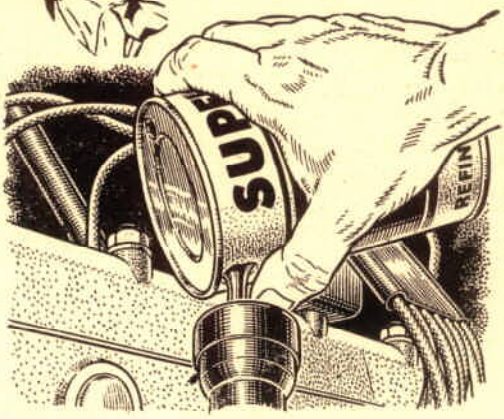
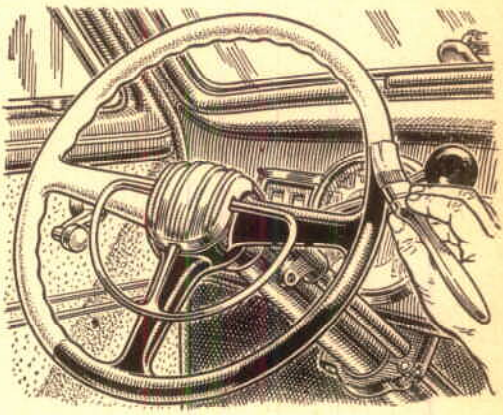
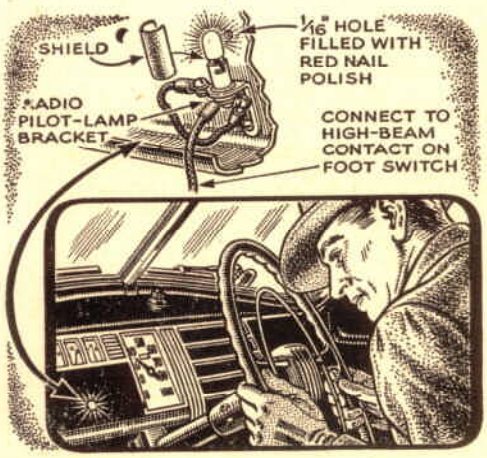
Hints from the Model Garage



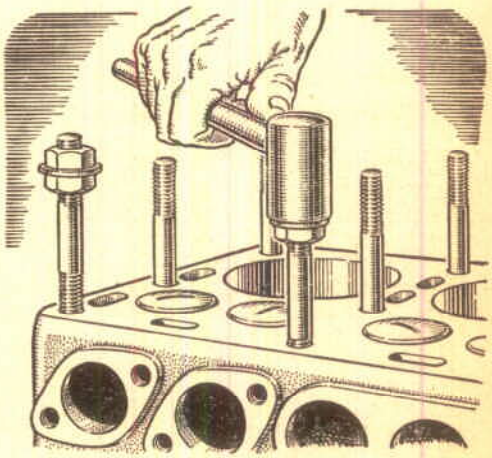
Where's the Funnel? If you can't find it, pour oil in the crankcase this way. Punch one hole in the top of the can and another in the side just under the top rim. Keep a finger over the side hole until it's in position over the inlet.



Refinishing Steering Wheel. Model-airplane dope is better than most paints for refinishing a steering wheel that tends to blacken your hands. It dries hard in a few minutes and is not affected by perspiration as paint may be.



High-Beam Indicator for Old Cars. If your car is an older model not fitted with a high-beam headlight indicator, you can quickly remedy the situation. R. L. Parmenter, of Middleboro, Mass., did the job as shown. Ground one of the lamp terminals. Drill a 1/16" hole through the dash ahead of the lamp and fill it with red nail polish. A fiber shield fitted around the lamp keeps light from showing on the floor.



Two Nuts Tighten Stud. This variation of the old two-nut trick makes it possible to use a socket wrench in reseating studs in an engine block. The washer between the two nuts keeps the wrench from slipping down over the lower one. After the stud has been seated by turning the top nut, the nuts are released by first turning down the lower one with an open-end wrench. This keeps the stud from loosening.

When Your Car Won't Start... What Would You Do?

Simple Screwdriver Tests Following a Systematic Procedure Will Help in Spotting the Trouble When You Are Stuck on the Road

WHEN you are out on the road, with no service station or telephone near, and your car stalls, what can you do? If you have a screwdriver and a little automobile sense, you can do a lot. You can also do a lot with these two things right in your own garage if your car stalls there. And even if you discover that the trouble is something that you aren't equipped to fix yourself, you can at least give the shop mechanic the proper clue and be sure that he brings the necessary parts to get you off in a hurry.

The chances are that the trouble will be in the fuel system or the ignition, most likely in the latter. With the ignition switch turned on, you can tell immediately whether you have gas in your tank, for the gas-gauge needle should register. If you have gas, take a look at the ammeter. Its needle will show a slight discharge, which is proper; it may swing completely over to show a full discharge; or it may show no discharge at all.

Turn off the ignition switch quickly if the needle shows full discharge, for that is a sign of a ground between the switch and the coil, and it could burn off the insulation. Search out the ground and repair it. If the needle shows no discharge, it could mean a dead battery or that the breaker points in the distributor are open, or it may just be stuck.

When the ammeter needle shows a slight discharge, it indicates that current is flowing. You will already have tried your starter; that's how you know you are stalled. But step on it again, and this time note whether the engine turns over freely, for if it does, then both the battery and starter are functioning properly. If the starter is sluggish, however, it may be because of a weak or defective battery, or the battery terminals may be loose, corroded, or dirty. It also may be caused by a mechanical failure in the starter or starter switch, or by a broken cylinder-head gasket that has allowed water to seep into one of the cylinders.

To determine what part of the starter circuit is at fault, turn on the light switch and step on the starter again. If lights go out or become dim, the trouble is probably in the battery or its connections. Clean and tighten the battery connections and the cable terminals, and replace any doubtful-looking cable if you have a spare one. The battery itself may be tested with either a hydrometer or a voltmeter if one of these is available. A hydrometer reading should indicate better than 1.250 specific gravity for a battery that is in good condition, while a voltmeter reading taken across the positive and negative posts should indicate about six volts, or close to whatever the voltage of your system happens to be.

