Fault Diagnosis

Many years ago, probably in the late 'eighties, a local Sidevalve Club member phoned me in desperation; he had been unable to start his 100E for two weeks. Normally it started first touch, but one Saturday it refused to go. He decided to change the spark plugs, and when these produced no results, the points and condenser. Still not running, the distributor cap and rotor were replaced, then in turn the HT leads. That left only the coil, so a new one was bought and fitted, still to no avail.

Having, as he said, replaced the ignition system, attention was then turned to the fuel side, and a new pump was bought and fitted. With the car still not running, he unearthed and thoroughly cleaned his spare carburettor, but to no effect. It was at this point that I received his call, and went around the following Sunday.

Within two minutes of my arrival, the engine was running. In fact, it took longer to reset all the parts he had fitted to within the specifications than to find and cure the fault.

So why had he not found it? Basically, he was an amateur, and had gone about it in an amateurish fashion. I was, and still am, a professional mechanic and did it professionally, and the difference is that this professional way works.

His method is known in the trade as "diagnosis by substitution". Basically, you guess at what the problem might be and change it, and if that doesn't affect a cure, you take another guess. In this case, he'd spent over £80 replacing parts which were fully serviceable, *but still hadn't found the fault*. I carried out some basic tests, established what the fault was, and cured it. What worries me currently is that a lot of the friendly advice which appears on various internet boards follows the same amateurish logic: "I had a similar problem once and changed such a thing," "It might be caused by this part so change it and see." No, that isn't how to go about it; the fact that your problem had a particular cause is no indication that the current one shares it.

For the record, and in the above case, a screwdriver blade in a plug lead established that there was no spark. A test lamp immediately showed that there was no feed to the coil, which then led to the ignition switch, and there was the problem: the spade connector on the blue/black cable which feeds the coil had opened out slightly, allowing it to become detached. Gently squeezing it with pliers and refitting was all that was needed to restore normal service. Nothing had needed to be replaced, and no amount of parts replacement would have found the problem, unless he eventually became desperate enough to change the switch. There is a logical and effective sequence to fault finding which produces results quickly, effectively and – and this is important – more cheaply.

Let's go back to basics. For an engine to run, it must have three things: adequate compression; air and fuel in sufficient quantities, in about the correct ratio and thoroughly mixed; and a good, hot spark at about the right time. If an engine has all of these, *it has to go*, it has no choice. If it won't run, one or more of these is deficient. What we should do is first find out which one isn't functioning, and then establish the reason.

Compression.

An engine draws in air and petrol as the piston descends on the Induction stroke with the inlet valve open. After Bottom Dead Centre, it rises on the Compression stroke and the inlet valve closes. The indrawn air and fuel are trapped within the cylinder in

a decreasing space, which forces up its pressure and temperature. This higher pressure allows for more efficient combustion, releasing more heat and therefore power from the fuel. If there is no compression, the fuel might not burn at all, but certainly will produce very little power, probably insufficient to make the engine run.

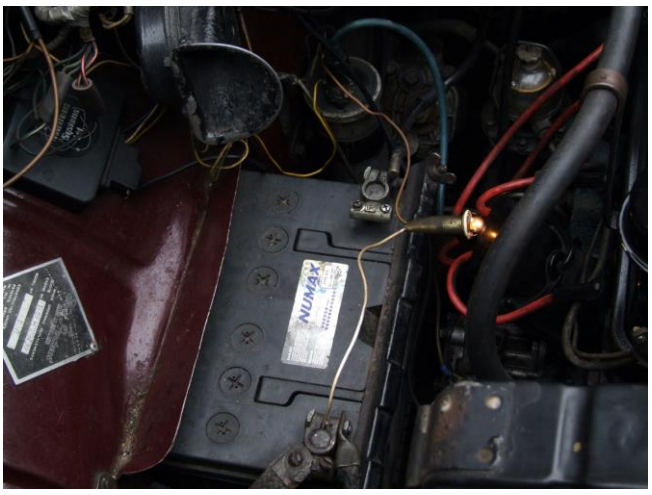
The sidevalve engine has a low compression ratio (7:1) so doesn't give much compression to start with, so a bit of a loss isn't a major issue. But unless an engine has been standing for a long time, allowing the valves to seize open, or there is catastrophic internal mechanical damage, low compression is unlikely to be an issue, at least on more than one cylinder. If there is no compression, the starter will spin the engine over far faster than normal, and this can be heard. But if you want to be sure, a rough check is to remove all the spark plugs, put your thumb over each plug hole in turn, and spin the starter. If air forces its way past your thumb, or better still, blows your thumb off the hole, it will be enough.

Ignition.

As any AA man in the 'sixties would tell you, most breakdowns were caused by ignition faults; this being before vaporisation became more rampant. Although there is a sequence to follow, I'd take a short cut first.

