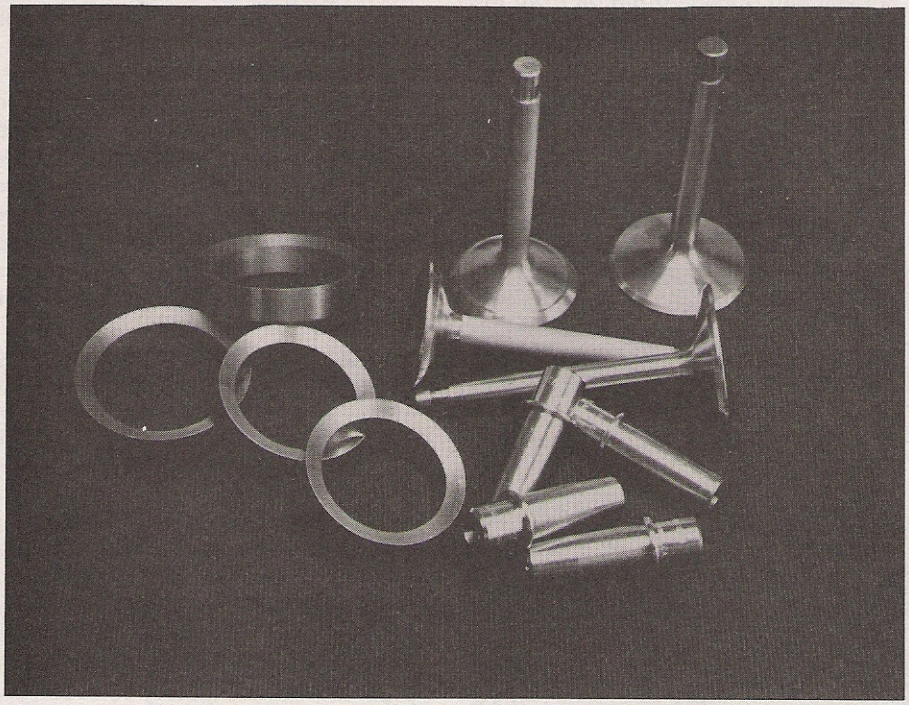
Shovelheads: Making 'Em Last Part 1

By Joe Minton



These valves, seats, and guides from Branch Flowmetrics are made of the best modern materials. They will more than double the life of a shovelhead valve job.

There was a time when shovelhead engines were getting cammed, carbureted, piped, ported, and stroked all in the search for more power. Long life wasn't all that important. If ya got a bit carried away and broke something, well—there were more parts down at the Harley shop. That has changed. The shovelhead has been officially obsolete for six years now, and parts are beginning to get scarce. For instance, at the time this was being written (6/89), Harley had no cylinder heads for shovelhead engines.

Then too, Harley-Davidson's Evolution engine is far more advanced than shovelheads are. The Evo engine is smoother, cooler running, and stronger. It will make more power with a cam, new pipes, and a hot carb than you can get from a ported stroker shovelhead, and it will last longer. The Evolution is the largest single engine-improvement Harley has made in 50 years.

The success of the Evo engine has moved shovelhead-powered Harleys into the "keeper" category. More and more of us are returning our shovelhead engines to stock specs. We've gone from trying to make them fast—to making 'em last.

In this first segment, we will deal with getting maximum reliability out of the top end of the shovelhead engine.

You can build your shovelhead so that it will last many, many miles and make excellent power, too. Actually, you can make it better than it ever was originally. Near the end of its shovelhead production, Harley made parts changes that dramatically reduced oil consumption. They also improved ring and valve life. Those parts can be fitted to most any shovelhead. Also, there are some aftermarket pieces that are better than stock.

Lead-free gasoline has caused considerable anxiety among shovel owners. The rumor has been that the old valve seats would wear very rapidly when used with lead-free gasoline. The rumor was only about half right, but lead-free running is an issue and something can be done about the problem.

Many shovelheads have had their hydraulic tappets converted to solids in the attempt to get better cam action and more power. While solids may take advantage of more agressive cams, they also make more noise. Then too, those aggressive cams often result in high wear rates. More moderate, high-quality cams together with hydraulic tappets will give a wider powerband, quieter running, and much longer engine life.

PISTONS & RINGS:

Stock factory pistons are very good. They have skirts shaped so that they become round and fit the cylinders properly when the engine is running at normal operating temperature. Most aftermarket pistons do not fit as well at running temperatures and often have to be fitted rather loosely (.004-.005 inches). Such large clearances result in piston-slap and somewhat shorter life.

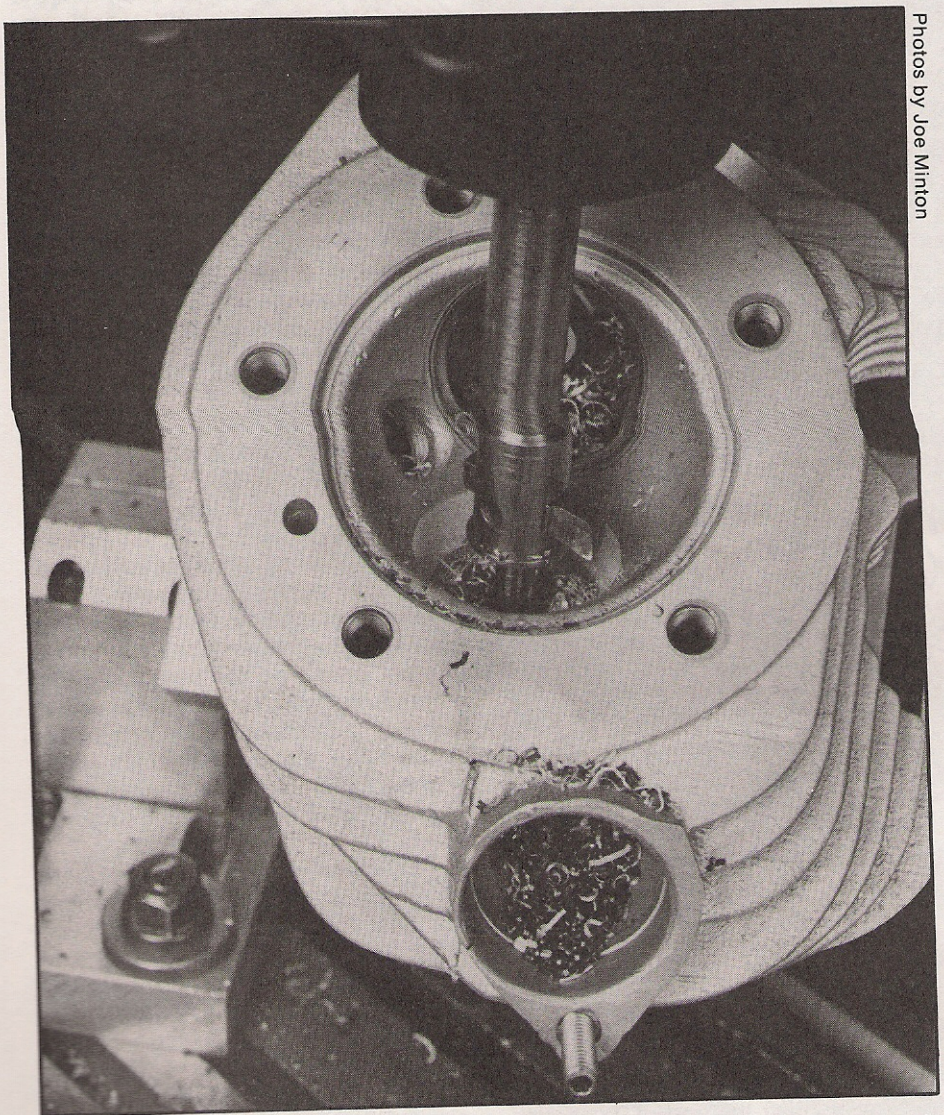
The shovelhead's semi-hemispherical combustion chamber shape isn't the best for today's unleaded gasolines and they have a tendency to detonate as a result. We could get away with high compression ratios back in the days of high-octane leaded gasoline, but no more. If you try to run 10-to-1 these days, you stand a good chance of detonating the tops right off your pistons. Lower