If the lights remain bright when the starter button is pressed, the trouble may be between the battery and the starter, or the starter switch may be at fault. Try the connections in this part of the circuit first. If they are clean and tight, look for the disorder in the starter or the starter switch.

Should the ammeter needle refuse to budge when you step on the starter, there is no current flowing. This may mean that the breaker points in the distributor have been burned or that there is a loose or broken low-voltage wire or connection between the distributor and the ammeter. With a screwdriver, ground the low-tension wire at the distributor terminal. If you don't get a spark with this test, the current is cut off somewhere in the connections leading back to the ammeter. Working backward, ground each of these connections with the screwdriver until you come to one where

you do get a spark. The trouble will lie at this connection or between it and the distributor.

If you get the spark at the distributor terminal, it is an indication that current is flowing at least that far, and it is usually a safe bet that the fault will be found in the distributor—most likely the breaker points will be burned or dirty. Take off the distributor cap and check the condenser terminal and the condenser hold-down screw for tightness; then examine the condenser lead wire for a break. Should these things be found in good condition, open and close the breaker points and watch for a spark. If you fail to get one, the points must be cleaned and adjusted.

This cleaning can be done effectively enough in an emergency with the abrasive strip from a paper of matches, with a knife blade, with the sharp edge of the screwdriver, or with anything else convenient that you can use to scrape the scale from the contact faces. If you have no gauge for setting the gap, a quick adjustment can be made by using a piece of newspaper folded into four layers. This thickness will be about .020", which is the approximate gap setting for most distributors.

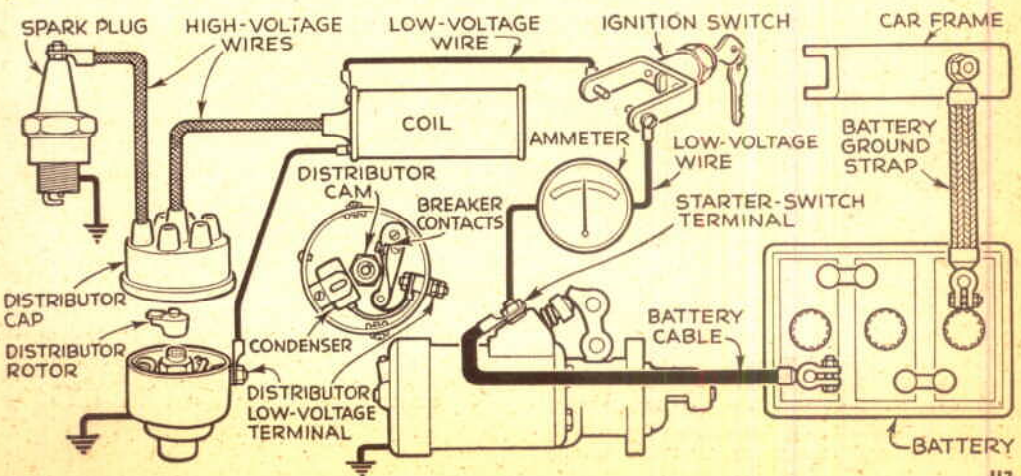
Suppose, when you stepped on the starter, the ammeter showed a discharge of from 3 to 5 amp. and the needle fluctuated rhythmically. This 3 to 5 amp. is the normal current the ignition coil draws, and fluctuation of the ammeter needle, which is caused by the opening and closing of the points, indicates that current is getting to the points. Should the ammeter register between 3 and 5 amp. but remain motionless when the engine is turning, start looking for a short somewhere in the distributor or the low-voltage lead connected to the coil.

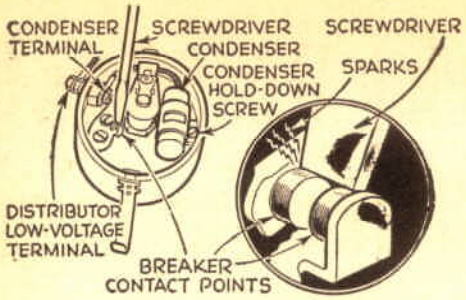
There is a good chance that the short will be in the condenser, so check this first by inserting a piece of paper between the breaker points to keep the current from flowing to the ground. The ammeter needle should return to zero if the condenser is good. If the needle still registers, take out the condenser hold-down screw and move the condenser away from the distributor. Should the needle now return to zero, the condenser is shorted and the current is leaking through its insulation. Unless he has been forehanded enough to take along a new condenser, there is not much that the average motorist can do about this except to thumb a ride or start walking to the nearest service station or telephone.

Another way of checking for a defective condenser is to examine the breaker points. If the contacts show a distinct blue tinge with a hard scale on the surfaces, the condenser is leaking. To check further, crank the engine until the breaker points open; then turn on the ignition switch and bridge the points with a clean screwdriver blade. If there are no sparks, the condenser is defective. For further proof, disconnect the condenser wire and again bridge the points with the screwdriver. If the screwdriver does draw sparks this time, it is a sign that the defect is in the condenser.

Should the ammeter-starter test prove O.K., that is, the needle show a discharge of from 3 to 5 amp. and fluctuate when you press on the starter button, there still may be trouble in the ignition system, or there

WHERE TO TRACE FOR A BREAK IN AN AUTO IGNITION SYSTEM





Sparking should occur when the breaker points are bridged with a screwdriver. If the condenser is leaking, you will not be able to get a spark

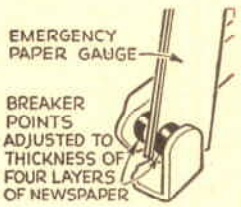
may be a stoppage in the fuel system. Look into the high-voltage circuit first. Remove the wire from one of the spark plugs and have someone press on the starter button for you; then, while the engine is cranking, hold the terminal of the wire ¼" to ⅜" from the engine or spark-plug base. If you get a fat spark that readily jumps the gap, the trouble is in the spark plugs or in the fuel system.

