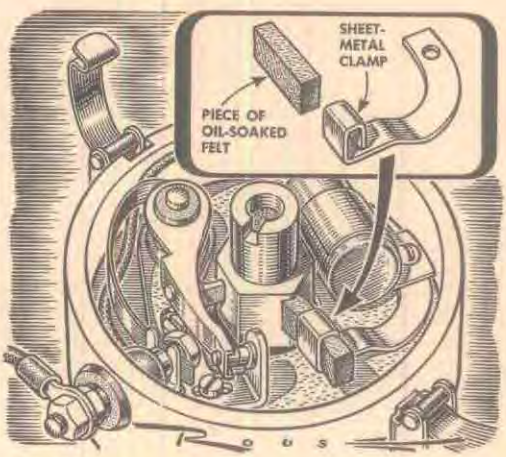
A rectangular piece of metal with one end screwed to the sunshield makes a handy clip for your sunglasses. Just slip the case on the clip. Sheet brass or aluminum might be used for the clip. Polished with steel wool, either metal will look good.



An annoying rattle may develop in the passenger seat of late-model Fords which have a small metal plate and limit bolt as shown here. The rattle usually can be eliminated by applying a ready-cut tire patch to the metal to act as a cushion.

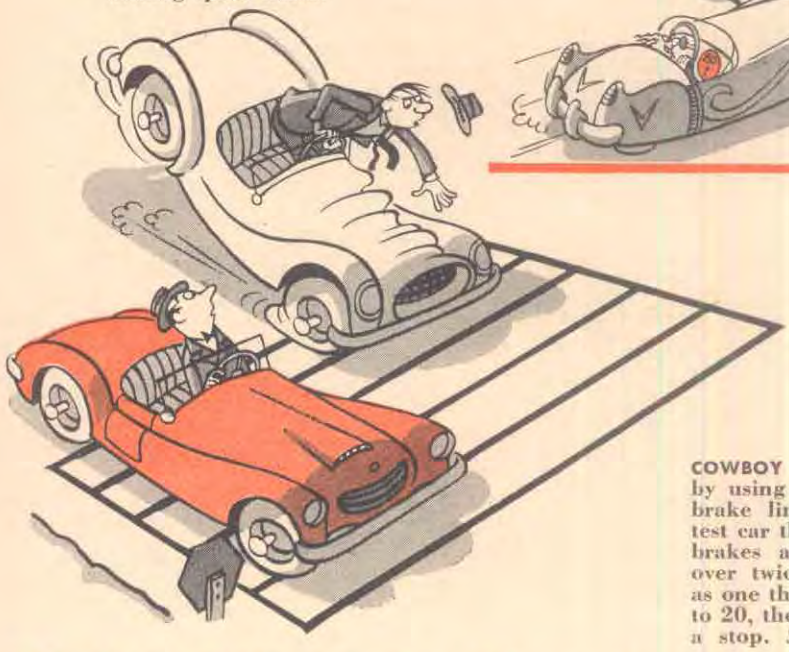


A short in the wiring of an old car is sometimes difficult to hunt down because it is intermittent and unpredictable. If that happens to you, try connecting a doorbell in series with the hot lead to the ammeter and systematically bouncing on the bumper and wiggling the wiring until the sound of the bell leads you to the short.



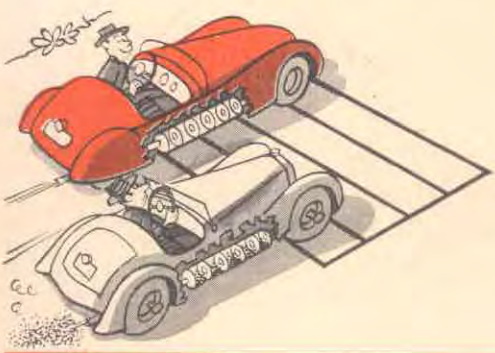
Ignition troubles are sometimes traced to rapid wear of the fiber rubbing block that actuates the ignition points in the distributor. This wear can be reduced by keeping the cam lubricated. A felt oiler held in a sheet-metal clamp is one way of doing this. Apply a drop or two of light oil to the felt.

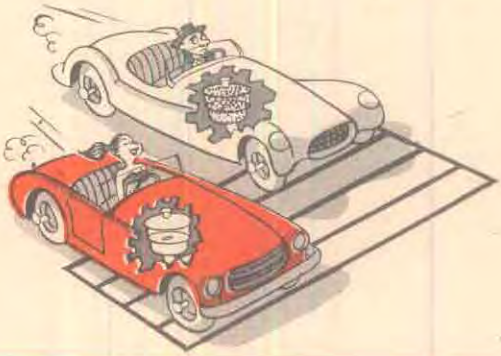
FAST DRIVING gulps gasoline like crazy. Two test cars with standard transmissions got 19 to 21.5 miles to the gallon at 40 m.p.h.; 16 to 17 at 60. At 80 they got a scant 11 miles to the gallon. Dropping cruising speed from 60 to 50 saved about 12 percent on gas. *Keep your driving speed down.*



COWBOY STOPS waste fuel by using its energy to heat brake linings and tires. A test car that jammed on the brakes at 40 m.p.h. used over twice the gas to stop as one that coasted from 40 to 20, then braked gently to a stop. *Slow down slowly.*

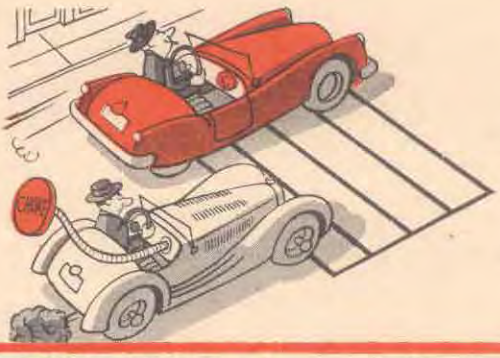
Eight Ways to Save Gasoline—and Dollars



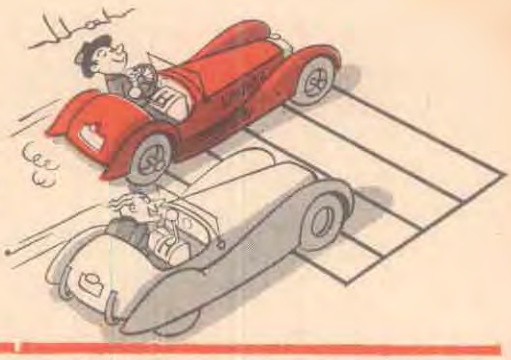


A DIRTY MUFFLER gives you a dirty deal. It builds up exhaust back pressure, and every pound per square inch steals slightly over two percent of your power. Fuel use climbs about three percent for 1 p.s.i. of back pressure; five percent for 1.4 p.s.i. (A straight-through muffler ups power, changes fuel use little.) *Keep muffler clean.*

A FILTHY AIR CLEANER makes your car "breathe" hard—and wastes fuel. In the 20-to-60-m.p.h. range, a really dirty cleaner costs about 1.5 miles to the gallon. The test used an oil-wetted, screen-type cleaner fouled with the dust from driving 200 miles on a gravel road 30 yards behind another car. *Have your filter cleaned twice a year.*



CARELESS CHOKING can keep you heading for a filling station. If a hand-choke knob is out more than ¼"—15 percent—you lose money. With choke 40 percent out, a car made only eight miles to the gallon, compared to 21.5 miles with choke all the way in. (Defective automatic choke could cause similar losses.) *Use your choke as little as possible.*



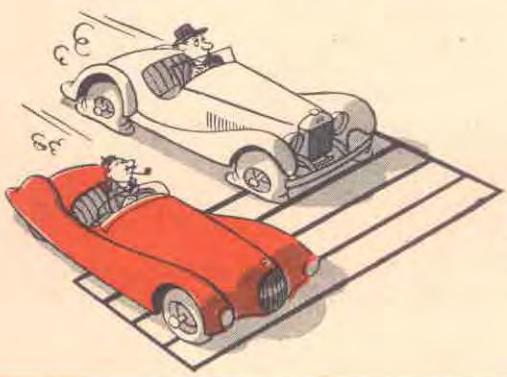
JET GETAWAYS are fine for the fly boys—but will cost you gasoline. Accelerating at wide-open throttle costs you more gasoline than at part throttle. Fuel consumption is highest in first gear, lowest in third. So the more you can stay in third, the more gas you'll save. *Accelerate at part throttle—and accelerate in third as often as possible.*

Good driving can cut your fuel bill by as much as one-third—and looking after your car properly will add even more economy.

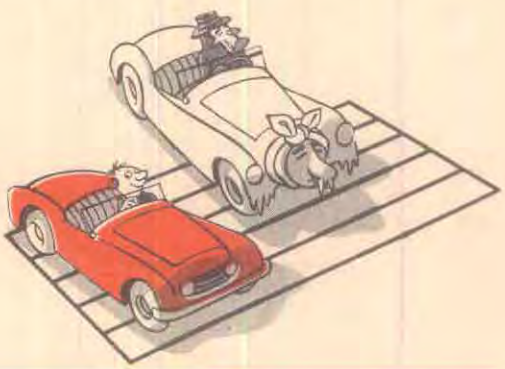
AUTO designers are putting some fancy engineering into making your engine run more miles on less gasoline. But there's one vital part they can't redesign—you. And often it's this part behind the steering wheel that wastes the most gas.

Just how careless driving and maintenance spill fuel down the drain is shown here. The drawings are based on a report to a section of the Society of Automotive Engineers by three Ford researchers—H. S. White, O. Enoch, and A. L. Haynes.

Actually, even with perfect driving, only about one gallon of every six you buy does useful work pushing your car. The other five are eaten up largely by friction and heat losses. But the report shows that driving habits can make a lot of difference in how far that working gallon takes you. Driving the same cars over the same mail run, good drivers averaged 15 miles to the gallon; poor drivers, only 10.



LOW TIRE PRESSURE means high gas consumption. A car running 30 m.p.h. with a normal load wastes about 15 percent of its power for every four pounds the tires are underinflated, due to increased road friction. At 20 pounds per square inch, tires absorbed 7.6 brake horsepower; at 28 p.s.i., only 5.76. *Keep your tires properly inflated.*



COLD ENGINES are gas-hungry engines. It takes about five miles for a car to warm up after a cold start. A car left in the open used about 15 percent more fuel than when its engine had been prewarmed to the temperature of a garaged car. The outdoor car also took twice the distance to warm up. *Keep your car garaged in cold weather.*

How an Expert Aligns an Auto's Front End

It takes delicate instruments and a lot of know-how to keep the wheels of modern high-speed cars rolling true and safe.

By Howard G. McEntee

WHEN old Dobbin was a colt, buggies and wagons rolled around corners with ease. But in this motorized age, you have to go to specialists like Arnold Nadworny to keep your car taking the turns properly.

Nadworny is a wheel-alignment specialist. Every working day he deals with the intricacies of caster, camber, toe-in and kingpin inclination—all part of that mathematical jungle, front-end geometry, that confuses so many apprentice mechanics.

Knowing how to make adjustments, Nadworny is convinced, is just the beginning of what a good front-end man should know. He should also know why. Nadworny has a success story to tell about that—his own.

Some years ago he was a traveling trouble shooter for a manufacturer of the type of equipment he now uses. Hit by a yen to settle down, he looked around for a likely place to establish his own shop.

The community he picked already had several alignment shops, all reasonably successful. But Nadworny knew that they had a failing in common. They could do a front-end job, but the operators had never bothered to find out the reasons for what the books told them to do. Some even used their equipment incorrectly.

It Takes More Than Fancy Gauges

Nadworny's confidence that he could get a slice of the business by doing a better job has paid off. His shop is now a leader in the community.

One thing strikes you when you take a car to Nadworny's shop—the amount of work he does, the checks he makes, before taking even one reading from those fancy gauges you associate directly with front-end

alignment. But without this preliminary work, he explains, you never could know whether the readings you get are correct.

The first rule for aligning a front end is that the car must rest on a level surface. And the car won't rest level if tire pressure isn't equal all around.

So Nadworny, like all thorough front-end men, makes sure that incorrect tire pressure, spring sag, spring shackles, shock absorbers and bent or eccentric wheels are not causing the car to tip one way or the other. This check includes the whole car, not just the front end.

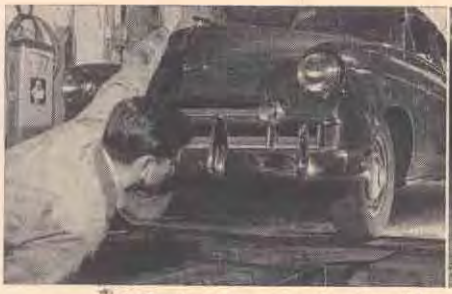
Each Maker Has Own Specifications

At the front end, checks and any necessary adjustments are made of the spindle bolts and bushings, the wheel bearings, tie-rod ends, the upper and lower support-arm pins and bushings, the lower control arms and bushings, steering arm, spindle, axle, torque and radius arms and wishbones.

Then, finally, comes the alignment itself. Camber, caster, toe-in, kingpin inclination and toe-out on turns all are brought to specifications furnished by the car manufacturer. (To understand these confusing terms, see experiments that follow this article.)

Specifications vary considerably from car to car and year to year. Surprisingly enough, some manufacturers specify no camber and toe-in as the ideal. That has been the case with all Chrysler-made cars since around 1940, and the corporation has sought to impress on its mechanics that "front wheels straight ahead and straight up and down" is the goal to shoot at. Lately, Plymouth has also listed zero caster as the ideal specification.

In the old days, mechanics could do a pretty good job of hitting alignment angles by eye. But knee-action front ends brought complications. Today it takes specialists like Arnold Nadworny, using specialized equipment, to do the job right.



1 Beginning a job, Arnold Nadworny guides car up ramp of alignment tester. As front wheels begin to climb ramp they cross toothed bar, giving a toe-in reading on the dial at the left.

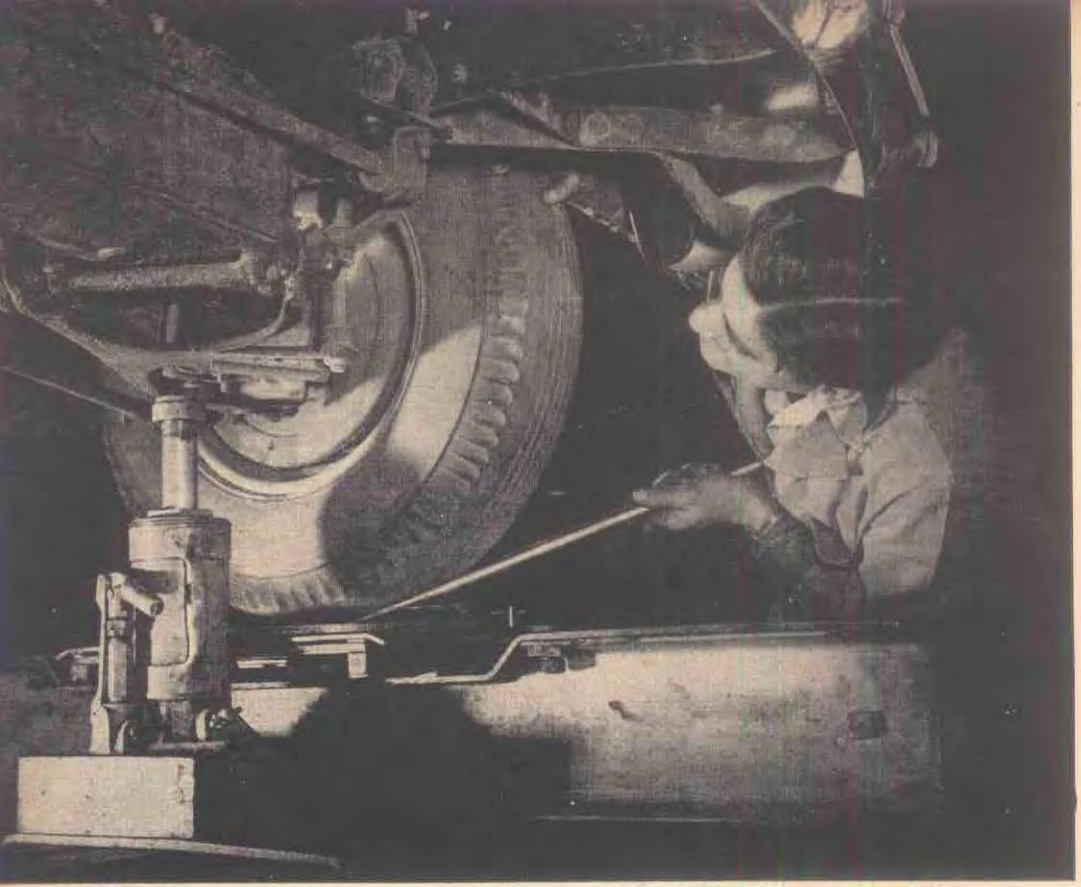
2 Toothed bar, free to move sideways, records how much tire is dragged sideways. Same toe-in measurement can be made on rack. Wear on inside treads here suggests alignment is needed.

3 Too much toe-in was one trouble, so Nadworny corrects it first thing. Toe-in is adjusted by changing length of tie rod or rods. Screw arrangement here facilitates the job.

4 Before other alignment checks, Nadworny inspects wheel bearings, repacks them and removes looseness. Early in game, pressures also are brought to same reading in all tires.

5 Jacked-up wheels are shaken vigorously to see if there is play in kingpin bushings or knee-action parts. It is rarely worthwhile to attempt wheel alignment if such parts are worn.

Please turn the page for 8 more alignment photos.



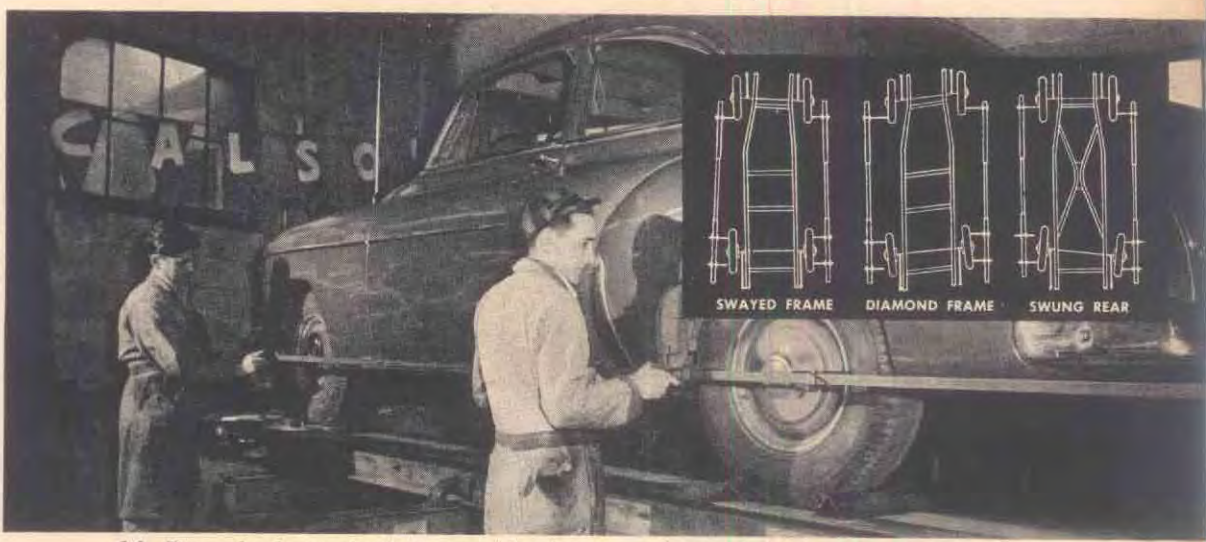
6 **Kingpin and knee-action wear** is even easier to detect if a pry bar is used. Both wheels also are shaken to reveal play in tie rod, drag link, pitman arm and steering gear.

7 **Actual alignment checks** now begin. This gauge measures both caster and camber. For an explanation of these alignment terms, see the experiments following this article.

8 **Angles are recorded** on chart as the job progresses. Note that gauge points rest against rim edge—not on tire or wheel ring. Curved scale indicates both caster and camber.

9 **Camber is adjusted** on this particular car by rotating eccentric upper pivot pin. It has socket for Allen wrench Nadworny is using. In this case, 180° rotation gives entire adjustment range. Same pin is threaded to move front and back to change caster.

10 **Hydraulic pressure** from jack is used to bend knuckle for increase or decrease of camber if eccentric pin does not allow enough adjustment to give correct reading. The forged knuckle support can stand such bending without any ill effects.



11 **Rear wheels are checked, too.** After front wheels are set absolutely straight ahead, tracking gauge is used on both sides of car to find whether front and back wheels are parallel and same distance apart. Sketch shows tracking defects that gauge may reveal. Tolerance of only ⅛" is allowed. Frame straightening is also a Nadworny specialty.

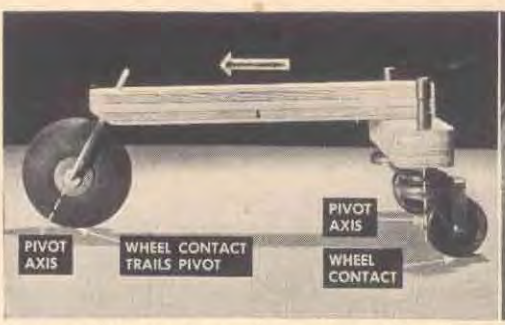
12 **As final fine point,** excess lash in the steering-gear mechanism is taken up by rotating an adjustment. This then is locked in position.

13 **Drag link is adjusted** to center steering wheel. With front wheels straight ahead, center bar of steering wheel should be horizontal. An uncentered wheel causes play in gearing. After a final check on alignment ramp and a road test, *this* car is ready for travel.

Models Show Why Car Wheels Need Alignment

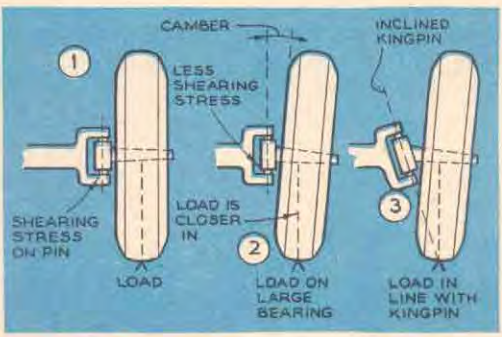
By Harry Walton

Terms like caster, camber, kingpin inclination, toe-in and toe-out are confusing until you know the reasons for these simple engineering tricks. Lots of mechanics don't.



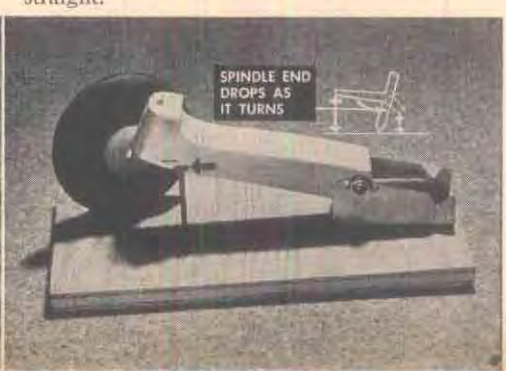
Caster. Ever try to push a piece of furniture with a reversed caster? It wabbles because the point of wheel contact is ahead of the pivot axis. But if the point of contact trails behind the pivot axis, direction is easily controlled. Front auto wheels are given caster for the same reason. In the model at left, above, the single wheel on the inclined pivot axis (kingpin) shows the method used. While it looks like a reversed version of the casters at the rear, the two are actually alike because, here again, the point of wheel contact is behind the pivot axis.

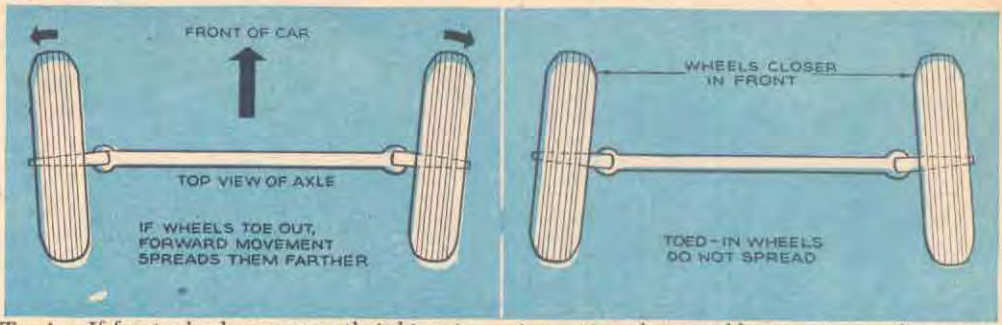
The multiple-exposure photograph at right, above, shows that both types of castered wheel will swing in whatever direction the model is being pushed.



Camber. View of a much simplified wheel, spindle and axle at left shows that the load represented by the weight of the car comes between the wheel bearings (1). This looks reasonable until you consider that this off-center thrust is constantly trying to bend up the spindle and shear the kingpin. By tilting the spindle downward slightly, the wheel leans out at the top (that's camber) and you bring the load line closer to the main bearing, giving it less leverage to shear the kingpin (2). Front-wheel brakes required longer spindles, aggravating the problem. It was met by inclining the kingpin also, so its axis meets the load line (3).

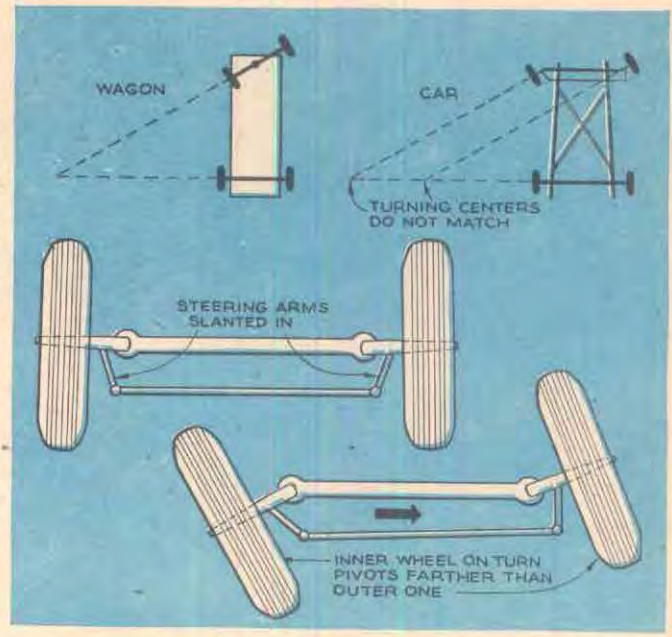
Kingpin inclination not only brings load of car in line with the kingpin axis, but also adds steering stability, making the car tend to keep a straight course and even come back to it after a turn. The mockup below shows why. With wheel straight ahead, spindle is parallel to ground (or slightly downward because of camber angle). As steering turns the spindle body, end of spindle tends to swing down farther. Since it can't push the wheel into the ground, it raises the car. Pencil mark (arrow) shows how the axle rises as the wheel is turned from straight-ahead position. The weight of the car seeks to turn wheel back straight.

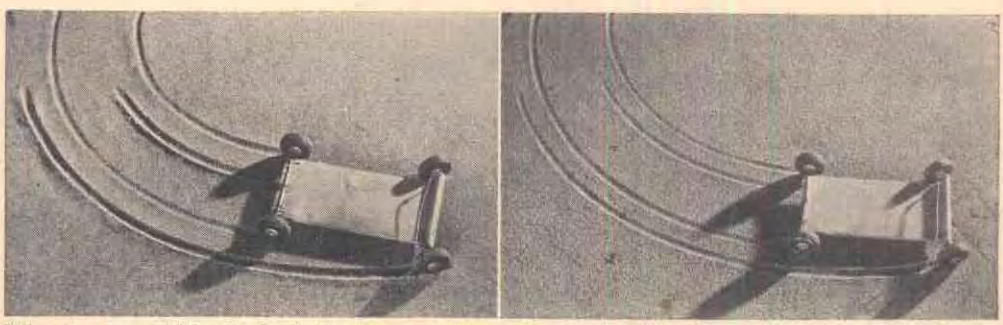




Toe-in. If front wheels swung on their kingpins without a tie rod between them, you can easily imagine how they would both fold back when the axle was pushed forward. Even with the tie rod, tendency would remain, increased by braking action that would wear tires and transmit every road shock directly to the tie rod. Toeing in the wheels slightly while they are pointing straight ahead counteracts their natural tendency to spread apart.

Toe-out. In buggy days, the pivoted front axle and the fixed rear one swung around a common turning point. But when front wheels were independently pivoted on a rigid axle, swinging both equally gave them a different turning radius, only one of which could be the same as that of the rear wheels. The inside front wheel has to be turned farther than the outside one to have the same turning center. Faced with the problem of having toe-in with wheels straight and toe-out when in a turn, engineers solved it by slanting the steering arms. Move both equally, and the inner one swings farther from the straight-ahead position.



