

## HOW TO RELOCATE A PRESSURE REGULATOR

### PURPOSES, ADVANTAGES:

Ease of maintenance, access, protection from heat, better reliability.

### DISADVANTAGES:

Two or three hours' work, the regulator can be heard clicking off at full load since it is attached to the frame and not to the engine.

### PARTS NEEDED:

Rubber hose for return line, brake fluid resistant for LHS2 cars, gasoline resistant for LHM cars. Pressure is low.

US made steel brake line. Six feet of 3/16" diameter for main feed line from regulators to original main feed, near the brake master cylinder.

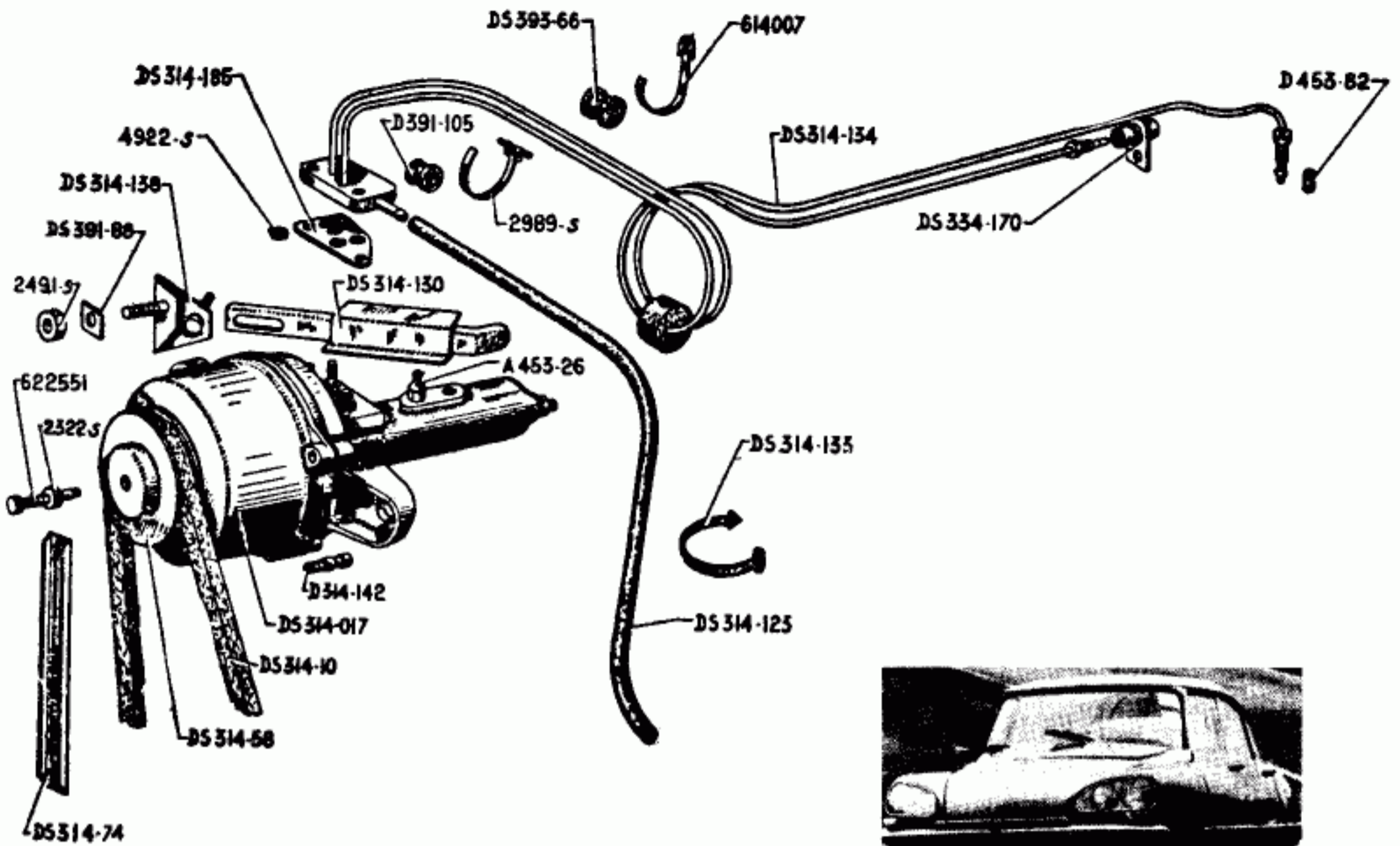
US made 1/4" diameter steel rake line, 6 feet long, for pump to regulator connection and coil.

