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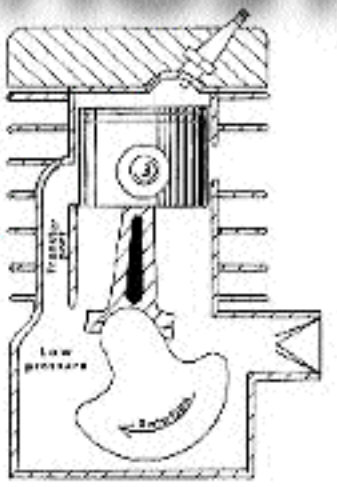
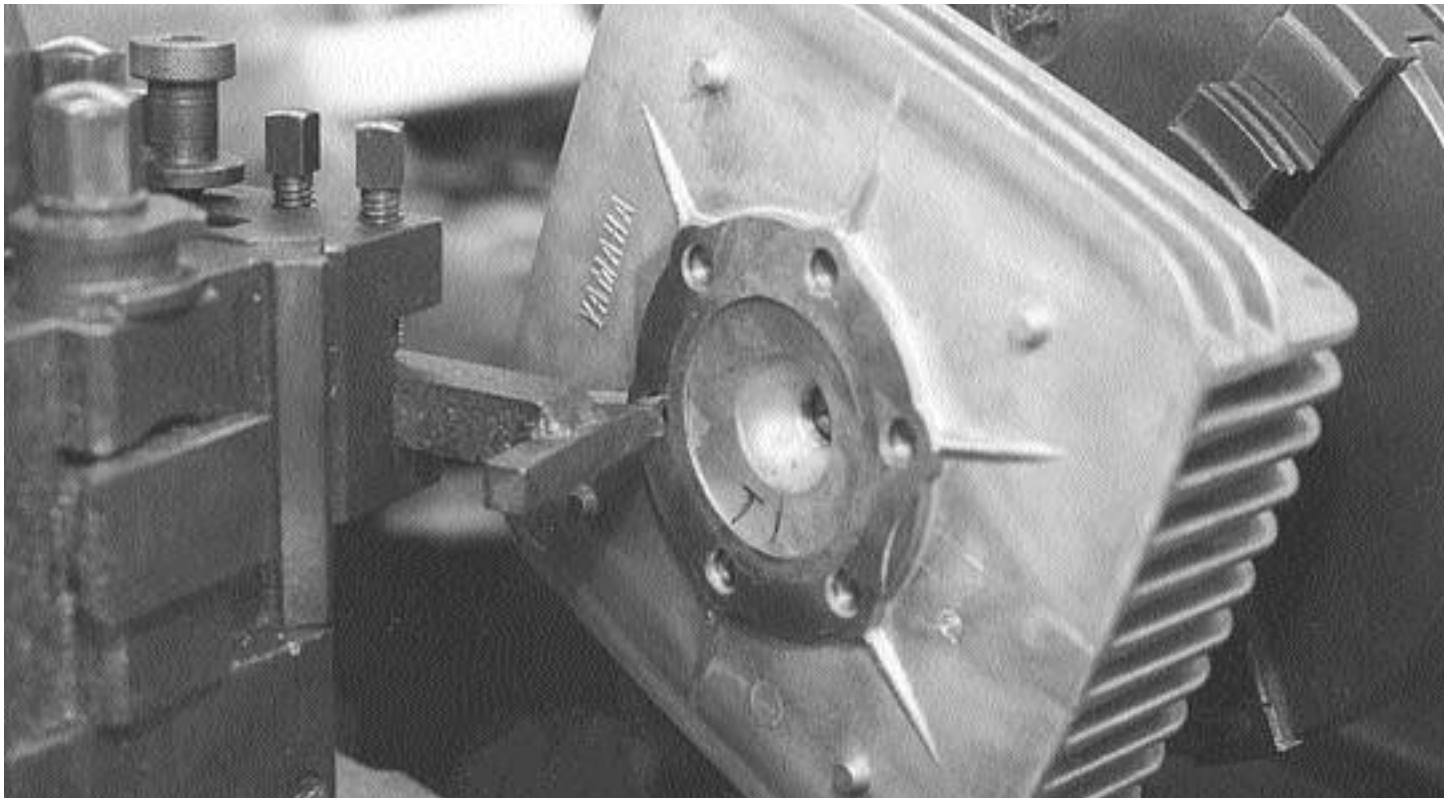
SQUEEZING THE MOST POWER OUT OF YOUR ENGINE