To test the ignition system, pull off a plug lead and insert a Philips screwdriver into the end. Holding the screwdriver BY THE HANDLE so that part of the blade is about 1/8" - 1/4" from a metal part of the engine, spin the engine over with the ignition on. You should get a nice healthy spark between the blade and engine. If you do, you've pretty well eliminated the ignition system. The only part not tested is the plugs, and all four are unlikely to die at once, unless they have become wet with excess petrol (take them out and look; if they are wet, try to burn off the fuel on them. At home this might be done – very carefully – on a gas hob. Hold the plugs in insulated pliers; they will get hot!).

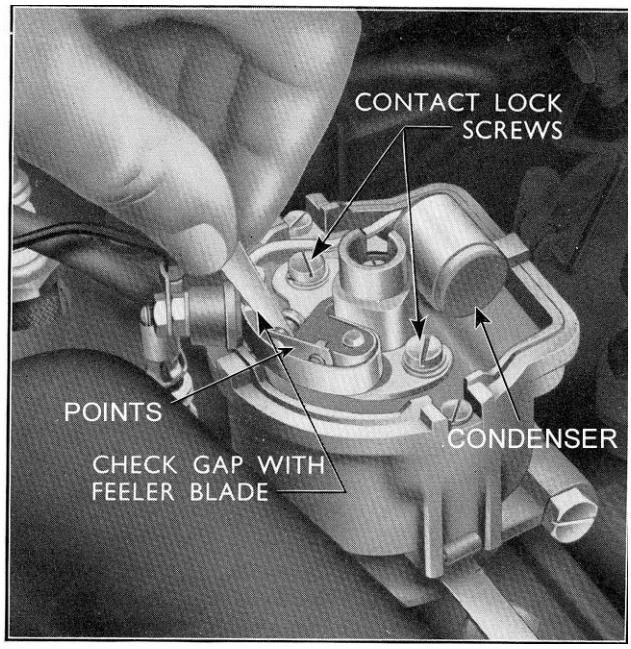
If you don't get a spark, you need a test lamp. Connect one lead to earth and the other to the battery live terminal to check it works. Now connect it to the SW or negative side of the coil with the ignition switched on (CB or positive if you've converted to negative earth). It should light up in all conditions. If it doesn't, there is no feed to the coil, as described above, and you need to check that there is a feed going into and coming out of the ignition switch. Assuming there is a feed to the coil, check if it lights up when connected to the CB or +ve side of the coil (assuming it's still positive earth). It should light up when the points are OPEN, but not when CLOSED.



A simple test lamp made from two lengths of wire and a bulb and holder. Small crocodile clips on the ends of the wires would improve it. It is here connected between the live LT side of the coil and the earth post of the battery. The ignition is on, so the lamp is correctly lit up.

Remove the distributor cap and rotate the engine by hand

to ensure that the points are fully closed, then attach your test lamp to the coil LT lead which connects to the distributor. If it lights up, the current isn't passing through the points to earth. Check the LT lead at the distributor end; if it is intact, the lamp will again light up and the fault is inside the cap; if not, the lead is faulty and should be replaced. Assuming that the lead is alright, either the cable between it and the points is damaged; or more likely the points contact faces are dirty or burnt, or the points aren't closing fully. In either of the first two cases, change both them and the condenser, especially if they are burnt. If the last, reset the gap and possibly lightly oil their pivot.



Inside the distributor, from the workshop manual. The points gap is checked with a feeler blade; 0.015" is the one. The points should be on the heel of the cam, as shown, and so open at their widest, and there should be a slight resistance to moving the blade – a 'magnetic grip', as it is termed. When the engine is turned so that there is no contact between the points' fibre heel and the cam, the points must be fully closed.

If the lamp had not lit up with the points closed, turn the engine until the points are fully open and repeat; this time it should light up. It might not be quite as bright as before due to the resistance of the coil's primary windings, but still quite bright. Failure to light up could indicate that this primary winding has burned out; disconnect the LT lead and try again. If it again doesn't light, it's the coil; if it does there is a short circuit below the cap. This could be a wrong or defective connection, the points not opening, or the condenser has developed a short. If the connections check out alright and the points can be seen to be open, change the condenser. Be aware that condensers have a limited shelf life, even sitting unused in their boxes. Buying new old stock can be purchasing an item that is 20 or 30 years old, and absolutely useless. A defective condenser might allow the engine to start, but run roughly and refuse to speed up.

Assuming that the LT side has been proven or made to function but there is still no spark, we need to check the HT side of the system. Be aware that the coil can produce up to 25,000 volts, which is enough to cause you problems if you get caught by it. The easiest way to check is to disconnect the main (king) lead from the centre of the distributor cap and, using insulated pliers, hold the lead's end about ¼" from a good earth and spin the engine with the ignition on. You should get a strong, blue spark; if not, it's either the coil or king lead. The latter might be copper wire and a test lamp check will show if it's intact; carbon trace type need an ohmmeter to check them. They do have a built-in resistance – for radio suppression – but if the reading is infinity or 1, there's your problem. If the lead passes the test, it must be the coil.