compression of 8-to-1 or so will allow you to run almost anything that'll burn. High compression will add a small amount of bottom-end power but you might have to use aviation gasoline to keep your engine together.

Near the end of the production life of the shovelhead (1982), Harley started using a piston ring set that did a much better job of oil control. That ring set (p/n 21920-83 for the standard size) will fit stock shovel pistons and you should use it.

Along with the new piston rings, the factory started fitting valve guide seals to their new cast iron guides to counteract a problem with excessive oil consumption. It seems that the shovelhead doesn't drain oil from the top end very well. Oil will collect in the rocker boxes and the level will rise above the top of the guides. When this happens, oil will get sucked into the engine between the guides and the valve stems.

When the new guides and seals are combined with late-vintage piston rings, typical oil consumption will be reduced from about one quart per every 500 miles to one per quart per every 1,500 miles. More importantly, the engine will run better. Plugs will last longer, the tendency to detonate will be reduced, and the pistons will stay cleaner.



Photos by Joe Minton

In this operation, Don Smith machines the old seat out and cleans the hole in preparation for the new valve seat. It is an exacting procedure best done by an experienced Harley machinist.

VALVES & SEATS:

The leaded gasoline we used to run had lubricating properties. The lead compound would plate out on the valve seats and act as a lubricant between the valves and seats. The life expectancy of the older shovelhead valves and seats is roughly halved when the engine is run with lead-free gasoline.

New, harder and longer-wearing valves and seats are available, from Harley and other sources. The Motor Company's valves (intake p/n 18075-81, exhaust p/n 18086-81) are very durable. However, these valves are nitrided and cannot be ground. Thus, if they ever do wear, you'll need to replace them. Harley's valve seats (intake p/n 18018-66, exhaust p/n 18017-66) are made of the latest lead-free material. The only possible problem with the factory valve seats is that they may not be large enough in diameter to fit a worn head.

New valve seats are difficult to install and should be inserted by a machinist with specialized tools and experience. We have three sources you can depend on. There may be a reliable shop near you that can fit seats, guides, and do a proper valve job. If not, consider one from our list.

Harley-Davidson itself overhauls shovelhead heads. They will fit their lead-free seats, valves, guides, seals, and springs. The complete factory overhaul will cost approximately $200 per head, when shipping costs are included.

There are some important limitations with the factory work, though, You will not get your original heads back; they are overhauled on an exchange basis. There is nothing wrong with their practice except that it results in a very high rejection rate. If one of your heads has a broken fin or

a gouge, it will be rejected. The factory is not in a position to fit oversized seats. If one of your heads needs a large-diameter seat, Harley will not be able to help you. Also, the Harley-Davidson overhaul service can take several weeks.

Jerry Branch of Branch Flowmetrics and Don Smith of Gordon's Motorcycle Madness both have an overhaul service that's somewhat more versatile than the factory's.

Branch is best known for his porting service but does a brisk business in head-overhauls as well. Branch will fit lead-free seats for $35 each. He also fits iron or Amco-45 valve guides for $9.95 each plus $6.00 each for installation. His stelite-tipped, chrome-stemmed valves run $24.95 each for intakes and $25.95 each for exhaust valves. Branch valves are made from the same material Cosworth used in their Formula I engines and it has proven to be almost indestructable. A Branch spring set, including alloy retainers, costs $45.50. Overhaul labor is $50 per head. The real bargain from Branch is the port work. For an additional $135 he'll port and polish a set of shovelheads. A complete job runs about $384 for parts and either $100 or $235 for labor. If you choose to get your heads done by Branch, you should go ahead with the port work. A Branch-ported shovelhead will make a lot more power without radical cams or other high-stress parts. It'll also run smoother and be more responsive.

Branch needs three to eight weeks for his overhaul service. The longest delay will be between November and June when his shop is loaded with head work.

Don Smith of Gordon's Motorcycle Madness also does complete head overhauls, much of which is custom. Don can fit seats and valves to just about any set of Harley heads, even if he has to weld them back together first. He uses the latest lead-free seat material from the Martin Wells Company, the same source as Jerry Branch and, I believe, the Harley factory use. Anyway, the material is first-rate. In addition to the 6 thousandths/inch interference fit between the seats and head, Don crimps the head material over the seat to make sure it will never come out.

Smith will fit either Manley or Precision Machine valves. He has used both for years and they have shown excellent reliability and low wear rates. He charges $40 each for valve seats installed. He will remove and replace valve guides for $6 each plus the cost of the guide. Like Branch, Don will fit either the good factory iron guides or those made from Amco-45 bronze. He will make oversized valve guides on a custom basis if a particular head has need of them. A valve job will cost another $30 for both heads. Glass beading is an additional $20.

Much of Don Smith's work is on older heads and he has learned much about reconstruction as a result. A head overhaul will be turned around in a maximum of two weeks' shop time. He does very nice work.

DETAILS:

Rocker arms should have all but a thou or so of their end play shimmed out. Some of the rattle common to shovelhead top ends is simply the rockers sliding back and forth on their pins. Evolution engine rockers are a snug fit in the rocker carrier and they don't rattle.

Make sure all gasket surfaces are flat. Careful use of a large and a medium-size, single-cut mill file can be used to remove burrs from cases. A piece of 320-grit, wet-or-dry sandpaper and a large piece of plate glass can be used to flatten heads and rocker boxes.

If you use a silicone rubber as a gasket dressing, be *very careful* about how much you use. Silicone rubber will clog oil passages and could cause your newly overhauled engine to melt down.