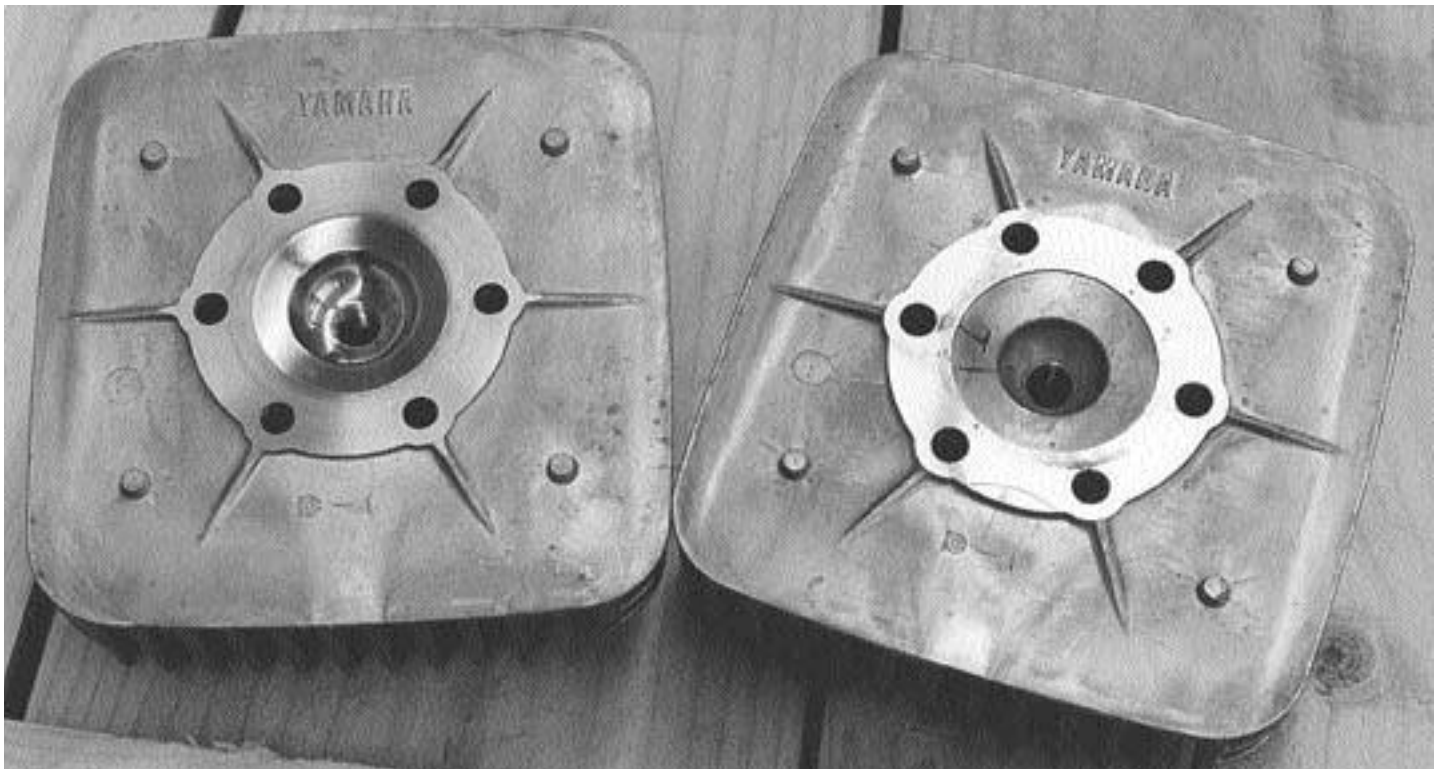
Don't Know Squat About Squish? Read on...