Before going any further, wipe the outside of the plugs to remove any dirt or dampness that would short-circuit the high-tension current, and then try to start the engine again. Should it still fail to start, remove one of the plugs. If the plug is wet around the base, it is an indication that the fuel system is all right and, naturally, that the spark plugs are at fault. Remove all of the plugs, clean them, and set the gaps. An emergency adjustment for this last can be made by folding a piece of newspaper into five layers for use as a gauge. Always bend the side electrode, never the center one, when changing the gap, as there is danger of breaking the insulation.

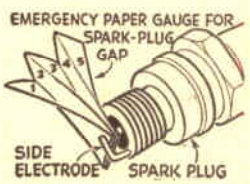
If the spark plug you first examine is dry at the base, check the fuel system. A quick test can be made by simply removing the air cleaner and looking down into the carburetor throat while the throttle is jiggled back and forth. If there is fuel in the carburetor, the accelerating pump will push gas through the pump jet, and the choke valve should then be checked. This valve should be closed when the engine is cold. If fuel is reaching the carburetor and the choke won't close, the engine can be started by covering the carburetor throat with your hand to prevent the entering of air while the engine is cranking. Don't choke this way after the motor catches; the vacuum created can injure your hand severely. Try priming the carburetor if you have one you can't see into. If the motor then catches but stalls again, fuel isn't getting into the carburetor.

Operation of the fuel pump is checked by disconnecting one end of the fuel line from the pump to the carburetor and cranking the engine. Fuel will spurt out of the line if the pump is working. If it doesn't, check for clogging in the line from the tank to the pump before putting the blame on the pump. Disconnect the line at the inlet side of the pump, remove the tank cap, and blow through the line. There should be a gurgling sound from the gas tank if the line is open. Be sure in addition that the air valve, or the tank-cap pinhole, which permits air to enter the tank as fuel is drawn out, is functioning properly.

If the pump seems at fault, remove the sediment bowl and clean the screen; then replace them, being sure that you have an airtight fit. Use a new bowl gasket, if possible, because it is sometimes difficult to get an airtight fit with an old one. If you have no new gasket at hand and the bowl won't fill up after being replaced, you can swell the old cork gasket by heating it with a match, but take care that you do not set it afire. Should the pump still refuse to function, it will have to be removed and repaired—unless you have been forehanded enough to carry a spare pump or diaphragm.

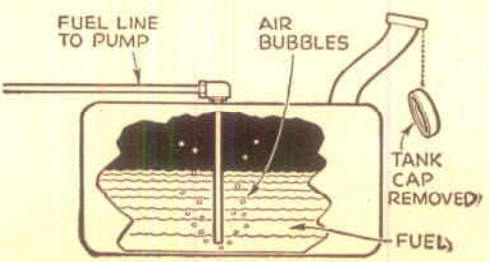


Folded newspaper forms a .020" thickness gauge that is near enough for setting a distributor gap



Newspaper is also used for emergency setting of spark-plug gaps. Bend only the side electrode in making the adjustment

Stoppage in a gas line is found by disconnecting the line at the pump and then blowing through it. Gurgling will be heard at the tank if it is clear



Seeing What Goes On Inside Your Car Engine

By Kenneth M. Swezey

BEHIND all the complicated mechanisms under the hood, in the chassis, and on the dashboard of your car lie simple and fundamental principles of physics, mechanics, chemistry, and electricity. Some of these were discovered hundreds or even thousands of years ago by such pioneers as Aristotle, Archimedes, Newton, Faraday, and Bernoulli. Many can be demonstrated dramatically in experiments you can perform in your own home.

On this and the next two pages, POPULAR SCIENCE shows you a few simple demonstrations of basic automobile principles that father and son—or even the whole family—might enjoy performing together. Your laboratory can be the kitchen or rumpus room; your apparatus such things as soda straws and tumblers, candles, and tin cans.

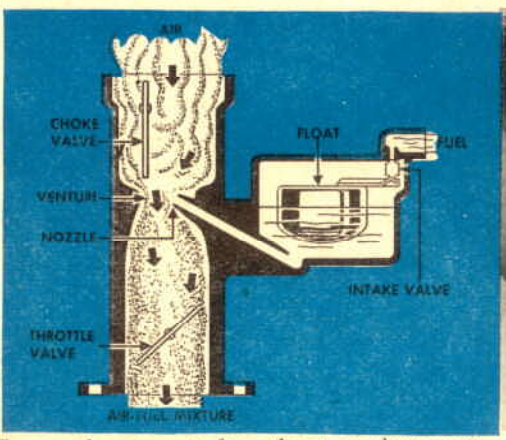
Let's start by looking inside the carburetor. With two halves of a soda straw and a glass of water, you can show how air streaming through this device lifts gasoline, scatters it as vapor, and mixes it with air.

After flattening one end of each straw, stand one in water and hold the other horizontally, flattened ends together. Now blow strongly through the horizontal straw, aiming the air across the tip of the other. Water will climb up in the vertical straw and spray out.

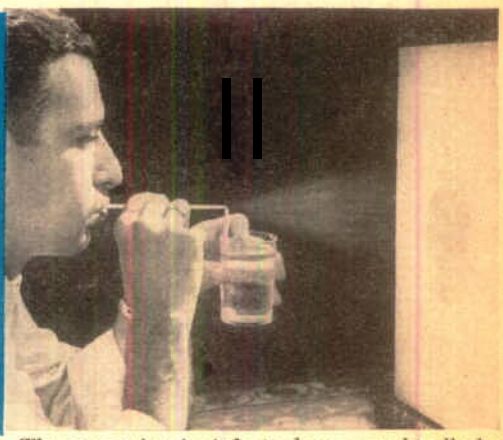
The secret? Daniel Bernoulli, famous Swiss scientist, discovered it more than 200 years ago. Increase the velocity of a fluid (such as air or water), and the pressure inside that fluid will be *decreased*.

According to this principle, air speeding over the tip of the vertical straw is at a lower pressure than that of the still atmosphere. Since the atmospheric pressure on the water in the glass is greater than the pressure at the tip of the straw, water is pushed up into the air stream.