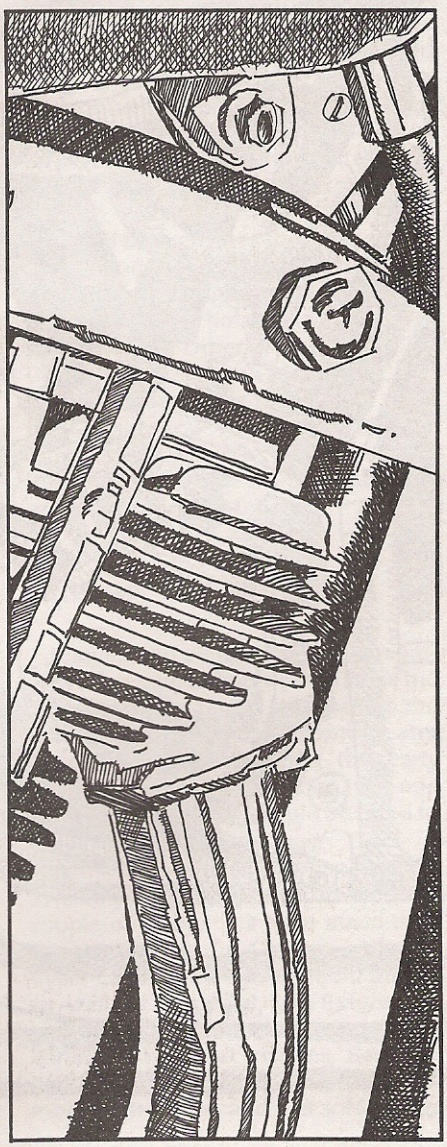
Ten years ago, an average shovel top end would need some serious attention about every 20,000 miles. A shovelhead top end built with the parts recommended will last a very long time—perhaps 50,000 miles.

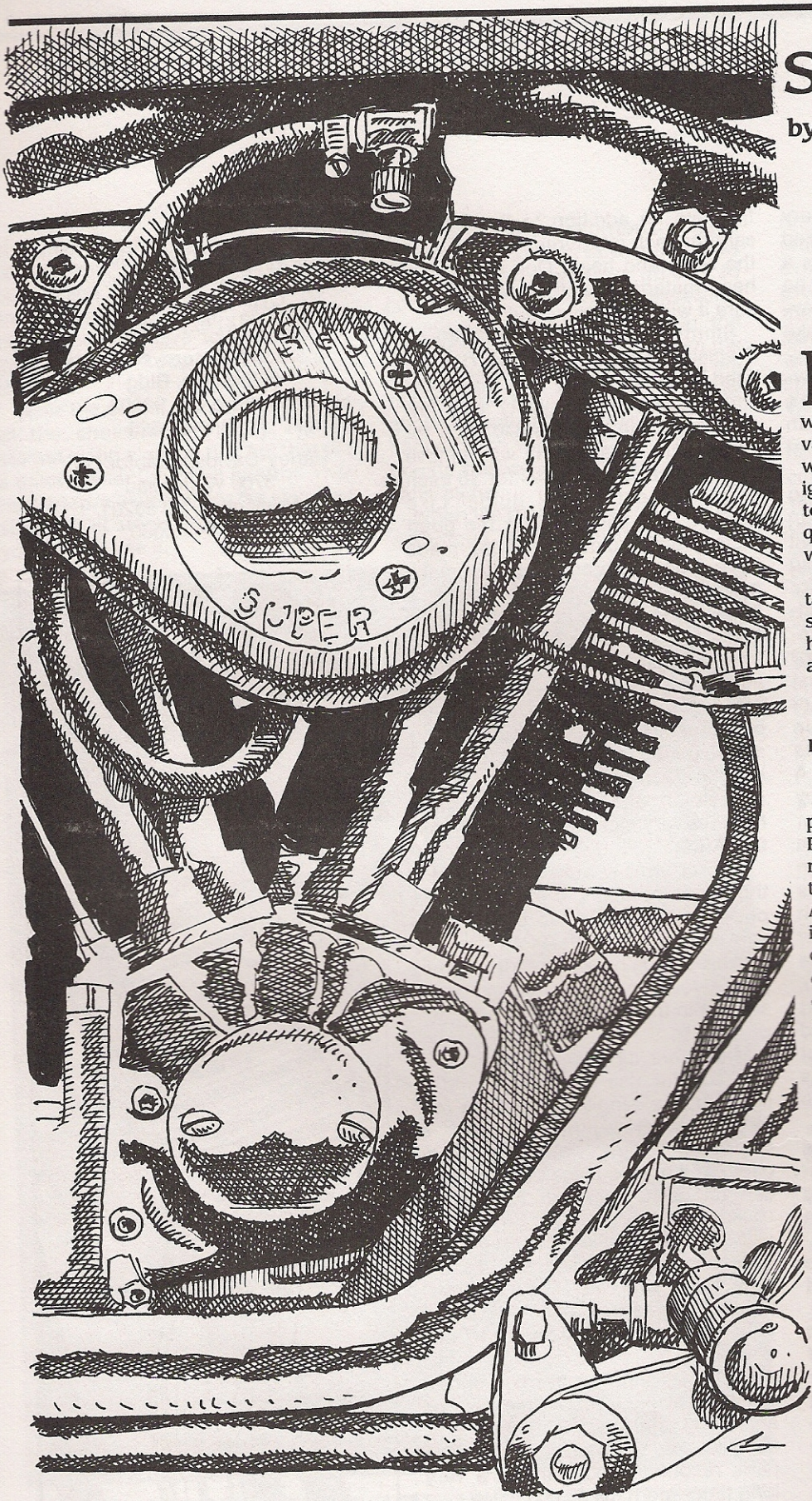
SOURCES:

Branch Flowmetrics
5556 Corporate Dr.
Cypress, CA 90630
(714) 827-1463

Gordon's Motorcycle Shop
1586 Morse, Bldg. 1
Ventura, CA 93003
(805) 642-3525

Harley-Davidson Motor Co.
3700 W. Juneau
Milwaukee, WI 53201
(414) 342-4680 ■





Shovelheads:

by: J. D. Chandler

Last month we published the first of several shovelhead engine articles. That first article dealt with the top-end, including pistons, valves and cams. This second article will cover the crank, oil pump and ignition. Our goal with these articles is to help you build a good-performing, quiet-running shovelhead engine that will last.

Long life has become a more important consideration. With that understanding, we have chosen parts that have proven themselves to be reliable and long-lived.

INSPECTION:

An important and often-overlooked part of any overhaul is inspection. Parts, including cases, that have been run long and hard can develop cracks that cannot be seen with the eye alone. Aluminum parts like cases can be inspected using a penetrant dye kit you can find at an aircraft supply store or can get through a Snap-On Tools dealer. These kits are easy to use and might save you some grief later.

Magnetic (Magnaflux) inspection is the best way to make sure steel or iron parts are free of cracks. This service requires special equipment and you will have to find someone with those tools and the experience to use them.

If you are rebuilding a well-used shovelhead engine, you really should get everything looked at. By the way, even new parts can be cracked. Consider it.