Article and photos by Jean L. Genibrel

Whether you run a 2-cycle or a 4-banger the object of the power game is to get the most out of the energy stored in the fuel which enters the engine. Easier said than done. Losses from friction, heat, drag from the charge and inefficient burning all add up to a loss of almost 66 percent of the total potential power out-



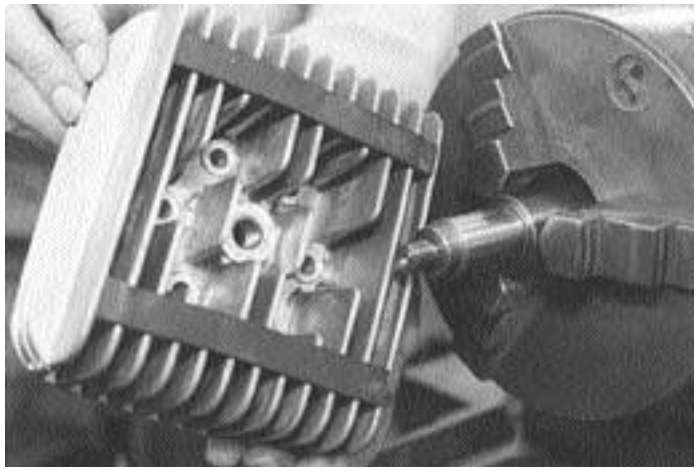
The gasket surface on the head must be cut down to reduce the squish area.The object is to bring the squish to .030-inch The band is at an angle to the gasket surface. A thousand of an inch removed from the gasket surface will not equal the same amount on the squish area.Marchioni takes several small steps and checks the distance between the head and piston several times during the process. Incidentally, the top of the barrel can also be cut instead of cutting the head.



The head on the left has received the JM treatment. The one on the right is stock. Note how much larger the bowl on the modified head is and the squish band is much narrower.

put of a motor. Obtaining 100 percent efficiency is impossible, but gaining a few percent here and there is very much within the racers' grasp.

Friction can be reduced by using a true synthetic oil, heat can be put to work by wrapping the exhaust pipes with insulating material, the air intake can reduce its drag by using a well designed low resistance filter that smoothes out the flow and the combustion chamber of the engine can be massaged to yield the most energy out of the fuel as possible.

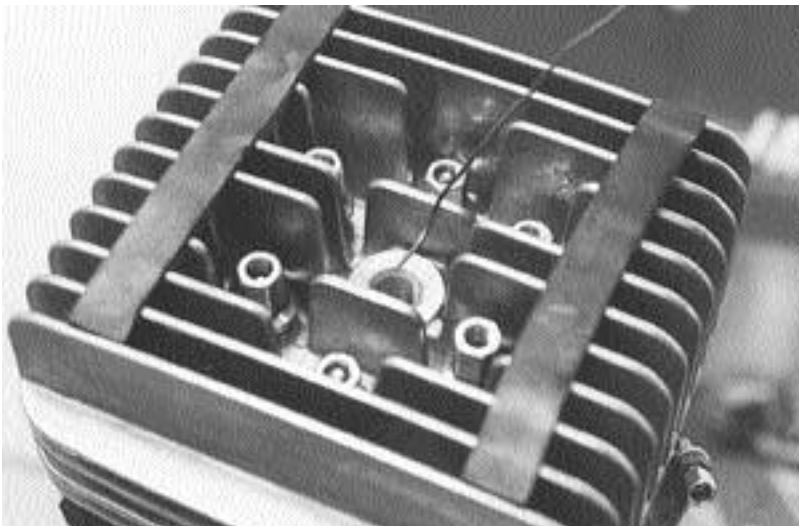


In order to reduce the squish band height, the head must be installed in a lathe using a mounting tool such as the one seen here.