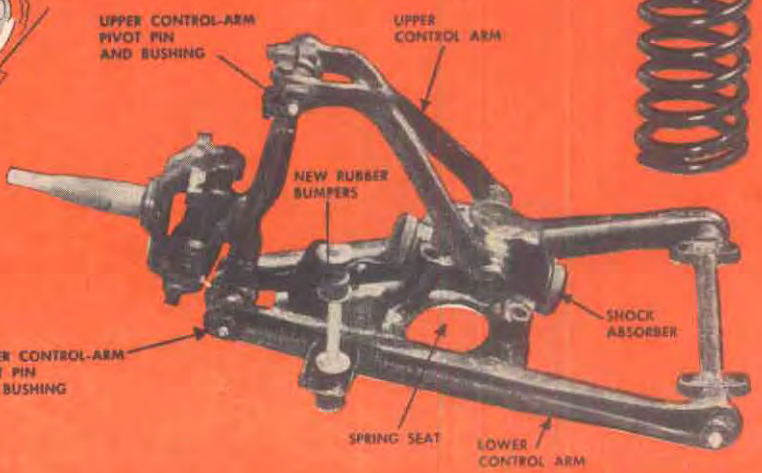


Why tires wear if front wheels don't turn on the same center is shown by sand tracks of a four-wheeled model (left). Rear wheels make sharp clear tracks. Front wheels (in this case with *excessive* toe-out) throw up a ridge of sand. Battling each other, they are being dragged sidewise in their own tracks. With proper toe-out, front wheels make tracks as sharp as rear ones (right), proving they are not being subjected to any sidewise thrust.

How to Install a

Trade in that road-weary assembly for a reconditioned unit. A bolt-on job, you can do it in an afternoon.

By Herbert R. Pfister



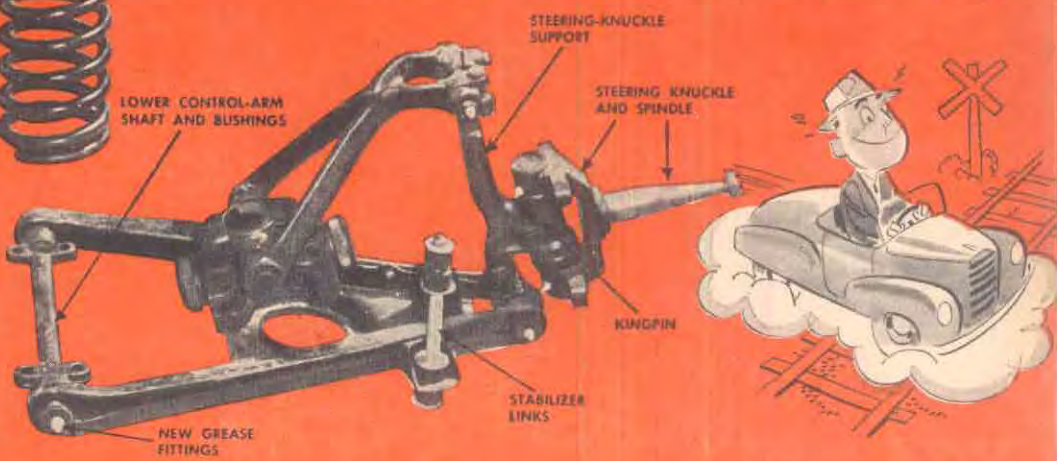
1 Block up car safely. Pull hand brake tight and chock rear wheels. Jack up car and put heavy blocks under frame to support it about 18" off ground. Don't set car on jacks alone; metal-to-metal contact and small base could spell trouble. Extra jack, or more blocks, under front transverse frame member forms stable tripod of supports.

2 Remove stabilizer links and push stabilizer arm up out of way. Take off brake drums, inspect wheel bearings and races, and put them in solvent to dissolve old grease.

Front-End Assembly

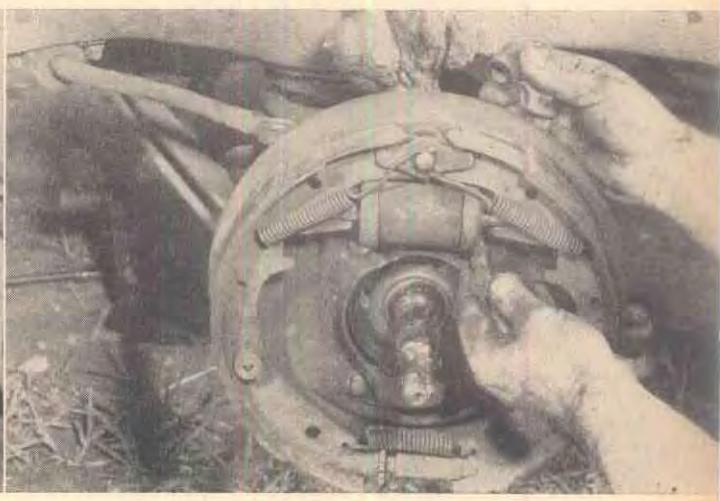
A BAD front end can make an otherwise perfectly good automobile seem like a loosely piled load of scrap. If you get a square-wheel ride and the tires squeal on gentle curves, your best bet may be a factory rebuild. You need an afternoon's time and a set of box wrenches to install it yourself.

What is a factory rebuild? These assemblies are difficult to tell



3 **Disconnect brake line** where flexible hose joins metal tubing. If convenient, brake-shoe backing plate can be suspended from fender brace with wire, making this unnecessary.

4 **Remove four bolts** that hold brake backing plate on steering knuckle and slide plate off spindle. This will release steering arm, which is left undisturbed on tie rod. Small collar in right hand is one of two spacer collars held between backing plate and steering knuckle by two upper bolts. Take care not to get grease or oil on brake lining.



5 Remove pivot pin. Place jack under lower control arm, unscrew lock nut and remove pivot pin from lower control arm. This separates upper assembly from lower control arm, permitting removal of spring.

6 Worn threads of pivot pin indicate that replacement has been long overdue. Practically all flexing action takes place on upper and lower pivot pins, causing rapid wear if they are grease-starved.

from new replacements. Shock absorbers, control arms and steering knuckles have been restored to like-new condition, and *new* pivot pins, bushings and kingpins have been fitted to them. New grease fittings, rubber bumpers and rubber-cushioned stabilizer links complete the restoration. Each unit is completely asembled, ready to be installed on the frame of your car, making reaming of kingpin bushings and tedious fitting unnecessary.

New coil springs are not included and may not be needed unless the old ones show signs of fatigue. But their cost is so reason-

9 Nothing left now except tie rods and steering arms, which are washed and ready to be linked to new assembly. This is good time to check tie-rod ends for looseness and replace if necessary. Tripod method of blocking up car can be clearly seen.

10 Begin assembly. Remove lower control-arm pivot pin on rebuilt unit to separate arms. Clean frame with wire brush and bolt shock absorber on. Cam-locking pliers, snapped on nuts, act as third hand while bolts are tightened from under hood.

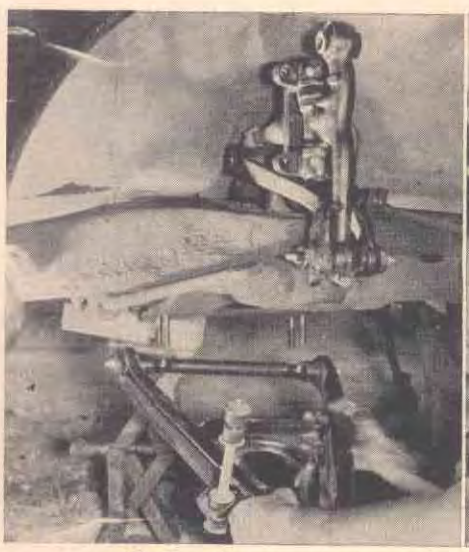
7 **Let jack down slowly** to drop the lower control arm and gradually ease tension off the coil spring. Note how the steering knuckle and spindle have been pivoted back out of the way over the shock absorber.

8 **Fully relaxed spring** can be lifted out of spring seat when control arm is lowered. With spring out of way, lower arm comes off safely, and shock absorber can now be removed as nuts are in upper spring recess.

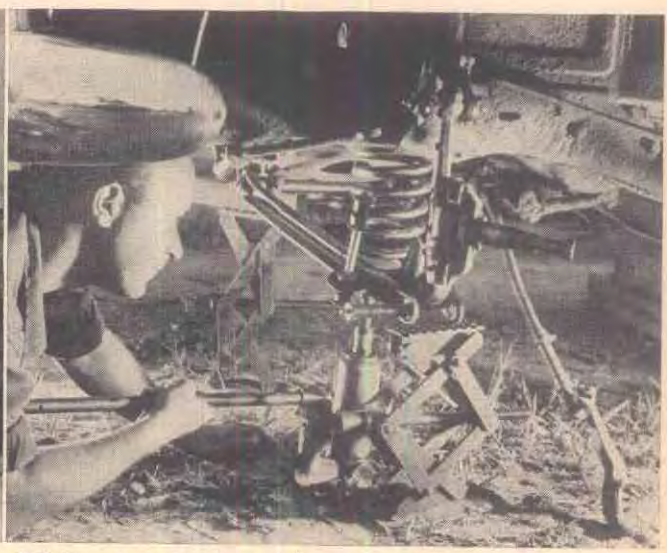
able ($9 to $12 per pair) that replacement now is a good investment for the future.

Where to buy them: Auto wreckers, parts shops and some auto-supply stores are finding an ever-growing market for the rebuilt assemblies. I bought mine from a local automobile-supply dealer, the Flushing Motor Service, 135-01 35th St., Flushing 54, N. Y.

Cost: The price tag, depending on the make of car, is between $55 and $70 plus your old front end in exchange. The only other cash outlay is the charge ($5 to $7.50) for having the wheels aligned when you are finished.



11 **New lower control arm** is lifted into position on transverse frame member. Use *new* bolts, nuts and lock washers here as lower arm takes brunt of road shocks.

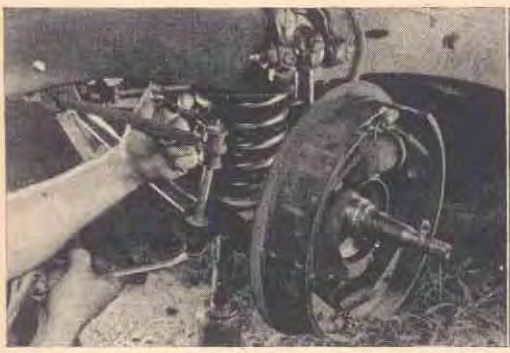


12 **Insert spring** in seat flat end up. Turn it so bottom end of coil fits into shaped lower spring seat. Here hydraulic jack lifts control arm against spring tension while scissors jack, raised by hand, follows to catch arm if hydraulic jack should slip. Raise arm until threaded holes line up, then slip rubber dirt seals on pivot pin and screw it in.

Please turn the page for more front-end photos.

13 **Don't forget lock nut.** Shakeproof washer and lock nut hold pivot pin secure. If pin should work loose while riding, you'll need another front end—possibly another car, although looseness in running gear should be detected by an alert driver.

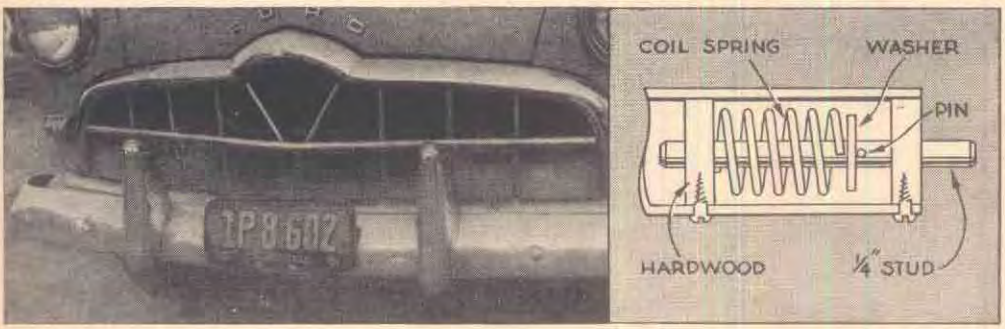
14 **Set steering arm** on original bolts pressed into holes in steering knuckle. Steel spacer collars (in hand) make up thickness of steering arm. Slide brake backing plate on spindle, and tighten nuts. Use new cotter pins to lock castellated nuts.



15 **Attach new linkage** to stabilizer arm and connect brake hose. Finish washing wheel bearings and races, and pack with fibrous wheel-bearing lubricant. Mount brake drum and bearings on spindle, adjust castellated spindle nut—and don't forget the cotter pin.

16 **Bleed brake lines** with bleeder hose into a jar of brake fluid to eliminate air bubbles. Then drive slowly to nearest wheel-alignment shop and have camber, caster and toe-in set by machine. Also have entire assembly greased unless you've already done so with hand gun.

Open Grille Helps Keep Engine Cool and Makes Heads Turn to Look



Ever since I installed a new grille on my car, people keep exclaiming:

"Look! The new Ford!"

I made the change because I frequently haul a trailer over desert roads. The new grille allows air to flow freely through the radiator and keeps the engine cooler. In desert driving, that's important.

The cross bar is 1¼" stainless-steel tubing, the uprights ½" tubing driven into slightly undersize holes drilled through the larger one. Studs made of ¼" screws fit into wood plugs driven into the ends of the 1¼" tubing. One stud is spring-loaded as shown in the drawing so the assembly can be snapped into ¼" holes used for the original grille. Metal screws hold the center slanted bars at the top.—*H. E. Eckler, Topanga, Calif.*

Rubber Bushings Give an Old Car a New-Car Ride

If your car has direct-acting shock absorbers, chances are that long before the shocks wear out, the little rubber bushings that keep them from rattling on their mounting brackets wear thin.

For $1.60 and an hour's time you can restore your car's ride by cushioning the shock-absorber mounts with new rubber bushings. Sixteen bushings at a dime a piece make a complete set. The difference is well worth the time and expense involved.

Installation of the bushings is a simple job. On most cars, one wrench will do it. Two types are common; a tapered bushing, which fits into an eye at the end of the shock absorber and a collar type with parallel sides, which fits over a stud on the shocks. To install either type, back off the nut that holds the metal retainers over the bushings, remove the old ones and slip the new ones over the stud. If a torque wrench is available, tighten the nuts to about 25 foot-pounds' torque. Check the shocks, too, while you have them off.

Drawer Under Dash Holds Glove-Compartment Overflow

There's room under the dash for maps, sunglasses and the like if your glove compartment is always full of other items.

This composition-board drawer rides on wood runners mounted on the radio bracket and held to the dash with self-tapping screws. Assembly is chiefly with cellophane adhesive tape, which also seals the joints.

A slight pitch of the runner grooves toward the front of the car eliminates the need for a catch. The drawer face hides the runners from view and also serves as a stop.—*Tom Root, Plymouth, Ohio.*

There's more to it than push-pull, click-click, but these

Installing a Rebuilt Engine

Is a Weekend Project

1 Removing hood. All Bill had to do was take out two bolts at front and at rear, and lift it off. On some older models of cars it also would have been necessary to remove radiator brace rods and hood side panels.

two amateur mechanics did the whole job in 24 man-hours.

By Wesley S. Griswold

WHEN an engine starts to grow old and tired, a lot of car owners nowadays order a rebuilt engine. Some of them install the engines themselves. It's not as easy as painting screens; on the other hand, it doesn't require a trained mechanic's know-how.

Take the example of William Ahlstrom of Dalton, Ill., the proud and careful owner of a 1947 Dodge sedan. A few weeks ago, when Bill's original engine had begun to show its age—57,492 miles—he ordered a rebuilt engine from Sears, Roebuck, which happens to sell more of them than any other company in the U.S.

Neighbor Helps

The crated engine arrived on a Friday. By Sunday evening, after a total of 12 hours' work during the weekend, Bill and his helpful next-door neighbor, young Bernard Corbin, had the rebuilt engine in place and running, and the old engine bolted into the return crate to ship to Sears, Roebuck for $23 credit.

They were no better mechanics than the average, though both had fooled around with cars ever since they had first owned one.

But they did have three special advantages: a two-car garage to work in, a small hydraulic jack and a professional-size hoist, borrowed from a friend with a small trucking business.

If you plan to install a rebuilt engine in your own car, you could get along all right with these three substitutes: a back yard, blocks in place of a jack and a heavy rope sling suspended from a sturdy tree limb. (Be sure it's sturdy; this Dodge engine weighed 430 lb., and a Ford V-8 tips the beam at about 455 lb.)

Tools Were Simple

Bill and Bernie used the following tools: a ⅜″ ratchet wrench with a 6″ extension, 9/16″ and ⅝″ wrenches with open and box ends, ⅜″, 7/16″ and ½″ open-end wrenches, side cutters, long-nose pliers, chisel, hammer, screwdrivers and a big crescent wrench.

If Bill had been changing engines in a Ford or Chevvy, he'd probably have left the transmission in place. This would make the job of shoehorning it out and in somewhat easier, though it would have left him with the fussy task of sliding the splined shaft into place on reassembly. If he hadn't been able to borrow the tracked hoist, he'd probably have used the classic shade-tree ritual: pull the engine up, roll the car away, let the engine down, switch blocks, and do it again.

Bill let us bring along a photographer and follow the job, step by step, as he did it. The pictures show how he and Bernie went about it.

2 Lifting out radiator. Bill and Bernie first drained it, then disconnected top and bottom hoses and took out six bolts, three to a side. On older models it would have been advisable to remove bumper, grille and fenders also.

3 Knocking out radiator fender. Bill chiseled off the six rivets that held it. (Small bolts will hold it in later.) Now there was plenty of room in which to lift the engine forward, even with the transmission attached.

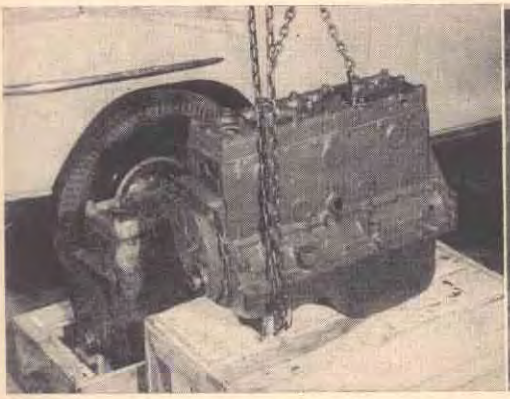
Please turn the page for more engine photos.

4 Removing engine-mount bolts. The ratchet wrench and extension came in handy here. Next Bill took off the fan. Bernie meanwhile was disconnecting gas and oil lines, heat indicator, air filter and accelerator linkage. But most engine accessories were left on for the moment.

5 Removing vibration damper. This meant taking out six bolts with ratchet wrench, removing fan belt and pulley. Meanwhile Bernie was disconnecting starter, coil and generator wires and battery ground cable, also removing bolts connecting exhaust to manifold.

6 Disconnecting drive shaft from transmission. While Bill was under the car, he also disconnected emergency-brake cable, shift and clutch linkage and speedometer cable. One safe way to get working clearance is to run front wheels up on planks laid flat.

7 Sling is bolted to the head, using the third pair of bolts from the front. With front of engine thus supported, Bill removed rear mount bolts and used a hydraulic jack to take up weight of bell housing. Engine and transmission could now be slid forward and lifted.

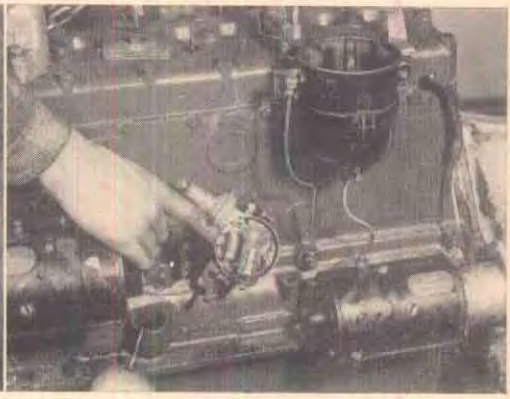


9 Engines are transposed, the old one resting in the crate, the rebuilt one on top. Sling position was changed to balance block without transmission. A rebuilt engine, experts say, may even be better than a new one, because it is seasoned, has no expansion in it.

10 First step of reassembly was sliding the fluid-drive unit onto eight supporting bolts at the rear of the block. Here Bill is driving dowel pin from block into bell housing. Bernie removed protective grease from all bolt holes and surfaces that were to mate with accessories.

8 **Ready for dismantling,** the old engine rests on the crate containing the rebuilt one. The men then completely stripped it. They scraped dirt and grease off the engine accessories with a putty knife and then washed the parts clean with solvent, which was not allowed to get inside starter, generator, distributor, or fluid-drive unit. The big thing, as always in taking anything apart, was to remember what was what and where it went. Bill and Bernie made an effort to keep bolts grouped together with their parts.

11 **Adding the transmission,** its splined shaft being inserted into the clutch assembly and fluid-drive unit before its housing was bolted to the bell housing. Six bolts do the job. A fussier man might have cleaned off the transmission before putting it back on.



12 **For correct timing,** Bernie held thumb on No. 1 spark-plug hole while Bill cranked engine until Bernie felt compression and saw that timing pointer was lined up. Then Bill inserted distributor with rotor in position to fire on No. 1.

Please turn the page for more engine photos.

13 **Easing the rebuilt engine in,** after attaching most of the cleaned original outside parts. Sling is now back in its original position, so that the transmission will tip downward and rest on the hydraulic jack. Bill and Bernie put in new clutch throw-out bearing, spark plugs and oil-filter cartridge, and used a tune-up kit to rejuvenate the old distributor.

14 **With the help of a pry bar,** Bill eases the rebuilt engine onto its mounts. The chain still holds most of the weight. Bernie was under the car by the hydraulic jack, making sure the bell housing didn't push the rubber mountings off the frame's front cross member. With a little horsing, the engine lined up dead true on its mounts.

15 **On the home stretch,** Bill hooks up the flexible gas line to the fuel pump, which had had to be replaced. He had also installed new gaskets. Bernie is busy with the accelerator linkage. The washed-out air cleaner and new radiator hoses are all that have to be put on.

16 **Thoroughly cleaned** and spruced up, the radiator is slid back into place. Bill had sprayed the tank with a thin, quick-drying varnish on Saturday afternoon. Small bolts with lock washers under the nuts replaced the rivets cut from radiator fender.

17 **Checking the timing** with a neon timing light. The crankcase was now full of clean oil and the radiator filled. The timing needed only slight adjustment. When the engine was warmed to 160°, Bill checked all the head bolts again for tightness.

18 **The road check was okay,** and Bill waves a happy goodbye to the kibitzers who had watched him and Bernie switch engines on the '47 Dodge. Bill has to remember that he must drive the rebuilt engine as carefully for the first 1,000 miles of use as the engine of a new car.

How to Use Your Dimmer Switch

A "ONE-EYED" DRIVER may not know that one of his lamps is shot. It's a courtesy of the road to flick your own headlights a couple of times to suggest to him that something is wrong.

ON THE CREST OF A HILL or on a turn, the glow of headlights tips you off that a car is coming. It's a refinement of the art of dropping your beam to hit the switch before the other car comes into view.

WHEN HIGH BEAMS BLIND YOU, it's perfectly acceptable to flick your own brights a couple of times to nudge the other guy's memory. But blasting with your own high beam puts you among the fools who use the highways, some of them now dead. You should remember that a blinded driver instinctively pulls away from the edge of the road—into traffic.

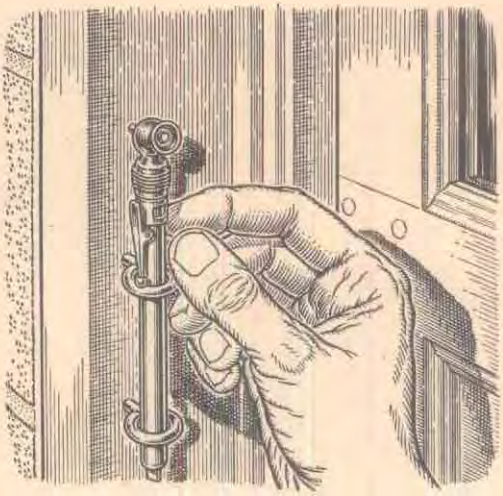
SHOULD YOUR DIMS BURN OUT and you still must drive, turn your lights on and off momentarily to tell an approaching driver that you have troubles—and are not really the dope he may think you are.

WHILE TRAILING ANOTHER CAR, remember to switch down your beam to take the glare out of his mirror—a courtesy you would certainly appreciate if your positions were reversed. A trailing car's high beams can trouble you even if it's quite a distance behind.

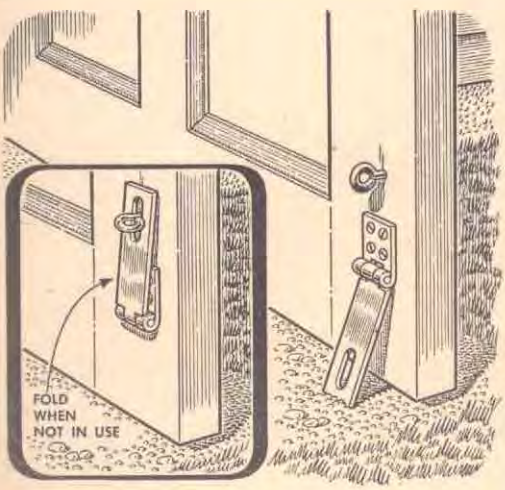
READY TO PASS A CAR, flick your lights up and down. Keep them down until you are abreast of him, then kick them to bright. If the other driver is as thoughtful as you, he will kick his down as you cut back in.

Hints FROM THE MODEL GARAGE

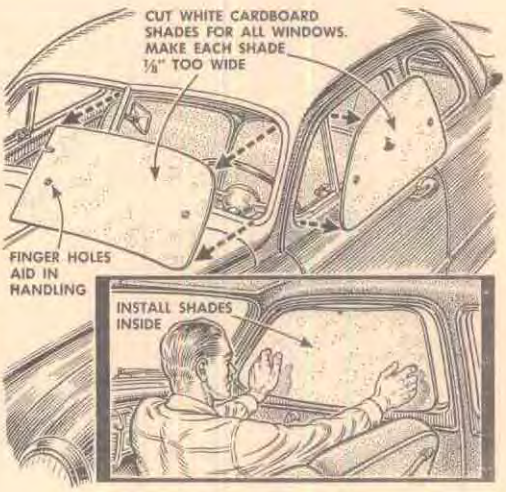
Washing the distributor cap thoroughly with white gasoline may save you the cost of a new one in the case of ignition trouble. A film of grease and dirt inside and outside the cap can cause shorts, resulting in missing and misfiring.



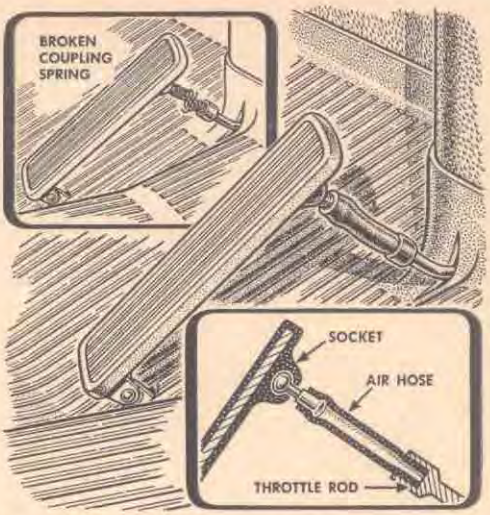
A tire-pressure gauge can only do its two important jobs (stretching tire mileage and tipping you to oncoming trouble) if you keep it where you can always find it for checking cold tire pressures. A pair of screw eyes in a garage wall make a handy rack.



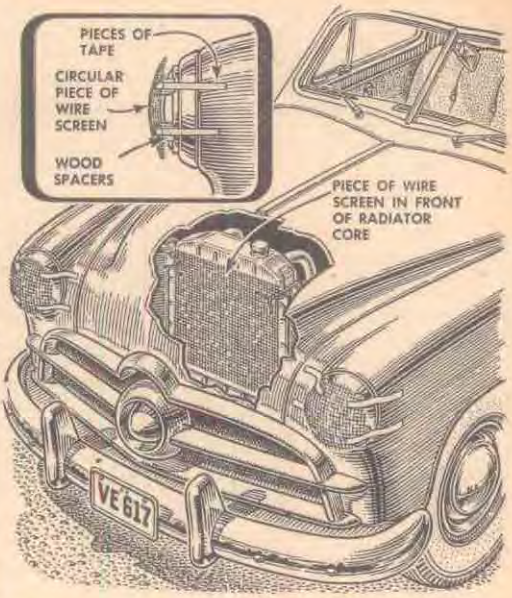
A hasp can be used to hold a garage door open. Screw it to the lower edge of the door so that the extended flap will dig into the ground as the door closes. Fold up the hasp and mount a screw eye in the slot to hold it up while not in use.