### HOW TO:

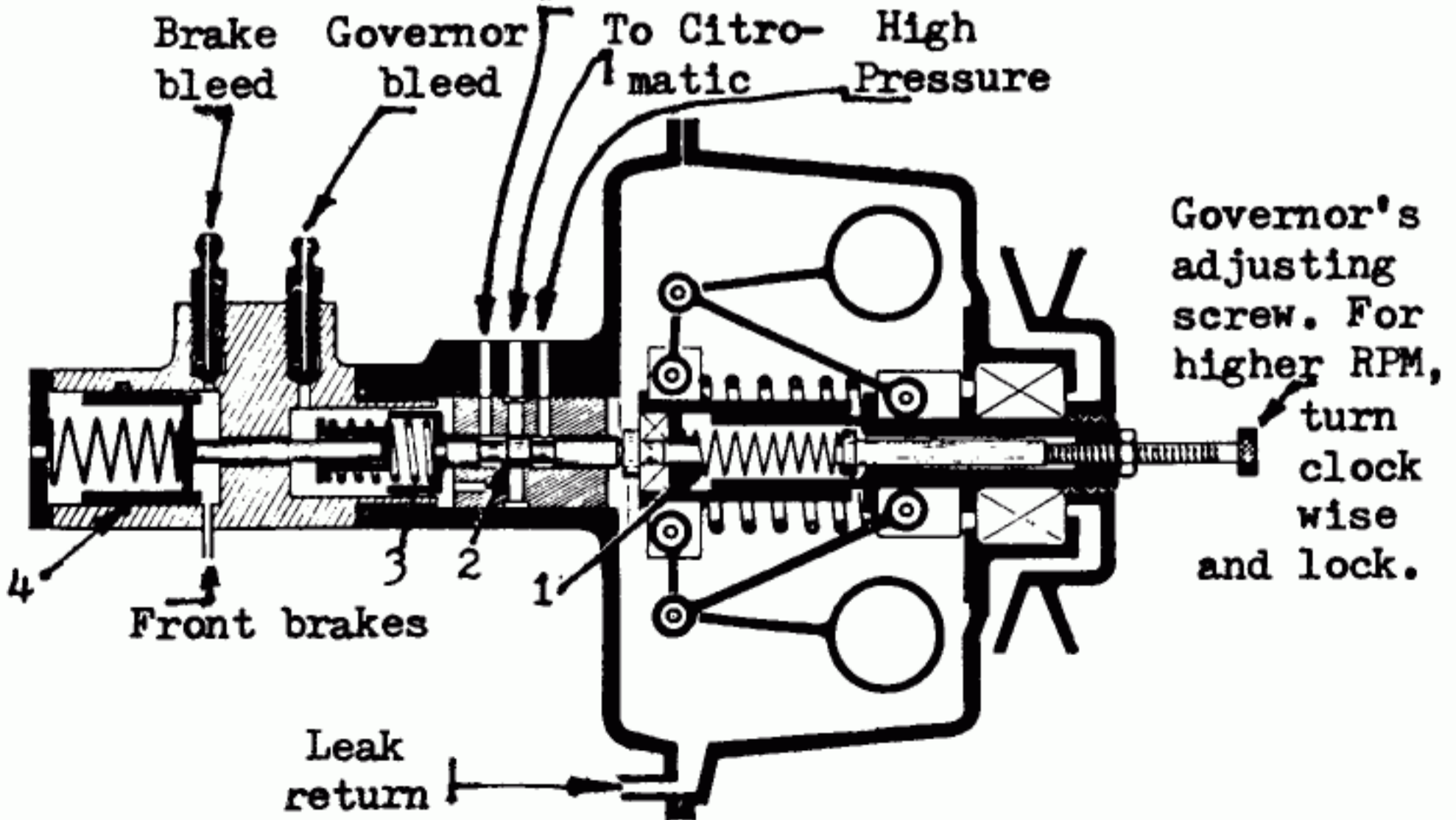
Take a look at the chapter on hydraulic piping repairs (Hydraulicline) before going into this.