CRANKSHAFT:

Harley-Davidson has made important improvements in their crankshafts in recent years. Unfortunately, those

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improvements came along after the shovelhead engine was out of production. There is nothing wrong with stock shovel cranks; it's just that there are better parts available from other companies.

Shovelhead flywheels are made of cast iron which can sort of wear out after a few rebuilds. Evo wheels are made of forged steel and the latest versions have one-piece wheels and spindles, making a three-piece crank compared to the shovelhead's five-piece crank. The tapered holes in the cast iron wheels will expand and make it difficult to get a really rigid and straight crank. A shovelhead that gets run hard can actually make its crank go out of true because the relatively soft iron wheels will deform and lose their grip on the tapered shafts and crank pin.

Although best known for their stroker kits, S&S Cycle has been making stock replacement forged steel flywheels for several decades. They also make high-strength rod assemblies and high-quality spindles. In fact S&S can furnish complete crank assemblies for nearly any Big Twin ever made.

Most mechanics would rather build a crank using S&S wheels than the stock iron ones. The steel wheels are more rigid and make it much easier to build a straight crank.

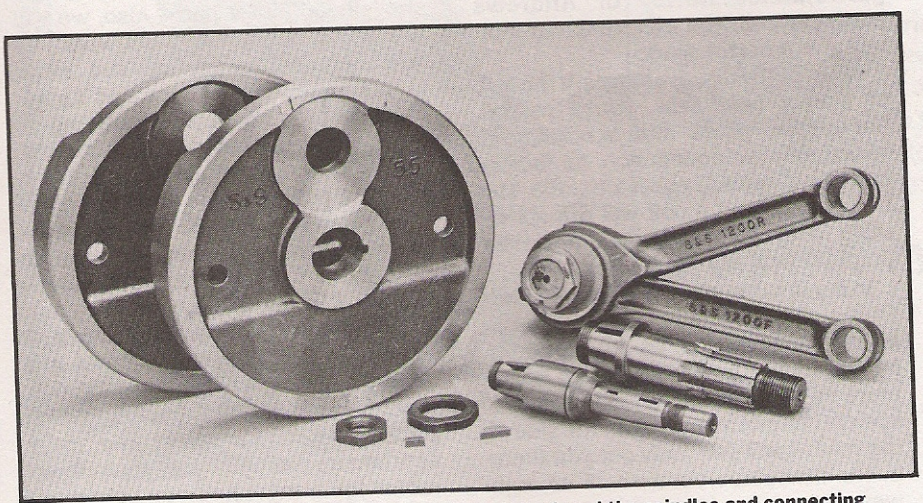
When you replace connecting rod bearings, including the pin, be careful about what you get. Stock factory parts are quite good, as are those from S&S. However, there have been some sub-standard crank pins circulating. Be careful.

If you do not have an experienced Harley engine man around to build a rod set, you might consider buying a fitted set from either Harley or S&S. Rod bearing set-up is critical and requires considerable skill. Just having the equipment isn't enough. Like I said, be careful.

How smoothly your engine runs depends more on the crankshaft than any other single engine sub-assembly. If the crank is crooked or out of balance, the engine will vibrate. There are tolerances for crankshaft straightness. Always try to hit the lowest numbers. The straighter the crank, the smoother the engine.

Crank balance—the proportion of ballast weight added to the crankshaft opposite the reciprocating mass of the piston assembly plus half of the connecting rod weight—is somewhat controversial in that not everyone agrees what the balance factor of a Harley Big Twin crank ought to be. For instance, Evolution cranks are balanced to 60 percent by the factory. (In other words, a weight equal to 60 percent of the combined weights of one piston assembly plus half the weight of the connecting rod is added to the crankshaft, on the side opposite the connecting rod and piston.) Engineers found that the rubber-glides liked 50 percent but the rigid-mount Softails ran better at 60. Since rubber glides are smooth no matter what, Harley balances all their engines to 60 percent to accommodate the rigid-mount bikes.

Many, many engine builders use 49- to 52-percent balance factors for shovelheads. Others, including S&S Cycle, have settled on 60 percent. The lower number tends to produce more high-frequency vibration which is harder to live with. The lower frequency vibes of the 60-percent crank are generally more tolerable.

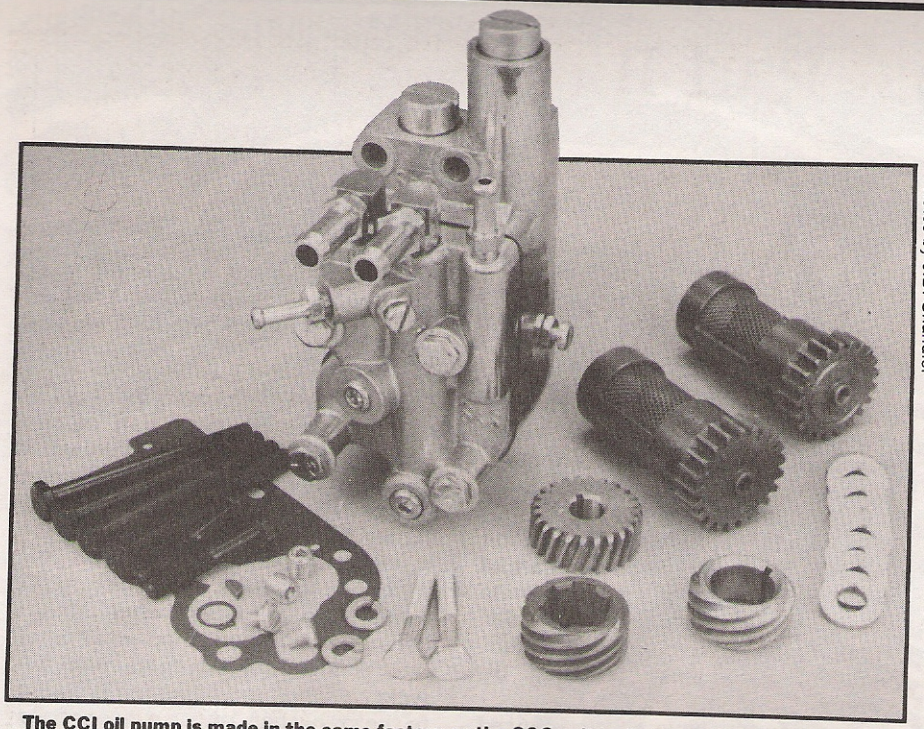


The same only better. The S&S flywheels are forged steel, and the spindles and connecting rods are stronger than stock components. These parts will build up into a stronger and longer-lasting crankshaft. They are at least as good as the latest factory shovelhead parts and much better than older ones.

OIL PUMP:

Shovelhead oiling systems were improved several times over the life of the design. The last pump, still used on the Evo motors, has a 33-percent greater oil delivery capacity than the early cast-iron pump did. This late (1981 and later) pump can and should be fitted to earlier shovelhead engines.