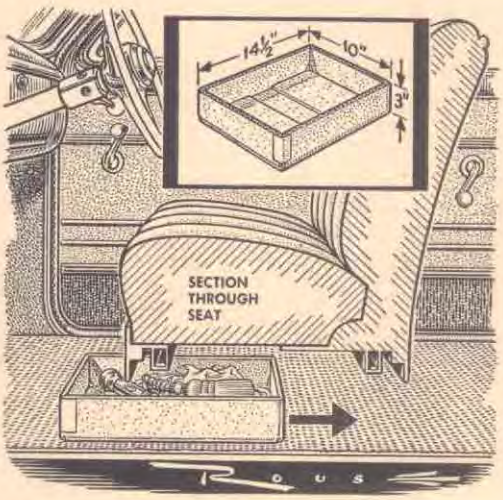
Cardboard shades fitted into the windows and windshield on the inside will help keep your car from heating up like a greenhouse when you must park in direct sunlight. Cut the shields about ¼" too big. Spring them in place and they will stay put.



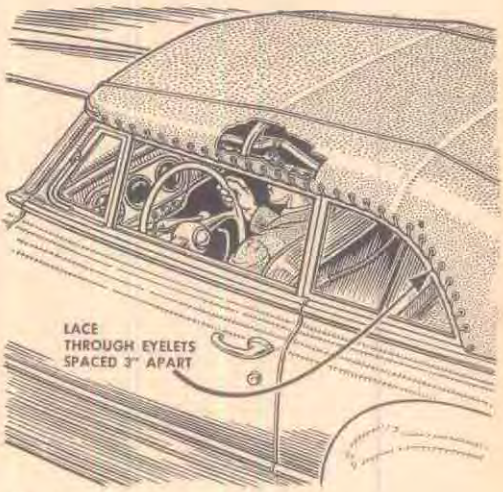
Coupling springs on the accelerators of Ford and International trucks sometimes break as shown in the upper inset. Because few dealers stock the springs, one garage operator gets the trucks back into service while waiting for delivery of factory replacements by installing a piece of air hose. The hose simply twists into place.



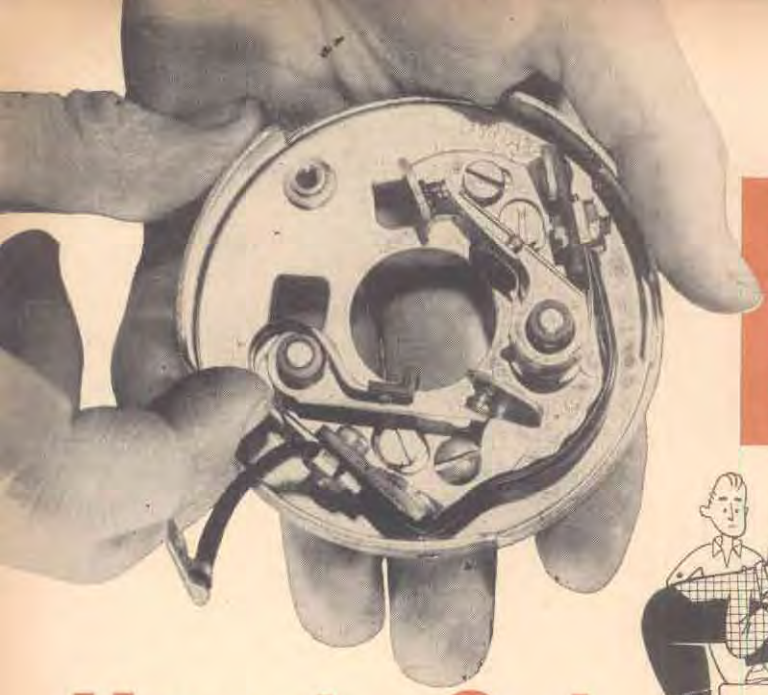
Flying stones can break head lamps and damage the radiator when you travel at high speed over the gravel roads that you find in some parts of the country. A piece of screening slipped down in front will protect the radiator core. Round pieces of screening taped over the lenses with wood spacers will take care of the glass.



A flat cardboard box can be slipped under the front seat of some cars to provide additional storage space. A box of the dimensions shown will be suitable in most cases. Such a container will take some of the load off the usual glove compartment.



To keep out drafts during bad weather, one convertible owner spaced black eyelets along the edge of the top and then lashed the top to the frame. This kept the top from drawing away from the frame—and shut out gusts of cold wind.



HERE'S THE GIMMICK the writer installed—an accessory ball-bearing breaker plate combined with dual breaker points. It costs less than $8. Insulated strip between the two sets of points is only change in basic wiring.

How to Get Hot Sparks Oftener

If you feel that your distributor falls down on the job, dual breaker points and a new plate may give it a shot in the arm.

By E. F. Lindsley

MAYBE you're like me. Maybe your friends often find you with your hat under the hood of your gasoline chariot figuring ways and means of making the blankety thing pay you better returns. So maybe you've wondered whether dual points and a ball-bearing breaker plate are a sound investment.

They are. Last fall, I installed both units in the distributor of my Buick and performance has improved noticeably. You probably could get the same results. But whether you do depends partly on the kind of car you drive. Ford and Auto-Lite distributors are not adapted to the unit I used, Dyna-Flyte dual points and distributor-plate assembly,* primarily because they either have dual points already or are not badly troubled by breaker and rotation problems. Most other cars, sixes and eights, could use the accessory dual points, a ball-bearing plate, or both the points and plate.

What are the benefits? If you answer yes to any or all of the following questions, the chances of a cure are better than good:

Has your engine ever stuttered its way through a high-speed missing session just when you were out to make time? Did it do this even though you had new plugs, properly gapped, and supposedly nourished by a hot spark through healthy lead wires and a good distributor cap?

Have you occasionally eased down from highway speeds to pass through a town and found the engine bucking so badly that it was miserable to drive under 30 without shifting into second?

Have you ever sensed something wrong with the idle when you stopped at a red light, yet when you stopped next time the idle was smooth as cream?

Does your car have acceleration "flat spots" where your pressure on the gas pedal

*Renberles Products, 16108 Roselawn Ave., Detroit.

HOW UNIT IS INSTALLED. First step is to strip points and condenser from old breaker plate, remove the retaining screws, and lift out the plate. Then put in the new unit and attach the vacuum advance unit with new, slightly longer screws provided in kit.

tells you something should be happening but the speedometer lags lazily?

What's the cause? Such erratic engine performance as well as short-lived tune-ups all indicate a breaker-point system falling down on the job.

To understand why, think back to the lever usually identified as "spark" on cars of the Model T era. Nothing was automatic then about the advance and retard of the moment when fire jumped the spark-plug gap. You retarded the spark for starting, advanced her all she'd take while cutting along at top speed, and eased off while climbing a hill, until the knock was below frightening proportions.

Eventually, centrifugal advance systems were adopted. These have weights, like the flyballs on a steam-engine governor, to turn the breaker cam against rotation as the engine speeds up. This spark governor retards the timing to a reasonable point for starting and advances it as you pick up speed.

High-compression and high-performance demands, however, complicate the work a centrifugal control is expected to do, especially at high speeds. You get best full-throttle, full-load performance with advance to a certain point. Any more would be inefficient and destructive. Yet at part-throttle cruising, considerably more spark advance would be an advantage.

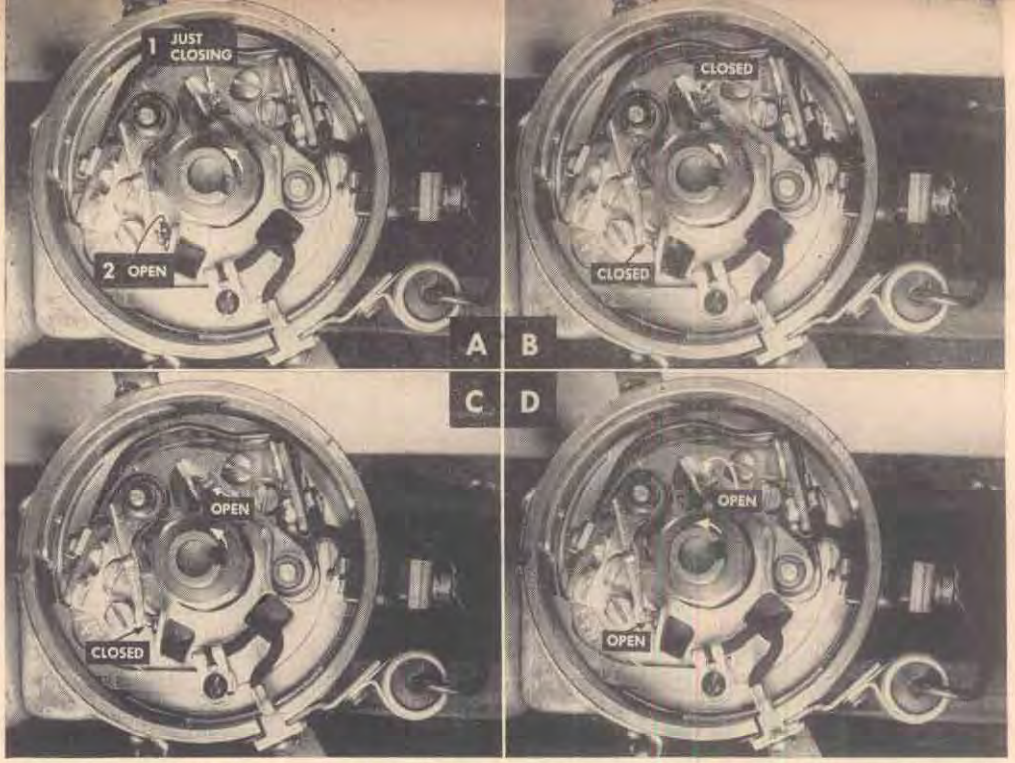
Here's where a vacuum advance comes in. Operated by the varying vacuum in the intake manifold, it provides the additional advance in the middle speed ranges that the centrifugal mechanism cannot give.

How vacuum advance works. In most cars, the vacuum diaphragm moves a link arm back and forth to rotate a movable breaker plate. If the breaker plate rotates as it should, if the spring pulls it back to its designed location when vacuum is low, your engine will function smoothly.

But here's the rub—and rub is the right word. Through wear, dirt, manufacturing variations and sheer perversity (or so it seems), the breaker plate does not always move as advertised. Consequently, the odd behavior which you sense in the driver's seat reflects the misbehavior of the vacuum advance system.

One of the original methods of mounting a breaker plate consisted of providing a groove inside the distributor housing to serve as a race for small steel balls supporting the plate. Unfortunately, wear in the groove and balls eventually limits movement

ACCURATE POINT CLEARANCE is vital. Feeler gauge of wire-type shown is okay with new points. If points are worn, dial indicator is better. Condenser must go outside. Maker recommends condenser of higher capacity, but writer found original worked well.



HOW DUAL POINTS WORK. By lengthening the dwell angle, dual points give coil a longer period to build up a charge, thereby assuring a hotter spark. Here, in photo A, points at left (No. 2) are open and plug has just fired, and points at right (No. 1) are just closing. In photo B, the left points have also closed—and the dwell period begins. In photo C, points 1 have opened, but no spark occurs because points 2, which control the timing, are still closed. In photo D, the second points are open—and spark jumps the gap.

of the plate. About three years ago a sliding bearing replaced the ball race. This newer unit is longer lasting, but still leaves much to be desired in breaker movement.

It should be noted here that the type of distributor I am talking about can be recognized by the vacuum unit attached directly to the distributor housing. On types such as that found on the Chevrolet, the vacuum unit is mounted to one side of the distributor and just pulls and pushes the entire distributor around.

What's the cure? So much for the symptoms of breakeritis. The cure is a breaker plate so mounted that it moves with absolute freedom and just the proper amount of drag to match the calculated characteristics of the spring and vacuum diaphragm. The breaker plate that I installed is a precision device with a nicely machined bearing race and about a jillion small steel bearings to carry the load with beautiful smoothness.

One poke with your finger will convince you just how slick it is. Install one and drive the car, and you'll be even more convinced. If you are content with a single breaker point, this ball-bearing plate can be used in the factory-installed distributors of a long list of cars.

Why dual points? To appreciate the advantages of making this switch, you must consider just what a tremendous job we demand from a single set of points and an ignition coil at high speeds when the engine is turning up around 4,000 r.p.m. or more.

At this speed, each cylinder fires 2,000 times each minute. Multiply this by eight cylinders and you find that the coil is asked to charge and discharge 16,000 times each minute. Even at the speed of electrical energy, this isn't easy. To get a hot, intense spark, the coil needs a full charge of current long enough to saturate the primary. This build-up must take place during the fraction of a second the points are closed. Anything we can do to help along this charging of the coil improves high-speed ignition.

The period of time the points are closed is measured in degrees of cam rotation and is usually called dwell angle. Dual points increase the dwell angle, giving the coil a longer time to build up a charge. Second,

dual points reduce the amount of work each contact surface has to do. Thus, your points should last longer.

Installing the unit. Although dual points and the ball-bearing plates can be installed without removing the distributor, you'll find the job easier and get better results by clamping the works in a shop vise. Removal takes only a few minutes. If you are careful to watch exactly where the rotor on top of the cam is pointing as you lift out the distributor, there should be no difficulty in dropping it back and engaging the drive gear and oil-pump drive tang.

Complete cleanliness and secure connections, second nature with a good mechanic, are the main things to watch for. Otherwise, the directions that come with the parts are easy to follow.

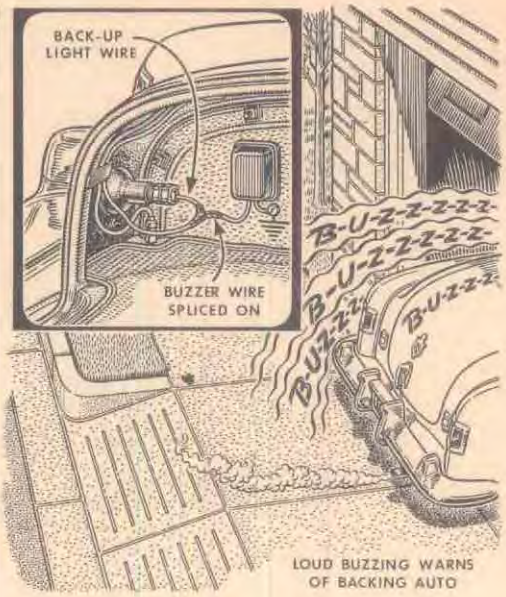
Adjust the point clearances very carefully, drop the distributor back in its opening, and time the engine on the nose. If you don't have a timing light, you can get by with one of my trick solutions.

Timing tricks. For timing, I normally use an old tail-light bulb with a couple of lengths of doorbell wire soldered on. I clip one wire on the hot terminal of the battery, and the other I hook or wedge gently on the breaker point. With duals, you time on the second point to open.

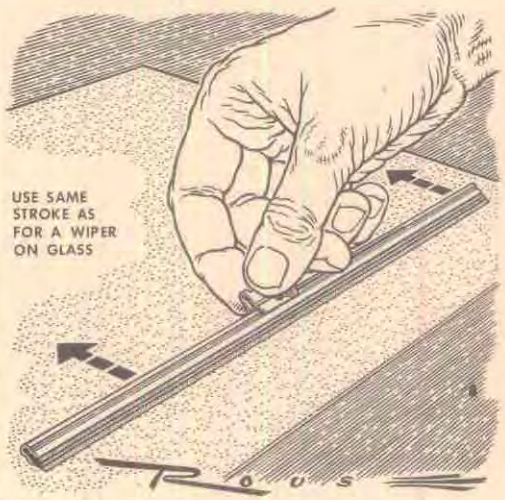
Then, with the engine turned so the timing mark is lined up with its pointer and the distributor rotor in position to point to No. 1 spark-plug wire when I clip the cap back on, I carefully turn the distributor body until the light just goes out as the points open. I then tighten the distributor hold-down screws and the job is done.

Another version of the same trick is to turn on the ignition, with the primary wire connected from the coil, and have someone watch the ammeter. The slight discharge through the coil will show on the ammeter. As the points separate, the needle will flick back to zero. Still another timing trick is to take the high-tension lead from the coil and, with the ignition on, hold it about ⅛″ from the engine block. As the points break, a spark will jump. If the timing marks are lined up, the engine is in very close time.

I have checked all these methods carefully with precision-timing equipment. If you are careful, they seldom will err by more than 1°. END



A back-up buzzer is an added safety measure for pedestrians when you back out of a driveway. You can install one quickly in the trunk of a car equipped with automatic back-up lights, using a door buzzer spliced in the wiring of one of the lights. Mounted and grounded on the metal body, it sounds off every time you back.



Worn windshield wipers can have their efficiency restored by stropping the edges on sandpaper until clean rubber shows for the entire length. Then you hold the blade on edge and slide it lightly lengthwise on the paper to square it up.

How's Your Muffler?

A leak anywhere in the exhaust system—manifold gasket, muffler or tailpipe—can turn the family sedan into a rolling gas chamber. Here's how to check yours.

Average life of a muffler has been figured to be about 23,000 miles, equal to 2½ years of driving for the average U.S. motorist. Look at the speedometer or a calendar to find out whether you should think about yours.

You're lucky if drowsiness or headaches warn you in time that deadly carbon monoxide is getting into your car. Don't trust an open window to keep you awake. If you postpone repairs, you are gambling with your life.

Inspect old muffler for heavy carbon or gum deposits after removal. Their presence suggests faulty ignition. Better check spark plugs.

An exhaust extension is often a practical addition as well as a decoration. It may lessen chance that monoxide will sweep back into car and will carry corrosive fumes away from the body metal.

To check for leaks, tap the muffler and pipes gently with a hammer the next time your car is on a lift. Does the muffler rattle from loose parts inside? Does the rust that is shaken loose show up any cracks or holes? A more thorough check is to pour a little oil into the carburetor when the engine is running. Stuff a rag loosely into the tailpipe to increase back pressure and watch system for escaping smoke.

Grease placed in front end of a new muffler will soon vaporize and coat the inside of the muffler, providing some protection from corrosion.

A dent in the tailpipe, which is sometimes caused by backing into a high curb or driving over an obstruction, is a troublemaker. A whistling noise on acceleration is often a tip-off. Any restriction that impedes exhaust flow will increase back pressure, causing inefficient combustion, loss of power and reduced gas mileage. Back pressure can burn or warp exhaust valves.

The Truth About Your Brakes

Can you count on them? Are they keeping up with power? What's Detroit doing about it?

By Frank Rowsome Jr.

ENERGY-ABSORBING gadgets like auto brakes do not have the glamour of energy-producing gadgets like engines, but they are fully as important; running out of brakes tends to be more exciting than running out of gas.

"Accidents due to defective brakes," the Association of Casualty and Surety Companies reports, "have contributed to more than 40 percent of all mechanical-defect accidents." Insufficient or inferior fluid, worn linings, and worn master or wheel cylinders are the chief culprits.

But sudden, total brake failure is actually quite rare. Far more common is a gradual deterioration of stopping performance, built up over thousands of miles. Since it comes imperceptibly, it can sneak up on a driver: on a hard stop the pedal will come nearer the floor, but only a *little* nearer than it did last month.

A complicating factor is that expert drivers can be trapped by their own competency. With a combination of skill and good judgment, you may go thousands of miles without a crash stop—then, suddenly, the chips are down. That's a bad time to discover worn brakes.

What is Detroit doing about it?

Even though brake engineers have enough glittering equipment and Greek-letter mathematics to split an atom, brake work is largely done on a let's-try-it-and-see basis. Brake design is intricate, and a theoretical approach is hampered by technical mysteries (what *is* friction anyhow?) on which experts disagree.

There is also general Detroit agreement that you don't fool around with brakes. Styling spears, power-operated

How to Use Brakes

USE BRAKES SPARINGLY. Unnecessarily hard or frequent braking not only wastes gas, tires and brakes, but it adds to fatigue and is the mark of an unpolished driver.

PUMPING OR FANNING THE PEDAL (a rapid on-off movement) can help with directional control on a slippery surface, or when a pedal goes dangerously low.

IN A STOP FROM HIGH SPEEDS, it is preferable to build up the *rate* of deceleration as quickly as comfort permits, doing most braking while still traveling fast.

IF TRAPPED BY A TIGHT TURN, try to stay off the brake pedal. If the turn is going to make tire-to-road adhesion chancy, you can't afford to spend adhesion in braking.

MAKE A PRACTICE of using the brake pedal to test for possible slipperiness when you come to a different kind of road surface, or the weather changes.

GUARD AGAINST the tendency to grow so accustomed to your car's brakes that you allow them to become badly worn.

Brakes gulp energy even faster than today's engines produce it

CLIMB INTO A ZIPPY 1954 SEDAN, select a deserted stretch of highway, and belt the gas pedal. When you get up to 75 m.p.h., hit the brakes hard—just shy of a squawling crash stop. You'll get back to zero fast. Where it took a 200-plus-hp. engine 20 seconds and 1,300 feet to accelerate you, the brakes do the opposite in less than five seconds and 275 feet. The energy they soak up then amounts to *500 or 550 horsepower.*

antennas, and even the seductive curves of your combustion chamber can be left for the brass and the sloganeers to tinker with. But nobody ever bucks for anything but the best possible brakes that the budget can provide.

What are the problems? A brake designer, in theory, can count on six inches or more of pedal travel and a peak pedal pressure of about 150 pounds. (Even Grandma, using her elderly knee as a kind of toggle, can push that hard.) But the competitive heat is on the brake designer to lighten the job. So he specifies a brake-shoe linkage that has a servo effect—one that uses a "wrapping" shoe that borrows energy from the car's momentum to do part of the work.

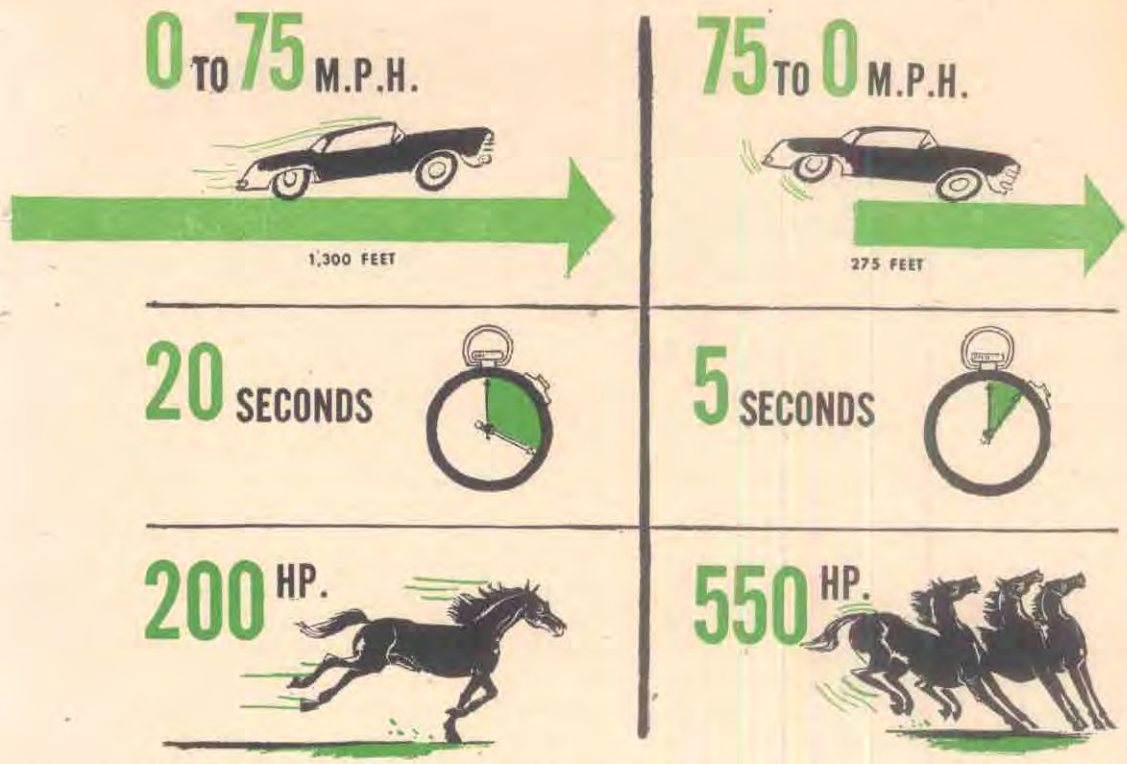
This is fine—a kind of poor man's power brake—but it brings its own headaches. One is the need to equalize wear among brake shoes; another is that brakes must obviously also stop a car from rolling backward; a third is that if you get *too* much self-actuation, the brakes may accidentally lock. A continuing problem with self-energizing brakes—which most U.S. cars now use—is that the more "servo" you put in, the less constant it is.

But constancy is *the* prime brake virtue. To be truly safe, a brake should deliver a predictable, proportional response despite wide variations in speed, load, temperature, humidity, frequency of applications and a host of other variables. (You can see why the pros usually refer to a brake as "she" and use the term "morning sickness" to describe one common ailment. This is the snappish habit otherwise docile brakes have of pitching you on your snoot the first time you touch the pedal in the morning—a matter of moisture condensing inside and upsetting servo calculations.)

The harried designer has a packet of other problems. Where's he going to dispose of brake torque, a gigantic twisting force that, on a hard stop, wants to pretzel the suspension? What about forward weight transfer, which tries to nose-dive a fast-stopping car? How can he best divide up the work between front and rear brakes when a car will have enormous variations in load distribution?

At proving grounds and technical centers, they say:

- *Brakes are not, on performance, lagging behind engines. They have had an increasingly mean job: heavier cars, higher average speeds, transmissions affording less engine braking. But they are holding their own. Stopping performance is demonstrably better than before the war.*
- *Power brakes are here to stay, having outlasted some sharp behind-the-scenes controversy.*
- *Disk brakes, although under study by many makers, are apparently not going to supplant drums in the near future. The best of them work well but they are too expensive.*
- *The fade problem—progressive failure of brakes during severe use—is being assailed from several directions, including special cooling and linings.*
- *Brake governors—clever little gadgets that unlock a sliding wheel to reduce swerve in crash stops—are being studied.*



How's he going to get big, cool-running drums with small tire diameters? (Bigger drums wouldn't be an unalloyed blessing: more area and more leverage, at the cost of higher surface speeds and more unsprung weight.) And how's he going to design a hydraulic system that will withstand 1,500 pounds to the square inch, last indefinitely, never fail suddenly, and cost less than the competition's?

They love power. Brake engineers as well as lady drivers like power brakes; there's less need to sweat for a soft pedal, and tougher linings can be specified. They don't stop a car any faster, of course, but they make it *easier* to produce any given deceleration.

Standard equipment on some '54 cars and comparatively low-priced options on all others, modern power brakes are vacuum-operated boosters that multiply pedal input by three or more. A good deal of ingenuity has been spent in providing reactive feel, vacuum storage, and "fail-safe" performance.

Low-pedal power brakes—with total travel about that of the accelerator—let a driver swivel his foot on the heel between brake and gas. This is quick and easy, but also has provoked a sharp undercover fight on safety. Reducing pedal travel reduces leverage produced by the driver's foot, which is all right as long as boost is available.

Say the high-pedal advocates (notably the four Chrysler divisions): An engine killed at less than 20 m.p.h. on a winding downgrade may not be momentum-started through an automatic or overdrive transmission. An inattentive driver —let's call her a dopey dame—may not know it, and may use up the vacuum reserve unconsciously. Then a sudden emergency, on a low-pedal car, may call for immensely high pedal pressures.

That there is some cogency to the point is suggested by Olds' use this year of a bigger vacuum tank, and by Buick's new optional electric vacuum pump. This writer has tried out both high- and low-pedal jobs with engine cut and vacuum reserve expended. In the high, effort is only a bit more than with unboosted brakes. On low-pedal cars you have to

What's the Quickest Way to Stop Your Car?

If you believe that locked wheels will pull a car down faster, you'll be backed by Ford engineers. If you pick braking-just-shy-of-sliding, you'll have many GM and Chrysler people in your camp.

Most automobile people have long cherished the notion that maximum braking comes when a wheel isn't quite dragged, maximum acceleration when it isn't quite spun. It is a plausible notion. Ford's experiments, however (involving static friction coefficients, torque and other factors), suggest that it isn't true.

However the experts resolve the dispute, it is plainly an excellent idea not to rely on sliding wheels to stop you.

tromp very hard indeed. Startlement is perhaps a big factor, which suggests the merit of running an occasional rehearsal.

Those wonderful disks. Prophets have long been hailing disk brakes as the coming thing. They do a fine job on heavy aircraft, have been widely touted as a major reason in Jaguar sports-car victories, and have done well on the heaviest Chryslers.

Disks—which work by pinching pressure on a disk turning in the same plane as the wheel—have big advantages. Unlike a drum, a disk won't distort under pressure. It won't expand with heat in a direction that reduces useful pedal travel. Counting both sides, it has a bigger "swept" area than a drum. And open, racing-type disks are about as perfectly ventilated as a brake can be.

The drawbacks are also considerable. If you expose the disks to grit and rain, you'll shortly get pitting and roughening of the disk surface, which is murder on lining life. (Car brakes, unlike racing jobs, must go thousands of miles without attention.) But if you enclose the disk in a housing, as Chrysler does, you go back to building ovens—enclosed containers with heat sources inside.

