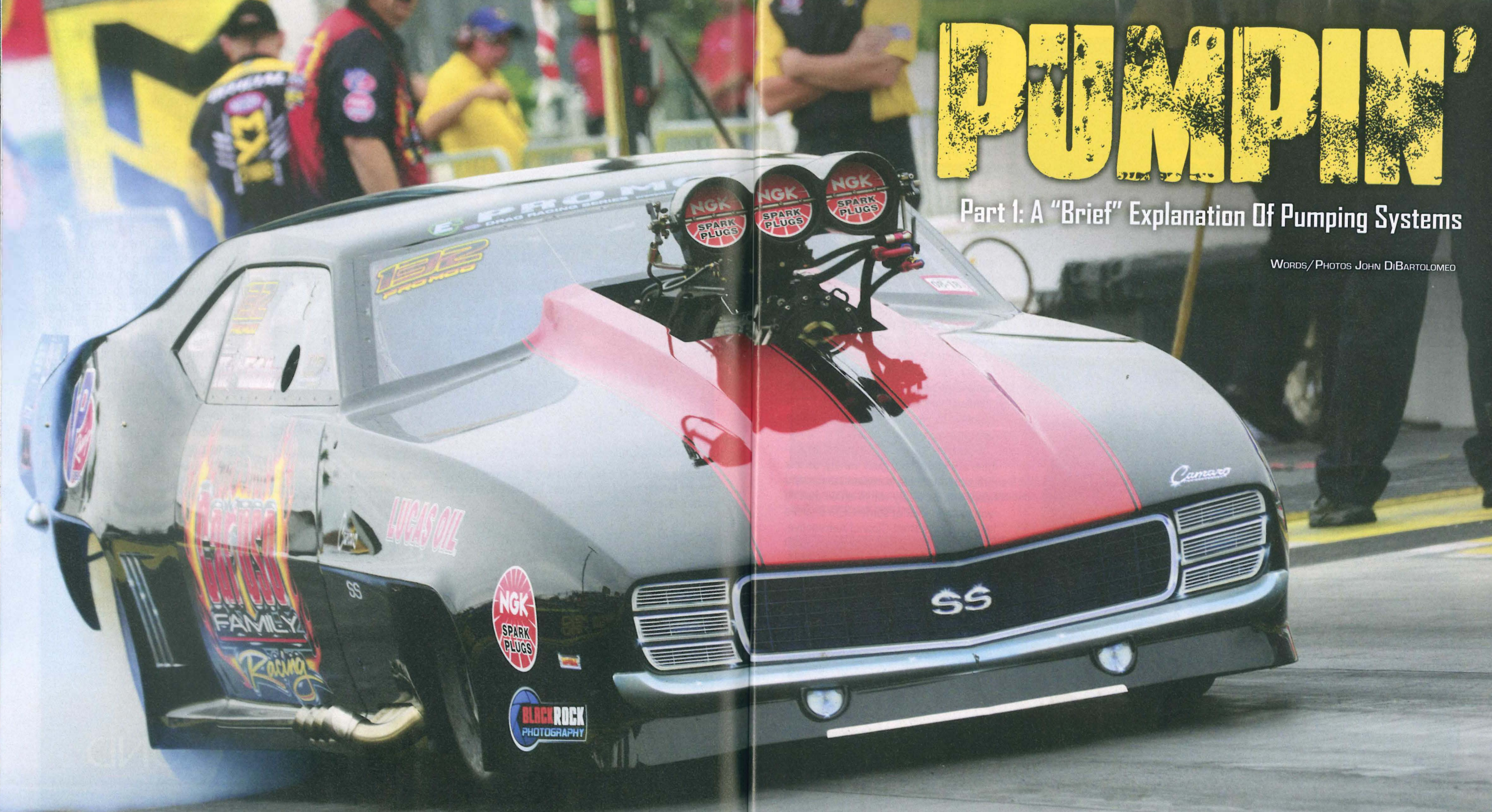


PUMPIN'

Part 1: A "Brief" Explanation Of Pumping Systems

WORDS/PHOTOS JOHN DiBARTOLOMEO



When it comes to moving fluid through our engines, there are really only a certain number of ways to accomplish that feat. While there are a variety of pumping mechanisms available, when it comes to our race cars, there are only two distinct styles, a positive displacement mechanism and a velocity or centrifugal-style. As for oil and most fuel pumps, they all fall under the positive displacement heading

with a number of separate sub-categories of pumping mechanisms. While there are pros and cons to each system along with becoming very complicated, they really are very simple to understand and we'll attempt to touch on the basics. Basics because it can become rather complicated.