Prepare the lines for installation as shown on drawing. Each item shown has a purpose and a reason for being. The regulator will be fastened to the frame and the high pressure pump is still attached to the engine. The same engine is moving on its mounts. The regulator is not moving. Something will have to absorb the difference in motion.

The high pressure line, 1/4" diameter, will have to flex and, since it is too short on a straight line basis to take the tending safely, it will have to be coiled a minimum of 3 turns in a spot where there will be no mechanical interference with moving parts nearby. Since the coiling increases the resiliency of the line, it will and tend to "sing" or "ring" at or near high pressure. This ringing fatigues the metal faster than relative engine to chassis motions will. As a matter of fact, a properly coiled line can take a couple or million flexions without failing, that is about 280 000 Miles, while the ringing will fatigue the same line. in less than 100 miles! The ringing can be prevented by wrapping the line, at its most flexible point or nearby, with a large foam rubber item such as what is found on the line exiting the regulator on the original installation. This foam block, to be fully functional, should be leaning against something hard and steady such as the frame. The same block can be replaced by a rubber strap of the configuration shown above, installed by gently tying the line to the frame or the like. A piece of truck inner tube makes wonderful straps.



Return to tank



The regulator is to be fastened to the chassis of the car, ahead of the steering's right clamp-relay box. The original equipment can be used for either type of regulator with an extra bracket made out of a small piece of 20GA steel. Do not use aluminum since it fatigues and breaks 8 times faster than steel under vibration. Pop rivet the brackets to the chassis: four to six rivets are plenty. You do not want the regulator to faithfully follow the frame, in case of accident, ripping and kinking hydraulic lines, but rather have it come unhooked and stay loose. Four steel rivets will give a strength of about 800 lbs., which means that the regulator will come 'unhooked' with any impact above 25 Mph, when this part of the frame goes haywire.

The main feed line can be routed from the regulator, down and fore to the rear inside of the front cross-team, located under the radiator shroud. Then the line joins the brake lines under the left half-shaft to come up again for connection to the main feed near the brake master cylinder unit. This line is the 3/16" diameter steel line and is quite flexible. It must therefore be clamped down by stress or physical means such as clamps or straps, however . . . the pipe must not chafe or be allowed to vibrate against anything hard, under penalty of quick failure. Therefore, the line must be 'bundled' in a piece of rubber hose at each and every point where it might touch.

The rubber return line may be run along two different ways. I prefer the following: from the regulator, along the 1/4" steel line (bypass the coiling), to the high pressure pump area, up to above the water pump (behind it), and down between the engine and to the alternator or generator, back to the original return line. Since running out of fluid will cause this line to blow apart, strap its junctions and wire them as shown: This will save you some fluid when you fill the system again.