Moreover, by the time you get a disk brake smooth, self-adjusting, self-actuating, and all the rest, you end up with an intricate, costly mechanism.

Anatomy of fade. A brake is an energy converter that trades foot-pounds for calories. When you overfeed it energy, it produces too many calories, which generally means fade trouble. Fade is the alarming loss of stopping power that can occur when you hit the pedal hard and often, say, down a long mountain grade.

There's a distinction between pure fade and "loss of pedal." The latter, when your foot goes smack to the floor, may come from low fluid, wear, or drum expansion; but unless there is actual hydraulic failure, you can correct for it in a pinch by pumping the pedal back up. True fade is different: a heat-caused change in the coefficient of friction between lining and drum. You push like all get-out, and the pedal still has travel left, but you don't do much stopping.

The experts aren't sure how it happens. Some talk obscurely about monomolecular behavior. Others theorize that oily liquids used as a binder in linings come boiling onto the surface under intense heat. There's no question that extremely fade-resistant linings can be made; the difficulty is that you have to pay elsewhere in things like loss of smoothness, higher unit pressures, or a tendency to score drums.

The other avenue of attack is through cooling. This includes such measures as the electric blowers on the rear brakes of the Mexican-race Lincolns.

Suppose a car is put to a standard fade test. Accelerate it to 75 and brake it down to zero at a standardized high deceleration—just shy of sliding rubber. Repeat the cyclé immediately, for up to a hundred times. As the brakes grow hotter, the required pedal pressure climbs up. If the car is a bad fader, you'll reach a point where you can't get the standardized high deceleration no matter how hard you push. More likely you'll reach a kind of stability. Needful pedal pressure may climb up 30 or 35 percent, then level off and hold.

What happens, of course, is that the brakes have become as heat-soaked as they will get. It follows that everything designers can do to lower this stabilized temperature helps control fade. Most past work has been on metallurgy and heat transfer inside the brakes. In the future there'll probably be more attention to air flow outside, including ducting, fanlike disk wheels, and more fins.

Decelostats yet. On a crash stop with all four wheels sliding, you have almost no directional control. A rolling wheel wants to go where it's pointed; a sliding one doesn't give a hoot where it goes. One possible answer to high-deceleration swerves is the "decelostat" or brake governor. This is a rotation-sensitive dingus that instantly and slightly eases braking on a sliding wheel.

Similar devices work well on trains, to prevent "flat" wheels, and on aircraft, where a blowout caused by a locked wheel on the landing run-out can be bad business. Preliminary proving-ground work suggests that governors may help a bit on fast-stop swerves. Detroit people are close-mouthed here. END

Beat-Up Station Wagon Converted into a Handsome Pickup Truck

ECONOMICAL conversion instead of costly rebuilding has improved the utility of our wooden-body station wagon. For an outlay of $55.60 we now have a vehicle with pickup-truck capacity and passenger-car riding qualities.

The photos show what we started with —and what we now have.

All decayed wood was stripped away from the rear of the body and the rotted part of the top sliced off. Side sweeps shaped from ⅜" exterior plywood were then installed in the rear body panels. Stanchions at the rear corners were cut off at tailboard height. Other changes included a bulkhead behind the middle seat and a plate across the end of the cut-off top. Removal of the rear seat from the vehicle gives us easily accessible rear cargo space.—*Bill Knodt Jr., Essexville, Mich.*

Now YOU Can Have Power Brakes

With this new booster kit, plus an evening's work installing the unit, you can give your postwar car tiptoe stopping power.

By E. F. Lindsley

IF YOU have been thinking that power brakes are strictly for the luxury jobs, you can shift your thoughts now to the ordinary car level. You can install them on your present car if it isn't *too* old, remove them in 10 minutes when you trade, and put them right back on your next wagon. Thus you can spread the initial cost over as many cars as you may own in the next 10 years.

This is possible because the term *power brake* actually means that a source of extra boost has been dropped into the hydraulic system between your foot and the wheel cylinders. If your present brake system is up to snuff, your car is just as well adapted to power brakes as the newest trick on the showroom floor, allowing for minor details of yearly model changes and improvements. The only thing you lack is something to supply the pressure that you now apply to the hydraulic fluid when you make with the leg muscles. The new Bendix Hydrovac unit will do this for postwar cars.

Leverage vs. Power

Don't kid yourself: it takes power to stop a car. According to Bendix, 70 pounds of foot pressure gives about 400 pounds per square inch in the normal hydraulic system without the booster. Here, the brake pedal is mounted so the push from your foot is crowbarred up through a pretty big leverage before it moves the master-cylinder piston. Conventional, built-in power brakes mount

POWER-BRAKE KIT has been worked out to make home installation practical. At left you see the main cylinder of the Bendix Hydrovac booster. The writer is studying instructions.

A CONVENIENT LOCATION for the unit in this car was found in the fender well. Holes were drilled for the cylinder-retaining bracket. This is the only drilling that is required.

the pedal close to the floor and do away with this leverage, figuring of course that the power will take over for the lost leverage.

This is an advantage, according to some, because the driver doesn't lift his foot in going from gas to brake. On the other hand, since the power comes from the engine vacuum, if the engine quits, without the old-fashioned brake-pedal linkage you've got darn few brakes.

When you put on a Hydrovac booster, you retain the original pedal leverage. Even with a stalled engine or a failed power unit, you still have the brakes the car was built with. Admittedly, you have to lift your foot to hit the brake pedal, just as you always have. But the vacuum booster has a 2:1 power ratio and gives out with over 800 pounds to stop your car.

Power Braking Gives Surer Control

My first reaction was an unimpressed "So what?" My leg wasn't knotting in agony from pushing a brake pedal.

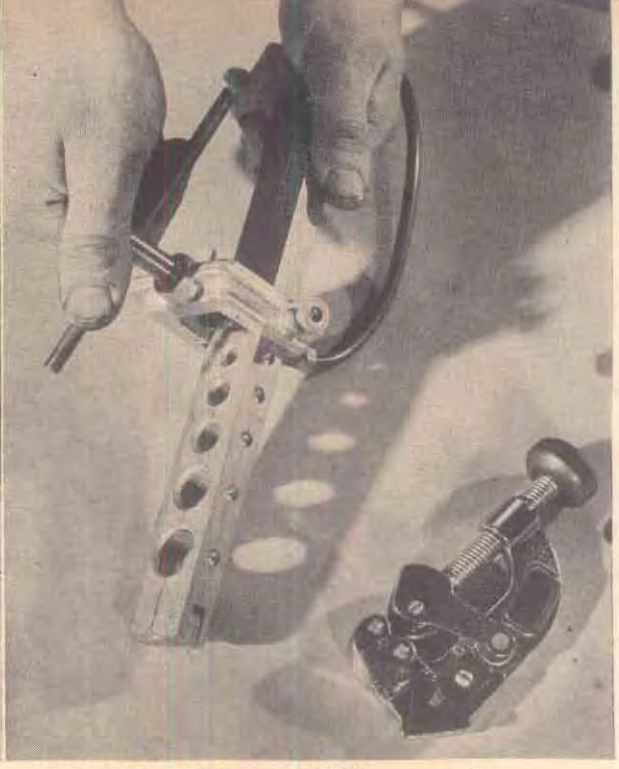
The first time I made a traffic stop with the power unit, the car almost did an outside loop on dry pavement. Two days later, I was starting to enjoy the new control I had. Later that week I left on a trip that racked up 4,000 miles, much of it in the Rockies, and with several days of 800 miles at a stretch. The trip really sold me. Strange roads and schedules that demanded high speeds sometimes brought me into unexpected turns and situations where the amazingly fast and smooth braking was a real lifesaver. Tiptoe pressure is all it takes to ease the car down beautifully.

Fits Anywhere You Can Squeeze It In

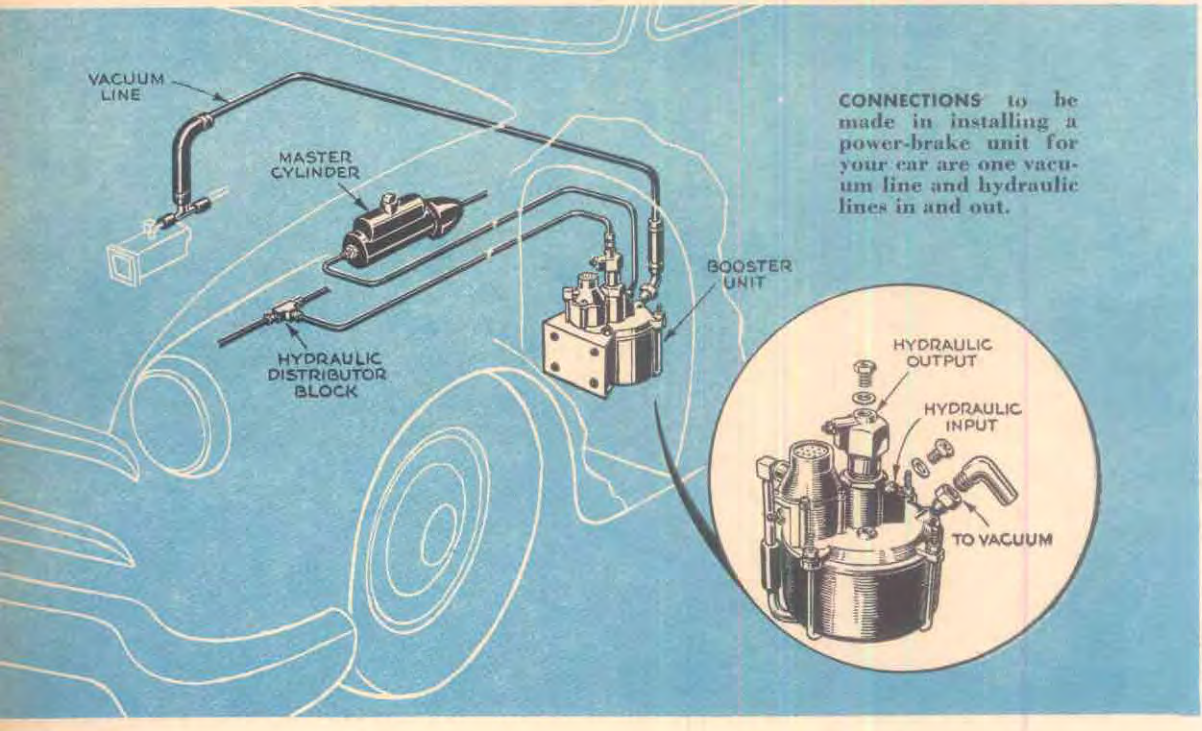
Although vacuum-booster cylinders have been familiar to truck operators and mechanics for years, this is the first real passenger-car unit. The Bendix unit will fit any conventional car with conventional hydraulic brakes, will mount and function almost anywhere you can find a nook to hide it, under the hood or elsewhere, and is generally rugged and insensitive to differences in engine size, climate, or the skill of the installer. The makers have packaged it in kit form with the really simple fittings and hardware sorted into well-marked boxes. An evening spent with a drill, screwdriver and adjustable wrench should see power brakes on your car. The flared tubing can easily be made up at any garage.

It is only fair to ask where the additional

SHAPE AND LENGTH of hydraulic tubing for vacuum and hydraulic lines can be found by making templates with soft wire solder. Form copper tubing gently to match solder-wire contours, avoiding sharp bends and flats.



HAVE TUBING FLARED, at a reliable garage, for making the hydraulic connections. Remember, these lines must hold 800 lb. of hydraulic pressure. Failure can be serious. Don't forget to slip fittings on before flaring.



CONNECTIONS to be made in installing a power-brake unit for your car are one vacuum line and hydraulic lines in and out.

IT IS IMPORTANT that the hydraulic lines be well supported and free from vibration that could cause cracking. Kit contains hold-down clamps. Tape the areas where clamps contact the tubing to prevent metal-to-metal chafing.

INTAKE-MANIFOLD, VACUUM-SOURCE connection is readily made with T fitting and hoses in the kit. Connection must be tight; a leak in vacuum line would reduce effective power of unit, cause poor engine performance.

AFTER CONNECTING vacuum line to unit with hose and clamps, you are ready to bleed the system. The instruction sheet will help you do this if you want to attempt the job yourself, but letting an experienced garageman take over will usually cost you very little.

power comes from to boost the brake pressures up to 800 pounds plus. And why haven't we been using it all the time?

We have. The vacuum windshield wiper has been wheezing with us from the early days. Even at a healthy idle, normal engine vacuum is equivalent to 18 to 20 inches of mercury. Apply this to a diaphragm about the size of the lid on a one-pound coffee can and you have a force to be reckoned with. Couple that force to a hydraulic master cylinder and you wind up with real power. Because the power comes from the pumping action of the engine, your foot does little more than energize the controlling action of the valves in the power cylinder. END

Push-Button Car Seat You Can Install Yourself

Whether you're lazy or not, it's a luxury to be able to readjust the driver's seat at the touch of a finger.

By Roland P. Loewen

THIS is the story of a de luxe touch I added to my car—an adjusting mechanism that puts the front seat just where I want it at the touch of a switch.

Two convertible-top electric motors, resurrected from an auto graveyard, do the trick. These were designed to raise and lower the top by driving a set of gears and screws. Convertibles built by the Chrysler Corp. just before and after World War II have them.

I dug up two complete assemblies—motors, gears and screws. I also got the relay that guards the motors from overload and the reversing switch that controls them. A few pieces of strap iron and two switches to limit the seat travel completed the materials for the job.

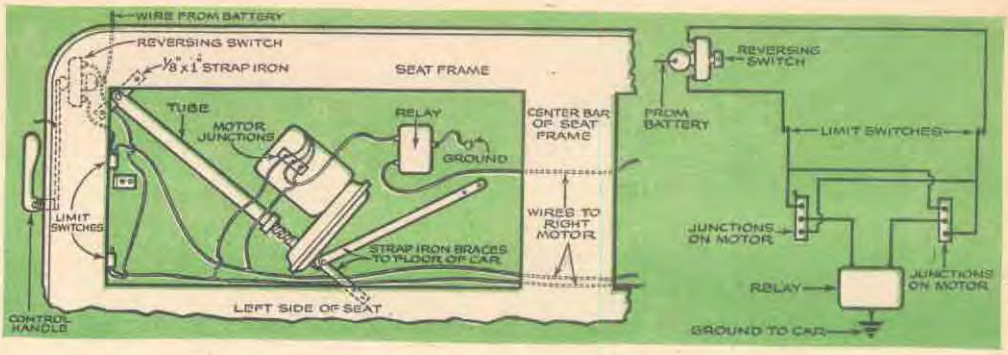
Cleaning and testing the equipment was the first step. I opened the plug, poured out the old oil, took the gearbox apart and washed everything thoroughly. After reassembly, enough No. 30 motor oil was put in to half fill the gear case.

As a test, I connected two wires to my car battery and fastened one to the center junction on one of the motors. I then touched the second wire to each of the other two terminals in succession to make sure the motor would run in both directions.

The second motor was tested the same way and then both were connected through the relay as shown in the accompanying diagram. With this setup both motors

CONVERTIBLE-TOP MOTORS are located at an angle to move seat fore and aft. Gears driven by the motors turn screws in and out to move seat. Seat handle (foreground) controls switch.

LIMIT SWITCHES on left end of seat frame shut off current when seat reaches its forward or rear limit. Pointed piece of strap iron bolted to floor operates the switches.



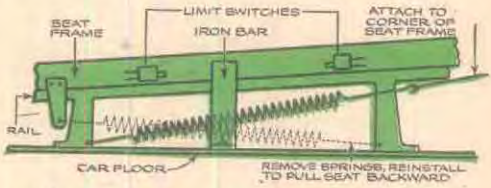
should turn. As a final test, each motor was connected separately through the relay. If the relay is perfect, you should hear it click as it kicks out the connected motor to keep it from running.

Placing the motors. In my De Soto, I found it necessary to mount the motors at an angle to keep the seat frame from striking them in either the extreme fore or aft position. The screw shaft and tube were shortened with a hacksaw to about 12" and a drill was used to make new holes in the tube. If you make a similar conversion, be sure to cut off the clamp end and not the screw end of the tube.

Two steel brackets clamped to the gearbox boss with nuts and large washers were bolted to the floor to fasten down the motor assembly and keep it from twisting. To raise the assembly off the floor slightly I used the original mounting brackets and pins, adding an eye bolt and spacers. In each assembly, the pin was run through the bracket and eye of the bolt at floor level. The bolt itself was run through the gearbox boss, providing the means of attaching the two brackets.

The front corners of the seat frame were drilled and flat steel pieces bolted on for attaching the screw tubes. Before bolting the motors tight, be sure they are placed so they both put the same pull on the seat. It may be necessary to adjust one of the tubes to achieve this. Self-tapping sheet metal screws do a good job of fastening the relay to the floor.

Helper spring. Most seats have a spring at each side to help pull the seat forward. In my case, I found that the seats had a more solid feel, especially during



quick stops, after I had reversed them to pull back on the seat. The motors still have plenty of power to shove the seat forward.

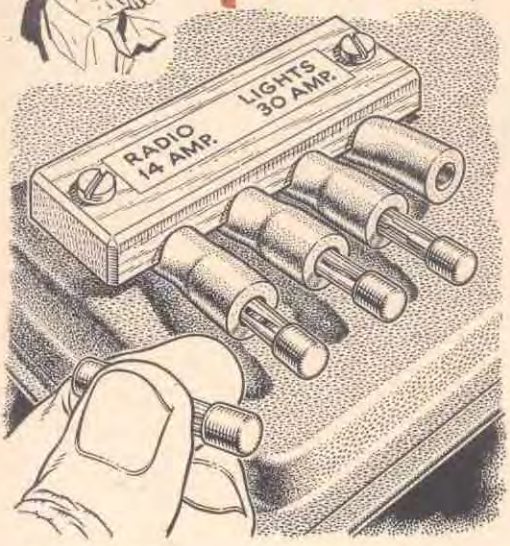
Limit switches placed on the left side of the seat frame automatically cut off the current when the seat reaches either its extreme forward or rear position. Regular limit switches with rollers on the ends of lever arms are available in most electrical shops. The 115-volt size will work. A bar fastened to the floor operates the switches.

I mounted the reversing switch on a bracket under the seat, drilled a hole in the handle and linked it to the regular seat-adjustment handle. The switch was wired so that moving the handle forward moves the seat forward, moving it backward does the same to the seat.

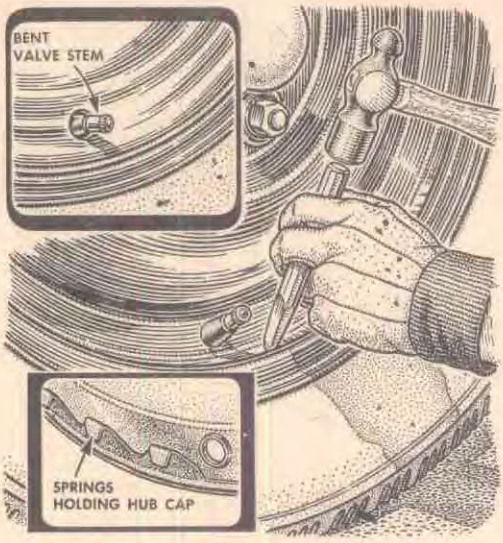
Box Under the Hood Keeps Roadside Tools Handy

You can relieve the strain on the glove and luggage compartments by mounting a toolbox under the hood of your car. A cartridge case from an army surplus store, a tackle box or any other metal box with a lid will serve the purpose. Attach it with bolts or sheet metal screws. Wrap the tools in cloth to keep them from rattling.—*R. E. Klinck, Cedar Rapids, Iowa.*

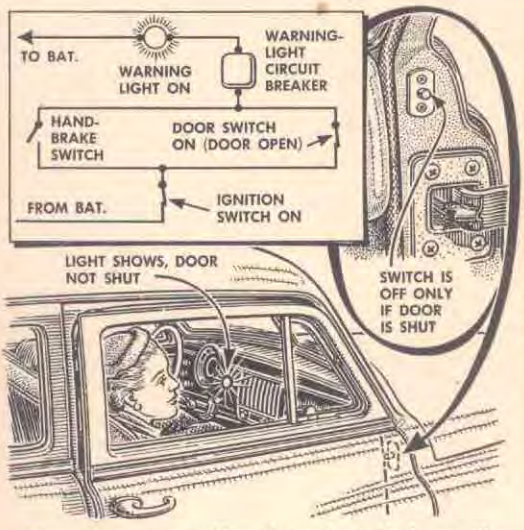
Hints FROM THE MODEL GARAGE



Tuck spare fuses into a clip made from short lengths of windshield-wiper hose for quick replacement as needed. A notched wood block screwed to the inside of the glove-compartment door holds the hose.

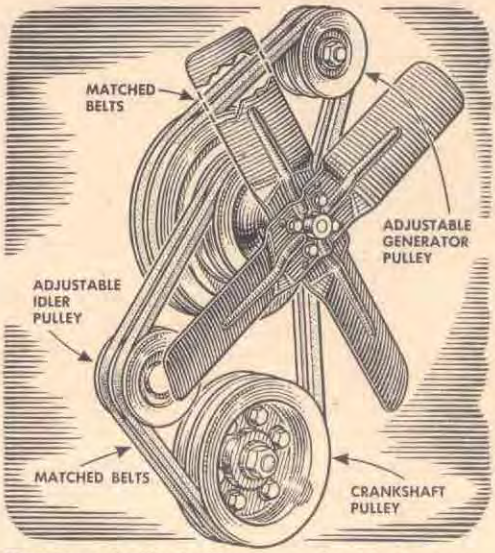


Raise a series of burrs around your wheel rims to keep the hub caps or wheel rings from creeping and distorting the valve stems. Chisel the burrs along the marks made by the spring tabs inside the hub caps.



Mount a normally closed switch on the right-hand door to warn you when it's partly unlatched. Wire it through the ignition switch to the hand-brake warning light or a separate bulb on the dash so that you'll know the door is shut before you start.

Join two pieces of inner tube with a leather strap to make a pair of sleeves that will protect your arms from dirt or a hot manifold when reaching in or around the lower parts of a motor. Use the sleeves for protection against sparks when welding.



Replace both belts on a dual-belt drive, even though only one is worn. Slight differences in lengths of belts bearing identical numbers can make one belt do more than its share of work. Matched belts are packed in sets to be used together.

Long boards or other objects too long for the inside of a car can be hauled on the roof, using inflated inner tubes as cushions. Tie the load to the bumper ends to keep it from pivoting, and slip lengths of hose over ropes to protect car finish.

Use a toothbrush to remove the dried and whitened polish from body seams or behind chrome trim. The same brush can be used to *put* wax in these places as a precaution against body rust or to clean dust from the instrument panel and radio grille.

Caught with a flat at night and no trouble light, you can reflect enough light from the headlights to see what you're doing. A road map or newspaper, partly folded down the center and held or propped in front of the car, will do the trick.

Quit Skidding! Build a Sander

Grit poured under the rear wheels will give you traction when you need it most. This writer equipped his car for $5.

By E. F. Lindsley

A LIGHT snow had given the streets the glassy surface that pays off in work for the body shops. When the stop light showed green, my tires slipped and screeched and I got going up the grade only with difficulty. The driver in the lane beside me pulled away surely and smoothly. Stretching my neck at the next light, I finally spotted his secret—the nozzle of a wheel sander like the ones locomotives and big trucks have had for years.

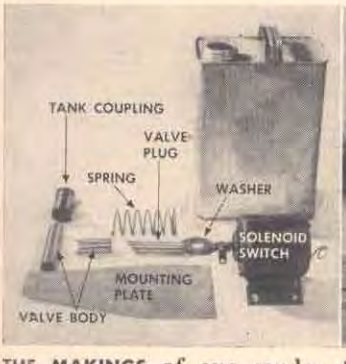
That experience was enough. I decided I wanted wheel sanders, too. It came as a jolt, however, to learn how much they cost—strictly de luxe on my budget. So I set out to get them for less.

I did. A five-buck bill easily covered the cost of the ones I built and installed myself. Less will do it for you if you have a well-stocked junk box.

What will they do? Sanders are no substitute for careful driving. Neither do they outmode chains. In deep snow, chains are the only answer. Sanders are most useful on glare ice and hard-packed snow—or when you need to get out of a steep driveway.

They can shorten stopping distance as much as 30 percent when used in conjunction with the usual pedal-pumping action recommended for braking on ice. At a dead stop, they won't help you start unless you can roll far enough to get your tires onto the sanded area. However, if you get jammed up against the curb and can't pull away, it's not too hard to dump a handful of sand and then get out and kick it under the tire.

The big payoff is the almost instantaneous



THE MAKINGS of one sander include a solenoid switch with a clevis (once linked to a starter pinion), parts of valve body cut from electrical conduit, and a piece of ⅝" shafting for the plug. Sharp 45° end of this cuts off flow of grit without jamming.

FILE RIGHT-ANGLE PART of valve body to fit main piece and solder or braze together. Then drill a series of small holes around side as shown, knock out the waste, and clean up edge with file or hand grinder so that the valve plug can enter freely.

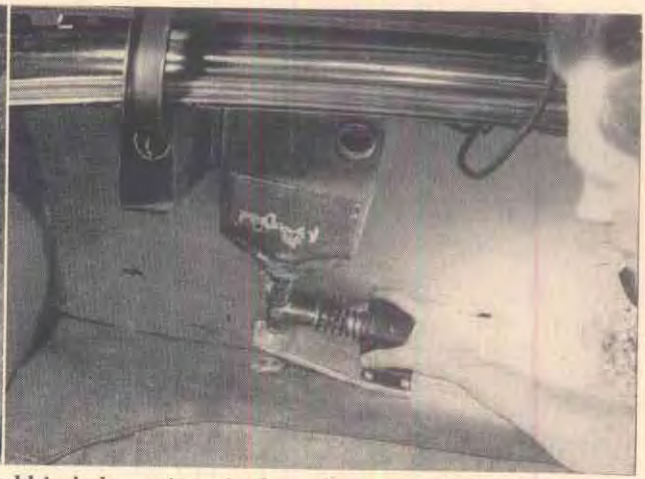
FILE END of valve plug to fit solenoid clevis, join with a rivet. Solder on washer as spring seat. Assemble with sloping face of valve plug down. If spring is too stiff for solenoid pull, trim off a turn. Mounting-plate edges are bent up, corners soldered.

A TURN-LIGHT SWITCH mounted on the steering column controls the flow of sand. Single switch puts sand under both rear wheels.

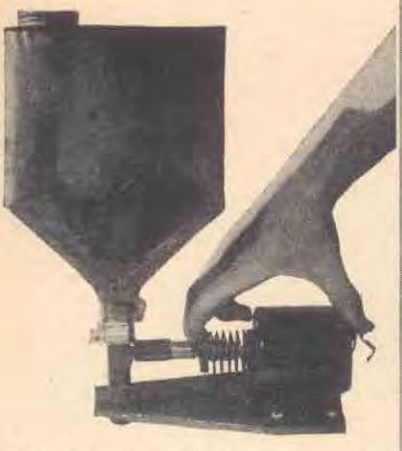
response of a car starting to broadside. Provided your speed is at all reasonable, sanders will promptly get the back end around where it belongs. Then there's the brake-loaded slide into a car stopped ahead of you. Sanders will save you a bump, embarrassment and perhaps a repair bill.

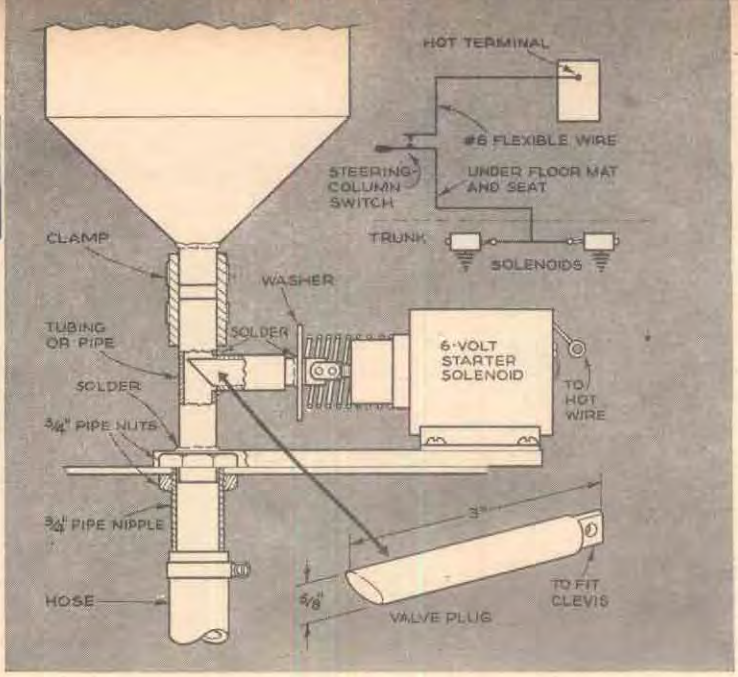
But it isn't sand. Sanders don't use sand at all, but a very coarse grit made from slag or what have you. Ordinary sand won't work; it packs, lumps, absorbs moisture and freezes. Its small grains jam the valve solid. Don't even try it. Go to an accessory store catering to truckers and buy the proper grit.