To learn one of the ways to extract some power from the combustion chamber we turned to Jean Marchioni of J.M. Racing in Arcadia California, the importer of the Vortex engines and Tony karts. Jean has done much of his engine and kart tuning training in Europe where 2-cycle engine building has reached a pinnacle. Jean was the engine builder and tuner for Alex Barron the ex-karter now Indy car driver for Dan Gurney's All American Racers. Marchioni

The amount of power gained by reducing the squish area can be calculated.. If we start with a squish band of stock width and a height of .085-inch we find that this will contain a volume of 1.1 cubic centimeters or about 10 percent of the air/fuel charge. By reducing the squish down to .030-inch we would gain a 63 percent decrease in squish area volume. And 63 percent of 1.1 cubic centimeters is almost .70 cubic centimeters. We would now have an extra .70 cubic centimeters of useable air/fuel mixture in the combustion area. If the combustion chamber volume at TDC is 9 CCs (with the plug installed), and 1.1 CCs were trapped under the squish band, we net out 7.9 CCs in the combustion chamber. If the combustion chamber gas volume is increased by .7 CCs, we have improved the net volume by 8.8 percent (.7 CCs divided by 7.9 CCs). The air fuel volumes proportionate to the power output, thus the power output should increase 8.8 percent.

Another slight increase in power will also be experienced from the added turbulence created by the additional gases flowing into the burn zone and by the cooling effect the newly introduced charge will have.



To check the squish height, Jean uses a short piece of solder bent at one end.The solder is inserted in the spark plug hole parallel to the crankshaft.If the solder is inserted perpendicular to the crank the piston will rock and will yield a false reading.Thirty thousand of an inch should be the minimum distance allowed between the piston top and the head to prevent the piston from hitting the head when the throttle is released.

explained that the squish area is one of the places that is often overlooked by engine builders in the US and it can be a cause of lost power or, if approached properly a source of extra power.

J.M. explained that the only way to get all the energy out of the fuel entering the engine is to burn that fuel completely at the precise time during the compression stroke. In order for the fuel to burn completely, all the mixture must be in one as compact area as can possibly be produced in the center of the combustion chamber.

"Making power" is not always a matter of what you do but often how you do it.

Marchioni went on: "The combustion area consists of three parts: 1-the piston top, 2-the combustion bowl and 3-the squish area (also known as the quench area). The volume composed by the first two, on 2-stroke motors is controlled by the rules with a minimum volume. To improve power that volume must be brought to the smallest measurement legally possible (increasing the compression ratio). The squish area is the best place to reduce the volume."

On the Yamaha and most 2-cycle motors, the squish area is the donut shaped band located on the periphery of the combustion chamber. When the piston reaches top dead center the squish band becomes a thin area shaped between the piston top below, the head above, with the cylinder wall on one side and the combustion chamber on the other. This area is not a good place for gases to remain during the burn; the gases must be squeezed out of the outer edges of the combustion chamber toward the center where the gas ball can be efficiently ignited and burnt. The squish band is very thin and surrounded by relatively cooler surfaces causing the gases that remain in the squish band to burn poorly or not at all. In addition, the flame front cannot reach in such small an area to ignite the gases. The result is that some heat (energy, power) is left on the table. The gases squeezed out of the quench area serve to increase turbulence in the combustion bowl to improve homogenization of the air/fuel mixture, improving burn and reducing detonation.

Reducing the squish band to zero would be ideal. All the gases trapped in the band would be placed to good use in the combustion chamber. Obviously even a few thousand of an inch are not sufficient to prevent the piston from hitting the head when the engine is running. At high speeds a connecting rod can stretch as much as .020-inch and more when the throttle is closed suddenly. Allow a minimum of .030 to .025-inch between the head and the top of the piston. This distance will allow for some carbon build-up on top of the piston.

The angle between the piston and head should be equal throughout the squish band, however for motors turning consistent high RPM such as road racers and on some Sprint tracks with long straights, Marchioni recommends adding a slight angle to the squish towards the center of the head. This is done to reduce detonation and allows the motors to run cooler at wide open throttle.

Remember that when the squish band is reduced, the combustion area volume also diminishes. Typically, once the squish has been set down to .030-inch the combustion volume will be too small to pass tech and it will need to be reset.

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