"Centrifugal and positive displacement pumps have two totally different flow characteristics," says

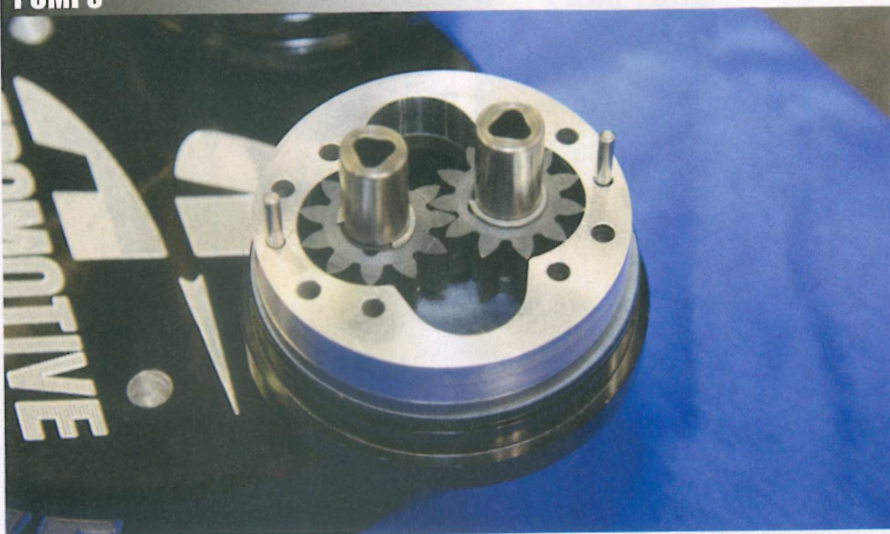
Don Meziere of Meziere Enterprises.

Because of that statement and for sake of this story, we'll stick to a positive displacement pump, discussing just what they are and how they fit into your race applications. We'll save the discussion of centrifugal designs for another time.

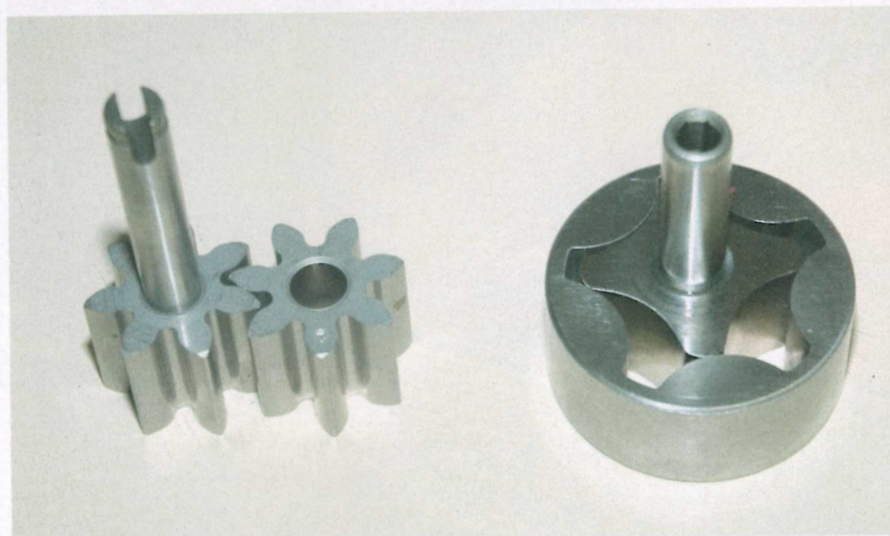
"There is so much more to pumping mechanisms than simply the style of gears, vanes, etc.," says