Just how and where you mount your sanders will depend on the shape of your car trunk. If it calls for a pair of small tanks as mine did, make them easily removable for filling. If you can find room for big metal hoppers, their extra weight will require

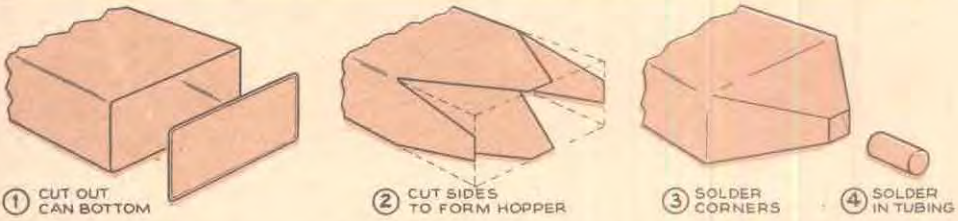


HOSE IS CLAMPED on pipe nipple held in hole in trunk floor with pipe nuts above and below (left). Hopper and valve unit slip into pipe nipple a short way (right) but can be removed for refilling. This rig snaps into place under deck, but could be held by spring.





CUT CAN to make hopper, and solder in tubing. Unit above is ready for trial. Solenoid action should be snappy, spring strong enough to push plug back reliably when current is cut.



secure mounting, possibly with strips of inner tube. Big tanks won't need filling so often, but after the novelty wears off you won't use grit as rapidly as you'd think.

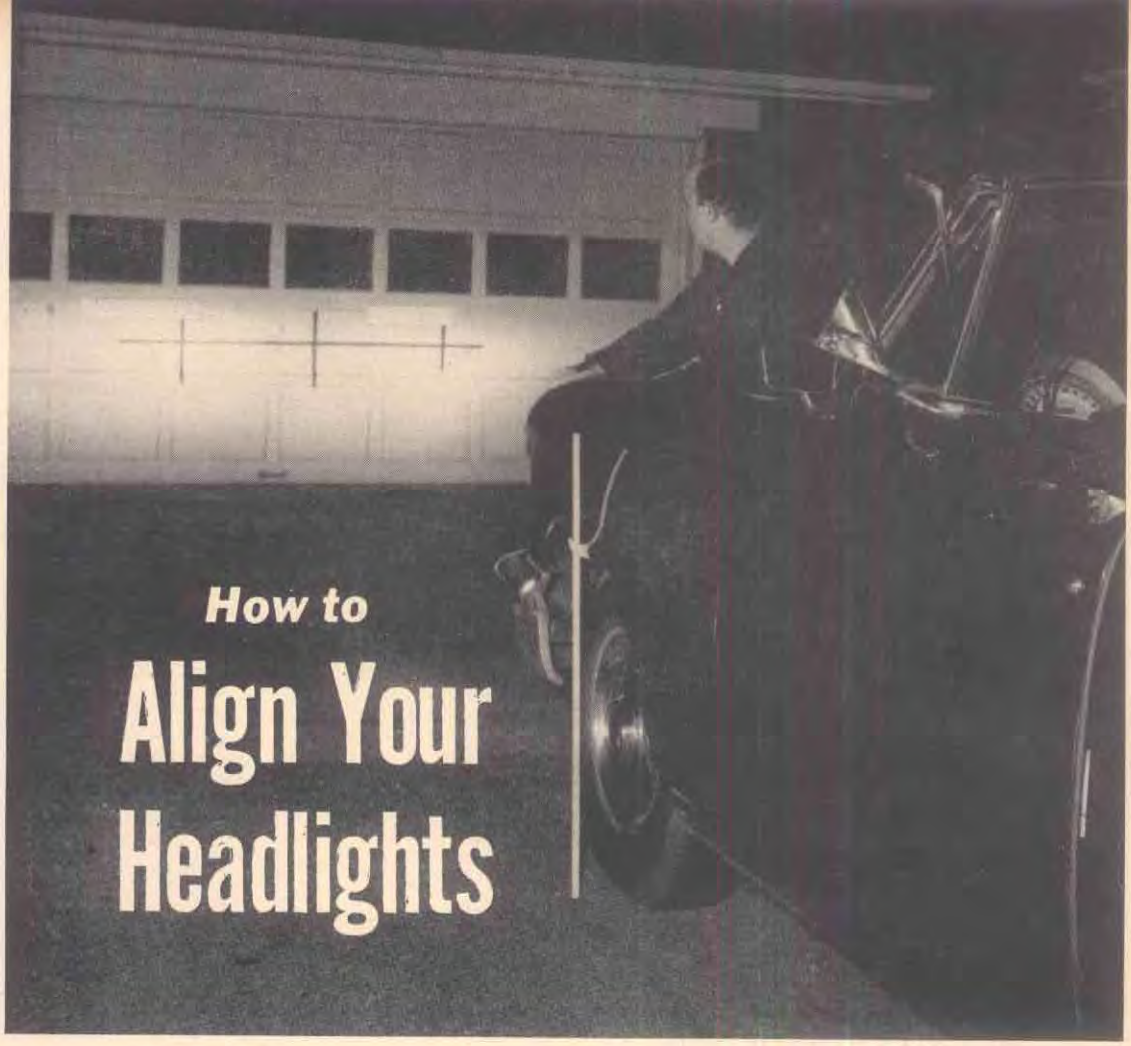
The valve control. Although a cable-operated valve would work, quick response is so vital that you haven't time to tug on cable pulls. I bought two old Buick starter solenoids for a buck each, stripped away the relay parts from the back of both, and hooked the hot wire from the control switch to the one terminal with the big connector eye. The ends of the other two wires are screwed down against the housing.

In picking your solenoid switches, get the kind with a clevis, which simplifies the valve hookup. You may prefer to leave on and use the solenoid relay, because your control switch will then have to handle only a small current.

Prowling around the wrecking yards, I bought a flip-type directional-signal switch. Not needing the stuff that flips it back after you turn a corner, I stripped the unit to the switch and indicator light. Since the two sanders work together, only one pole of the switch is hooked up.

Wiring is simple. Hook up to a hot terminal somewhere, run the wire to the switch, down the steering column and under the floor mat to the trunk, and branch a line to each solenoid. The car frame provides the return side of the circuit, so be sure both solenoids are securely grounded.

SANDING GRIT must drop just in front of wheels, but hoses must not touch tires. Because bumper jack shifts body out of alignment, it was used only to put another jack under axle. Hoses should be straight; bends or sags trap sand.



How to

Align Your Headlights

Are they a glaring example? With tape and a couple of sticks, you can teach them manners in short order.

WHEN approaching cars blink their lights at you repeatedly, even though you're on low beam, you can bet that your lights are out of adjustment.

But don't bet your life—or the other fellow's. In a half hour or less some evening before supper, you can aim your headlights accurately. You'll be helping along highway safety—your own especially. And it won't cost a cent.

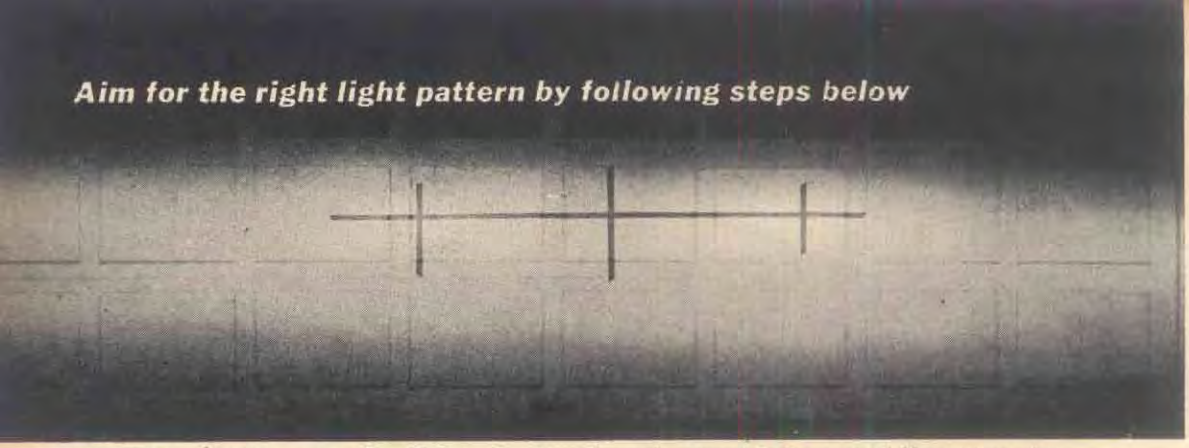
The high beam must reach well ahead for today's fast driving. The low beam should illuminate the edge of the road and show you curves before you get to them, even in the face of oncoming lights. Correct adjustment will give you both.

Using ordinary tape, two sticks, and a tape measure or yardstick, you can follow the steps shown on the next two pages to make that adjustment yourself. All you need is a wall or door at which you can point the car squarely. Because aiming points are marked visually, it does not matter if the ground isn't perfectly level.

One thing first: some state laws permit centering the high beam 2″ below lens center at a distance of 25′. Others specify that it be depressed 3″. Check this point with your license bureau or a reliable service garage to make sure your own job will conform to specs.

Please turn the page for step-by-step pictures

Aim for the right light pattern by following steps below



PERFECTLY ALIGNED, your headlights should form a light pattern like this. Only the high beam is adjusted. Correct aiming of the low beam is automatic because of filament spacing. The numbered steps below show how you can align headlights without special equipment.

1 IN LATE AFTERNOON, while it is still light enough to see, place car squarely in front of a wall or garage door and exactly 25′ away, measuring from the headlight lenses. Rock the car a bit to make sure the springs are free, without any set. Have the car empty and tires inflated to normal pressure. Measure from the ground to the center of the headlights as above. Subtract 2″ (3″ in some states) and cut two sticks to this exact length.

2 TAPE THE STICKS to front and rear fenders alongside wheels. Sight along the tops of the sticks to establish the height of the aiming line on the wall or door. Have a helper mark it while you direct him, or stick up a piece of tape as near as you can and sight several times until you manage to get it right on the nose. Repeat with the sticks on the other side of the car. Then join the two marks to make a horizontal line across your aiming surface.

3 SIGHT THROUGH the center of the rear window and over the hood ornament or centerline to establish a center mark on the aiming surface. Stick a vertical strip of black tape there, across the horizontal line.

4 WITH A YARDSTICK or tape, measure the exact distance from center of the hood to the center of a headlight. If the hood hasn't a centerline or ornament, measure from center to center of both lamps and divide by two.

5 **MEASURE THE SAME DISTANCE** to each side from the centerline on your aiming surface. Stick vertical cross lines of tape at each measured point. These are aiming points for lateral adjustment of the headlights.

6 **IT SHOULD BE** nearly dark by now. Remove external screws and lift off trim rings. With high beam on, hang a coat over one headlight to align the other. There are usually five screws around the sealed-beam unit, three holding it in. Two others are for adjustment. First turn the one at left (as you face the lamp) to center the hot spot sidewise on the aiming point. Next, adjust the top screw to center it vertically. Drawing below shows correct centering on cross tapes. Cover this headlight to adjust other the same way. END

ALMANAC
FOR MOTORISTS

Pithy proverbs, provident counsel and omens and portents of interest to horseless-carriage operators.

▶▶**A slapping cross link** on skid chains should be repaired or wired back immediately. Otherwise the flailing links will chip off the protective coating inside a fender and permit destructive future rusting.

▶▶**Minutes spent** in gently warming a cold engine are the mark of a man who respects his bearings and cylinder walls. He who races a cold engine is descended from horsewhippers.

▶▶**Recheck non-permanent antifreeze** if you do any trafficky driving on a warm winter's day. Some antifreezes lower the boiling point to a level where it is easy to lose protection without realizing it.

▶▶**On bare roads** with banked snow at the side, beware the unexpected icy patch that often occurs when the melt drains across the road and then freezes slick.

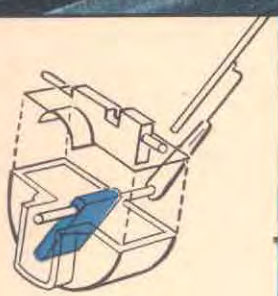
▶▶**Rhythmical rocking,** with the least possible wheel-spin, will save many a call for the tow truck. To prove it, watch an inept driver race his engine and promptly dig deep troughs that chock his rear wheels.

▶▶**How are those wiper blades** holding out? If they just smear up the wheel spray from the fellow up front, better replace them at your next gas stop. They're cheap.

How a Windshield Wiper Works

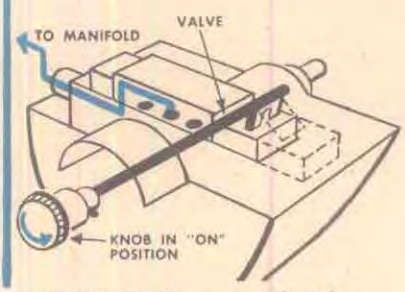
HERE'S WHY your wiper motor always stops blades out of your line of vision. Suction cup in motor does it. Closing valve links manifold to cup. When paddle hits cup, suction holds it.

Flipping those blades back and forth is a pushover for this clever, hard-working little motor that's powered by air trying to get into your car engine.

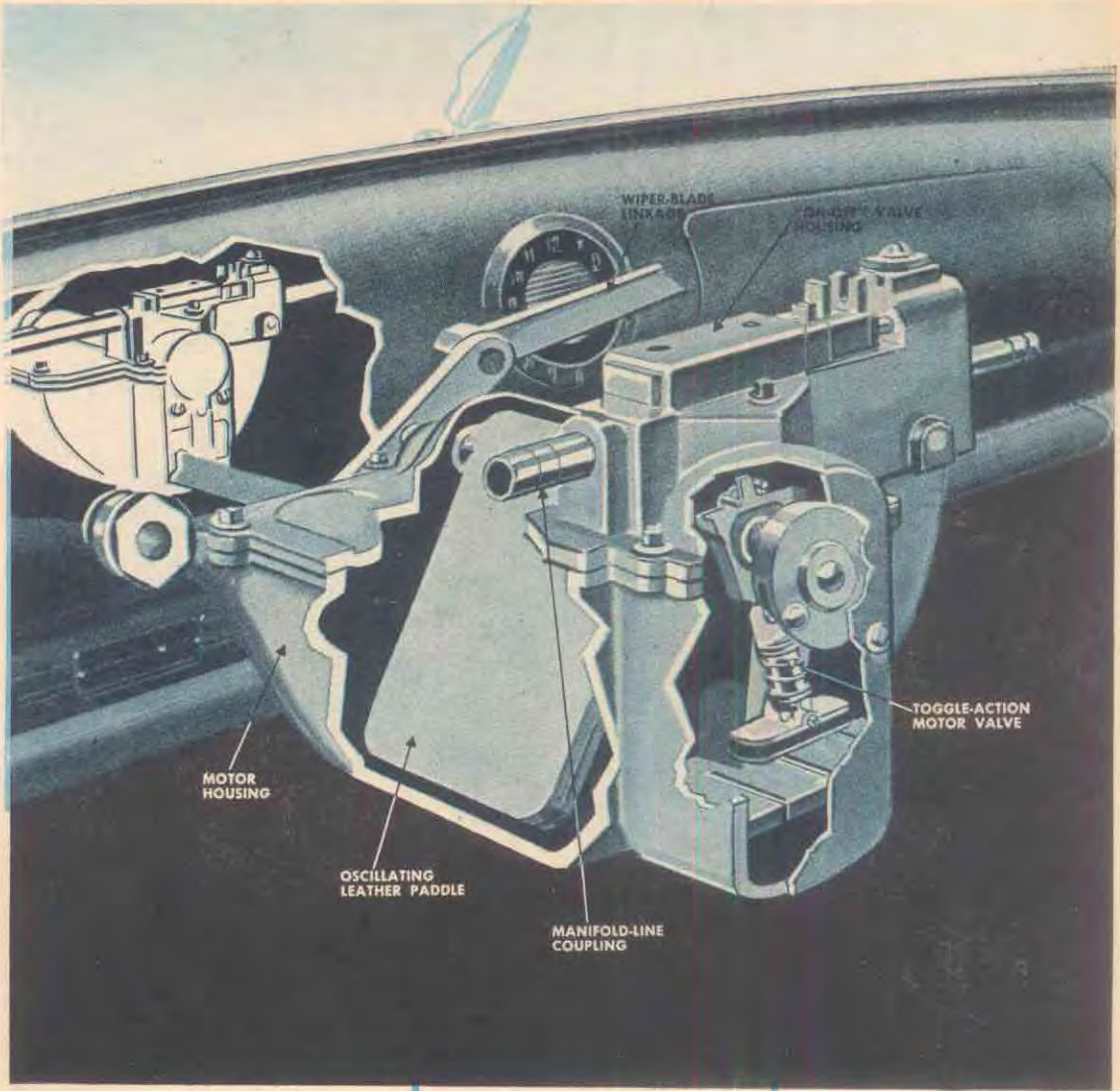


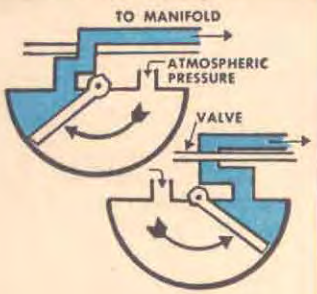
MAIN PARTS of wiper motor are a thick leather paddle and a half-cylindrical housing in which the paddle swings like a pendulum. Shaft turns with it. Wiper blade, or linkage for twin blades, fits on shaft end.

BLOCK ON TOP OF HOUSING has three ports on one side and a hose connection at one end. Center port leads to hose connection and line to engine's intake manifold. Other ports lead to two sides of paddle.

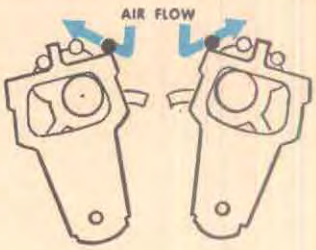


WIPER KNOB is connected with valve that sets up routes for air at normal and semivacuum pressures. In "on" position, line from center port to manifold is open and air is drawn in through this port.

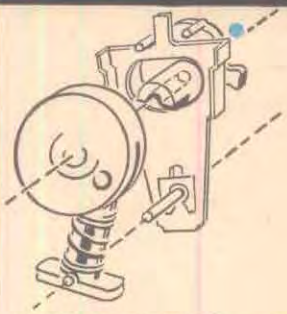




BY BRIDGING THE CENTER PORT alternately with the ports on either side, pressure is reduced, first on one side of the paddle, then the other. Air entering the unbridged port kicks the paddle through its arc.



VALVE, which bridges two of three ports and uncovers the third, is shuttled back and forth by a kicker plate. Kicker must be tripped quickly at the end of each paddle stroke, to reverse unbalance of air.



KICKER IS TRIPPED by a spring-loaded disk engaged by paddle-shaft end during latter part of each stroke. Shaft turns disk past its center point of spring tension, producing toggle action.—*Henry B. Comstock.*

How to Build a Rev Counter for Your Car

Why a Tachometer?

Wonder how high the engine in your car winds up? This homemade $16 tach tells you.

By Howard G. McEntee

MANY racing drivers say that a speedometer is of little use to them—but they practically drive by the tachometer. Pilots and speedboat drivers agree that the tach is *the* indispensable engine instrument.

Now I have no intention of racing the family sedan, but I am curious about how high my engine winds up during acceleration through gears and at cruising, and what an automatic transmission does to the r.p.m. There are commercial tachs that will show all this, of course, but their $40-$55 tags stopped me cold. So I built my own.

It's a honey. You connect it with just one wire to the distributor or coil. It has no effect on engine performance and takes only a tiny amount of juice. Except for the meter it has no moving parts, and there's no dry cell to replace. The readings are "linear"—quarter-scale is 1,000 r.p.m., half-scale is 2,000 r.p.m, and so on.

It is made of ordinary parts, available from the radio mail-order houses, and will cost you about $16 if you have to buy everything. You don't have to be a radio expert to build it; a friend who is a novice with a soldering iron put his tach together in an evening.

Kinds of tachs. My first plan was to get an extra speedometer and link it by flexible cable with some rotating part of the engine ahead of the clutch. The tough job was to find this part. Using the camshaft would have called for fussy machining. Rigging a drive off the generator, water pump, or even fan belt would be awkward.

My next try was to work out a generator-type electrical tach. In this deal the engine spins a tiny generator especially designed to put out juice in exact proportion to its speed, with the output shown on a dash meter. But this didn't work out either; the equipment is costly and there's still a mechanical-drive problem.

Next I studied commercial tachs. One uses an ingenious switch or "sending unit" under the distributor cap, and another links the distributor to a "transmitter" that has a special high-speed isolation relay. Borrowing from these fine instruments was a little beyond me.

Circuit requirements. I jotted down what my circuit would have to do: 1. It should count the pulses in the ignition primary and report the rate on an inexpensive meter. 2. It should be accurate over the 450- to 4,000-r.p.m. range. 3. It must not affect engine performance. 4. It must not itself be affected by variations in battery voltage, plug gap or point setting—none of which is constant, even in one engine.

Test rig. On the workbench I put together a testing lash-up consisting of a standard coil and a distributor, spun by a variable-speed electric motor. An old mechanical tach gave comparative readings. This contraption isn't necessary if you build a tach like mine, but it is handy for experimenting.

Construction. Decide first whether the meter is to be mounted separately or the whole unit is to be fitted in a single box. If you have a centrally located dashboard clock that's on the fritz—as many are—the meter may go nicely in its hole. A clamp bracket that secures the meter to the steering column is also neat.

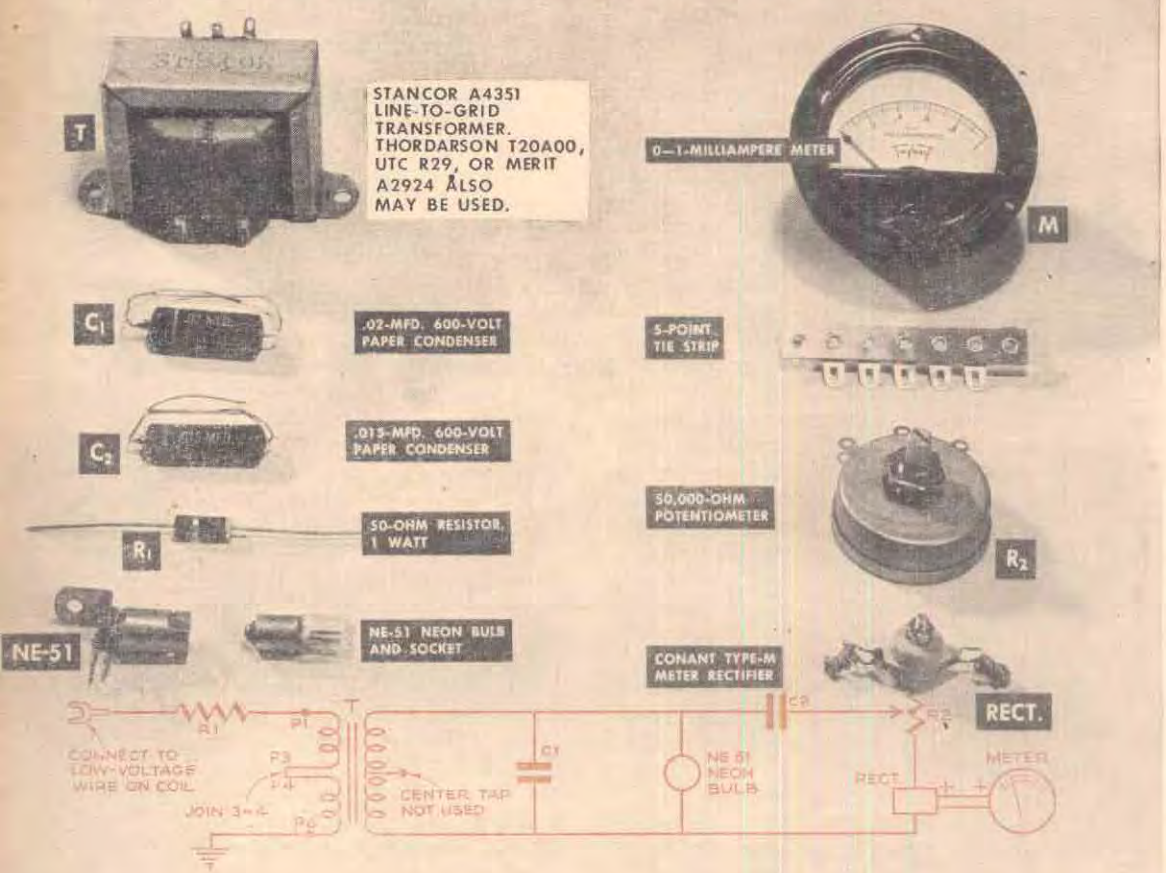
For ease of wiring, all parts but the

A TACHOMETER is standard equipment on racing and sports cars, aircraft, and speedboats. It continuously reports how fast an engine is turning over and reminds you to keep engine speed in the ranges for best fuel economy and engine life.

● As you build your tachometer, check all parts carefully to be sure they are not defective, especially T, R1, C1, and the neon bulb.

● The tachometer discussed here is used with a 6-volt system, but will work as well with a 12-volt system. If you convert to a 12-volt system, be sure neon bulb lights at all engine speeds. If not, reduce the value of R1. It might also be necessary to make connections to only half of the transformer primary (connect to terminals 1 and 3).

● The bulb keeps readings correct regardless of change in the battery voltage or charge when car lights are on. However, reading will be higher without the bulb since it acts as a limiter to hold down peak voltage.



meter and the calibrating resistor are attached to the transformer and wired up before being put in the case. The long lug strip is soldered right to the top of the transformer mounting strap, and the neon-bulb socket soldered to the side. Make the connections mechanically secure before soldering with rosin-core solder.

When you have the parts wired, connect the tach leads to ground (the engine or chassis) and to either end of the low-voltage wire that runs between the coil and distributor. Rev up the engine and note whether the neon bulb lights up at high speeds. It should light without flickering when the engine revs up fast. If not, cut down the value of R1 until it does. The lamp will flicker at idling speed, once each time a cylinder fires, but that is normal.

The neon lamp stabilizes the circuit, tends to compensate for variations in the ignition system, and holds readings steady despite changes in battery voltage. Do not try to calibrate your tach without making sure that the neon lamp glows steadily at top engine speeds.

Scale. The values shown give speed readings up to 4,000 r.p.m. with an eight-cylinder engine. Actually, a range up to 4,500 or even 5,000 could be secured by re-adjustment of R2. But I figured that four quarter-scale divisions of 1,000 r.p.m. each would be most useful.

The common 0-1-ma. meter scale has five main divisions, on which it would be awkward to read a 4,000-r.p.m. range. I was able to substitute a scale from another meter having four main divisions, which works out fine. You can lick the same problem in several different ways:

- Calibrate the standard five-division scale to read 1,000 r.p.m. per division. (But un-

less you run a hot mill, this will crowd most readings over to the left.)

- Ink in a new scale on paper and cement it over the old one.
- Write to the meter manufacturer for a special scale—many makers supply them.

Calibration. If you are mainly interested in relative r.p.m., calibration is a cinch. Just adjust R2 so that the meter reads 450 to 550 r.p.m. at a warmed-up idle and you're in business.

To get accurate calibration, the quickest way is to take the car to an ignition shop or garage having an electric tach as part of its engine analyzer. Take along a couple of extra .01- and .005-mfd. paper condensers in case you need to change the value of C2.

Have the garage tach connected and bring the engine speed up to about mid-range, say, 2,000 r.p.m. Set R2 so that your new tach corresponds. Then try it at 1,000 and 3,000 r.p.m. If the pointer goes beyond at both points, you should raise the capacity of C2 and readjust R2 to center the pointer again at the midscale speed. If on the other hand the pointer doesn't quite reach 1,000 and 3,000 after having been set right at 2,000, C2 must be reduced in capacity.

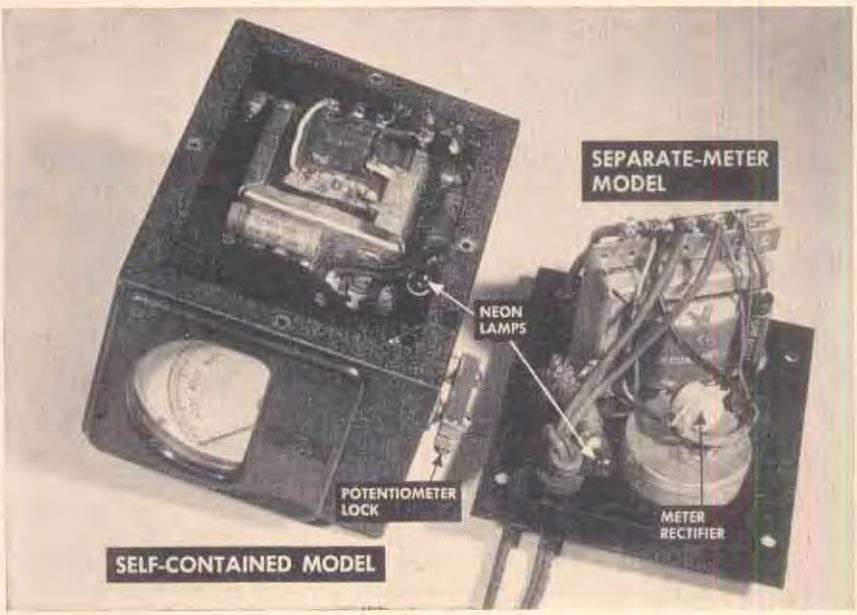
To increase C2, add .01 or .005 mfd. in parallel with the existing condenser. To reduce it, substitute a condenser having .005-mfd. less capacity.

