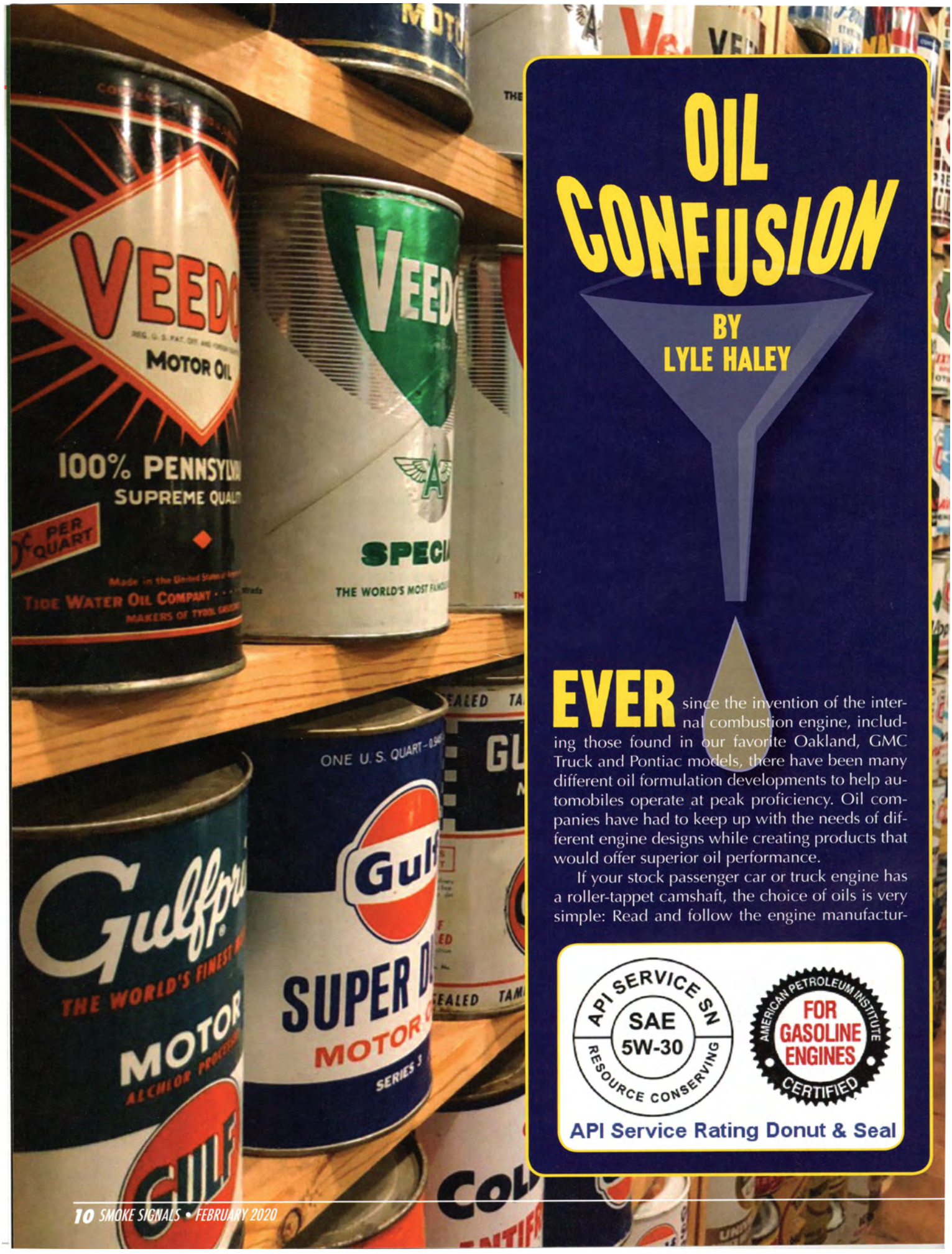


OIL CONFUSION

BY LYLE HALEY

EVER since the invention of the internal combustion engine, including those found in our favorite Oakland, GMC Truck and Pontiac models, there have been many different oil formulation developments to help automobiles operate at peak proficiency. Oil companies have had to keep up with the needs of different engine designs while creating products that would offer superior oil performance.

If your stock passenger car or truck engine has a roller-tappet camshaft, the choice of oils is very simple: Read and follow the engine manufactur-

API Service Rating Donut & Seal

er's recommendation. Manufacturers refer to an API specification that is found in the "donut" on oil bottles. The donut shown here *(opposite page)* indicates a product with the SN gasoline engine oil classification.

