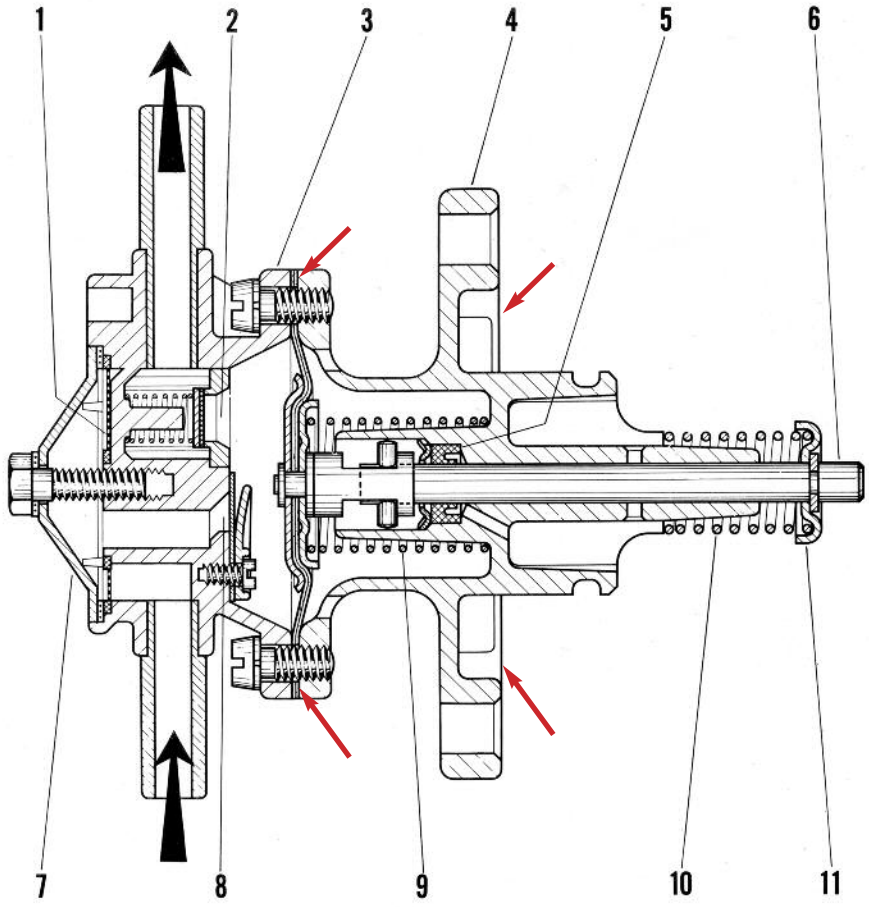
Get It Pumpin'

The Ins and Outs of Fuel Pumps, Part 2

By Bruce Smith

If you're taking apart an old fuel pump, you'll probably encounter one of two possibilities. In the best of cases, you may find that it needs a bit of cleaning, maybe some flattening of mating surfaces, an inspection for worn pieces, and a basic re-assembly with a rebuild kit. This is the hope for cars that have been maintained regularly and driven often – sometimes not the case for our best loved old cars. The more likely scenario is the need of more serious repair. Since an old pump probably isn't ready for a simple swap of the parts found in a rebuild kit, it's worth addressing remedies for some of the issues encountered and described in the first part of this article (in the July-August 2015 issue). Before moving into ways to fix the damage, dirt, or decay depicted previously, there are a few other issues worth adding to the list.

A "C", 912 fuel pump. Red arrows indicate mating surfaces that must be flat.



1 Fuel screen
2 Outlet valve
3 Upper assembly
4 Lower assembly
5 Oil scraper
6 Actuating plunger
7 Cover
8 Inlet valve
9 Diaphragm spring
10 Plunger spring
11 Spring retainer

More Bad and Ugly

The slate of potential problems can be expanded by opening up the sealed outlet valve of a later C/912 fuel pump (#2 at left). This is an area that can usually be left alone and, once opened up, can be difficult to repair. Under the retaining ring peened in place are a small phenolic valve and a fine wire spring. The valve is sealed against the upper surface of the retaining ring and is actuated by suction from the pump diaphragm. If this valve and seat aren't sealing properly, there may be wear or damage to either or an accumulation of crud in the small cavity beneath. Pictured below is an example of one such pump. By carefully drilling the peened areas staking the ring and prying it off, the valve and spring are revealed. These pieces don't come with a standard C/912 rebuild kit and the parts contained in an A/B kit can't be used in their place. So care must be taken to preserve what you've got. In the case of this pump, after removing scores of residue that filled the cavity, the spring was carefully bent back into shape, the phenolic valve was polished, and the valve seat on the retaining ring was resurfaced flat. The results after repair are shown at bottom, ready for careful re-assembly.