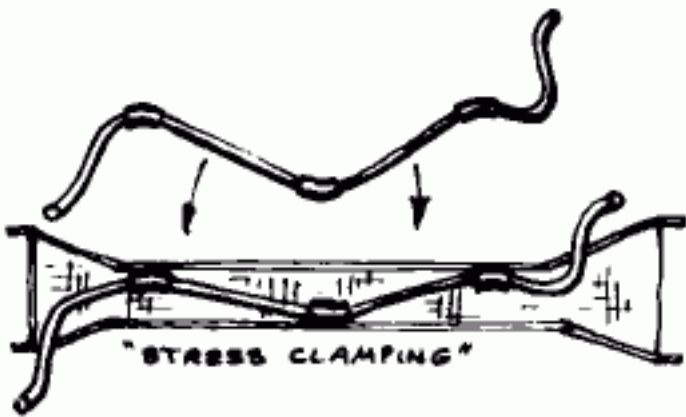
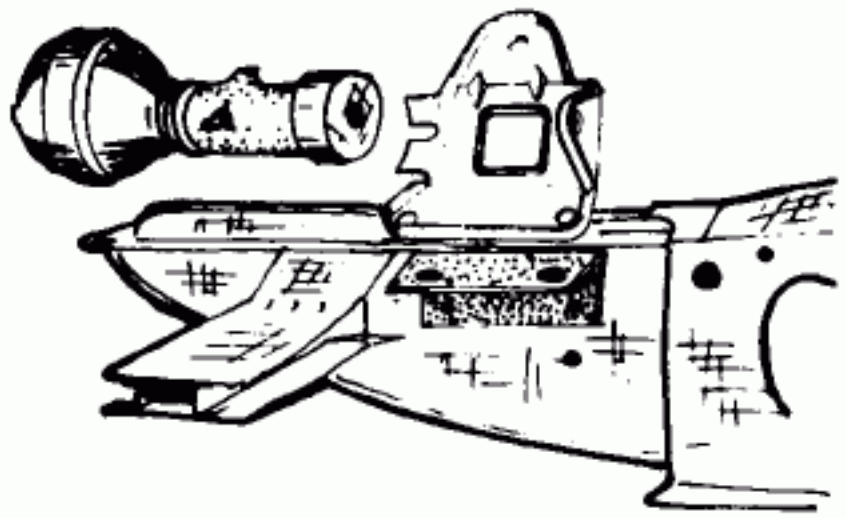
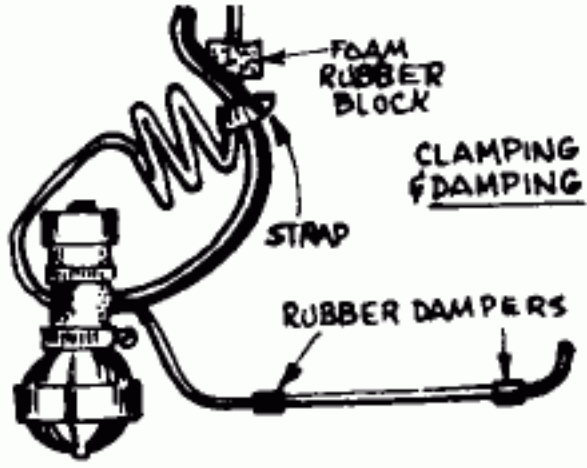
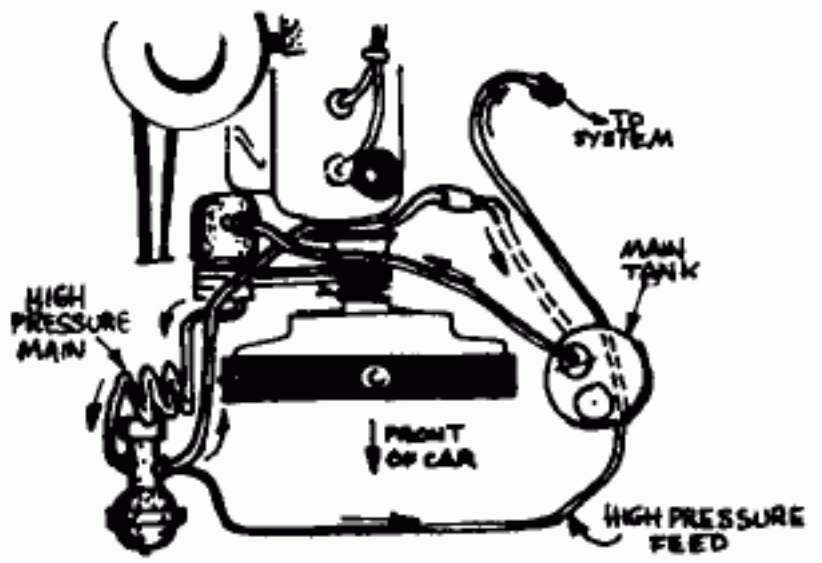
#### (GENERAL RECOMMENDATIONS FOR PREPARING HYDRAULIC LINES:

1/4" diameter lines. US made, match the original Citroën lines with a bit of play. No problem. On the other hand, the 3/16" US made lines do not fit into the corresponding Citroën fitting without drilling out the Citroën fitting to 3/16" diameter. No problem there either.

The lines can be prepared as shown below, using above described US made steel brake lines, brass compression fitting's beads and original Citroën fittings.

Do not use lines that have been kinked in bending. Do not bend the lines more than twice FULLY: it badly fatigues the steel and can cause failure of the line.

Should you have no bending tool, use your thumbs as shown and apply more and more force until the metal yields to where you want it. Do not apply any more force after the metal yielded, the pipe will kink.



Do not bend the pipe to less than:

- 2 inches radius on  $\frac{1}{4}$  line,
- $1\frac{1}{4}$  inch radius on  $\frac{3}{16}$  line.

Blow lines clean with compressed air after finished welding and clean with alcohol on LHS2 systems or kerosene/gasoline on LHM systems.

#### PRECAUTIONS FOR RELIABILITY~

The lines must be protected against excessive repeated motions, vibration, impacts and chafing. Any small such disturbance repeated a million times will shorten the life of the line by metal fatigue (the same that breaks the iron wire after bending it four or five times). The lines must be clamped and damped against something steady like the car's chassis or frame, or against other lines. They must never touch "a little" but squarely lean against straps or frame. Any shyness in contact will cause bouncing with vibration, resulting in fatigue and breakage.

Make sure the lines clear everything such as the transmission shaft, the fan, the belts, the steering arms.

Make sure the line does not block access to the brakes, the radiator draincock or any alignment to any nut or bolt you will have to reach in a later intervention on the car.

Wire up all the rubber hose connections since we are using straight piping and it can come apart should any air get trapped into the regulator: this air will occupy very little space in the regulator, under 2000 PSI. However, the same tiny volume of air will suddenly occupy a lot of space, when the regulator cuts out and releases into the low pressure return pipe. As a matter of fact, it will occupy almost 2000 times the space it occupied under pressure. Should the rubber hose not be well attached, it will get torn off instead of slightly swelling, while the air rushes back to the main oil tank.

Please refer to the chapter on fluid replacement and the one on hydraulic line repair.