Road testing is another way to calibrate your tach. This may not work very well in cars with hydraulic couplings or torque converters, but can be employed on any standard-transmission car, including one with overdrive. (If you have overdrive, lock it out for the test.) You need to know the rear-end ratio, usually given in the owner's manual.

Measure the distance the rear wheels turn in one revolution, calculate how many revolutions they make in one mile, and multiply by the rear-axle ratio to get engine r.p.m. at 60 m.p.h. You can then reduce this to a table showing r.p.m. in high gear at 20, 30, 40 and so on. Don't forget that many speedometers read high in the upper ranges, so if possible check yours first over a measured mile.

Fours and sixes. My tach was worked out for an eight-cylinder car. What about sixes and fours? A four has just half as many ignition pulses at a given speed as an eight, so a tach calibrated for an eight will read exactly half as high on a four. On a six, the readings would be reduced to 75 percent.

This means that if you want your tach to read 0 to 4,000 r.p.m. on a six-cylinder engine, you need a lower setting or lower total value on R2, and possibly an increased capacity for C2. For a six, use a .02-mfd. condenser and a 25,000-ohm pot; for a four, a .03-mfd. and 10,000 ohms. The values may not be on the nose for every car, but they will give you a start for calibration. END

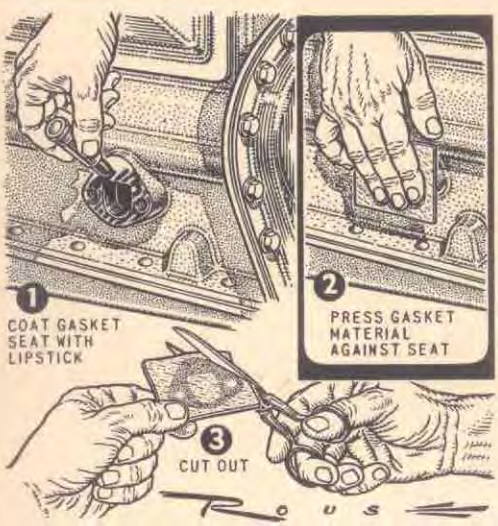


Two versions of tach are shown here. One at far left is clamped to steering column by brackets on the side plate that is removed here. The other version is housed in metal box mounted in engine compartment, and wired to a meter set flush in dash. Nothing in tach is fragile or delicate, though meter should be protected from excessive vibration. Steel case is a standard radio part and costs 91 cents. It measures 3" by 4" by 5", makes convenient combined chassis-housing. Small card file would also do.

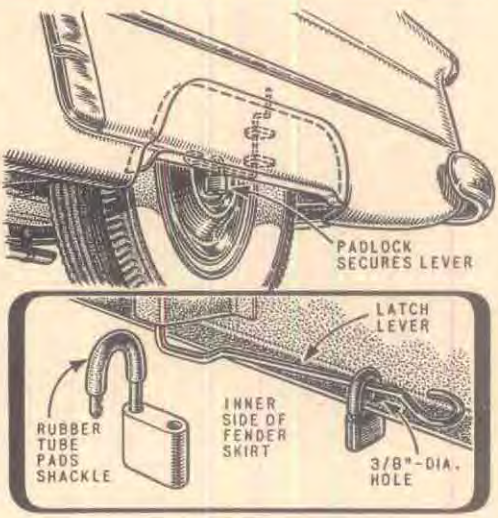
Hints FROM THE MODEL GARAGE

Stow a damp cloth in a plastic bag for cleaning dust and insects off your windshield between stops at service stations. Moisten the cloth with water or windshield cleaner and snap a rubber band around the neck of the bag to keep the fluid from evaporating.

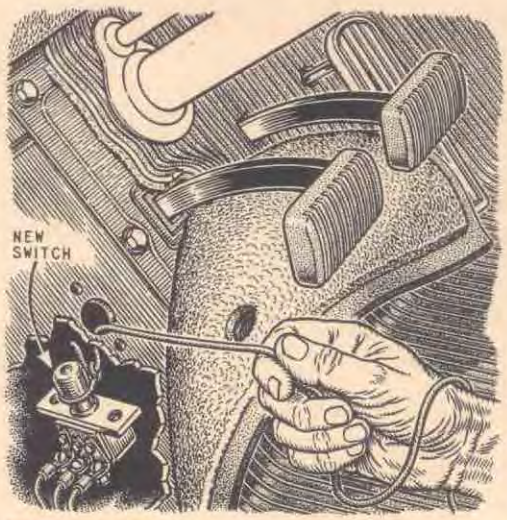
To foil gas thieves, bend a length of galvanized strap iron to fit the top slot of the hinged license plate and the edge of the trunk opening. With this arrangement, a gas cap behind the license plate cannot be removed easily without unlocking the trunk.



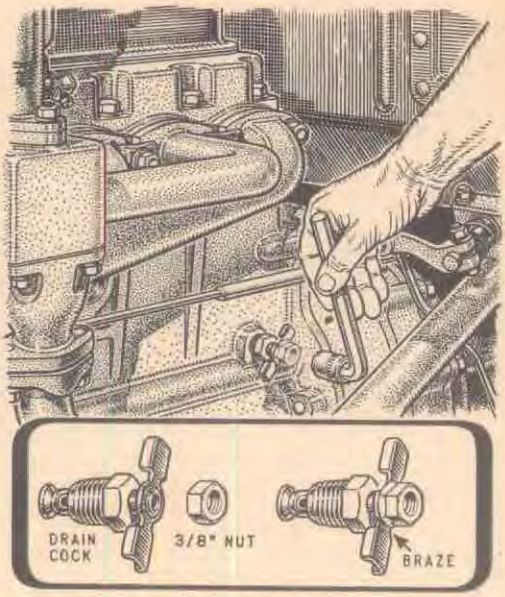
Use lipstick to outline the shape of a flange on sheet material when cutting a gasket. Smear it over the entire surface and press the gasket material against it. The resulting imprint will show the outline as well as the hole locations.



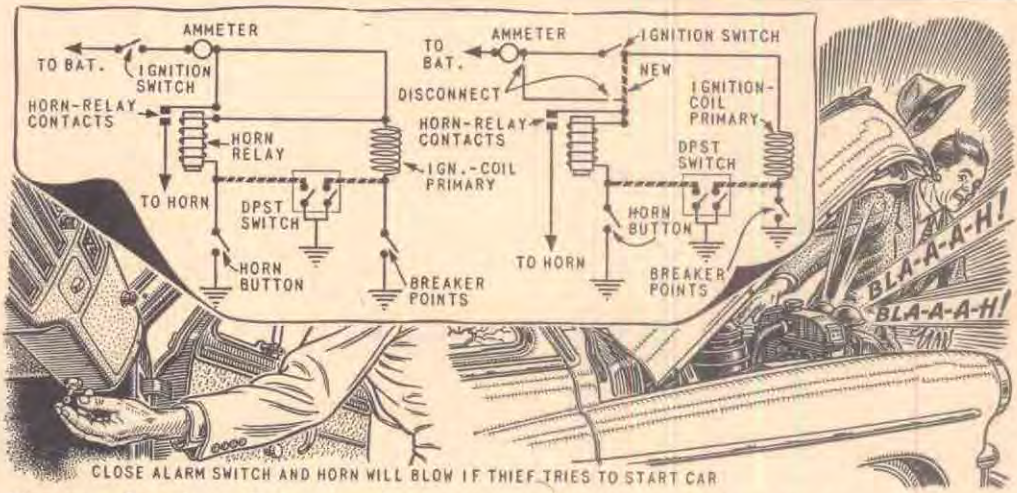
Thieves can't remove fender skirts if you fit them with padlocks to hold the clamping levers closed. Slip a lock over the lever arm and through a hole drilled in the bottom edge of each skirt. Cover the shackle with rubber tubing to keep it from rattling.



Tie a string to an old headlight dimmer switch before removing it to install a new one. This way you can pull the old one down by its wires and connect the wires to the new one. Tie the string on the new one and pull it up from inside the car.

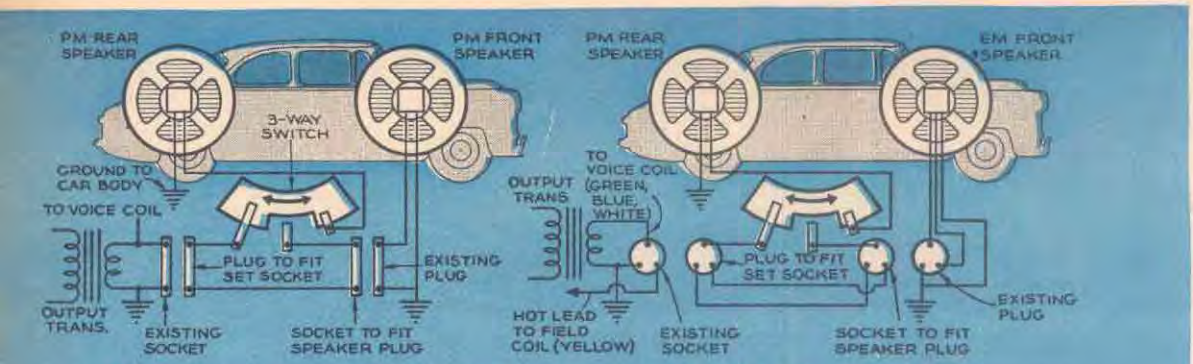


Braze a 3/8" nut on the T handle of your car's drain cocks to make them easier to turn. They are usually hard to reach, too, but a 12-point socket wrench will slip over the nut easily and open the drain in the tightest spaces. Water runs through the nut.



Throw a toggle switch concealed under the dash when you leave your car, and a thief's attempts to start it with a trick key or by jumping a wire to the coil will be loudly announced by a steady blast of the horn. Even if he cuts the horn wire to work in silence, he won't start the engine; the breaker points are grounded and won't spark.

The diagram at left above shows how to wire a double-pole, single-throw toggle switch on cars having the horn relay wired through the ignition switch. Heavy lines indicate the new wires. On other cars, the toggle wiring is the same, but the horn relay is disconnected from the ammeter or starter post and rewired to the ignition switch as in the diagram on the right. In either case, the horn cannot be sounded with the horn button unless the ignition switch is turned on.



IF CAR RADIO HAS PM SPEAKER, follow this diagram. If front speaker is connected directly to set instead of through a socket and plug, cut voice-coil lead, wire in switch.

IF RADIO HAS EM SPEAKER, wire your rear speaker this way. Fit the switch into a harness that suits existing connectors so radio can be removed without disturbing wiring.

How to Install a Back-Seat Speaker

A simple wiring job that you can do yourself will add a luxury touch to your car at a cost of less than $4.

I GET living-room performance from my car radio since I installed a rear-seat speaker. The two speakers together give a fuller, more rounded tone. A three-way switch cuts in either the front or rear speaker or both at once.

You can buy all the parts including the speaker for less than $4. But first determine how big a speaker you can use and whether a round or oval one will fit the space better. In most cars the best spot is in the trunk under the package shelf. In my '48 Nash the manufacturer considerately placed two holes in the frame just right for my four-inchers.

If you use a single speaker, get a permanent-magnet (PM) type about 6" in diameter. If you want the three-way switching arrangement, buy a wafer type like the Centralab 1483. A bracket for mounting the switch, 30 feet of insulated wire and a pair of connectors complete your shopping list.

Follow the diagram that matches the type of front speaker (PM or electromagnetic) you have in your car. Two leads identify the PM type, three the other. It's easy to spot the voice-coil lead by the color of the insulation, which is either green, blue or white. Run the wire from the switch to the rear speaker under the floor mat or if you prefer, under the car itself.

I mounted the speakers under the package shelf without cutting it. This tends to subdue the high notes and let through only the bass. Grilles are available if you want to cut through the shelf.—*Harry Samuels, Huntington Station, N. Y.*

PAIR OF 4" PM SPEAKERS was used by the writer. These were mounted in the trunk under package shelf. Wire from the three-way switch was run under car and attached to one voice-coil terminal on each speaker. The other voice-coil terminals were grounded to car body.

CONNECTORS. The male plug fits the existing socket on the car radio. The female socket fits the plug which is on the front speaker. The switch is a three-way wafer type. It can be used to turn on either the front speaker, the rear speaker or both at the same time.

The mechanic rattled the tailpipe against the gas-tank bracket. "That's the noise," the customer said. "It sounds up here in front."

A Mechanic Checks A Rattletrap

. . . and tells how you can rid your car of annoying noises.

By Glen F. Stillwell

"CAR squeaks and rattles are generally acquired," the mechanic said. "They are not built into the car, and they are seldom what they seem."

I had driven to my neighborhood garage to complain about a door rattle.

"It doesn't rattle all the time," I told him. "Just now and then when I start out. Probably needs new rubber bumpers."

The mechanic shook his head.

"Your car's new. It shouldn't need anything like that. I think I know what your noise is, and it isn't a rattle—it's a squeak."

He put an end to the "squeak" by

smearing a little glycerin on the rubber door lining.

"What happens," he explained, "is that all doors must have a certain amount of up-and-down motion or they'd be hard to open and close. When the rubber lining is new and dry, this motion makes a rubbing sound like a rattle. It disappears when the rubber wears smooth."

It was a warm spring day and I decided to loaf around the garage a while, an instructive pastime that I indulge in as often as possible.

Another customer had been waiting while I talked to the mechanic. After pulling my car to one side, I strolled over to the hoist where the mechanic already was starting a quick grease job for him.

A front-end rattle. The customer was poking his nose under the front end. "Maybe I can find that rattle," he said. "Guess I'll have to—if anyone does."

"Is it in the front end?" the mechanic asked.

"Sure thing," the customer replied. "Everyone says so—and I've had mechanics clear across the country try to find it."

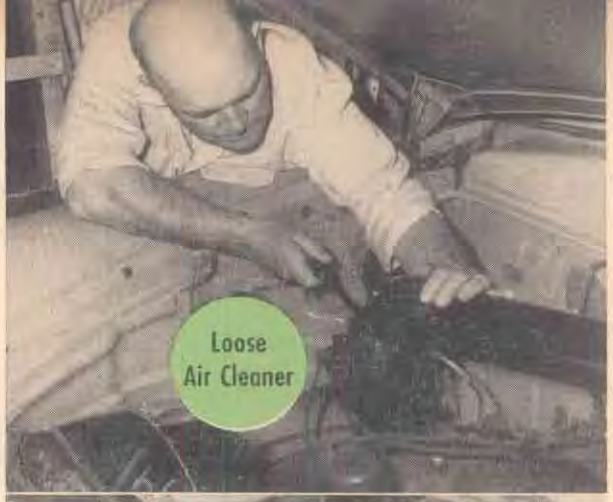
The mechanic, working at the rear of the car, suddenly put down his grease gun and I saw him looking closely at something. Then he glanced at the customer, still poking around the front end.

Sounds are telegraphed. Reaching up, the mechanic rattled the tailpipe against the gas-tank bracket. "That's the noise," the customer said. "It sounds as if it's up here in front."

"Afraid not," the mechanic said mildly. "It's here—this tailpipe is loose. Guess you and everyone else forgot just one little fact. Most car sounds are hard to locate because they telegraph from one area to another."

To me, this seemed a fine thing to know. So I followed the mechanic around for the next hour or so. Here are some things he told me:

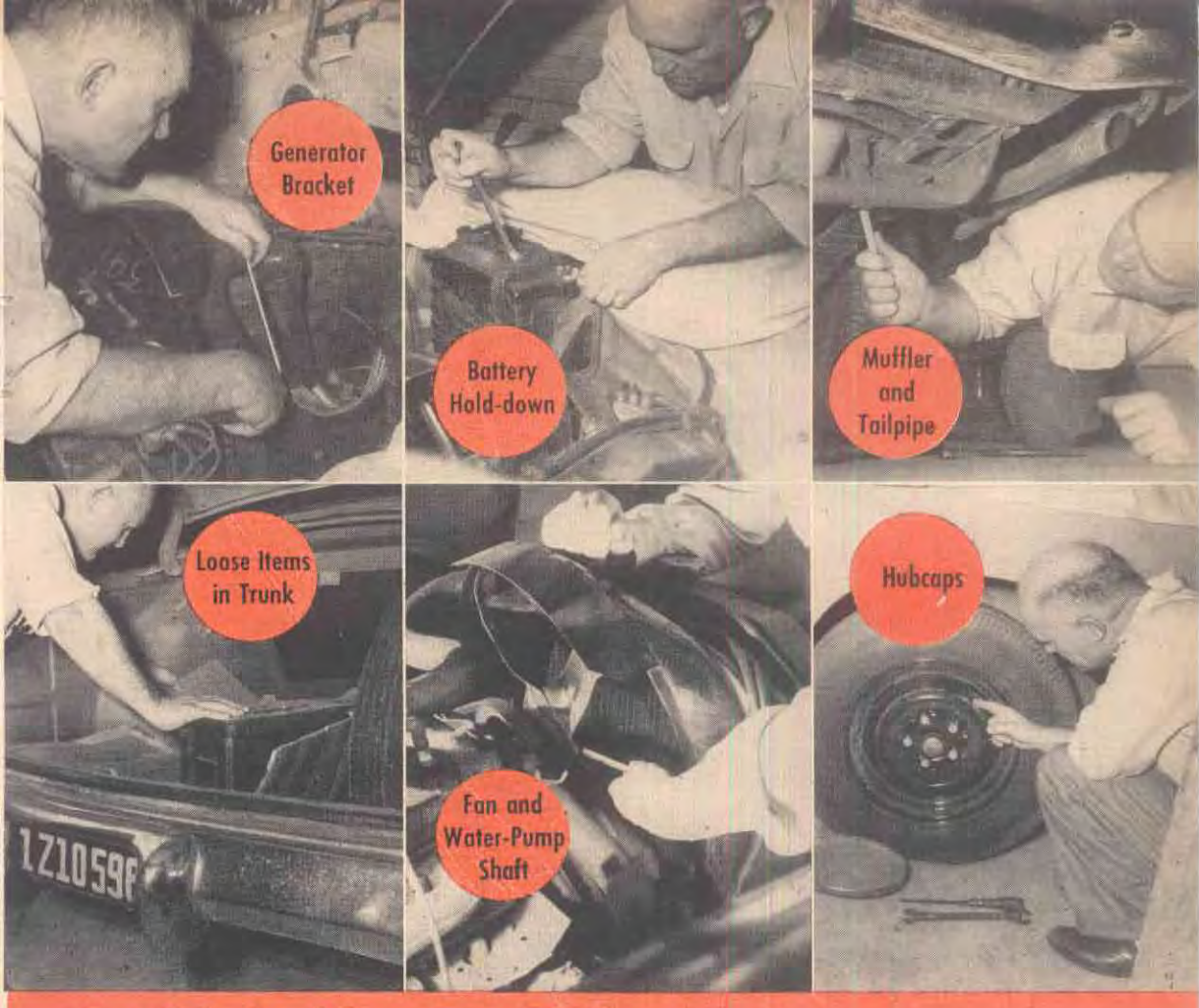
- Don't think a rattle or squeak isn't dangerous just because you've gotten used to it. If the noise comes from worn steering parts, for example, neglecting it may be inviting an accident.



8 Places to Look

- Unusual noises in your car should not be disregarded. It is not difficult for anyone to determine that a remote-sounding, metallic knock heard at evenly spaced intervals originates in the power plant or driven units. If such a noise is heard, the water and oil should be checked immediately. If your water and oil are okay or the noise persists after filling, the car should be headed for the nearest garage.
- Even if you have no squeaks and rattles, it will pay you to check thoroughly at regular intervals for any looseness or undue wear.

Body noises. These are frequent and usually easy to locate. Thumping noises and rattles often originate in doors and window-lift mechanisms. Check for loose



for Disturbing Car Noises

hinges and missing door bumpers. If jingling noises are noticed, check the glove-compartment lid and ash trays. Or there may be a loose wrench or forgotten metal object under one of the seats. If the noise sounds more remote, search the luggage compartment, giving special attention to the spare-tire mounting bracket and any loose equipment that may be rattling around.

Engine noises. Raise the hood and begin at the front to check engine accessories for rattles or unusual noise. Test the blades of the fan and then the belt. A V belt should not be too tight, or excessive wear will result. But a belt that is too loose will cause a squeak or rattle when the engine is accelerated rapidly. Engine dustpans, heater connections, pump and distributor shafts and air-cleaner components are frequent sources of strange noises.

Check pulleys, all mounting brackets, the throttle linkage, engine-mounting bolts and the gear-shifting mechanism for undue looseness. A check of this kind on one car disclosed that all the cap screws holding the fuel pump to the engine block were loose and one was missing. A few more miles without attention would have resulted in a stalled engine and perhaps a tow and costly repairs. Be sure to tighten the vacuum-pump housing and carburetor-flange cap screws to avoid starting difficulties and road trouble. Check bolts and brackets on the

ALMANAC
FOR MOTORISTS

Pithy proverbs, provident counsel and omens and portents of interest to horseless-carriage operators.

▶▶These are the days when plenty of unhappy cars, caught in heavy traffic with easy-boiling antifreeze, give excellent imitations of Yellowstone's Old Faithful. Moral: cooling systems will really thrive on just a *little* attention.

▶▶Now that the weather is growing more amiable, you might check the throttle arm on your carburetor to see if there is an adjustable acceleration-pump link. If so, put it in the warm-weather position. The old boat will be a bit perkier.

▶▶Wheeling along at 60 some fine spring morning, Absent-Minded Abner is very likely to pop open the floor ventilator for the first time since way last October. Old Abner sure deserves what he gets: two eyefuls of dirt and grit.

▶▶Two things to watch next time you replace spark plugs: be certain the threads are engaged right before you touch a wrench, and look for grit under the gasket. Forgetting can make trouble.

▶▶Don't jeer at a woman's catch-all handbag without looking over your glove compartment. If it has no old envelopes, burned-out bulbs, stale tobacco and partly used lollipops, take a bow.

generator and starter and also on the storage-battery carrier.

Chassis noises. Get your car on a lift if possible, and begin with the front bumper, license-plate bracket, gravel apron and shock absorbers. Examine radiator-mounting bolts for undue looseness, and then go over the entire steering gear, making sure that all nuts are tight and fitted with cotter pins.

Run your hands along frame channels and engine pans for forgotten tools.

Examine the transmission supports, clutch and brake-pedal linkage. Clevis lock nuts should be tight and fitted with the proper size cotter pins. All modern cars have hydraulic brakes, but some have mechanical-linkage systems and equalizers that require attention. Evidence of brake-fluid leakage should be thoroughly investigated.

Strange, hard-to-locate noises often originate in the muffler or connecting pipes. Remember that shaky mufflers frequently leak and may fill a car with deadly, odorless carbon monoxide gas.

Play in the drive shaft. Ascertain the condition of your car's universal joints by checking the amount of play in the drive shaft. The expert often checks up-and-down motion by using an automobile jack under the drive shaft at the universal joint. There is always a certain amount of free rotation, but undue up-and-down movement may indicate a faulty universal joint that would certainly be the cause of a hard-to-find clanking noise.

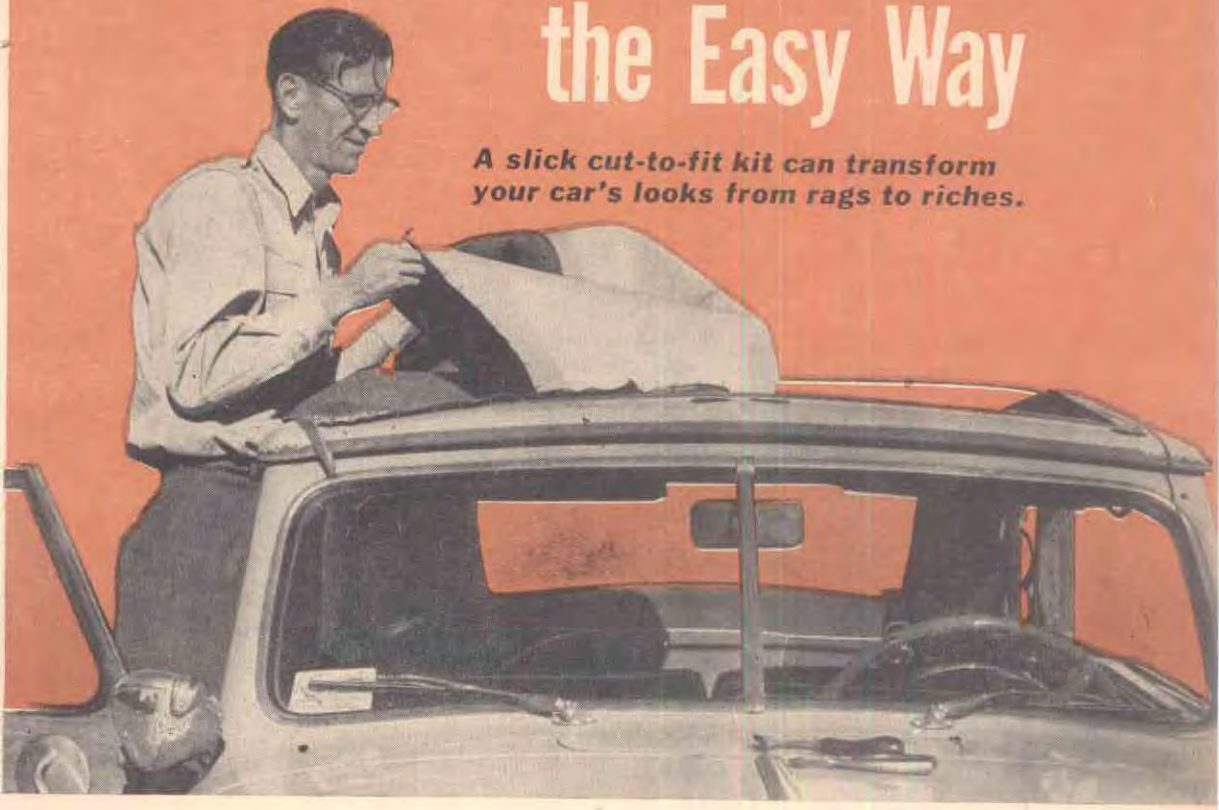
Next, tighten body bolts, gas-tank support brackets, rear-bumper and license-plate-bracket bolts. Don't neglect differential and drive-shaft stud nuts and cap screws. All wheels should be given attention. Strange as it may seem, the hubcaps on modern cars are sometimes the source of that elusive squeak or rattle. Examine their flanges for shiny areas which may be an indication of movement resulting in noise. Check fender bolts and the gas-tank hinged cover for looseness.

Work? It sure is—but you'll love that silence! END

It's a One-Day Job

Retopping a Convertible the Easy Way

A slick cut-to-fit kit can transform your car's looks from rags to riches.



By Bob Gilmore

IF YOUR convertible needs a new top, you can get it in one of three ways. The executive way: Have your secretary ask a garage to pick up the car, retop it and bring it back tomorrow. The hard way: Use the old sagging top as a pattern, overwork the family sewing machine stitching seams in heavy material, then tug and try to make it fit. The smart way: Buy a ready-cut kit.

You can get a kit for your make and model (for MGs too) from an auto-parts store or right out of a mail-order catalogue. All the work of cutting, sewing, binding and snap fitting has been done, leaving you little to do but tack it in place.

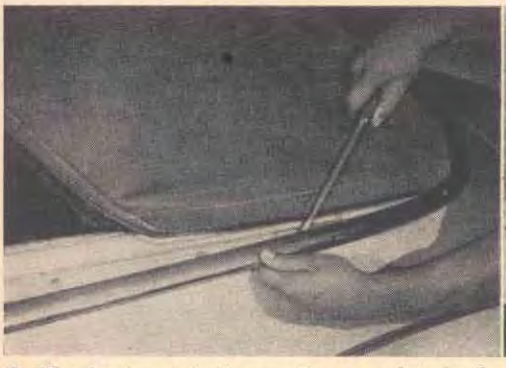
When ordering, be sure to give the year, make and model number of your car. Specify color from a choice of tans, greens, black or natural, and indicate the grade of double- or triple-ply cotton fabric you want, or choose a vinyl-impregnated fabric for a few dollars more. You can alter the styling of your car somewhat and improve your rear visibility by ordering a full-width rear window. If your car is a '48 model or newer, you have plenty of styles and fabrics to choose from.