Late-model pumps aren't always available as assemblies from H-D, so a couple of companies have made their own. Both Custom Chrome and S&S Cycle can furnish late-style oil pumps as well as a special drill fixture and instructions needed to install them on earlier shovelhead engines. S&S has had their version on the market for more than a year, and has sold a large



Photos by J.D. Chandler

The CCI oil pump is made in the same factory as the S&S unit is. Both are high-quality units. While S&S has more applications for their pump, the CCI pump is better-looking with its smooth lines and chromed finish. CCI's pump is a quality replacement for the expensive stocker.

number of them with no problems.

Both S&S and CCI pumps are well made but there are differences between them that you may find important. The CCI pump has a smoother shape and is chrome-plated. S&S does not chrome-plate their pumps and, indeed, warns against your doing so. S&S has gone to the trouble of producing six versions of their pump kit. The various kits will cover engines from 1936-vintage to the present.

Both the CCI and the S&S oil pumps cost only slightly more than half as much as a factory pump.

IGNITION:

Most shovelheads run on non-electronic, points-type ignitions. There's nothing wrong with that. The purely-electromechanical ignition has many advantages; it also has some important limitations. However, H-D's late electronic ignitions work a little better and are more reliable. Let's compare these two basic ignition systems.

Points-type ignitions have a couple of clear advantages: first, they can generally be repaired on the side of the road, with hand tools. Second, they don't cost as much. You can buy a complete advancer, points plate and points set from CCI for about $45. The stock Harley (electronic) black box will run you $153, and, you'll also need the $120 sensor plate!

Points ignitions have some disadvantages, too. First, they need constant attention. From the time you clean and set them, they will deteriorate in performance. Second, the advance mechanisms wear rapidly. That wear results in erratic timing and an unreliable advance-curve.

Current stock (Motorola) electronic ignitions have their strengths and weaknesses too. First the advantages: once timed, they stay timed. Period. The advance never changes because there is no mechanical advancer to wear out. If used with the latest high-performance Harley or Andrews Products coil, the electronic ignition will give a hotter spark.

Now for the disadvantages: if the box or sensor plate fails, you're parked. Sandpaper, pliers and screwdrivers won't help. A conversion to factory electronic ignition costs a bundle. The box, sensor and a coil will run something over $300 whereas a similar points set-up will cost under $100.

In my opinion, the electronic ignition as often as points do. They work better by providing a hotter spark and much more steady timing. While the points system can often be fixed on the side of the road, it will generally put you there in the first place because of its high wear-rate.

A word about sealants. There may be as many opinions about what sealant to use as there are engine builders. The silicone rubbers work but one has to be careful not to use too much, as the stuff can get loose and plug-up oil passages. Harley sells a Rolls-Royce product called Hylomar. Hylomar stays soft, and does not glue gaskets or cases together. It works well and I have used and preferred it for many years. Copper Coat and Gasgacinch work too.

More important than what sealant you use is the finish of the parts you put it on. Everything needs to be smooth and flat. A large flat single-cut mill file is wonderful for getting the bumps off of heads, cylinders and cases. Use caution of course but spend the time to make sure the parts really fit together closely.

There will be some of you who choose to restore your shovelhead engine to factory specifications and we applaud that. After all, if some of us didn't keep our bikes stock, future Harley enthusiasts wouldn't have any idea what a factory shovel was. If, though, you want to go on riding your shovel, you should consider making improvements as you rebuild it.

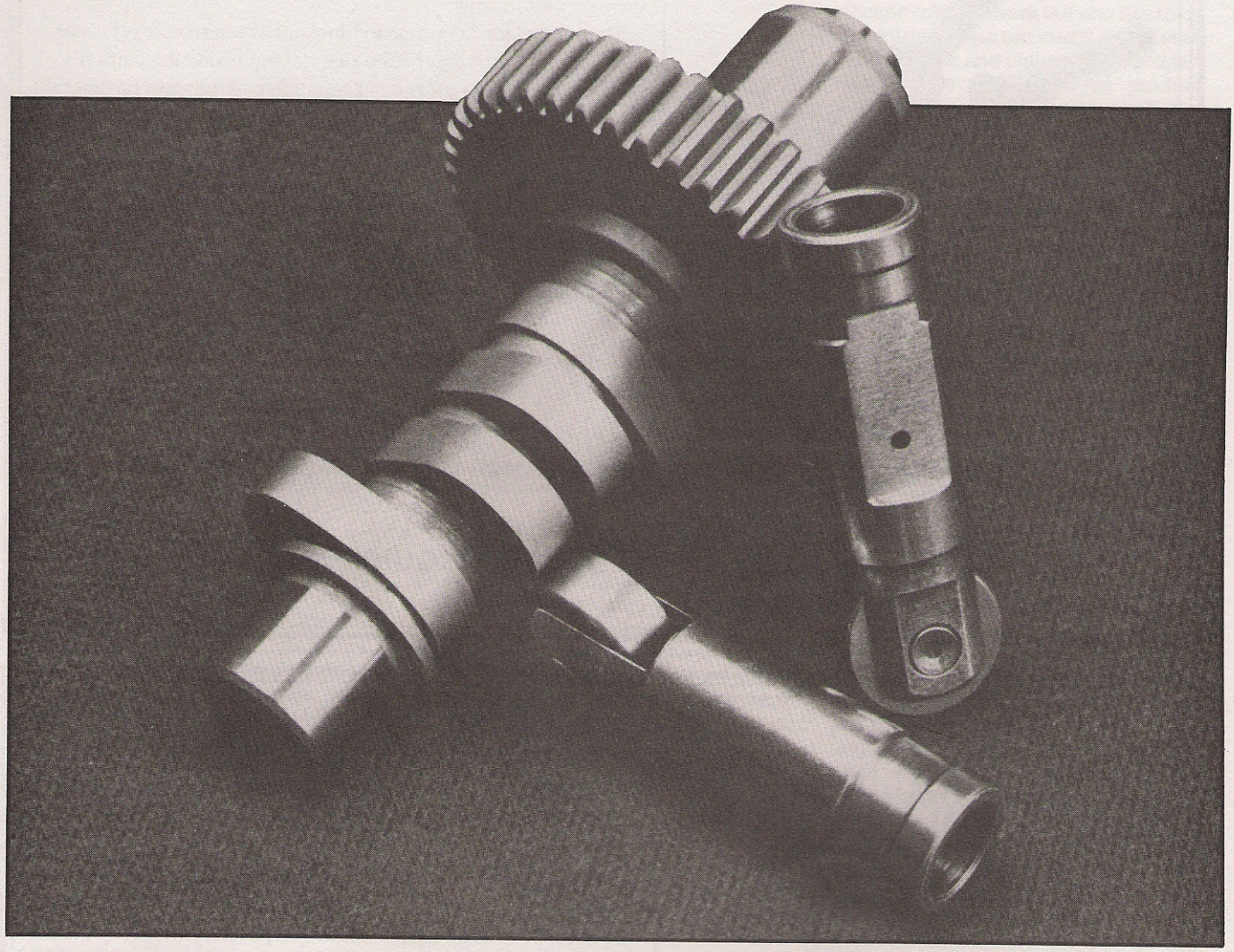
A carefully built shovelhead engine, put together with the latest and best parts, will last longer than they ever did while still in production. Harley may have stopped building shovelhead motorcycles but other manufacturers have continued to improve the parts. You can actually make your motor better than Harley did.