Up Fixin' an Old Fuel Pump

In an earlier age, many of the troubles with these fuel pumps would lead to scrapping an old one and replacing it with a new original. That's no longer an option but, thanks to those that don't throw stuff away, there is a decent supply out there of pumps in various states of disrepair. So whether you're fixing the one from your car or trying to resurrect one that was junked some eons ago, there are challenges that go well beyond simply installing a new rebuild kit. The solutions described here will be listed with some resemblance to the order of problems uncovered in the last article. In each case, a good cleaning of the organic and inorganic residue is necessary before beginning. Only then can the full extent of the problems be assessed. You can find some guidelines for cleaning pump bodies in the March-April 2014 *Registry* magazine.

Inlet / Outlet Leaks

Leaking brass fuel tubes are the result of an inherent design flaw in C/912 type APG fuel pumps. Most often on the outlet side, the brass tube fitted into the ZAMAK (zinc alloy) casting will work loose enough over the years to cause a fuel leak. Because of the low surface tension of gasoline (about 1/3 the value for water), fuel will tend to seep from small leaks, making it sometimes difficult to source. But this is a common failure of these pumps, which can be easily verified by simply wiggling the fuel line tube. If it is loose, you'll notice it. This could require a quite complicated fix of cutting the tube, drilling it out, and affixing a new one in some fashion.

Attempting to sweat a solder joint might prove successful but is difficult without separating the parts to clean them first.

A simpler fix would be to improve the bond between the brass tube and the casting in place. This approach can be surprisingly successful if the surfaces are properly prepared and the correct type of sealant is used. The best sealant I've found for this is a wicking grade high strength anaerobic adhesive made by Loctite. Loctite 290, AKA Green Loctite, is designed for pre-assembled metal parts and penetrates into voids by capillary action. It cures to form an insoluble seal in the open areas between metal parts. The cure process requires the presence of metal ions and the absence of oxygen and will lead to a strong seal that is insoluble in gasoline.

To fix a brass fuel tube, first thoroughly clean the tube and surrounding area. Polish the brass clean with fine steel wool and finish cleaning with acetone. Once dry, place a few drops of Loctite onto the seam with the tube held vertically and allow a meniscus to form. Curing will take about 24 hours but will only occur in the areas that the sealant wicks into. Adhesive that remains exposed to air can be wiped off after curing. I've repaired about a dozen fuel line tubes this way and have had no reports yet of failure.

Flat is Good

The mating surfaces on fuel pumps are those that contact the diaphragm (the top and bottom halves) and the base of the pump that contacts the pump spacer (see red arrows, opposite). Each needs to be flat enough so that all remaining voids can be accounted for by the corresponding diaphragm or gasket.

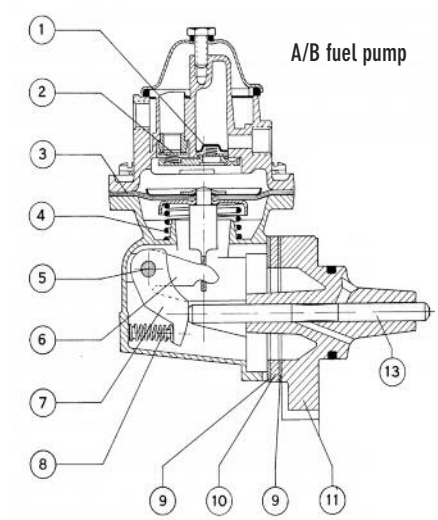
Unlike the C/912 style pumps that have an O-ring to seal to the engine casing, the base of the A/B pump must be sufficiently sealed to prevent leaking of packing grease held within the base. The design of the C/912 pump makes it less critical to seal the pumps base but it is imperative that the diaphragm mating surfaces are made as flat as possible. This could be accomplished using sandpaper and a flat glass or metal plate but is much easier carried out with a large flat bastard file. Care must be taken to clamp the sections and use smooth steady strokes but the amount of metal that must be removed with the most warped of pumps can be taken off pretty quickly using this method. Another approach is to use a belt sander. For example, a table top 4"x36" belt sander makes quick work of it, especially if you're doing a lot of pumps, carbs, and other parts. Flatness can be checked with a piece of plate glass and additional material removal until sufficiently flat.