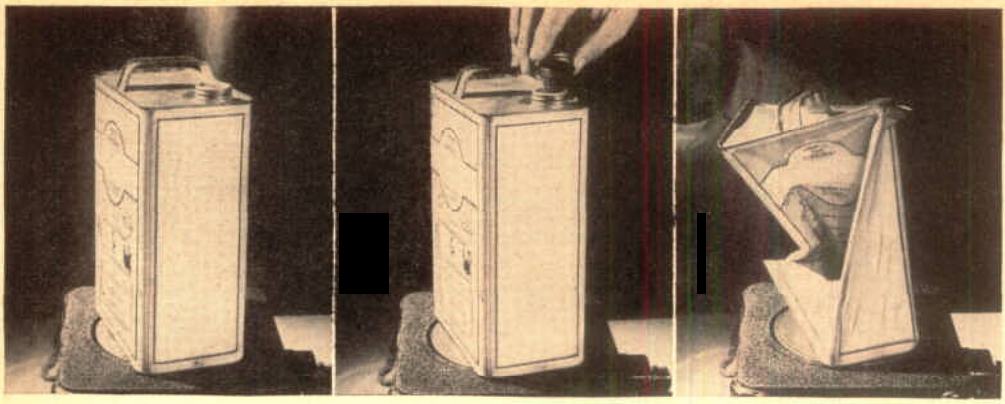
For some other unusual demonstrations of auto principles, turn the page.



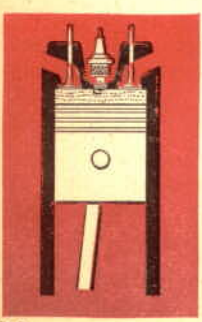
In a carburetor, air from the atmosphere must pass through a constricted tube, or "venturi," to reach the engine. This constriction speeds up the air, and the suction it creates pulls droplets of fuel from the nozzle. The mixture of air and vaporized fuel is highly explosive.



The venturi principle is shown graphically by this simple experiment. Air speeding across tip of vertical straw causes water to rise in it, emerge, and be sprayed out. Gasoline is similarly raised and vaporized. It's then ready to enter cylinder, as on next page.



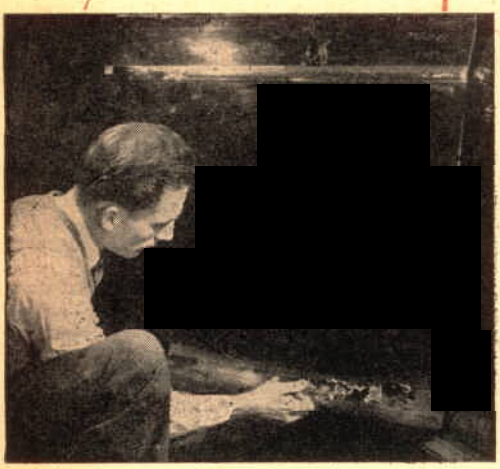
INTAKE To give power to your car, its engine repeats over and over the four-stroke cycle shown in the diagrams on these two pages. On the intake stroke, the cylinder is filled with the gas-air mixture from the carburetor. From a design standpoint, the big problem is to supply enough air. In fact, a big roomful of air must be crammed into the cylinders for each gallon of gas. Atmospheric pressure of nearly 15 lb. per square inch does the trick. You can demonstrate this pressure. Put a half inch of water in a flat-sided gallon can and boil rapidly. Remove from the heat and cap quickly. The steam inside condenses and internal pressure drops rapidly, leaving the can unsupported. Then tremendous outside pressure crumples it.



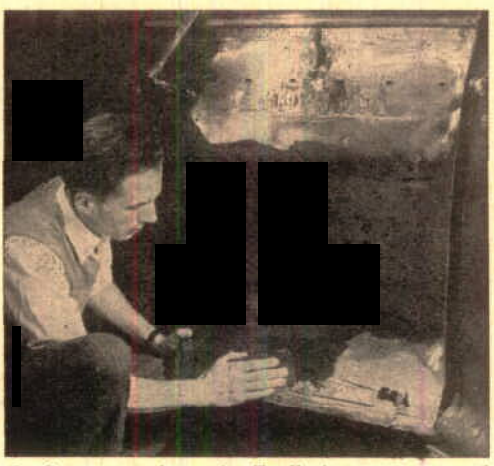
COMPRESSION Although gas and air will burn at atmospheric pressure, more power results if the mixture is squeezed by a compression stroke. Theoretically, the greater the squeeze the more the power. Practically, the amount is limited by the tendency of gasoline to explode prematurely from the heat of compression. Such premature explosions are one cause of "knocking." That gases heat when compressed can be shown by suspending a thermometer in a half-gallon jug and squeezing the air in the jug. Note the normal temperature first, then insert a bicycle-pump nozzle through the stopper. Pump about 15 strokes. (No more, or you may blow out the cork or break the jug.) The mercury will climb a degree or two.

Patch Up Your Car with Cloth

COTTON cloth impregnated with plastic offers an easy way to cover rusted or broken-metal areas in the fenders and body of your car. Already being used by a number of repair shops, the procedure is so simple that any handy man can do a good

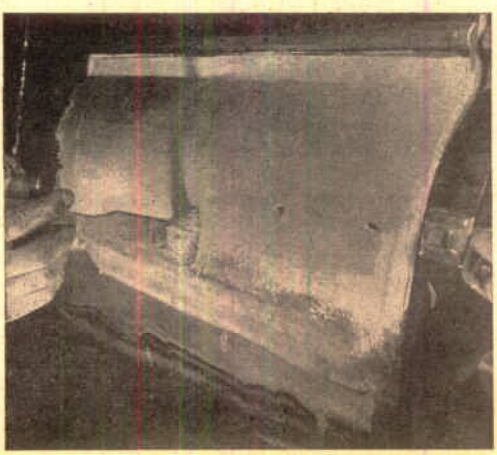


1. Here's the problem. Rust has eaten away the metal to such an extent that it breaks or you may poke a finger through it. This looks like a shop job—but you can do it yourself.