Over the next few issues we will continue to cover, in detail, the major shovelhead motor parts. Also, we will talk about how these parts work. We will discuss hydraulic and solid tappets, their advantages and limitations. We'll take a look at engine bushings, breathers and rocker arms. An engine must stay clean inside if it is to last. Good air filters keep dirt off of the cylinder walls. Effective oil filters separate hard wear-particles from the oil and the moving parts. We'll take a hard look at both filter types.

There are many different shovelhead engine parts on the market, and it is sometimes tough to pick and choose. Our goal is to print information which you can use, to select the most appropriate pieces for your shovelhead motor. We want to help you keep these babies running for a long, long time. ■

Shovelheads: Making 'Em Last — Part III

By J.D. Chandler



For good, lasting performance the Andrews "J" or "A" grind cams work well with standard hydraulic tappets.

There has been a long and unfortunate tradition of building engines with too much cam, too much carburetor and too much compression. As a result, there are many, many shovelhead motors that simply don't perform well in the rpm range where they spend most of their running time. A balanced selection of engine components is as important as cubic inches.

One shovelhead high-performance tradition is the solid lifter conversion. Like many traditions, this one contains more fancy than fact.

There is a bit of cushion or play in a hydraulic tappet, and to get proper valve action they require cams that open quickly. To get a hydraulic tappet to open a valve as effectively as would a solid one, the cam must have a little bump right at the beginning of its action.

Factory cams are rather mild and almost any increase in valve timing over stock will make more power. They open valves gently and don't keep them open all that long. Factory Big Twin cams are designed to run with hydraulic tappets. These cams have a little bump at the beginning of the valve-opening cycle. When you convert a set of hydraulic tappets to solids, the hydraulic cushioning effect is removed. The hydraulic cams bump, when used with solid lifters, opening the valves a bit sooner, and giving more cam duration. A solid lifter conversion has the effect of installing a slightly hotter cam.

There is a down-side to this, however. Solid lifters and hydraulic cams don't get along too well. That bump in the opening ramp of the hydraulic cam turns into a hammer blow when the tappets are solid. Solid tappets operating on a stock hydraulic cam may give more power but they will be noisy and very hard on the cam, tappets and

valves. Don't do it.

Besides, a properly-matched hydraulic cam will result in better performance, longer life, low maintenance (none in fact), and make the valve train almost silent.

While there is truly no substitute for cubic inches to achieve more power, the same principle does not apply to cams. I believe that the single most common engine-building mistake is to install too much cam. Proper cam action (opening and closing points, lift, and acceleration) is determined by engine design characteristics and the intended rpm at which the engine will operate. You can't expect to get more power by simply installing a cam with more duration or lift. A hot cam pulls more power off the bottom end than it adds to the top. In fact you could install a cam that is so radical, your motor will never turn enough rpm to take advantage of it.

However, there are aftermarket cams that will improve engine performance over stock yet are easy on the valve gear. There are more moderate cams that will add power throughout the rpm range.

For the best power from 2,000 to 5,000 rpm, install a cam that has no more than 250 degrees of intake-valve duration. Hydraulic cams like Andrews' "J" or the higher-lift "A" will give a stock shovelhead engine all the air/fuel mixture it can use at these rpm. If your valves are free to open to .500-inch, consider the Andrews "2" cam. This cam opens the valves early, has lots of lift and short duration, and will give wonderful power from idle to redline. Crane makes two cams that will give similar performance. Their grind numbers H288 or H288-2 work very well, especially if you take advantage of Crane's adjustment feature and advance the cam.

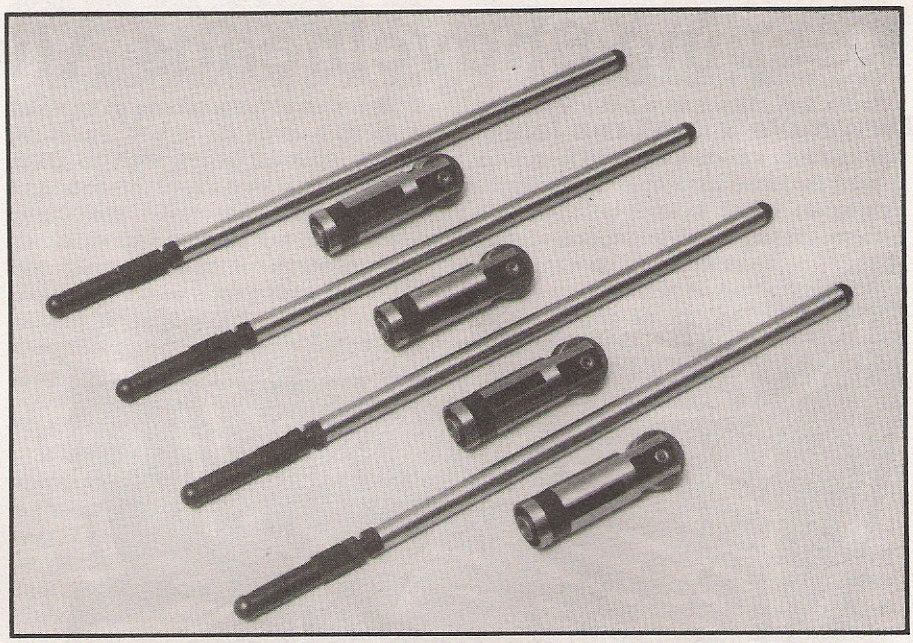
There are several companies offering alternate tappet and pushrod setups for shovelheads. Some are meant as light-weight solid conversions for high-performance motors. Some are designed to keep the pushrods away from the pushrod tubes in motors with extremely high-lift cams. None of these special parts are needed for the cams recommended here.

There is nothing wrong with these parts; you just don't need them for a normal motor.

Since you will be building your shovelhead motor to last, you won't be revving it past about 5,500 rpm. As long as you're not trying to turn astronomical rpm, most valve gear problems will disappear. You won't experience hydraulic pump-up, which only occurs when pushrods flex or valves float from having too little spring pressure and/or a cam with too much initial acceleration. The cams mentioned above can be used with stock valve springs, tappets, and pushrods. There is nothing wrong with any of the stock parts, as long as you aren't trying to reach very high rpm with radical cams.