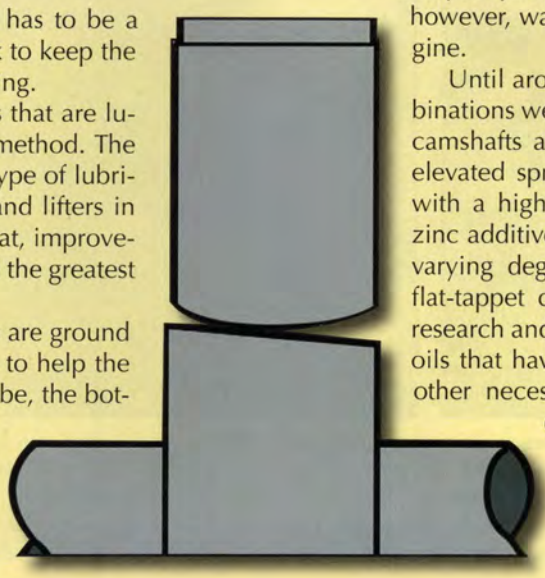
Roller-tappet camshaft engines need oil formulations (additives) that are different than flat-tappet camshaft engines. Manufacturers spend a lot of time and money to ensure that the oil classification they approve will work properly.

My experience has been that the flat-tappet camshafts in our 287-455cid Pontiac engines can experience high wear, so proper lubrication is absolutely critical. Determining the best oil for those engines is an oft-debated topic.

Keep in mind that there are two different methods of lubricating parts in an engine. Round surfaces, such as crankshaft rod and main journals and cam journals, are pressure-fed and live on what is known as a hydrodynamic "wedge." After the engine gains oil pressure, these journals are supported by a wedge of oil that keeps them from touching the bearing. This wedge only has to be a few ten-thousands of an inch thick to keep the shaft away from touching the bearing.

The second method is for parts that are lubricated primarily by the splash method. The highest component wear for this type of lubrication is found on the camshaft and lifters in a flat-tappet engine. Because of that, improvements in oil formulations have had the greatest effect on these parts.

Almost all flat-tappet camshafts are ground with a slight taper across the lobe to help the lifters rotate. To match up to the lobe, the bottom of the lifter is ground with a slight convex shape. This combination promotes lifter rotation in the bore to minimize wear. The issue here is that the pressure between the tappet and cam lobe gets very high and proper additives are required to prevent premature wear.



This is an picture of a hydraulic flat-tappet lifter with normal wear. The original convex surface can be worn either flat or concave as long as it is worn to a specific cam lobe. There can be many miles left on this combination of lifter and lobe if the right lubrication is used.

The ingredients in oils that have the best anti-wear properties for camshafts and flat-tappet lifters are zinc dialkyl dithiophosphate, better known as ZDDP and phosphorous. There are probably upwards of 30 versions of ZDDP and, for the sake of this report, we'll simply refer to them as "zinc." When comparing wear additives in oil, it is the zinc element which is generally talked about.

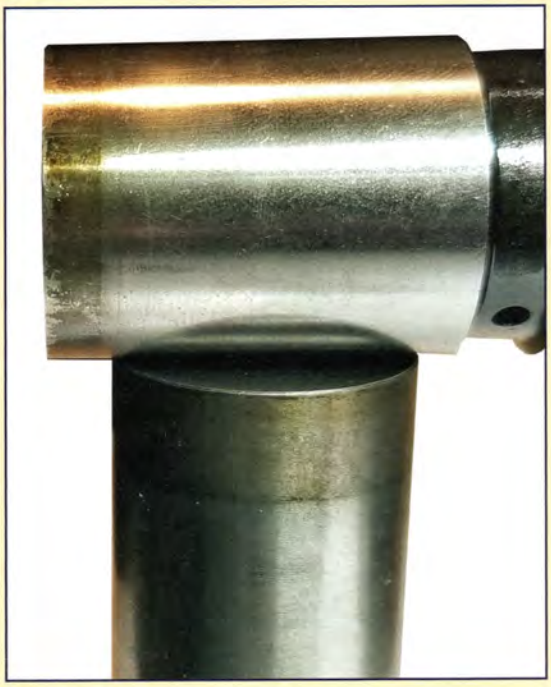
A number of years ago, our EPA determined that excessive amounts of zinc and phosphorous, when introduced into our automobile's exhaust stream, would damage catalytic converters. These elements were also determined to be harmful to plants and other things.