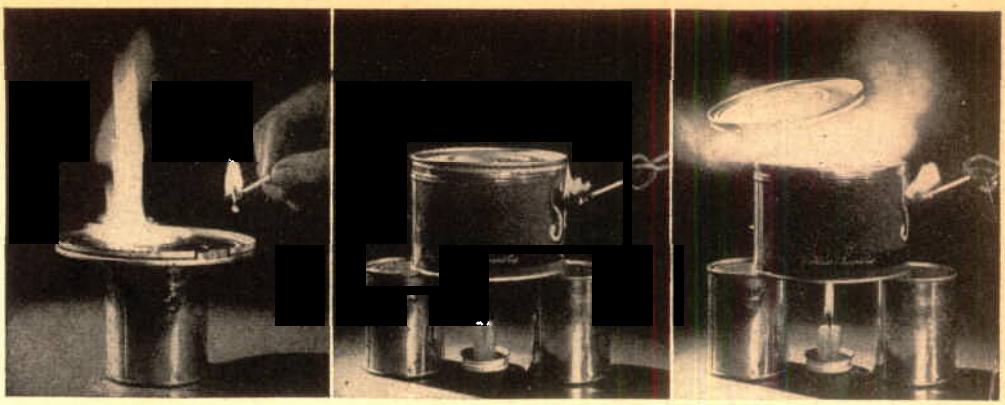


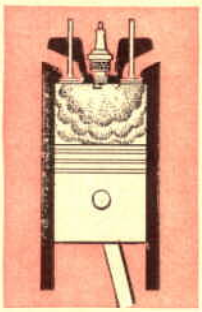
2. Scrape and sand off all the paint around the rust and clean down to the live metal. If the metal were broken or torn in a collision, you would start the repair job the same way.

5. Successive layers of Celastic Ⓣ may be used to build up spots where the original metal is completely gone. Allow each layer to set 15 to 30 minutes before applying the next one.

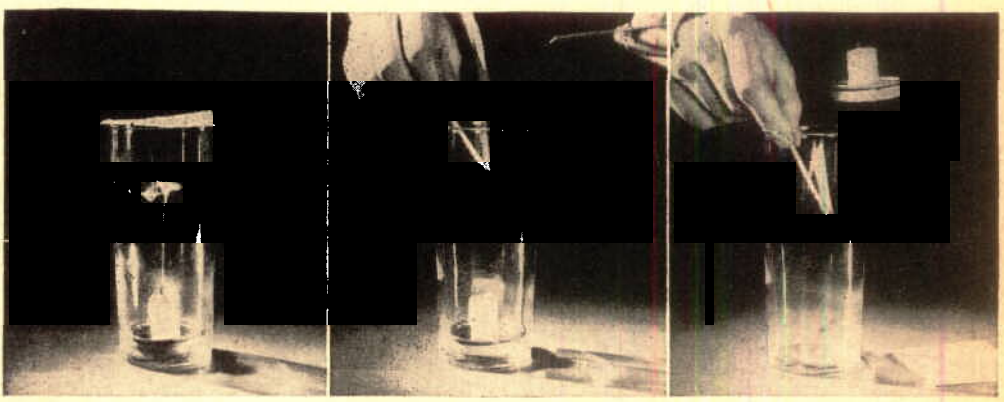


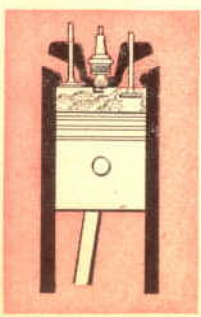
6. Brush metallic-base putty over the patch after feathering back the edges about 1½" with sandpaper or a power sander. Cut the putty to a thin paste. Allow it to dry several minutes.





POWER In the power stroke, a spark ignites the gas-air mixture, causing it to explode (more accurately, burn very fast) and drive the piston downward. *Because gasoline is too dangerous to play with, especially in the house, you had better not try this experiment, but the photos above show what happens.* In your car engine the gasoline must be vaporized. Liquid gasoline burns, as you see at the left, but not fast enough. At the center you have a situation comparable to a cold engine. In the can are a few drops of gasoline, but the vapor given off is so meager that nothing happens when a match is held to a hole in the lightly-covered can. But if the can is heated with a candle, as at the right, an explosion blows the lid off the can.





EXHAUST To prepare the cylinder for the next intake, an exhaust valve opens at the end of the power stroke and the spent gases are pushed out. Unless these burnt gases are forcibly removed, some would remain to prevent efficient combustion. It is easy to prove how this would happen. Light a short candle, fix it to a jar top fitted with a wire handle, lower the assembly to the bottom of a tall tumbler, and cover the tumbler with a piece of cardboard. As soon as the candle goes out, slide off the cover and lower a lighted match into the glass. Lacking oxygen, the match flame goes out. Now remove the burnt air by pulling out the jar top. Again introduce a lighted match. This time it continues to burn. END

patching job at home. It also has the advantage of being inexpensive.

In the form that you buy it, the material looks and feels much like any closely woven fabric. You can roll it, crumple it, and cut it with a pair of scissors. But dipped into a solvent, the plastic-treated fabric becomes extremely rigid as it dries and will hold the form into which you mold it.

Three bonded layers of the material are said to have a tensile strength equal to the sheet metal on an ordinary car. It does not rot, rust, or mildew, and it's not affected by severe climatic conditions. When dipped into an acetone-base solvent, the plastic-impregnated material bonds itself to any surface that does not have a highly glazed finish. After it has set, you can coat it with a metallic-base putty, sand it down to a smooth surface, and apply paint or enamel.

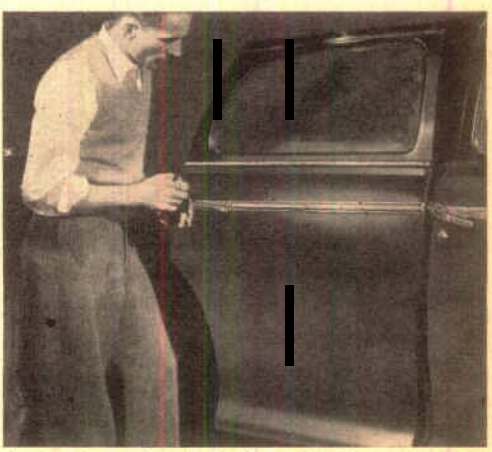
The material was developed several years ago and employed as an outer stiffener for self-sealing airplane fuel tanks. Since then, its characteristic of setting into a rigid form has brought it into use in a number of fields, often under the tradename of Celastic.