To see how to take off the old top and put on the new, please turn the page.

Off with the Old Top . . . . . .

1 Before stripping old top off, mark location of screws in welt ends, position of side seams and center of rear flaps. Use punch to mark wood body, but stick little triangles of masking tape at these points if body is metal.

2 Spread welt apart and pry upholsterer's tacks out with a screwdriver. Usually, after a foot or so of the welt has been freed, the rest of the piece, including tacks, can be pulled up quickly and easily with a few sharp yanks.



3 Metal trim strip is sometimes used instead of welt. Pry it up with firm pressure of screwdriver. Strip is C-shaped and is only snapped over backing strip on sides of body. Remove screws holding strip over fabric.

4 Pull last few tacks remaining under welt with claw tack puller. Screwdriver would do, but one slip might spoil your car's paint job. Gather up the tacks as you pull them—they'll be picked up by your tires if you don't.

5 Pull side-window weather-strip gasket out of its metal retaining frame and remove screws that hold frame over top flap. Finally, free old fabric by pulling out tacks in welt over windshield. Leave the side pads in place unless rotted or mildewed. If they must be replaced, your kit dealer sells them, too. Leave the old pad on one side while installing the new one opposite, to maintain original spacing of bows in the top frame.

6 **Set old window in new rear flap** as first step in preparing new top for installation. Get its position from the old piece, or follow the marks usually found on kit material. Trim excess fabric with a razor blade after framing the glass. Skip this step if you've ordered a full-width plastic flap with your retopping kit.

7 **Snap the flap in place** on original fastenings under the rear bow. Line up the center with mark previously made on body and tack the bottom in place, working outward from the center. The small piece held on each side of the flap by zipper is tacked at top and bottom to support flap and seal out drafts.

8 **Trim off excess material** along the flap bottom with a razor blade, cutting close to the tacks so the new welt will cover tacks and edge of fabric. Use tacks generously, spacing them about an inch apart to prevent slack spots and wrinkles later when the fabric is tight.

9 **Spread new top over bows,** then fasten the side snaps to original fastenings on side of body. Adjust the top so both sides are smooth and top is even across rear bow. Fit the sides around curve to meet rear flap by cutting (arrow) until fabric curves smoothly.

Please turn the page for more retopping photos.

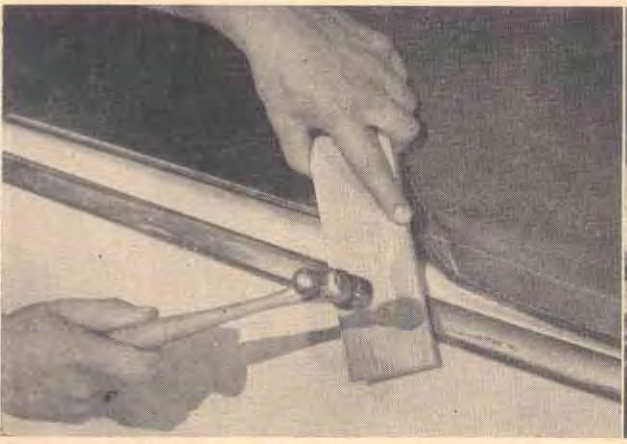
10 **Tack narrow rain flap** across the rear bow so that it lies over the rear-window flap to keep rain from blowing in. Start tacking at the center and work out to sides, driving tacks only part way in until you see that the flap will be straight. Pull out and reset tacks if necessary.

11 **Tack main top panel** over rain flap on the rear bow. This panel is stitched to sides from front to back, but several inches at rear are left unstitched for adjusting fit. Drive tacks in straight line and trim fabric close to them for easy and neat covering with welt.

12 **Now go to front** and pull top smooth for tacking forward edge. Don't stretch the fabric too tight—a few wrinkles will shrink out later. Align seam ends (arrow) with marks made on body before removing old top. They should be equidistant from windshield center.

13 **Look the job over** at this point and pull a tack here and there if necessary to get a perfect fit. Then drive all tacks home and attach welt across rear bow to cover tacks and cuts made earlier when fitting sides. Welt folds over itself to hide the tack heads.

14 **Tack or cement side flaps** to the rear quarter frame on each side. These flaps pull top smooth at sides, so adjust carefully before tacking. Screw retainers for window gaskets over flaps and trim fabric even with inside edge. Snap rubber gasket in place.



15 **Replace trim strip** or welt where top joins body. Screw strip in original position over fabric at rear. Then snap the side sections to the backing strips with smart blows of a hammer against a block of wood to keep from denting the metal. Now only the front is left.

16 **Complete the job** by tacking down front of top at corners. Fit fabric to the corners by slashing and folding it over itself. Tack and cover with welt across entire front edge. Screw decorative metal points over the welt ends—and the job is finished, ready for use. **END**

Care Extends Life of Top

DUST and dirt can wear a top thin in spots by abrasive action. Vacuum it occasionally and wash it when it's dirty. Clear waterproofing solutions can be brushed onto a leaky top, and there are dyes and canvas paints that will freshen up faded fabric. Best way to get an even application is to spray it on, but circular sweeps with a scrub brush will minimize lap marks. Small rips or worn spots can be patched with a press-on tape made for convertible tops. Back up the spot with a board and stick the patch on with a hot iron.

Build a Pair of Car Ramps

These handy elevators will give you more room for under-car jobs. Materials cost about $3.

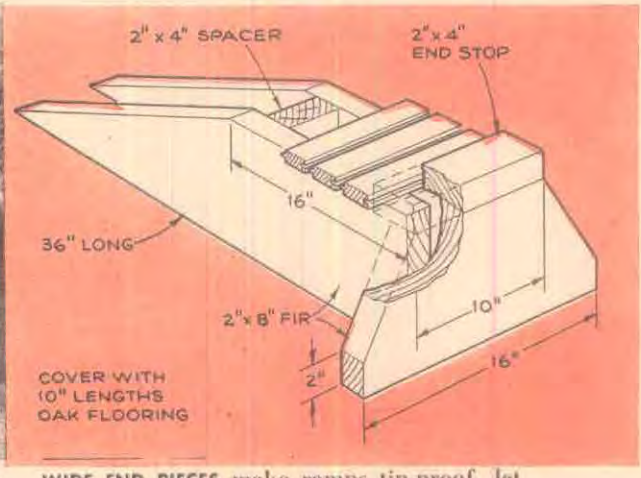
IF LACK of headroom is keeping you from maintaining your car or making simple repairs or adjustments on its underside, run it up on a pair of these husky ramps. They'll raise the car about 9″, giving ample room to move around—even room to swing a grease gun on fittings that point straight down.

A bundle of short lengths of oak flooring and a 12′ length of two-by-eight provide enough material for two ramps at a cost of slightly more than $3.

Lay out the sides on the piece of two-by-eight so that one diagonal cut will produce two sloping surfaces. This way, you'll save cutting as well as lumber. Clamp the sides in pairs and plane them smooth. Cut the two end pieces from the remaining two-by-eight. Stand the sides on edge, about 3½″ apart, and nail the end pieces to them. Nail a 2″-by-4″ spacer on edge between them at a point just before they start tapering.

Cut the oak flooring into 24 pieces, 10″ long, and nail them across the body. Space them out evenly so that there are five slats on the level part and seven on the slope. Nail a 10″ length of two-by-four across the end of each ramp. This will prevent the car from rolling over and off them.—*Herb Pfister.*

PLACE THE RAMPS ahead of the front wheels, sighting back to the rear wheels to line them up. If the repair job is at the rear of the car, back it up on the ramps.



WIDE END PIECES make ramps tip-proof, let you turn the wheels from side to side for access to grease fittings on kingpins and steering-arm ends. Block at end stops car.

Starting Your Car in Zero Weather

It takes more than pushing a button to get a car going when the mercury drops out of sight.

By E. F. Lindsley

WHEN winter nights pull the rug from under the thermometer, will your car always kick off in the morning? Or will the starter give a few groans and lapse into dismal silence?

In my case, the questions hit right home. I live in Wisconsin, where the thermometer often dips to 20° below, so I jumped at the chance to round up information about winter starting for POPULAR SCIENCE.

What I have found out should help people with heated garages as well as the rest of us who aren't so lucky. That's because a car that sits in an open parking lot for hours can easily need first aid to get going again.

We'll take it for granted that before winter sets in you'll put your car in top mechanical condition, remembering such things as a lighter oil, a charged battery with sound tight cables, and clean spark plugs. If your engine is in good shape, knowing *why* cold engines are hard to start, and using starting techniques based on this knowledge, will usually get you on your way.

Why Cold Engines Are Hard to Start

THERE are four basic reasons why a car is harder to start in periods of low temperature. First of all, congealed oil creates high internal friction, putting a heavy cranking load on the starter and battery.

This might not be so serious if the battery didn't lose a lot of pep in cold weather because its chemical activity is slowed down. The chart on the next page shows how serious this drop can be. If the thermometer goes low enough, even a fully charged battery is pretty feeble. Add to these two handicaps the tendency of gasoline to condense wetly on the manifold walls instead of entering the cylinders as a burnable vapor, and you have the root of the problem.

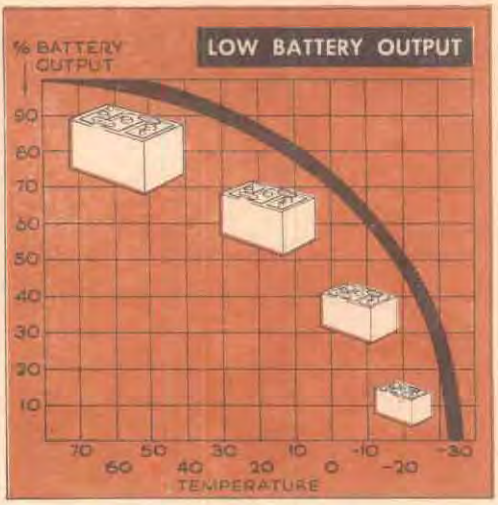
The fourth troublemaker is that in some unsuspected way the engine may not be up to snuff. For instance, frosted or snow-covered ignition parts will almost certainly impair starting, especially if ignition wires are cracked or rubber seal caps missing.

Or perhaps the linkage on an automatic choke may be so gummed up with varnish-

like fuel residues that the choke can't operate. These deposits should be washed off every 5,000 miles with lacquer thinner. Most other solvents won't work.

This is a job often overlooked in a fall tune-up for winter. When you look into it, check at the same time on the action of the choke unloader by having someone push the accelerator clear to the floor. Or you can pull the throttle rod wide open by hand. The choke butterfly should pop open. This is very important.

Modern cars with automatic chokes all have some kind of choke unloader. If an engine does not start after a reasonable interval of cranking, you use the unloader by holding the accelerator pedal to the floor while operating the starter for a few seconds.



How to Use Your Starter

STEPPING into your car in subzero weather, don't expect the battery to deliver more than half a dozen whirls of the starter. It may do better, but a pessimistic approach will help keep you from wasting what little output it is able to give. Remember it must do two jobs at once—turn over the cranking motor and supply juice to the coil.

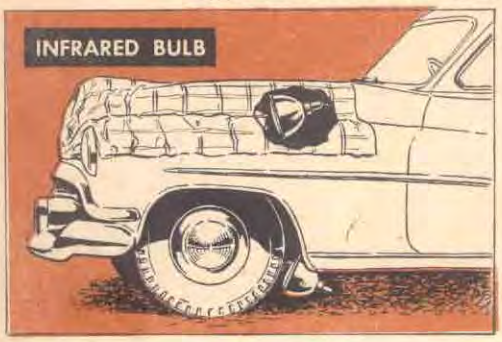
How to start may vary a bit from engine to engine and you'll have to learn what gives best results with yours.

Get ready before you hit the starter. Hold down the clutch pedal (if you have one) to take the transmission load off the engine. Apply the choke by pulling out the control if it is hand-operated. Depress and release the accelerator, then hold it partly down. (On some cars, pumping the accelerator two or three times to shoot gas into the carburetor throat is a definite help. On others, this will only get you into trouble. Your operator's manual or experience will show you which is best in your case.) Finally, turn on the ignition switch and hit the starter.

It's often best to operate the starter in bursts of about five seconds each. You will sometimes find that the engine kicks off just as you release the starter. This is because the battery at that split second can deliver hotter sparks at the plugs. If the engine fails to start in half a dozen starter bursts, use the unloader and try again.

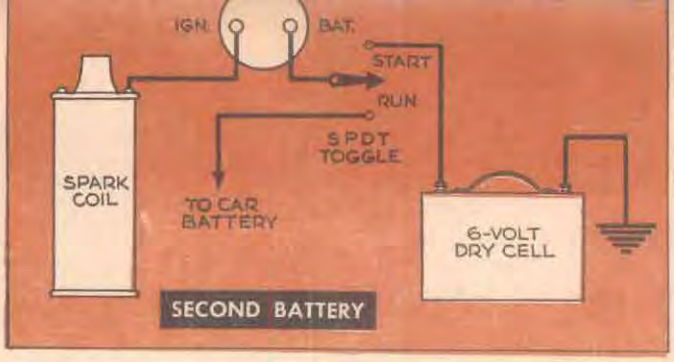
When the battery lacks enough oomph to turn the starter, a push or rolling down a hill is always a good bet. The weak battery can then devote all its energy to delivering a good spark. Shift into high gear, not low or second, for this.

Here Are Some Simple Starting Aids



IF THE car is inside a garage or otherwise sheltered, one or two reflector-type infrared bulbs will do a good job of keeping the engine warm. Use them on an all-night basis.

An ordinary 100-watt bulb in a large tin can will also keep the oil moderately warm. Trim the can so it is a close fit under the deep part of the oil pan. In such extensions of your 115-volt system, be careful of shocks and shorts—calcium chloride, widely used to de-ice roads, makes a perfect electrical path when it drips on a garage floor.



An extra six-volt battery with leads to be clipped on in parallel with the regular battery may be the solution to low cranking power. The accompanying sketch shows a neat permanent installation. Here, a six-volt dry-cell battery is used to supply juice to the ignition system during the starting period, freeing the regular car battery for the single job of cranking the engine. Throwing the switch after the car is running returns the load to the regular battery. If the extra battery is installed with easily disconnected leads, it can be kept in the house overnight. Thus kept warm, it will deliver more juice in the morning.

A trickle charger to keep the electrolyte in your battery active overnight is another practical idea. So is warming the battery.

Starting Aids That You Can Buy

BELOW and on the next page are some of the starting aids now on the market. One alone or a combination of several might help you out. First, though, you should be sure they meet the requirements of your car, taking into consideration the place where you keep it.

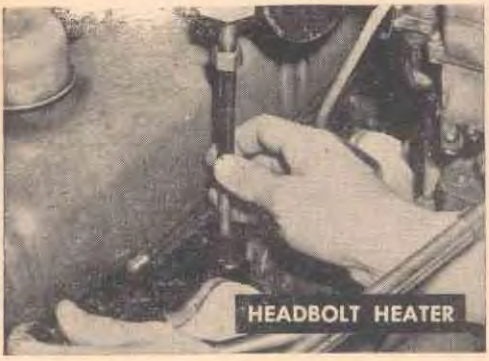
For instance, an electric heater at the end of a 200-foot extension cord will be too hampered by voltage drop to do its job. A water-jacket heater that really does the trick for a closely fitted new engine may not help an old car. A kerosene burner may be a disappointment if water-white kerosene is hard to find.

A headbolt heater is mounted permanently in the engine water jacket. It comes in sizes to suit all modern cars, but checking is necessary to be sure the water jacket is clear under the bolt opening you select. An extension cord plugs on the heater head.

A Calrod water heater goes inside the water inlet hose and an electrical lead runs to a receptacle mounted somewhere on the grille. Hook up a 115-volt extension cord and it goes to work.

If yours is a V-8 engine with two water inlets and two outlets, two headbolt or two hose heaters will do a better job—although one is usually enough.

Less expensive than permanently installed jobs, an oil-immersion heater inserted in the gauge hole will keep the oil at startable temperature while the car is garaged overnight. It is not recommended, however, for bringing a completely cold engine up to starting temperature. This type of heater might be used in conjunction with a water heater



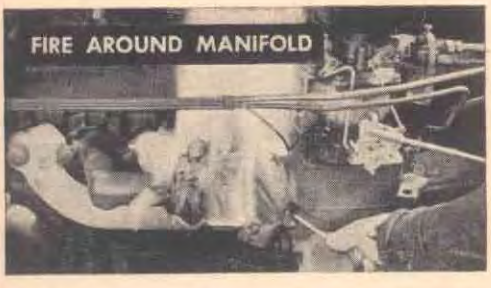
since the latter may not warm the oil very much.

Designed to help vaporize cold fuel, a carburetor preheater includes a heating element mounted in the fuel passage between the carburetor and intake manifold. This heater is switched on for a few seconds before the starter is engaged.

Another way of giving the fuel a shot in the arm is to use a Chevron starting primer. This gimmick punctures a gelatin capsule filled with a highly volatile ether-base fuel, and a nozzle sprays the fuel into the intake manifold. A new capsule is required for each starting attempt. These are most useful with updraft carburetion and manual chokes.

For cold-weather operation, a gas-tank antifreeze is always a wise purchase. Ice in the fuel lines or carburetor is a pretty common problem.

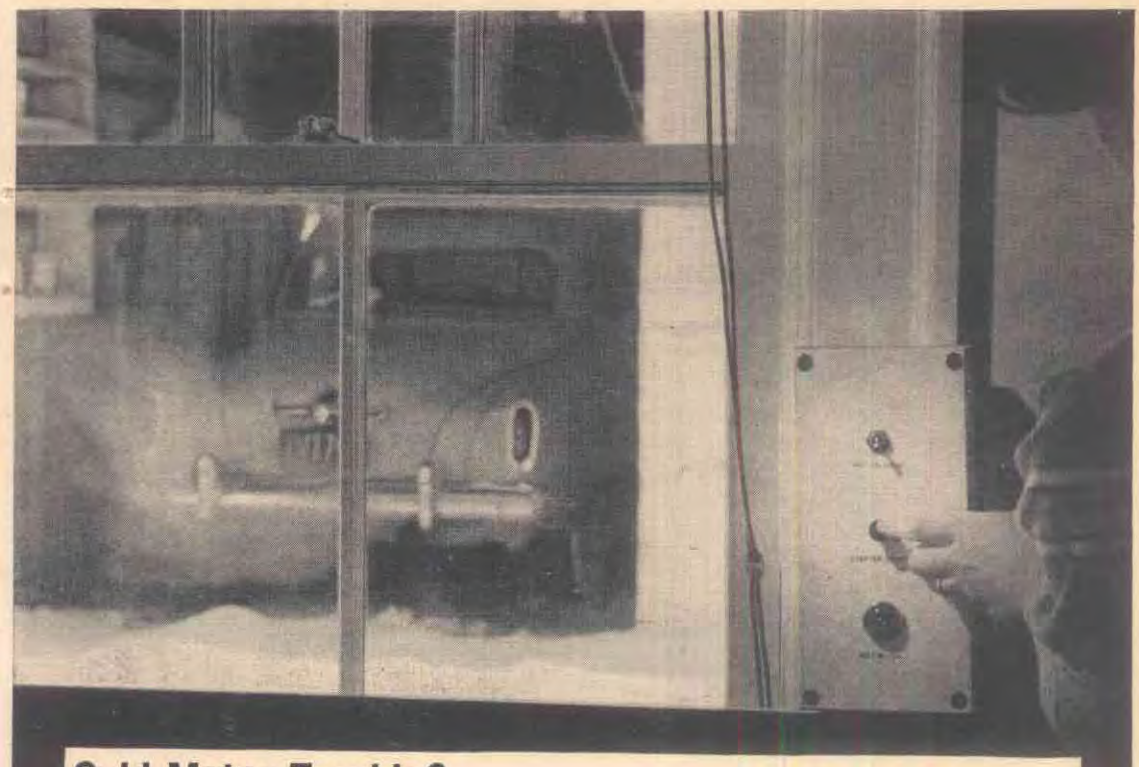
Strictly for Emergencies!



SOMETIMES, getting started may be a life-or-death matter. A car stalled in a remote spot in severe cold is no place to spend the night. Such a situation may call for drastic methods. Building a fire in the right place has been known to start a stubborn mule. If you must, you can do the same with a car.

Oil-soaked sand, asbestos or rags ignited in a hub cap and pushed under the engine will warm up the oil pan. Unless gasoline leaks are present, this is not particularly dangerous. Keep flames away from wires or hoses.

In conjunction with a fire under the oil pan, you could burn oily rags along the intake manifold to vaporize the fuel enough to get you started. Don't be alarmed if small flames play around the edges of the carburetor, but keep the fire away from wiring and rubber fuel or heater lines. A shovel of snow will douse the fire quickly. END



Cold Motor Trouble?

START YOUR CAR FROM YOUR KITCHEN

After I close a circuit running to the garage, my engine warms up as I eat breakfast. She's rarin' to go when I take off for work.

By Julian M. Sienkiewicz

IT'S a familiar dilemma: warming up the engine on a cold morning takes time when time is short; but starting out with a warm engine and heater is much better for the engine, and a whale of a lot more comfortable.

All done by buttons. My remote-control rig lets me start the engine from the kitchen. The car warms up while I have breakfast. When I go out to the garage, she's ready to roll. Two protective devices prevent mischances. An automatic warning light on the dash tells me not to drive off with the remote-control wires plugged in. And a "lurch" switch immediately kills the engine if, accidentally, the car has been left in gear.

The idea can be applied to any car having an automatic choke. In no way will it interfere with normal operation. The circuit shown is suited to a manual-transmission car with push-button starting, but minor changes will suit it to others.

In the house. The remote-control unit is very simple: a toggle switch to turn on the ignition, a normally open push button to work the starter relay, and a pilot light to signal that the engine is running. These are mounted in a ply-

wood box, and their six wires run in weatherproof cable out to the garage. For a quick disconnect at the car, I use a multiple connector, concealed under the gas-filler lid.

The circuitry is simpler than you might think. The ignition toggle is wired as a shunt to the car's ignition switch, and the starter button as a shunt to the car's starter button. So when in the kitchen you flip on the ignition and press the starter, the car behaves exactly as though you were out there doing it in person. The "engine on" lamp is connected to the generator and ground, so that the instant the engine catches, the bulb lights up to tell you. If the engine should stall, the light will report that, too.

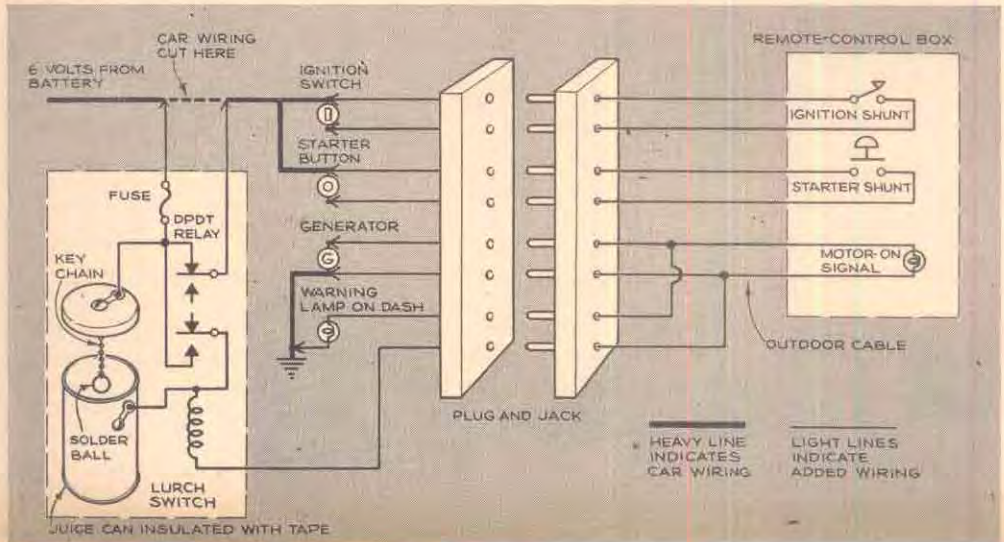
No lurching allowed. The lurch switch and relay may not actually be necessary, but are an investment in peace of mind. If the car *should* be left in gear, it will not travel six inches before both the starting and ignition circuits are cut off. I tried it.

A key chain, with a ball of solder at the end, is suspended inside a small, upright tin can. If the car lurches forward or backward, the ball touches the can wall, energizing a protective holding relay. This cuts the ignition and starting circuits and holds them open until the connector is pulled off.

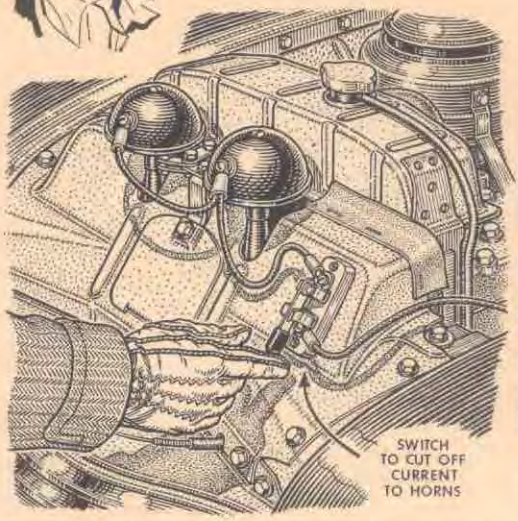
You'll notice there's a by-product advantage, too: If I should ignore the dashboard warning lamp and try to drive off with the connector still on, the lurch switch would stop me in inches. In the evening, I plug in and check to see that the kitchen ignition switch is off.

ONLY SECONDS are needed to plug in the connection at night or unplug it in morning. In the morning, the ignition key is turned on before disconnection in order to keep the motor running.

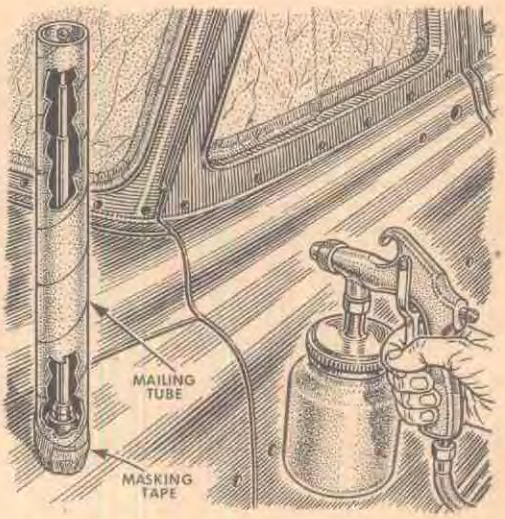
LURCH SWITCH AND RELAY, which make sure the car cannot take off on its own, are housed inside a coffee can mounted in the engine compartment. A 10-amp. fuse guards the system.



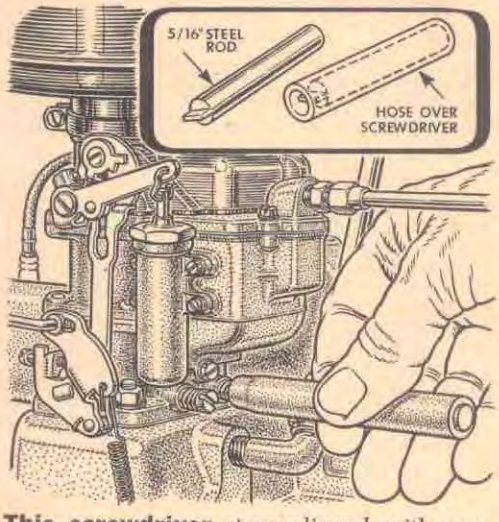
Hints FROM THE MODEL GARAGE



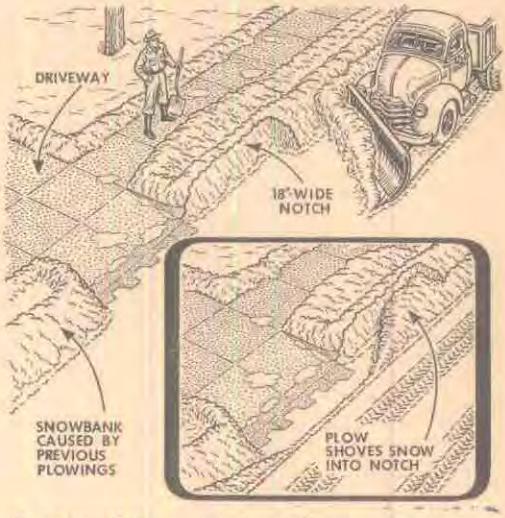
Install a knife switch in the power lead and you'll never be embarrassed if a stuck relay or grounded wire makes your horn break into a noisy solo. Just pull the switch to break the circuit quickly.



A mailing tube can save you the trouble of masking your car's radio antenna next time you want to do a partial or complete body refinishing job. Just slip the tube over the end of the telescoped antenna.



This screwdriver stays aligned with carburetor adjusting screws while you give your full attention to tune-up jobs. Make the screwdriver from 5/16" rod and draw on a tight sleeve of rubber hose with a ¾" extension to fit over the screwhead.