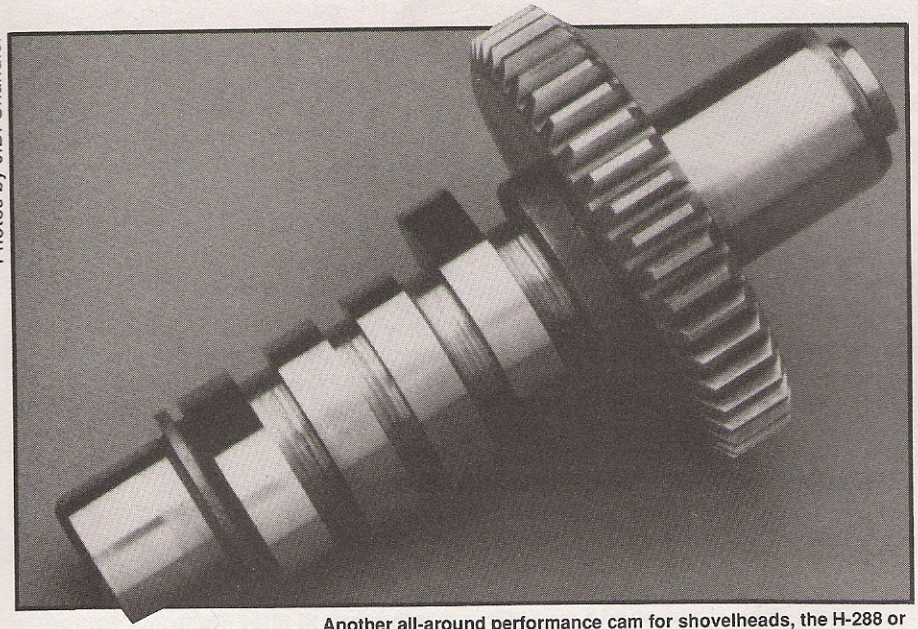
A mild hydraulic cam set-up with stock valve springs will wear very slowly and run quietly. The moderate cam-timing will also give your shovel motor a much wider and more useful power band. This hydraulic-tappet and mild-cam combination will give excellent performance and long life.

You may very well find that your scooter will pull harder in a moderate speed, top-gear roll-on with one of these set-ups than it did with the old high-performance cam you took out. ■



The word is out: aftermarket hydraulic tappet kits keep shovelhead valve trains alive. This set is manufactured by Crane Cams.

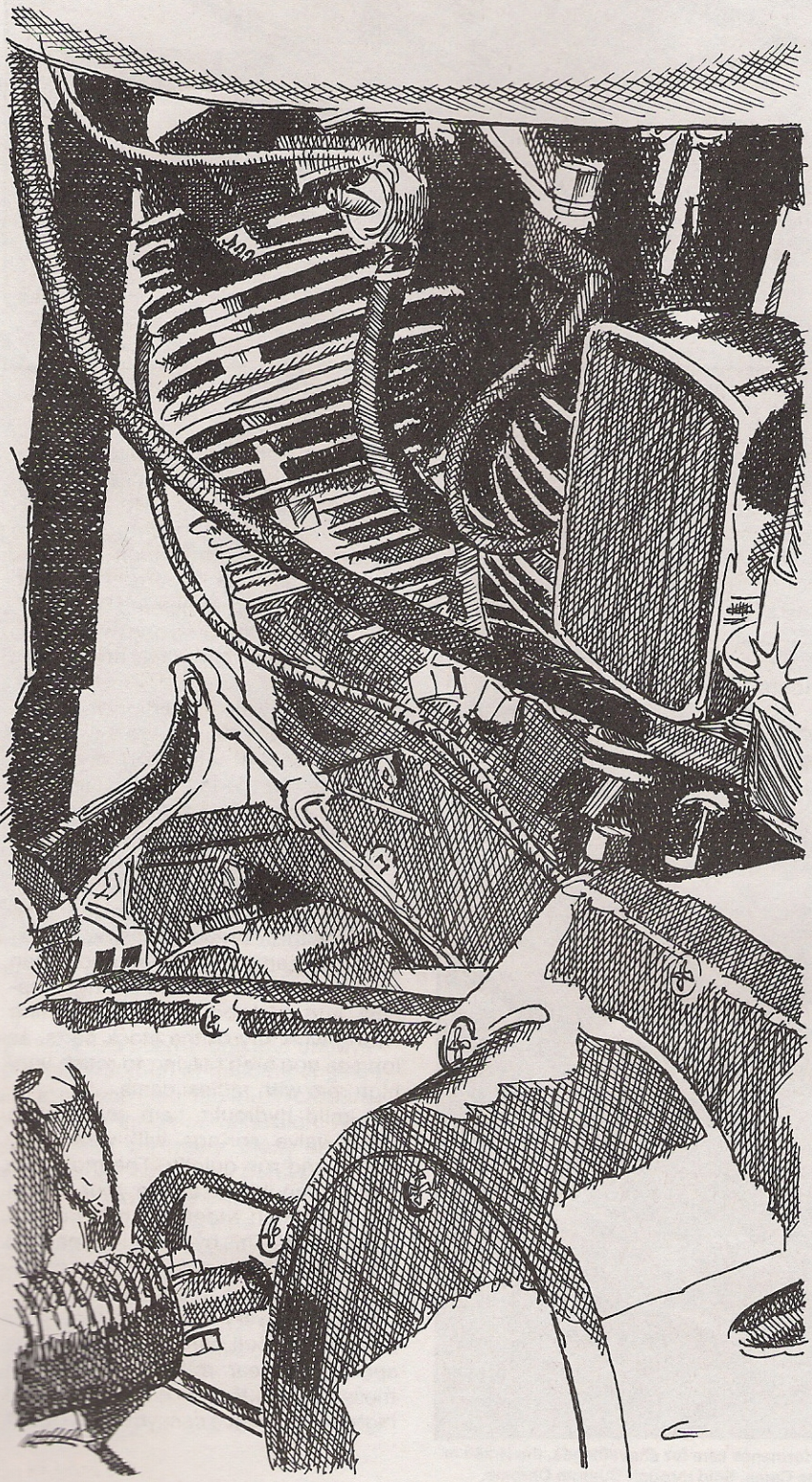
Photos by J.D. Chandler



Another all-around performance cam for shovelheads, the H-288 or H-288-2 cam from Crane Cams, Sold through Custom Chrome. (As used in the Easyriders Streamliner)

Keeping Shovelheads Alive—Part IV

Dirty motors don't run long.



This is the fourth and final in a series of articles devoted to making your shovelhead engine run well and last long. The first three installments were aimed at getting the best available parts inside your shovelhead motor, this one is dedicated to keeping dirt outside that motor.

Any engine can be quickly and thoroughly destroyed if it has dirt between its moving parts. Dirt particles are hard, harder than most engine metal. They are also rough and sharp-edged. However, what "dirt" is to an engine is a little different from what it is to us. Dirt particles so small they can only be seen with a powerful microscope, will grind an engine to junk within minutes of running.

If a piece of dirt gets between two moving pieces of metal, say a piston ring and its cylinder wall, damage will occur *if* the dirt particle is *bigger* than the space between the parts. If the particle is smaller than the space between two moving parts, they won't even notice its presence.

All the parts of your engine that move or rub against each other have oil between them. The thinnest oil film will still be about 11 microns (millionths of a meter) thick. Any piece of dirt that is smaller than the 11 microns will do no harm to those parts.