A. P. Deckert, of Buffalo, N. Y., distributes Celastic for use in the automotive trade. In addition to supplying repair shops, he

3. Cut a patch, allowing at least a 2" overlap, dip in solvent—but not longer than five seconds—and then whirl it in the air for a few seconds until the coating becomes tacky.

4. In applying, press the patch down firmly and mold to the original contour of the metal being replaced. Be careful to avoid pressure where there's no backing. Let it dry an hour.

7. Sand the putty to a smooth finish with a fairly fine paper (preferably No. 280). If the surface is still not as smooth as you'd like, apply a second putty coat and again sand it down.



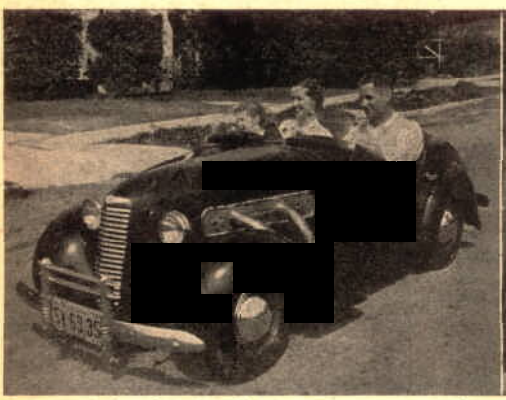
8. Apply paint—and the job's done, this one in a matter of only two hours. If you work carefully, the area will look almost like new. The cost? Well, it's surprisingly low.

is considering inexpensive kits for home use which include three thicknesses of the material, a can of solvent, some metal putty and reducer, sandpaper, and directions for carrying out the job. The three weights of the material are: heavy, about 1/16″ thick; medium, 1/32″, and thin, 1/64″.

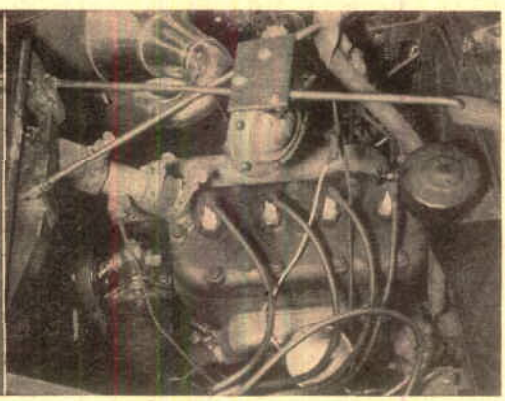
Body shops already have found Celastic both a time and money saver. For example, the job illustrated here took only two hours from start to finish, including a one-hour setting period for the patches, and the materials that were employed cost in the neighborhood of $1.50. Tests have shown that a patched area is practically as durable as a welded repair.

One automotive shop that has been using Celastic for body repairs also has found that it can be used to strengthen the sheet aluminum cabs supplied for Jeeps Ⓣ. Applied inside the cab, the material makes the aluminum much stiffer. END

As a stiffener, the fabric may be used in many ways. At the Crystal Collision Co., Brooklyn, it's applied inside aluminum cabs on Jeeps Ⓣ.



Everyone in the family can squeeze into the single seat. Notice the Nash grille at the front.



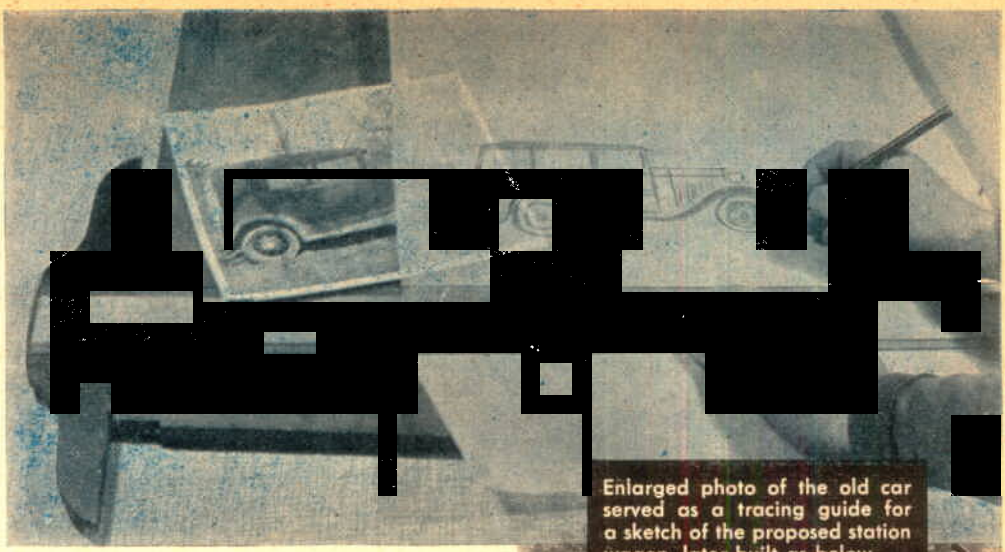
A souped-up Austin engine delivers 25 hp., and gives about 35 miles to a gallon of gasoline.

Homemade Midget Car Carries Three Persons

PARTS from a lot of different cars went into a midget auto that Harry B. Johnson, of Los Angeles, built in his spare time. Only 33″ high, it's wide enough to seat three persons with ease.

Both the chassis and engine are of American Austin manufacture. Frame and springs were lowered and midget racing-car tires installed. Plymouth instruments find service in the cockpit, Ford bumpers were cut down to suit, and a Nash grille was used. Fenders and body panels came from an Austin and Pontiac. False stacks decorate the hood.

The steering wheel is a plane-control wheel. Windshields were formed from clear plastic.



Enlarged photo of the old car served as a tracing guide for a sketch of the proposed station wagon, later built as below.

How to Build a Station Wagon

By George Daniels

A NEW station wagon from the showroom floor was too much of a luxury for my pocketbook. But I now have one—and the amount I spent converting my old bus, a Model-A Ford, to this style of body was only a trifle more than the price of a couple of new tires.