If there had been a spark from the king lead but not from the plug leads, it must be getting lost between the cap and rotor. Hold the king lead a ¼" above the rotor arm and spin the engine as above, checking for a spark between the lead and the arm. If you get one, the arm is unserviceable: there shouldn't be one. It means that the spark is escaping to earth rather than reaching the leads, so replace it. If that works alright and there isn't a spark, the cap is the final suspect. Is the sprung, carbon brush still in position inside? Are there marks where the HT current has been tracking? It isn't always easy to see, so if in doubt, change it.

The only other ignition-related problem is ignition timing, and this would need to be a long way out to stop the engine from running. Turn the engine until the notch in the front pulley aligns with the mark on the timing cover, undo the clamp and turn the distributor anticlockwise until the points can be seen to be closed. Connect your test lamp between the distributor LT lead and earth, then turn the distributor very slowly clockwise with the ignition on. Eventually the light will light up; at that point tighten the clamp as that is the correct timing position. The rotor arm should now be pointing at one of the plug lead connections in the cap, either No. 1 or No. 4. If it's the right one, the engine should run. If it won't but spits back through the carburettor, you're 180 degrees out; just move the leads around the cap two connections. Once running, set the timing accurately with a strobe lamp.

Fuel.

With the ignition checked and working, we need to check the fuel system. Slacken the fuel pipe union nut to the carb and spin the engine; fuel should spray out in solid squirts. If it doesn't, it's the pump or a blockage in the lines, but it's worth checking that the filler cap is allowing in air. It should: the pump can't work if air cannot displace the fuel used. Check also if the exhaust blocked. The fuel / air can't enter the engine unless the waste gases can escape. These would cause an engine to cease running, but not to fail to start.

If fuel had not been delivered, disconnect the fuel pipe going into the pump. On a sidevalve, the pump is mounted quite low, and if more than a couple of gallons is in the tank, it should start to come out. If it doesn't, use an airline to blow back towards the tank while someone listens at the filler neck, cap removed. No noise indicates a blockage, so you might have to remove and replace the pipe; a loud hiss that there is no fuel in the tank, the solution being obvious; while bubbles show that fuel (liquid, anyway) is present. Be aware that not all liquids are petrol; someone might have put in something else, diesel perhaps. Then again, if it is petrol but been in there for some time, it will have gone stale and refuse to burn, so the engine cannot run. Fresh petrol might be all that's needed.

If the line to the tank is clear and fuel present, but still nothing being delivered by the pump, this must be suspect. There are two types of pump for the 100E; they both look the same but don't interchange as the operating arms are different. These match the thickness of the gasket and you must ensure you have the right combination.

If fuel is being delivered, take the top off the carburettor and check the fuel level; the brass flap should be approximately horizontal. No fuel present or too much indicate a faulty needle valve, and replacement is the only cure. Otherwise, there is little to go wrong with these carburettors beyond blockages. Remove all the jets and blow through them with an air line, then blow through the holes from which they

came. In stubborn cases, the carburettor can be submerged in cellulose thinners; allow about a week for this to work through.

And that's more or less it. The vacuum pipe to the wipers can split giving a weak mixture, poor running and difficult starting; blank off at the manifold to check. A dirty air filter can reduce the amount of air going into the engine and so cause an over-rich mixture, again giving poor running and difficult hot starting.

Of course, we cannot leave without mentioning the dreaded fuel vaporisation. Fuel in the pump absorbs sufficient heat from the very close exhaust manifold and front pipe that one or more of the petrol's constituents boils, so causing bubbles in the system. These act just like air in a brake hydraulic system: the pump's pressure is wasted compressing the bubbles rather than forcing fuel up to the carburettor. This will occur only once the engine is thoroughly warm, and usually when the car stops for a period. It will normally keep up a speed, air flowing through the radiator removing the heat so vaporisation cannot occur. Once stopped, this airflow ceases; underbonnet temperature rises and the fuel boils. The engine then stops until all has cooled down again to the point where the petrol has reverted to all liquid. When this happens, no fuel will be delivered to the carburettor so our first test should confirm it.

Some cars are prone to vaporise; others never suffer. It is often brought on by a fault in the system – weak pump, for instance – which the heat merely exaggerates. But people have had some success by installing a heat shield between the pump and the exhaust system. Also, carry a hand water spray. Cold water sprayed on to the pump (but avoid hitting the hot manifold; it can crack) speeds up the cooling process and so helps identify the cause.

We have now covered all the checks, and should have a running engine, or at least know why it isn't. Go through the checks and find the fault. And please, no more of the "It might be…" suggestions, however well intended.