Covers and Valves

Damage to the cover tops on old fuel pumps is another indication of design flaws. The covers for C/912 pumps can usually be cleaned up and will seal fine with a new gasket ring. But it's a different story for A/B tops. In order to seal to the top bolt and fiber washer, the top contact surface must be strong and flat. I've had some degree of success repairing these by strategic hammering or by using a press but only when the damage is minor. A fully crushed top, like the one depicted in the previous article, is probably beyond repair. Yours might be worth a try but too much force will crack the ZAMAK. Testing for leaks is quite easy by leaving the valves out of the pump and assembling it. Plug one line and put water pressure to the other. If you get no leaks at about 10psi, it will probably be OK at the 2-4 psi of pressure it's under during operation. Otherwise, a new cover top is in store.

A/B pump (top) and C/912 pump have different cover shapes, but both can be worn or damaged.

The soft alloy valve seat in A/B type pumps can wear away over time. I've seen 50 year old pumps with valve seats in perfect condition and others (like the one pictured last time) worn completely away. It's important that this area is inspected and problems remedied if necessary. Leaks here are quite common and without a good seal your pump will not hold pressure. If in doubt, you can assemble the pump with the



VW fuel pump parts, including the base, that can be used in Porsche A/B pumps.

valves in place and subject it to a 10 psi water test. But a successful water test doesn't guarantee that it will continue to seal when put to use. A worn valve seat can mean that this pump section is scrap. The fix for the problem is to drill out and replace the entire seat (#2 in diagram at left). Since these pumps weren't made for replaceable seats, a DIY fix becomes difficult.

Pictured at left is a custom brass valve seat that we've made for these A/B pumps that not only solves the immediate issue but also provides a stronger sealing surface that is pretty much guaranteed to outlive you. To make the repair, the valve port is bored out to the proper diameter to match the new brass seat, which is press-fit into place. The height of the new seat is positioned correctly and the contact area to the phenolic valve is maximized while allowing for the natural motion of the valve. Using this solution, an otherwise good pump can be resurrected.

Potmetal Problems

Cracked alloy casings are probably going to be a show stopper. If there is integral damage to the mechanical structure of the pump, repair may be a risk not worth taking. But there is a very good way to make true metal repairs to zinc alloy that are permanent, strong, and non-reactive. A company named Muggy Weld sells a low temperature (350°F) tin/cadmium/zinc metal solder that works quite well for cast metal parts repair. With proper preparation and care, repair of damaged bolt holes in fuel pump and carburetor bodies can also be made. The applications of alloy soldering for our old carburetors, fuel pumps, and other parts are interesting enough to devote an entire article to the topic. Look for this tech article in a future issue!

Interchange Items

VW and Porsche fuel pumps shared several parts with our A/B type fuel pumps. This is a good thing when you're looking to replace broken pieces or the whole pump base but still have a decent top end. Pictured at left are parts from various VW fuel pumps which can be used in Porsche A/B pumps. There is a great variety of fuel pumps used in old VWs but most useful parts come from those used in 25HP and 36HP motors. There are also common components with some of the DVG and APG pumps used in old Mercedes, like the M121 motor from the 1950s and 1960s. The bottom line is that if the part looks to be the same, it probably will fit.

Springs and Pressure

Pump springs (#4 in diagram at left) aren't always standard, as those of you that have taken a few pumps apart may have also found. I've removed at least five different springs from A/B pumps over the past several months. Springs most often have five coils but some have six. Spring wires range from about 1.5mm to over 1.8mm. The springs in new rebuild kits (at least the ones I've used) have five coils of 1.72mm wire. It's hard to know why there are so many varieties but it's likely related to the commonality with VW pump bases.