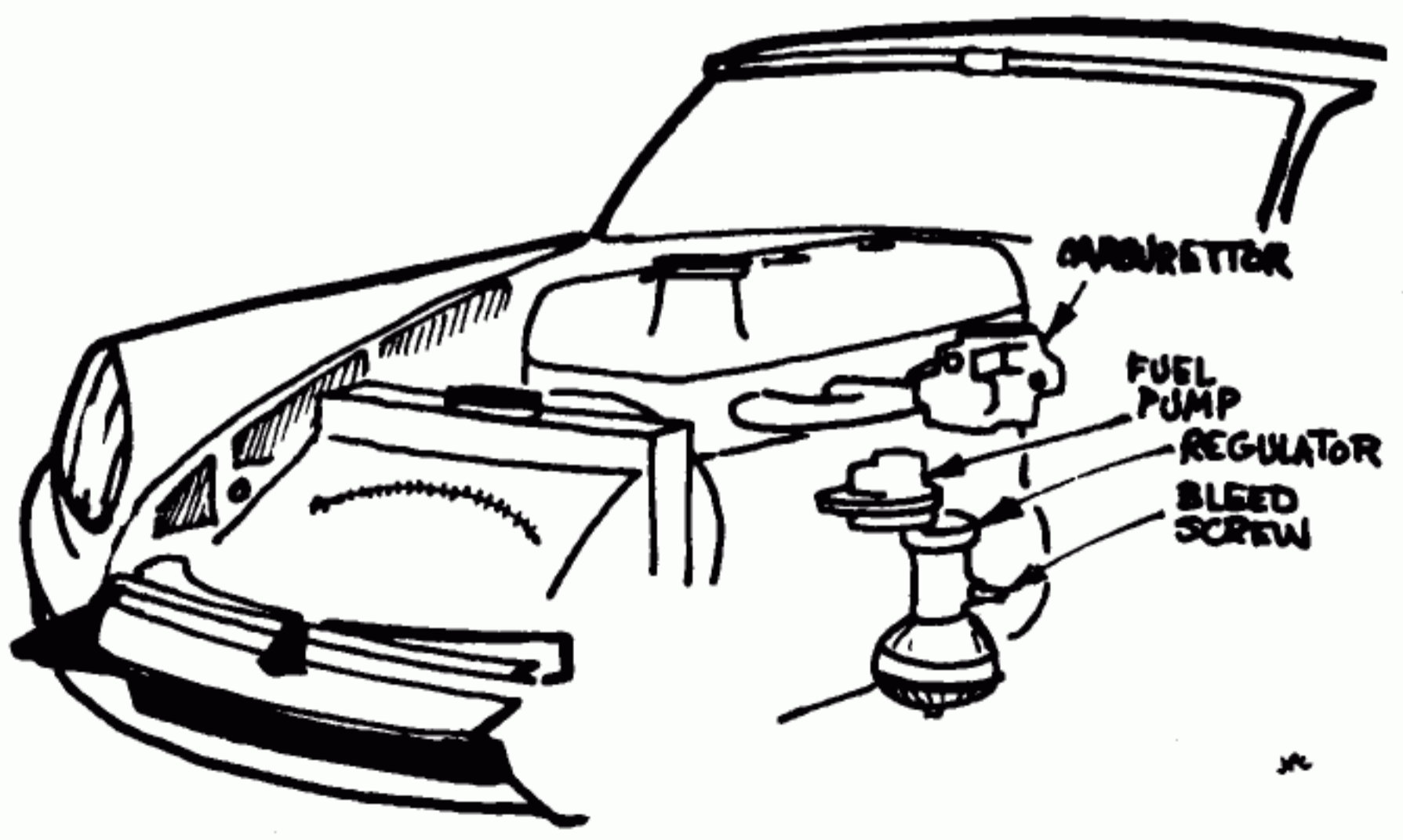
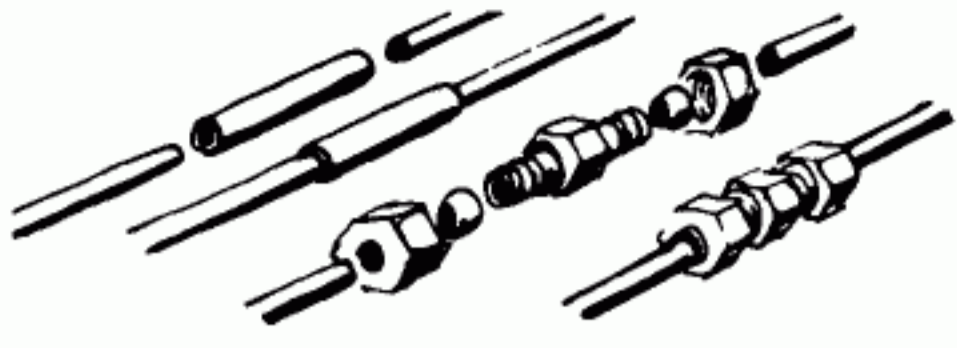
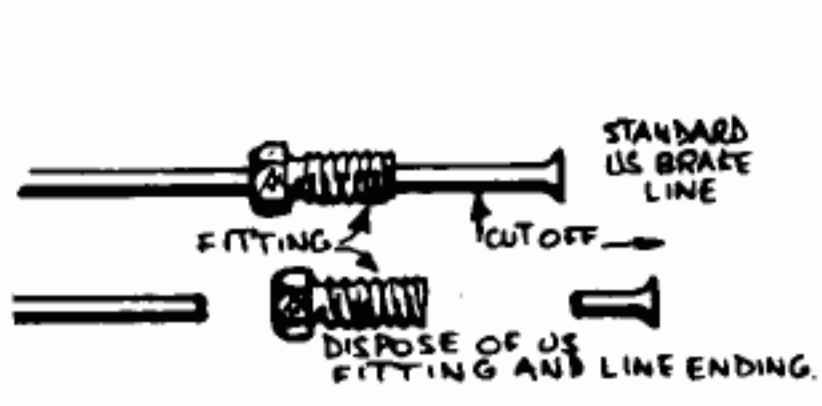
#### HYDRAULIC PIPING REPAIR