A snowplow won't backfill your driveway if you dig a notch about 18" wide and 8' long in the snowbank in the direction from which the plow will come. This gives the plow blade a chance to dump its load before it reaches the shoveled-out drive.

ALL MEMBERS OF THE FAMILY are strapped down, youngsters in the rear seat and parents in front, as the Lindsleys set out for a trip. The children like the idea, make believe they're riding in a plane. In addition to a belt across his lap, Pop straps on a shoulder harness for long journeys.

Safety Belts Help You Drive

Strapped down, you're protected if a crash occurs. But that's not the only use for seat belts.

By E. F. Lindsley

DRIVING thrills are for those who like them, not me. Our two cars are just family transportation—to work, to schools, stores and visiting. We roll up about 25,000 miles each year, well over 800 hours in the driver's seat if you figure an average of 30 miles an hour. That's a lot of passing, a lot of quick stops, a lot of the close ones we all see and have in everyday driving.

When I take the kids out in our boat, I insist they wear life jackets. When I crawl to the top of a stepladder, I'm not too proud to ask someone to steady it. I wear

Installing an Aircraft Belt

goggles when I run the workshop grinder, and I carry flares in case my car stalls on the highway at night. I also like my seat belts. If the big brave guys think that's silly, they can go right on doing so.

It has been proved time and again that seat belts pay off in a crash. Every time a Navy pilot sets a hot fighter plane on a carrier deck and fetches up against the arresting gear, he demonstrates that the human body can absorb a sudden stop easily enough —if snugly tied to the machinery instead of smacking around like a bird in a glass cage. The same goes for seat belts in cars.

Driving is easier, too. Most of us never discover until we use a seat belt that it gives the "seat-of-the-pants" feel that fliers rely on. You know instantly what the car is doing. An impending skid, excess speed on a curve, the gentle (at first) hint of a tire going soft, all are communicated to your senses in a way hard to describe but deeply satisfying as a driving experience. Inevitably, this results in better control of the car. Women accused of driving mechanically without really sensing the "feel" of the huge weight under their hands will find that a taut seat belt gives them a feeling of belonging to the car.

The driver is not alone in the added comfort. My wife noticed at once that she didn't have to grab for the handgrip when I took a sharp corner. Another joy for the family driver is seeing the kids stay put.

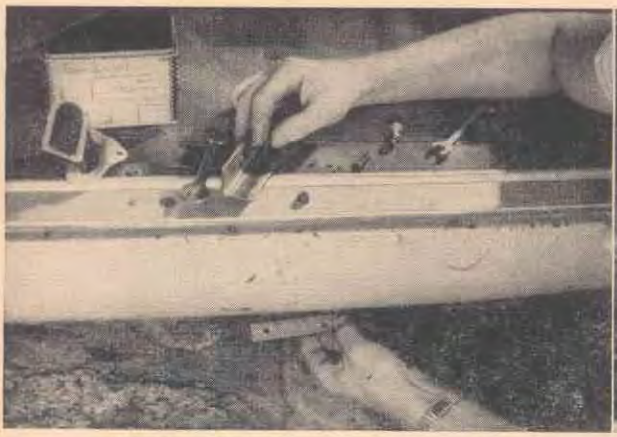
AIRCRAFT BELT can be used in small car or across one section of divided seat in larger one. You could adapt angle-iron anchor that writer used on Crosley to almost any car.

They must be strong. Seat belts may be called on to take a terrific load. For this reason, more than casual thought should be given to the materials used and how you install them. The most economical approach is probably the one I used on my wife's Crosley. Here, by plunking down about $7 at the local airport supply shop, I got a replacement seat belt of approved webbing with a quick-release latch, adjustment clips and terminal connection fittings. Such a belt will easily span the entire seat of a small car. On a conventional-size car, it would do fine for one side of the front seat.

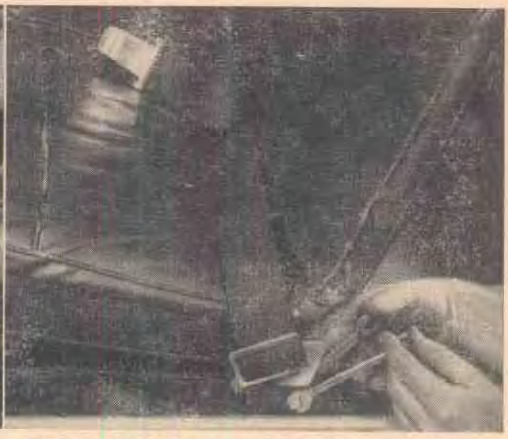
Installing a Kit Belt

SEAT-BELT KITS are available from several makers. Here, the writer is drilling edge of door to anchor belt he put on a Buick. Anchor there keeps door from flying open.

PLATED CLIP placed on door holds belt while not in use. Directions tell where to locate clip, but it's safer to probe with wire to be sure of hitting metal under fabric.



BOLTS with lock nuts or cotter pins are run through bottom panel and ⅛" reinforcing plate to secure anchor. Before drilling, check under floor for gas line or wires.



BELT TERMINAL is aircraft fitting made for the job and secured with best-quality bolt and nut. One belt across both seats is good idea for mother who takes child along.

Anchor points at the floor level and to the rear on each side of the seat seem best for this type of installation. But the thin metal of the body bottom panel usually makes it necessary to use a piece of flat metal to beef up the anchor.

You can buy a kit. Getting around to belts for my Buick, I found that a commercial kit was available to fit. The one I used has an ingenious anchor scheme. By attaching one end of the belt to the lower rear edge of the door you get extra protection against that old bugaboo of the door flying open in an accident. When this happens, the car offers less protection because it loses structural strength. The center anchor for the front seat and the rear anchors at each end of the rear seat are sturdy U bolts with back-up plates. On a four-door car, the rear belts are attached much like those in front. The kit gives instructions and templates for locating the holes you must drill.

A shoulder harness too. Impressed by the seat belts, I decided to try a shoulder harness on the driver's side. Some authorities claim a harness is all-important for the driver in a severe crash because of the steering column in front of him. I hope I'm never called upon to test the theory. Right now, when I pop into the car to run downtown, I snap on the seat belt and let the harness

CENTER ANCHOR POINT for inner halves of belt is off-center to driver's side. Right-hand belt thus can snug down two persons if three ride in front. Anchor is sturdy U bolt.

BELT FOR REAR SEAT also is held by U bolts and reinforcing steel plate. These anchors should be placed as far to rear as possible. The rear belt extends across entire seat.

Installing Shoulder Harness

SHOULDER HARNESS can be made from old parachute pack. By ripping away the excess, you have two strips of webbing and plenty of fittings for an adjustable harness. No sewing is required. Ripcord housing should be cut off and the padded front clasp used without change. The snaps for leg straps are used for attaching harness to anchor behind seat.

go. Out on the highway on a trip with the speedometer needle swinging toward 65, the harness is on.

Nose around some of the stock-car races and you'll see a variety of harnesses and methods of anchoring.

Searching around a few airports brought to light an average back-pack parachute (minus silk) which the owner cheerfully unloaded for a couple of bucks. An hour with a sharp knife unsewing the mess brought me all the soft shoulder webbing I needed, plus a hatful of snaps and tightening keepers. Anyone wanting a shoulder harness should make a quick circuit of the airports and war-surplus stores.

The installation was a snap. Two holes, a husky U bolt centered aft of the driver's seat with both ends of both straps clipped to it and I had a first-rate shoulder harness. I didn't do a thing to the snap and pad that go across the chest except cut off the ripcord housing. The snap slides up or down as you like it and keeps the straps comfortably across your shoulders where they belong.

Disadvantages. The greatest disadvantage of seat belts and a harness is inconvenience. They can't help you if you don't put them on. They help most if they are reasonably snug. When they are snug it's hard to fish your tobacco pouch or wallet out of your hip pocket. If you let them get dusty you may wind up with a stripe across your trousers. Also, the kind of guy that laughs at a drunken driver and smokes while pouring gas in an outboard may needle you about being a scared Willy. But I don't care. Seat belts make sense to me. END

TWO STRAPS run over and under the folding back rest, ends attaching to U bolt in floor. On a four-door car, the fabric at seat fold would have to be pierced for straps.

You can save half the cost by

Installing a Car Radio Yourself

By Howard G. McEntee

MUCH as I like music on the road, I balked at the price my car dealer wanted to tack on for a radio. Turned out I was right, too—for a little shopping around and a couple of hours' work I have a radio for about half that figure.

It works fine, and the installation wasn't much harder than attaching a rear-view mirror. I never even looked at the vacuum tubes. The single adjustment necessary was done strictly by ear. Anybody willing to get under the dash can do the same.

Choosing a set. If yours is a popular car, you can get a custom-styled radio to fit it for about $40. Universal sets that fit under the dash of any car cost the same or even a bit less.

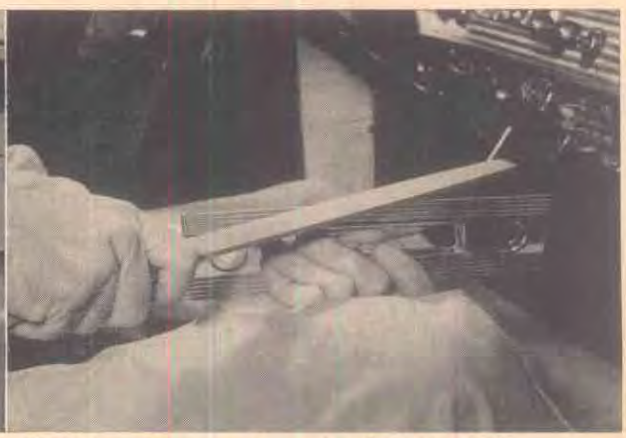
My set was the lowest-priced model of a well-known make; it cost $35. A

YOU DON'T HAVE TO ADOPT THIS POSITION for the job, but the author insists it's most comfortable way to get back of dash on modern cars. Here he loosens cover over radio cutout.

1 RADIO KIT I BOUGHT included the set (with built-in speaker), all mounting hardware and two suppressors. The dial plate (shown in foreground above) and antenna were extra items, but cost only about $3.

2 UNDER-DASH MOUNTING, like this, is easiest, and still leaves ample knee room. The long angle bracket (arrow) can be attached in different ways. But I preferred behind-dash mounting described hereafter.

5 SECOND BRACKET holding set to dash is mounted inside firewall with a long bolt. I ducked drilling a hole by removing an insulation-retaining button. Nut and lock washer go on engine side. Tighten firmly.



6 DIAL PLATE covers oversize hole in dash made for push-button set. As plate was wide, edges were trimmed with snips and filed smooth. It goes behind or in front of dash. To avoid vibration, I bent plate slightly.

trim plate to cover the oversize radio cutout in the dash was $1.30 and an antenna $2. A bigger model of the same make, with push-button tuning, a larger speaker and variable tone control would have cost $46.

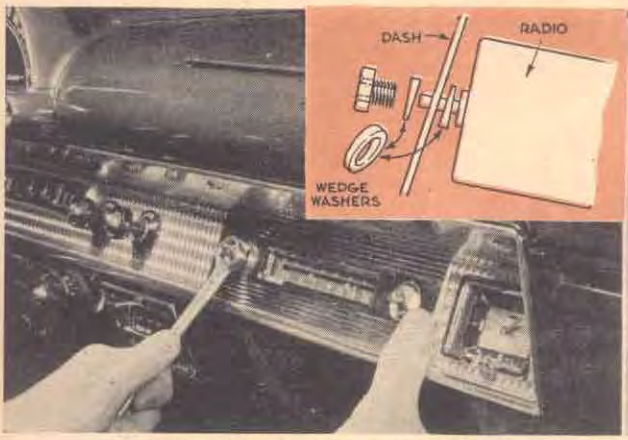
Antennas range from simple manual push-ups to motorized rigs, but the cheap one I used pulls in as much as a de luxe job would. I was careful, however, to pick an antenna that could be mounted from outside the car body. On some modern cars, it's next to impossible to insert one from beneath.

Mounting the radio. Late-model cars have dash cutouts for a dealer-installed set. The custom trim plate adapts this hole to the radio you buy. If your car has no radio cutout, you may find it easier to mount the set under the dash rather than behind it. A long bracket is supplied for this, and you need only drill two holes in the dash flange. Be sure to install the firewall brace, which supports the back of the chassis.

In mounting the set, make certain there is good metal-to-metal contact somewhere between it and the dash. This "ground" contact is one leg of the power supply, and unless it is properly

3 WITH CUTOUT EXPOSED, holes in the dash proved a bit too close together for tuning and switch shafts on the set. A round file soon made them fit. Ash tray under cutout was removed during installation on this 1954 Ford.

4 BRACKET FOR BRACE has to be mounted on back of the radio case with two of the self-tapping screws provided. The holes are already there, so it's a screwdriver job. Strap holds it to a similar bracket on dash.



7 TRIAL MOUNTING showed radio hit ash-tray frame. To tilt it, I cut four wedge washers from tubing. Two were cemented to radio to hold them during installation. Box wrench is best; it won't mar dash surfaces.

8 BOLTING BRACE to bracket on radio case completes installation of the set itself. Perforated strap comes extra long. I snipped it to length that made it draw up back of case slightly to allow enough space for ash tray.

made, your radio will be without juice.

The other leg of the power circuit is a one-conductor cable that must be connected to the "hot" or ungrounded side of the battery circuit. Since the set has its own on-off switch, this lead can go to the heater switch, cigarette lighter, battery side of the light switch or any other live terminal.

The preferred spot, however, is the "dead" side of the ignition switch—the terminal that is hot only when the ignition is turned on. This will insure having the radio off when you shut the engine off and prevent an unintended all-night drain on your battery that might cause starting trouble the next morning.

On some cars, the switch has an alternate key position in which the ignition is off but gauges and accessories are on. If you connect to this terminal, you can use the radio when the engine is not running, and still be certain the radio will be off when you take out the key.

One way to locate a live terminal is to turn on the radio and hold the power cable to various terminals until the set comes to life. Remember to give the tubes time to warm up.

Cutting out noise. Low-priced radios

9 BEFORE DRILLING for the antenna, I made certain its lead would reach set from this point, and that I could reach beneath to put on the insulator nut. The spot was punch-marked and a small drill started with great care (love that paint job!). Then the hole was enlarged with a ¼" drill.

10 A CONE REAMER in a hand brace would make the ⅞" hole required, or it could be filed out. But having a chassis punch, I reamed the hole only to ⅜" to take the bolt that draws the punch through. This tool (inset) makes quick work of cutting a clean ⅞" hole that is free of any burrs.

usually come with only two suppressors —a resistor to go into the high-tension circuit, and a condenser for the generator. On my 1954 Ford these proved adequate to hold down noise, even on weak stations.

Some older cars may require a resistor at each spark plug. If you're planning to buy new plugs anyway, you can kill two birds with one stone by buying the resistor type, which have the unit you need already built in. Though built to make the engine run better and plugs last longer, they will also suppress ignition noises in your radio.

One reason for interference may be that the engine hood is not well grounded. This permits engine static to reach the antenna. You can probably kill it by attaching a spring-bronze grounding strap (available ready-made) on the rear of the hood at the antenna side.

Some dashboard gauges may cause snapping noises; suppressor condensers

12 SPADE TIP on the power lead from the set is best connected to the keyed or "dead" side of the ignition switch. This insures that the radio is turned off when the car is left locked. However, if more convenient, the power lead could be run to the cigarette lighter, heater switch or any other live terminal.

13 HIGH-TENSION LEAD from coil to distributor is pulled out of latter and cut 1½" short. Without stripping, long end is pushed into suppressor and twisted clockwise. Cut end of short piece goes into other end of suppressor, terminal end back into distributor. Final job is mounting generator suppressor.

11 WITH CABLE AFFIXED to the inside end, antenna is dropped into place, and the lock nut inserted from beneath and tightened. Ball joint permits some vertical adjustment (above). Some antennas must be put in from below. The other end of cable (at right) is plugged into antenna socket on radio.

at the sending end (such as the gauge terminal on the gas tank) will quiet them. Front wheels, being partially insulated by bearing grease, may also be offenders. You can buy springlike gadgets that will ground them reliably. If the voltage regulator or electric clock causes annoying clicks, condensers will tame them, too.

Most noise from these sources will be audible only when the receiver is tuned between stations, and unnoticeable during a program. Try reception with the suppressors provided; you may not need any others.

Tune your antenna. Your last job, once the set is playing, is to tune the antenna circuit. With the antenna extended to full length, tune in a weak station at the high-frequency end of the dial. Then turn the trimmer screw (usually near the antenna jack on the set) one way or the other to obtain the loudest reception with the least background hiss to interfere. END

ALMANAC
FOR MOTORISTS

Pithy proverbs, provident counsel and omens and portents of interest to horseless-carriage operators.

▸▸**One of life's** persistent puzzlements is why women find it so hard to keep gasoline in a car. Most of them don't even seem to *see* the gauge until the pointer begins nudging the pin by Empty.

▸▸**Speaking of filling the tank,** if you keep the gas tank mostly full there'll be less moisture condensing on the inner tank walls these mornings, and less water to be trapped by the fuel system.

▸▸**Restraint** is the word if, with oilcan in hand, your eye lights on the oil cups on the distributor, generator and water pump. Sure they're there to be used, but just a few drops will do the trick.

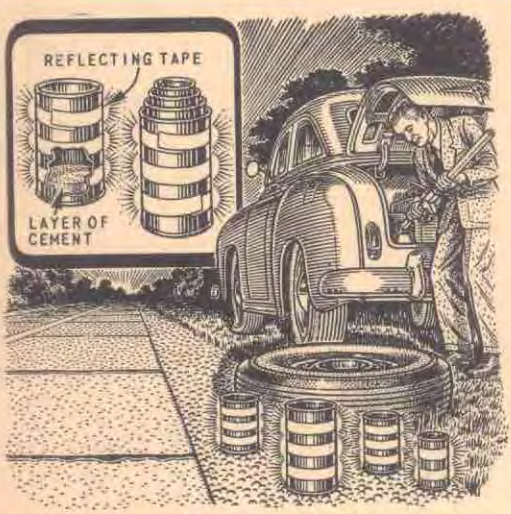
▸▸**Engine getting cantankerous** on cold starts? Before you begin working on the automatic choke, ponder how long it has been since the plugs were cleaned and gapped. On many engines, poor plugs insure poor starts.

▸▸**Beware those spooks** who drive serenely along with a turn signal winking away forgotten. Give them a wide berth: they may be wholly unconscious.

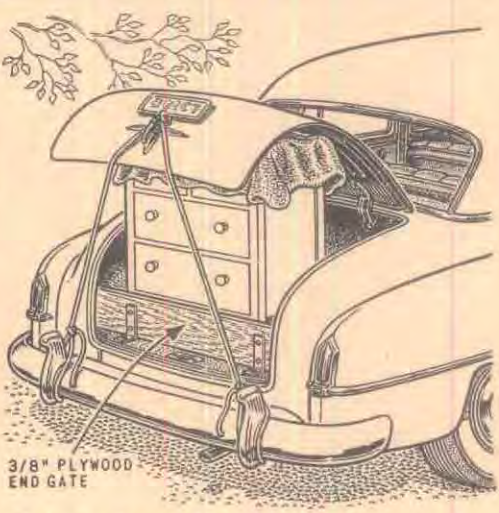
Hints FROM THE MODEL GARAGE

Rub soap inside hose ends when installing new connections between the radiator and motor block. They'll slip on the fittings easily and save you much pulling and tugging. For a thorough job, sandpaper the rust off the fittings and use new clamps.

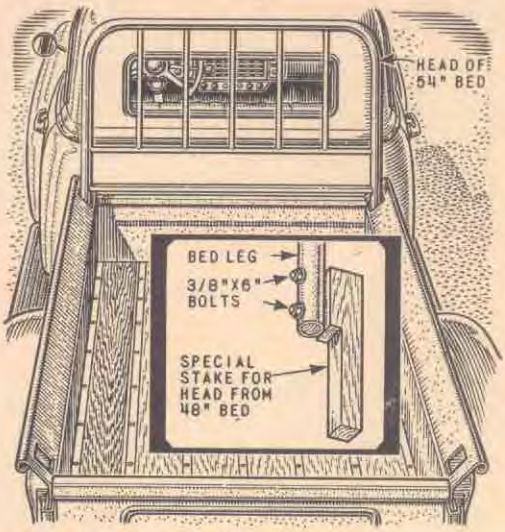
Bolt one or two truck-tire rims to the side of a pickup truck to keep cylindrical objects like oil drums or rolls of roofing from rolling about. Bolt the rims as high up from the floor as the sides will permit to keep the loads from tipping out.



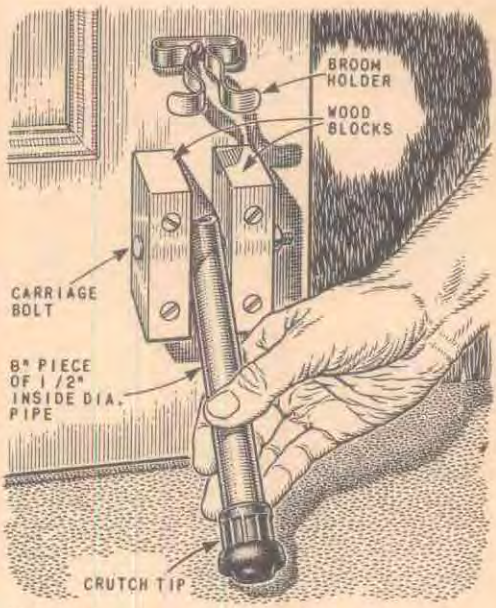
Wrap reflective tape around tin cans to warn passing motorists when you're stuck or changing a tire. Use cans of different sizes so they will nest compactly in the trunk and pour a little cement in the bottom of each can to keep them from blowing over.



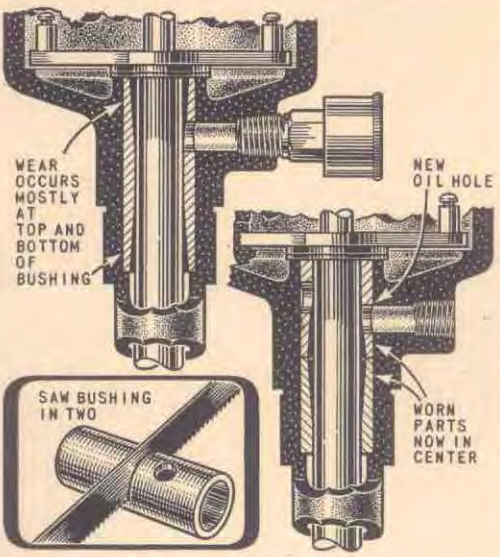
Put a plywood end gate across a low trunk opening to keep tools from rolling out when transporting a large object with the trunk lid up. Set it back far enough so that it won't interfere with the latch and secure it with metal angles bolted to the floor.



Use the head of an old metal bed to keep the load in a pickup truck from crashing through the rear window when you stop suddenly. Cut a hole in the body sides for the legs. Make the head of a narrow-width bed fit by adding wood extensions (inset).



Keep the garage door open while you back out by pivoting a piece of pipe on a bolt held by two blocks of wood screwed to the inside of the door. A rubber crutch tip keeps it from slipping and a spring clamp stores it up out of the way.



When a distributor bushing wears, play in the shaft affects engine performance. Because most wear is at the bushing ends, you can save fitting a new one if you cut the old bushing in two, drill a new oil hole and put it back with the center sections out.

Paint car tools bright orange or yellow to make them easier to see. Then you'll be less likely to leave them at the roadside when you take them out in snow or at night to change a tire or make repairs. The paint will also keep them free from rust.

Shine Up Your Car for the Parade

By Sheldon M. Gallager

WALTER A. HALL is a guy who *likes* to wash his car. Perhaps that's because he is so awfully good at it. In his 23 years as a research chemist in the Finishes Division of Du Pont, "Red" Hall has picked up quite a few pointers on the care and finishing of the old family buggy.

"Why does it always seem so hard to get a good shine on a car?" we asked.

"Nothing really complicated," Red said. "Mostly it's thoroughness, plus maybe a few little things that the average guy doesn't bother with, like using the wrong cloth or your wife's laundry soap instead of a special auto detergent."

We must have looked unconvinced.

"Here, I'll show you," he said, motioning toward a neighbor's car across the street. "There's a dark maroon job, one of the toughest colors to keep in shape. It's not a new car and it needs a bath pretty badly. Fair test?"

We agreed it was.

"How long does it take?" we asked.

"Actually," Red said, "you could do the whole thing in about four hours, pushing it a bit, of course. But it makes a fine weekend job if you wash one day and do the cleaning and polishing the next. That way, you're also sure that the car is completely dry before you start the elbow work."

For the next few hours, we watched while the master worked. The accompanying photos on this and the next two pages show you how you can use the same tricks to put a gleaming finish on your car.

1. HOSE DOWN CAR FIRST to loosen caked-on dirt and eliminate streaks that sometimes occur when washing water drips down over dry parts of car. Never wipe dirt with dry cloth—you'll simply grind it into the finish. Dirt won't come off, but the paint will.

5. REACH, BROTHER! When rinsing top, hood and back, don't forget that spray will push some suds back on clean side, so keep walking around car until all suds are off. Wash suds out of the rain gutter, too, or they'll drip down later and spoil your job.

9. WINDOWS ARE WASHED right along with car, but do need drying to prevent water-spotting while car itself does not. Use detergent suds on outside, merely a damp sponge cloth on the inside, as above. Even stickiest bugs will yield to water and elbow grease.

2. BE SURE TO USE special auto detergent, foamed into suds with hose. Ordinary soap leaves scum that dulls finish; house detergents hold dirt in suspension, may leave it on.

3. START AT TOP and sponge detergent on only half the car at a time. Working in small sections prevents drying of detergent that may cause streaks if it is left on finish.

4. RINSE SUDS OFF IMMEDIATELY and check for dirt. Very grimy cars may need second or third sudsing for thorough cleaning. Trigger-type hose nozzle controls water easily.

6. FINISHED ALREADY? No, just throwing out the old water and changing to new. This, says Red, should be done twice during the washing to avoid re-using dirty water.

7. FLUSH ALL DETERGENT out of body cracks and under trim so it can't ooze out later and streak your finish. Rinse sponge often to remove dirt that might scratch car.

8. WASH CHROME in same way as the rest of car. Skim only surface suds from the pail so you don't pick up dirt settled at bottom. Humpback sponge is easy to grip, gets in corners.

10. WHEELS COME LAST. After sudsing and rinsing these, also spray underside of car to wash off salt and other road-conditioning chemicals that may cause corrosion of metal parts.

11. SO YOU THINK IT'S CLEAN? Even after a thorough washing, look what rubs off. This is dead pigment—nothing to get alarmed about, but it's why you need a cleaner, too.

12. RUB, BUB—that's the secret of a really good cleaning job. Red uses a small sponge balled up in his fist and scrubs on liquid silicone cleaner with short, brisk strokes.

Please turn the page for more car-cleaning tips.

13. CLEANER IS WIPED OFF with soft cloth—an old undershirt is perfect, or an unsized material such as cheesecloth. On stubborn areas, you may have to apply cleaner two or three times. With slow-drying silicone cleaners, do whole car, then wipe; with others, work in small areas.

14. NICKED THE GARAGE DOOR? Don't worry, ordinary cleaner will remove most paint streaks; if not, use more highly abrasive rubbing compound, but apply it sparingly and wipe on gently so as not to wear away the paint. For taking off tar, asphalt, grease and other tough spots, use tar remover.

15. CHROME POLISH removes light rust and discoloration from bumpers and trim, but keep its abrasive action away from body paint. On heavy rust, use wire brush first. Where rust is beyond removal, you can hide it with chrome paint. Waxing after polishing will help protect chrome.

16. NOW COMES THE POLISH. Here you have a choice of three basic types shown at left above. If you don't mind elbow work, you can get a fine, durable finish with paste wax (at top). This is wiped on with a moist sponge, then buffed to a high sheen. Use two cloths, one to knock down thick excess and a second for polishing. Do small area at a time, and don't work in direct sun.

Combination cleaner-polishes (center) are good for quickie jobs, but may not last as long as a two-part cleaning and polishing job. Apply them like wax but more frequently—usually three or four times a year.

Easiest of all, thinks Red, is silicone polish (bottom). This is simply wiped on and off without heavy buffing. If polish is used every six or eight weeks, cleaning step need be done only every third or fourth time . . . Car looks pretty slick, doesn't it?

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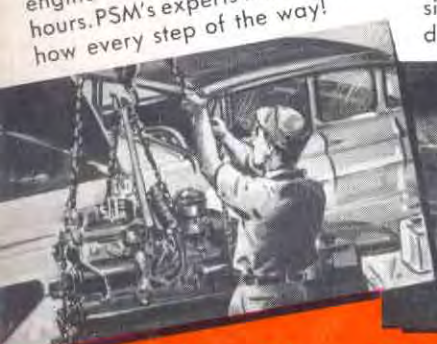

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