Given an old car in good running order, you can make a similar conversion. There are two ways you can do it—apply plywood panels over the old car body, or remove the body and build a new one from scratch.

If the car dates back to pre-streamline days, the first method is easier and cheaper. You use the old body as the inner framing, cutting out its back end. The flat body panels make it easy to install the plywood.

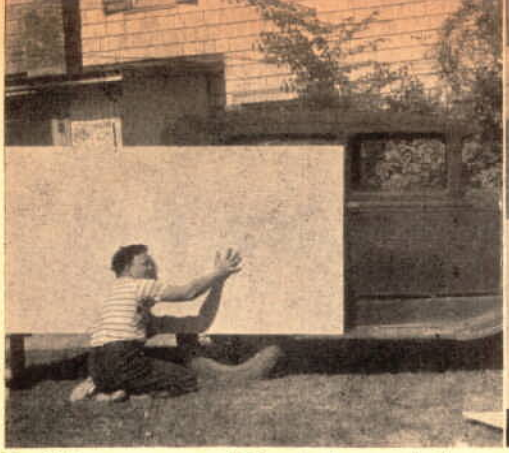
But if the car has lots of curves, it probably will be best to cut away the body just behind the windshield, leaving the posts in place. In a pinch, you could cut it away with just a pistol-grip keyhole hacksaw.

As the first step in either type of conversion, take a broadside photograph of the car. Line up the camera at right angles to the wheelbase at its middle point. Have the picture enlarged to 8 by 10 size.

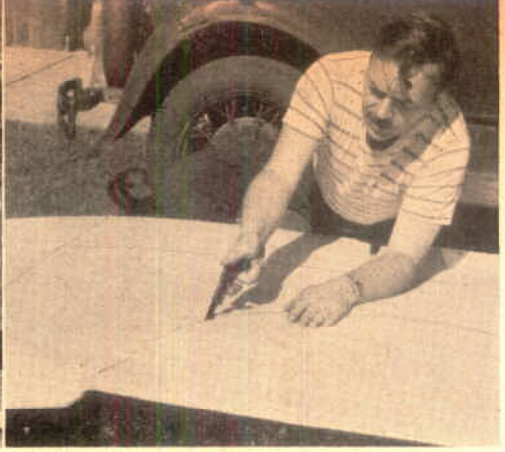
Over this photo, trace the general outlines of your intended station-wagon body, using the roof, windshield, and window posts as guides if you are going to use the old body as an inner frame. In your sketch, extend the body at least as far back as the rear tips of the back fenders. If you wish, it can overhang another foot or so.

This sketch will enable you to visualize the appearance of the completed body. From it, you can also estimate the materials needed. Using a ruler on the sketch, measure the proposed body in units of wheel diameters. Then measure the wheel diameter on the car itself. A little figuring will give you the approximate measurements of the body you plan to build.

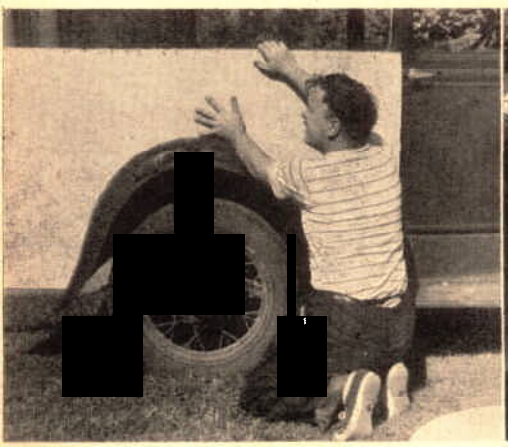
You are then ready to start to work. The photos on the next two pages show you how the new body can be built using the old body as the inner framework.



1 **Make patterns** of the body panels from fiberboard, using your sketch as a guide. After lining up the pattern sheet, mark it on the inside with a pencil for the fender cutout and for cutting to the lower edge of windows.



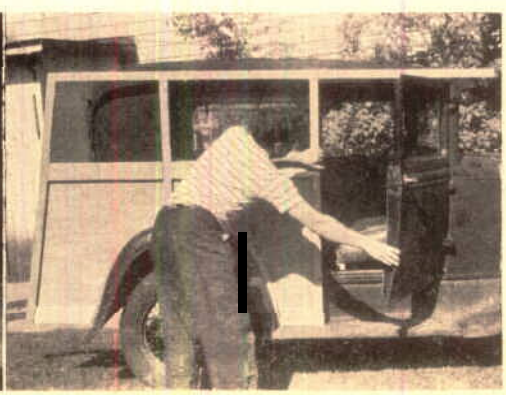
2 **Cut the pattern** along the waste side of the pencil lines. In addition to this pattern, you'll need another for the door. Patterns for one side are usually all you'll need; you can use them on other side with opposite face against car.



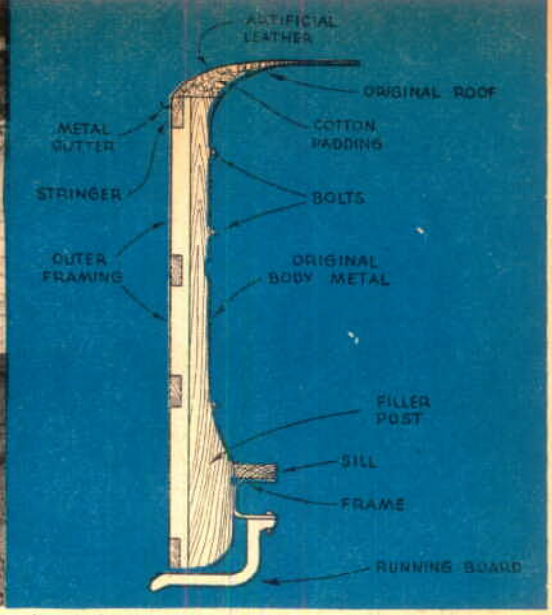
3 **Fit pattern snugly,** using a rasp to trim it as needed. Swing back or remove bumper for this. Cut filler-block frames to conform to body contours and fill space between pattern and body. Tack these temporarily to pattern.