Scott Hall of Moroso Performance. "The gear and housing material has to be somewhat matched together for the product. A steel gear and aluminum housing will have different expansion rates, and for that reason must be matched to provide the necessary clearance. While fuel pumps do pump in a linear fashion, the important thing is that they not fall off in output. Whereas an oil pump can fall off slightly

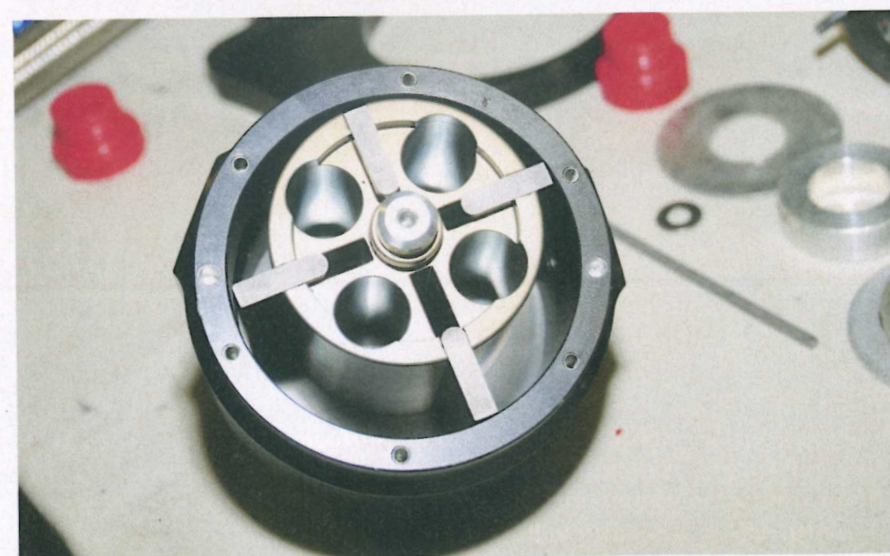
PUMPS



A positive displacement pump is one which traps a fixed amount of liquid and displaces it into a discharge section, although the heading encompasses a variety of methods to perform the function, with each best matched to the application.



When it comes to oil pumps, there are two different styles of pumping mechanisms, that being a spur gear (left) or gerotor (right).



A vacuum pump is also considered a positive displacement pump which moves air using a set of sliding vanes which allows for "chambers" to increase and decrease in size in order to charge and discharge air. However in addition, there is a roller vane system used in certain fuel pumps.

in flow and still provide the necessary lubrication, should a fuel pump fall off in flow, you'll end up with a lean condition which can cause all sorts of problems. But there really are so many more things to take into consideration when discussing pumping mechanisms, things which could take volumes to attempt to explain."

In any event, a positive displacement pump is one which traps a fixed amount of liquid and displaces it into a discharge section. Three basic separate sub-categories of this type would be a vane, spur gear and gerotor style. We should also mention that a typical supercharger found on top of a nitro, Pro Mod, alcohol, etc. car, is another form of a positive displacement pump which traps a fixed amount of air and displaces it into the engine. In the basic supercharger variety, you also have gears; or rotors; somewhat similar to an oil pump, but in addition, you have what is termed as a screw blower which uses two rotors twisted to resemble a screw.

However, most oil pumps on an engine are of the spur gear variety, as it is probably the most compact design and therefore fits nicely within an oil pan. "If you were to look at some OEM engines though," says Brett Clow of Aeromotive, "they use a gerotor-style oil pump and it does quite well."

Some external pumps will also use spur gears. The downside to them is the design requires two similar size gears mounted on separate axle shafts, with one being driven by an outside source; belt, gear or even a distributor shaft off a camshaft.

Gerotor, short for "generated rotor," pumps on the other hand require only one axle shaft with the internal drive gear (rotor) rotating inside of an external (idler) gear, sort of a gear within a gear principle. The acronym gerotor means that one gear of the pump is created and then it "generates" the shape of the second part. The inner gear would have one less tooth than the outer with the inner mounted off-center from the outer. As the inner rotates, it pulls in liquid and forces it out of the discharge port. The seal between the two, forces liquid in and out of the ports. The downside to a gerotor is it needs to be longer; or the gears wider; in order to work properly and provide the necessary volume and/or pressure.