Most engines in domestic passenger cars built after 1986 have roller-tappet camshafts, so the need for zinc and phosphorous additives was greatly reduced. To make the converters live longer — and to make our breathable air cleaner — the EPA took an axe to the levels of zinc and phosphorous in passenger car oils. This action, however, was very detrimental to a flat-tappet engine.

Until around the year 2000, different oil combinations were tried in an effort to keep flat-tappet camshafts alive, especially in race engines with elevated spring pressures. The use of diesel oils with a higher quantity of zinc (or, by dumping zinc additives into oil) was commonly done with varying degrees of success. Severe issues with flat-tappet cams in NASCAR engines prompted research and development to create purpose-built oils that have the proper zinc, phosphorous and other necessary additives to protect flat-tappet cams and lifters.

These purpose-created oils which bolster flat-tappet cam life are now available from different oil companies. If you compare a sam-

pling of different off-the-shelf brands of SN/GF-5 oil, they have an average of 800 parts per million (ppm) of zinc and 700 ppm of phosphorous in them. These amounts of additives are adequate for newer engines where the manufacturer has specified SN or GF-5 oil.



For high performance or street flat-tappet engines, an example of a purpose-built oil is Champion Brands Classic & Muscle Performance Motor Oil. It contains over 1600 ppm zinc and almost 1600 ppm of phosphorous. These numbers are even higher than were found in most oils that were available before the EPA rules took effect.

Besides the smooth surface finish of a lifter face, a visual check of its shape can easily be done. Use the straight side of another lifter to see if it is convex, concave or flat. Light on each edge means it's convex, and possibly could be used on another camshaft. Flat across or light in the center means it is worn to a specific lobe and should not be used except on the lobe it was mated to.

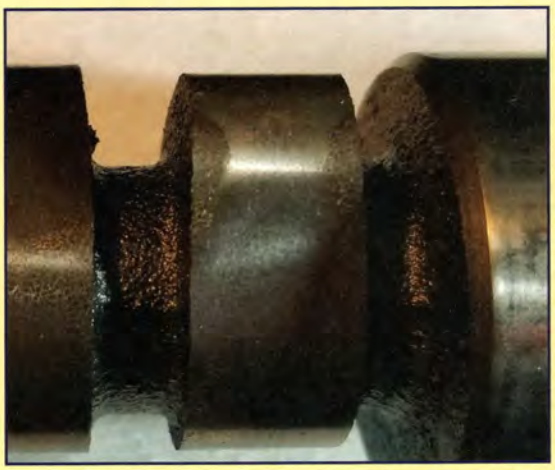
If a cam and lifters are removed from an engine, it is imperative that the lifters remain in the exact position they were running if they are to be used again. A used lifter should never go on a new cam unless it has a convex shape.

In addition to using roller cams in newer engines, piston ring wall pressures have been reduced dramatically to help increase efficiency, resulting in better gas mileage. Current piston-ring-to-wall-pressure in newer engines is about 25% of older engines. This is another reason why oils with less zinc can perform extremely well in newer engines.

A common message that I've heard from oil company experts is that just adding additional zinc to oil might do more harm than good. The available zinc additives can be different and the formulation of an oil requires the right recipe of ingredients to work properly.

With the modern science that is available, oil companies have created a variety of oils for the racing and street performance market (and, not only with engine oils but specialty fluids for everything in an automobile). Better protection for most all components is available due to these purpose-built fluids.

In conclusion, the choice of oil seems relatively simple for the majority of us. Modern stock engines with roller camshafts need the oil rating that is recommended by the manufacturer. Flat-tappet engines, however — whether performance or stock oriented — should use oil that was purposely created for them with the proper recipe of zinc and phosphorous additives. This includes vintage engines that can take advantage of better oil than was available when they were new.



These are examples of how wear patterns are created on a flat-tappet cam lobe and a roller-cam lobe. This picture of a Pontiac flat-tappet cam (left) wear pattern shows it starting by the edge of the lobe and then moving across the center as spring pressures increase. The Pontiac roller-tappet cam shows an even wear pattern around the lobes as the roller follows the cam profile. The roller cam has less friction between the roller and lobe than a flat tappet does between the tappet and lobe.

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