So, the trick is to limit the dirt that gets into your engine to particles that are less than 11 microns in diameter. The accepted standard in the filter business is 5 microns. I don't know why, it just is. Either way, the only readily available filter that will take out particles that small is the common paper-element screw-on filter (like those used on all the Evolution motors). The old OEM replaceable in-tank filters are only good for 40 microns; they just keep the rocks out.

For the sake of the life of your shovelhead motor, you should install a screw-on oil filter. Custom Chrome Inc. (CCI) offers three screw-on oil

filter conversion kits for various chassis configurations. Be sure that the filter you use has a low pressure relief valve. Harleys have low pressure oiling systems. If you use a car filter (high pressure) and it gets clogged, its pressure relief valve (built into every screw-on filter) might not work. Your engine wouldn't get any oil and you wouldn't get much farther down the road. Use only the filters designed for Harley motors. There is an important difference.

Additionally, you need to remember that since these filters only filter oil on its way back to the oil tank, any dirt that gets in the tank will probably find its way into your engine. So, you need to be careful about the oil you first put in the oil bag.

Be very sure that you pour only clean oil into the tank. This means that you keep your funnel really clean and that you wipe the tank filler with a clean cloth before you pour oil. I keep my funnel in a large Ziploc bag and my oil bottles in a sealed trash bag. If this sounds extreme, consider how small a five-micron hunk of dirt is: It would take more than 5,000 of them, side-by-side, to measure an inch!

If you wash your oil tank like H-D says you should, be very careful about how clean the solvent is. You could do more harm than good if the solvent is contaminated.

The other major source of dirt harmful to your engine is in the air it breathes. We've all seen dust in a shaft of light going through a darkened room. That's only what you can see. Think of how much microscopic dirt is floating around, too small to see but large enough to damage your engine. It takes a long time for a 20-micron particle of dirt to float down to the ground. If your motor's carb sucks it up, that particle could cause a lot of wear before it gets trapped by the oil filter you installed.

Most dirt particles that come in through a carb get blown out by the exhaust, without ever touching metal. However, if they do touch anything, chances are it will be the film of oil on the cylinder walls, where they'll stick. Large (10 micron or so) dirt particles trapped by the cylinder walls' oil film will cause wear all the way through your engine. The dirt will grind on the rings, cylinders, pistons and, when it works farther down, the bearings. By the time the oil filter traps it, that 20-micron piece of rock may have started a roller-bearing on the road to short life.

Some air cleaners will filter down to five microns, but not all of them. Also, only a few will both filter well and pass enough air to make real power. The late stock factory filters, with foam and plastic elements, will clean the air—and won't cost more than a couple of horsepower on a stock-port engine. The traditional S&S teardrop-shaped filter has a foam element, cleans adequately and passes more air than a stock air cleaner.

The very best is Harley's Screamin' Eagle series air cleaner kits. These kits use the excellent K&N Engineering cotton-cloth filter elements that have proven themselves so successful in off-road racing. It seems that the K&N material will filter out five-micron particles and allow plenty of air through at the same time. A free-flowing K&N element can be considerably smaller than a foam element that flows the same amount of air. H-D's Screamin' Eagle kits will fit all Keihin Harley carbs, including the new Sportster carb.

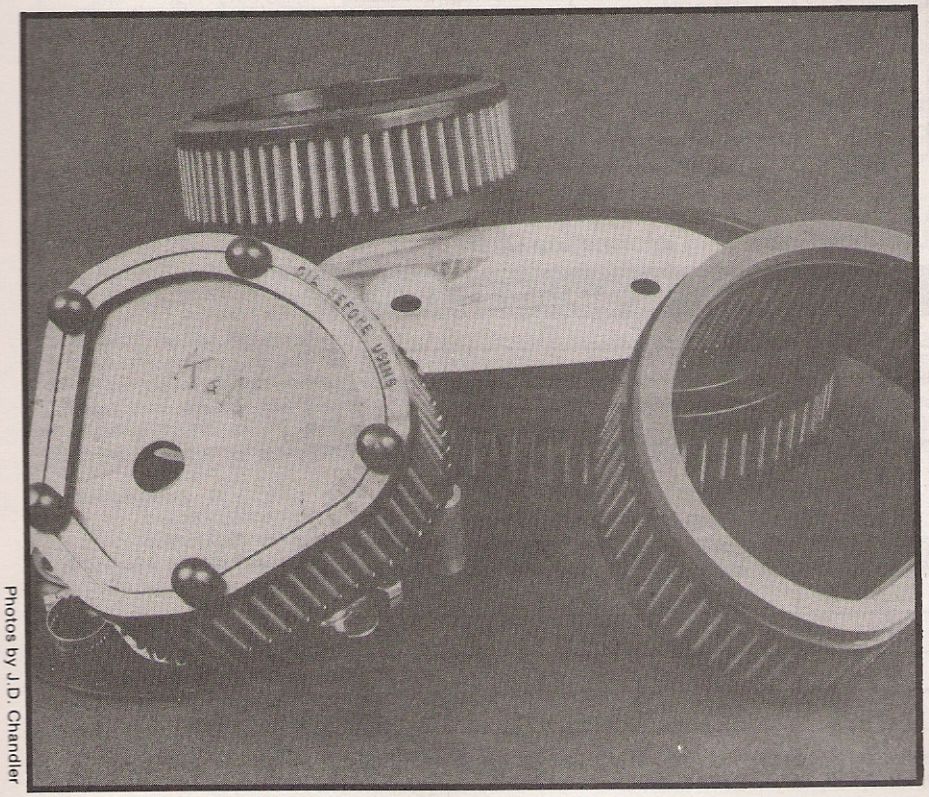
Neither the foam nor the cloth filter elements will work properly without being coated with oil. Most fine particle filtering is actually done by the oil. It is okay to let the filter elements get fairly dirty before you wash them. K&N even claims that their filters work a little better when they are coated with a layer of dirt. It seems that the dirt increases the filter area. You'll get best results if you use oil recommended by the filter maker; foam elements like thick, sticky oil, while the cloth ones work better with thin oil.

Small foam filters will generally limit top-end power, because they tend to be overly restrictive. However, I've tested cloth filters that didn't pass enough air because the chromed cover was too close to the filter element. Buy the largest foam or cloth filter you can live with and make sure it has at least ⅜-inch clearance between the element and the cover. If you have doubts, stick with the late factory filters, either stock or Screamin' Eagle versions.

The bottom line on all this is engine life. If you build your shovelhead motor as outlined in the past three articles, and keep it clean inside with high quality filters, it will last longer than any shovelhead you've ever owned. Period.

Next month we'll talk about engine oil—what it does, how it wears out, and how you can take care of it. Maybe we'll be able to help you choose the right oil for the way you ride.

—J.D. Chandler



Photos by J.D. Chandler

All these K&N pleated-cloth filters remove extremely fine dirt particles, yet pass all the air your motor needs. The kit is from Harley, the other filters are K&N replacements for stock Harley air boxes.