PUMPS

In a vane-type pump, a rotor is mounted offset from the housing with a set of vanes mounted inside of the rotor. As the rotor spins, the vanes are allowed to slide in and out to keep them sealed to the internal housing, while moving fluid; or air in the case of a vacuum pump;

through the housing in and out of the intake and discharge portions of the pump. The areas between the vanes become chambers which increase in size before they decrease through rotation as they become closer to the discharge port. That increasing and decreasing is



What is becoming very popular are centrifugal superchargers, but they fall under the heading of a velocity or centrifugal pumping mechanism, very similar to a water pump, which we'll cover in our next issue.

what forces the fluid; or air again; out.

"In some of our fuel pumps, we also use a roller vane style pumping mechanism whereby the rollers stay in constant contact with the housing, rather than vanes sliding in and out," says Clow. "The roller vane design is very efficient which works great for a continuous duty pump. But a sliding vane style system is very trash friendly. It can accept a little bit of dirt better than a roller vane. All positive displacement pumps do not like trash. They're not a happy camper when there is trash in the liquid they are pumping. In that regard though, a spur gear may be the most forgiving of that." Which probably should bring up a discussion of filters in at least a fuel system, but we'll again save that for another time.

"A roller vane design is very accurate in that it moves a fixed amount of volume each revolution," said Hall. "It can pump in a very linear fashion, the faster it's spun, the more volume it displaces. Whereas, a sliding vane design is primarily used in our vacuum pumps simply because vacuum doesn't need to pump in a linear fashion."

A gerotor might be more efficient and economical to build, and henceforth,

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A hand is holding a custom-built LEGO Technic model. The model consists of a black circular plate with two grey gears mounted on it. The gears are connected to a red Technic beam. The entire assembly is held together with various blue and red Technic connectors and pins. The background is a blurred green field.

used with great popularity by the OEM companies, but cost really isn't an issue in motorsports. In fact, when it comes to racing, the gerotor model can be more expensive due to the added machine costs of the housing. In addition, there is a lot more mass involved in a gerotor pump. "The mass involved in a gerotor pump is on the outside gear so to increase the volume, it requires a larger gear which means there is also a little more drag and size," says Clow.

Cavitation is the formation of a partial vacuum in a flowing liquid. As the oil pump spins faster and faster, it naturally wants to pull in oil. If there is a restriction on the inlet side, the pump can't do that, and pockets of air will form. This is something which can also happen when oil sloshes forward in the shutdown area, causing a loss of oil pressure along with sucking in air.

While it's generally understood that you can't have pressure without some sort of volume, you can have volume without pressure. And this fact becomes important when we talk about oil pumps. A simple example would be to turn on your garden hose full force. By squeezing down on the end of the hose, you'll create pressure as the water streams out of the end. Now open up that restriction and you'll notice the pressure drop, while for the most part, the amount of water (or volume) coming out of the end will roughly stay the same.

In order to increase the output volume of a spur gear pump, the gear diameter can stay the same with just an increase in gear height.

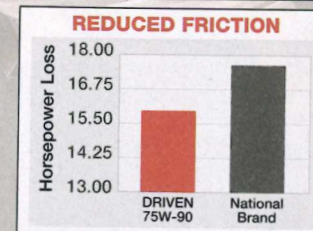


"Pressure is one thing, but flow is another," said Jack Hickman of Waterman Racing. "And that's the reason we have several different height gears for our pumps to properly match fuel volume to our customer's requirements. A spur gear will provide the most amount of pressure and hence the reason it's used in systems that require high pressure, such as mechanical fuel injection systems."

The choice of the type of pump-

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Brand	Iron (ppm)
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PUMPS



An example of matching the pumping mechanism to the application, Waterman Racing utilizes several different height gears in their fuel pumps to match the output volume to the necessary fuel requirements.

Regardless of the type pump you choose to use, it all comes down to volume and pressure, no different than the water coming out of your garden hose.



ing mechanism used is very application-driven. As Clow said, mechanical fuel injection likes a spur gear design while the company's Stealth pumps are of the centrifugal design partly because they're submerged in the fuel tank and suitable for EFI systems.

We could go on and on with pumping system explanations. Suffice it to say though, each design has subtle and unique differences which make them suitable for their specific application. ▮

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