These differences can lead to variations in pump pressure. To find out how much, I first measured several of these springs with a spring force gauge. The strongest (corresponding to the heaviest wire) measures about 1600 grams for 2cm of compression. The weakest is about 820 grams and a new spring measures about 1100 grams. When the weakest of these is installed into a pump and then onto an engine, the resulting fuel pressure is about 2.1 psi, just meeting the 1.9-2.6 psi range specified by the factory. A new 1.72 mm wire spring installed in the same pump delivered higher pressure, about 2.5 psi. Other factors can influence pressure but nothing else was changed. So while it's reasonable to be suspicious of the impact of using different pump springs, it seems that a wide variety of springs are able to achieve the pump pressures that our engines need.

Putting it all back together

Assembling a fuel pump isn't exactly the opposite of taking it apart. Your first indication of this is probably the flying springs as disassembly progresses. For the most part, assembly operations are intuitive. The steps needed have been covered elsewhere, but there are a few tricks involved. Mostly, some thought has to be given to the job that the diaphragm performs.

Combined with tension from the main spring, the in-and-out motion of the actuated diaphragm provides both the necessary pressure and volume of the pumped fuel. To optimize this, the diaphragm needs to be installed so that the maximum deflective force can be achieved. This is done by assuring that the rubber diaphragm member is lying flat between the pump halves during assembly. Porsche and VW designed a tool (VW 328b) to pre-load the A/B fuel pump during assembly. If you search a bit you can find various rigs that will accomplish the same thing.

An option just as adequate is to place the pump base between vice jaws with a small block of wood, about 1/2" x 1/2" x 1 5/8", inserted in the bottom pump cavity. With the rocker, spring, and diaphragm assembled in the pump base, closing the vice jaws will actuate the rocker arm to bring the rubber membrane in closer to the base. Once the surface is flat, assemble the pump halves to capture the diaphragm, leaving the highest potential for deflective strength. This correlates to the recommended 35mm loading of the rocker arm. The same thinking can be put to use when assembling a C/912 pump. Whatever method you use to assemble the pump, ensure that the diaphragm is positioned to achieve the greatest pumping force, i.e. as flat as possi-

ble when assembled. When you've got it right, you should be able to hear either pump type give a characteristic 'squawk' when all assembled and actuated.

Original or Electric?

The goal of this article was to address some possible solutions to common problems encountered with old fuel pumps. There's always the option to replace an old pump with a new solid state one, like the Facet type described in the earlier article. While this may have been a wise option when our cars were simply used Porsches, the choice in today's world of preservation and authenticity may be less attractive.

If you're thinking about adding an electronic pump to assist your mechanical one, consider that an original pump restored to good working order should work well for decades. And if you do install a Facet type fuel pump, you not only lose the satisfaction of a job well done, you will always be aware of its presence by its annoying tick-ticking.

There will always be more surviving old fuel pumps than the cars they belong to. It's worth trying to restore a few of them if you can.

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***headlights*, continued from page 63**

Cyclops claims a 20/40 watt (low-high) beam light replaces a 55 watt H4 bulb. A direct comparison of brightness is difficult and I was not equipped with a lux meter to measure results. Adding to the difficulty is that most incandescent bulbs emit light measured as 2,700 Kelvin (a color often seen as more yellow-white), while SMD technologies emit a whiter or blue-white light. These SMDs are seen in the 3,800 K range and some go to almost 6,000.

Reducing the current draw through the headlight switch, without resorting to relays, was a goal, since a 356 has a system that was barely adequate in its time and now is burdened with old wiring.

I installed the Classico lights on my 1958 Speedster and detailed it in photos. I also installed the Cyclops SMD technology, using my reflectors and lenses, on a G-series 911, equipped with European H4 reflectors and lenses that I wished to retain. Both systems went as advertised but, as noted earlier, the Cyclops requires 12 volts and, even then, includes a small, external and finned black box, which raises the voltage above 12 volts. Both produced a whiter light that "felt brighter", both seemed to be well-focused and both significantly reduced my night-time current demands. Note: any change in headlights often requires minor light re-aiming, which is easily done and often shown in owner's manuals.

The LED headlight appears clearly brighter in this photo with one original incandescent bulb still installed. One caveat to "eyeball" measurement is the fact that higher color temperature (toward the blue cast) gives a psychological impression of brightness.

Finally, this is a part-time pursuit for Jeffrey Fellman, the owner of Classico Wheels and he is often unavailable by phone; have patience and use email. Time will now tell how these lights hold up to the rigors of driving.