4 **Trace pattern** on ¼" waterproof plywood after you have a good fit. Cut on the lines. Try the panel on both sides of car. If the body has been badly sprung, it may be necessary to make patterns for both sides.

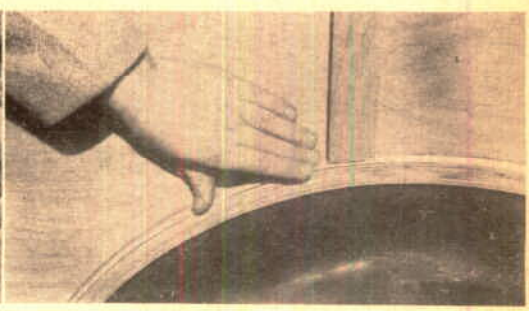
5 **Cap top edges** of panels with wood sills, covering space between metal and panels. Mastic in the joints will lessen squeaks. Attach panels with ¼" rustproof bolts.



6 **Try door clearance** after attaching framing temporarily. After trim fits perfectly, secure it with waterproof glue and screws. You now begin to see how your station wagon will look.



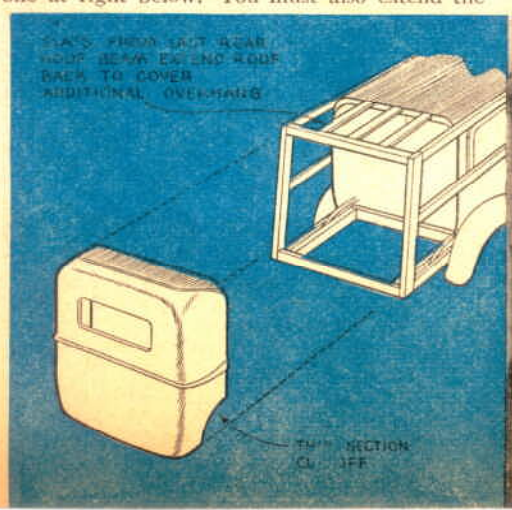
7 **Cut the inside panel frames** to follow the contours of original body. Remove handle from door for greater ease in fitting door panel. In stage shown above, rear panel is assembled but has not yet been attached permanently. Before bolting on the panels remove the upholstery from the inside of car. In drilling for bolts, be careful to locate them so as not to interfere with door or window mechanisms. The drawing above shows how the roof is finished off.



8 **Leave top longitudinal** of rear panel overlength to serve as guide in fitting the door panel. Clamp the latter in place to try it. Allow at least ½" clearance over the running boards so snow or ice won't jam the doors.

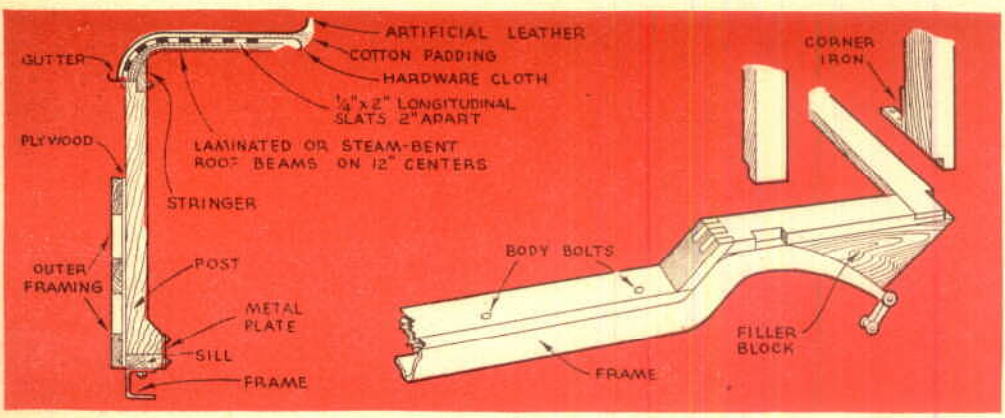
9 **Curved framing** over the fender can be laminated with waterproof glue, as this one was. You could also steam-bend it, or glue it up in sections. You will probably want to refinish the fenders and hood of car.

10 **Cut away the rear** of body and extend roof to suit new body overhang. If the station wagon is to be just a workhorse, you can install a simple half-height tailboard like the one at right below. You must also extend the floor back from the rear seat. Place a two-by-four cross beam under its rear edge. You can either remove the rear seat or build a frame of pipe to support it. For details on a curved-body conversion, turn the page.

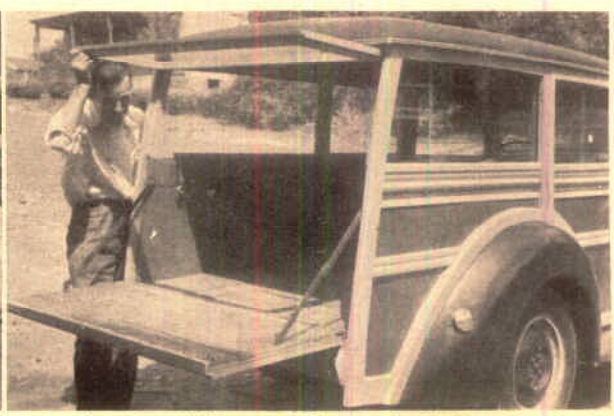


For a Slicker Job, Build the Body from Scratch

A showroom model. That's what the conversion above looks like. A new body was built after the old one had been almost entirely cut away, left. Note that a new floor has already been installed. For this type of conversion, remove fenders and remount them on new body. Rear bumper can be either removed or relocated.



Construction details are suggested here. Dimensions should be adjusted to suit the particular car. If the original front doors hinge at front, you can mount new ones on the same hinges. In any case you can probably use the old hinges, door catches, and window mechanisms. For uprights, glue up hardwood to at least 3" by 3". Assemble with bolts and glue.



Fit all joints nicely and strengthen them with metal angles where possible. For a professional-looking job, use two hinged panels at the rear as above. Three coats of outdoor varnish followed by wax will give the body a fine finish. If heavy loads are to be carried, install overload springs. And one final point: notify your state license bureau of the model change.