U.S. made steel brake lines can be purchased in most auto parts stores, in two useful sizes for Citroëns:

Outside diameter  $\frac{3}{16}$  inch for the commonly referred to as the "skinny" line, and Outside diameter  $\frac{1}{4}$  inch for the "fat" line such as the ones found between the high pressure pump and the regulator, or on some main brake lines.

Copper tubing cannot be used since vibration hardens the metal and ultimately causes bursting. The steel line can take the vibration quite steadily and nor change property as drastically as copper does. Steel lines do deteriorate with repeated bending caused by vibration, but the damage appears after a few million motions.

The skinny line will fit the Citroën fittings, after reaming (drilling) the fitting with a  $\frac{3}{16}$  diameter drill bit. This will remove a few thousandths of an inch and allow the 'domestic line' to pass through. The 'fat' line will go through the original fitting with no problems



The difficulty of creating the bead near the end of the Citroen line is resolved by brazing a brass bead, from a matching compression fitting (available from the local hardware store) 3/16" or 1/4" respectively. Silver soldering is OK providing it is not done on the line between the high pressure pump and the regulator. Tin soldering is OK on the suspension circuits as long as your spheres are in good condition and you do not drive in high position. Tin soldering is a definite no-no on the braking circuits.

The lines can be patched using the two following methods:

1. Slip a 2 to 3 inch length of 3/4 line over the two ends of skinny line. The two skinny lines must butt together. Braze, silver solder, or last resort tin solder, being careful that the metal 'sweats' into the gaps.

2. Use a standard domestic compression fitting to match diameter. They will fit and close original equipment.

#### BENDING THE HYDRAULIC LINES:

You can use the special tool available from local stores. You can also use your thumbs, holding the line as shown below and applying more and more force until the metal yields. Do not apply any more force when the metal is yielding as this might cause a kink in the pipe.

A kinked pipe should not be used again since it will tend to be seriously weakened and will not stand any corrosion later. The kink will have created invisible cracks in the metal. These cracks will get corroded readily and deeply, therefore reducing the total wall thickness and promoting failure.

Do not bend the pipe fully more than twice since the metal will have fatigued and will not have the original strength.

The minimum, bending that can be done safely is 2 inch radius for the fat line and 1 1/4 inch for the skinny line.

Do not use sharp tools to hold the pipe: they mark and cut the metal and may initiate cracks. If you want to use pliers anyhow, wrap them up in tape ... generously.

When the line is ready, deburr the ends, blow the dirt and filings out with compressed air and wash with alcohol on LHS2 cars, or kerosene or gasoline on LHM cars. Watch for fire!

The above recommendations may be somewhat disregarded at the expense of reliability, that is expected life. It is possible to use tin solder, dirty pipes, kinked tubes and sharp bends, but you cannot expect a life above one or two years for the line you repaired. Corrosion will eat the metal away and failure will cause the painful sight of a squat Citroën by the side of the road.