is not necessarily best. Insofar as gas-flow is concerned, there is a point of rapidly diminishing returns with increases in valve size, and larger valves are a positive embarrassment when dealing with long-overlap valve timing. Moreover, the big valves, which are always added mass in the valve gear lower the point at which valve-float occurs. Finally, increased valve sizes mean bigger clearance pockets in the piston crown, and make it difficult to get a sufficiently high compression ratio.

By juggling all these factors around, we settled on an intake valve of 1 5/8" diameter, and a Matchless "twin" intake valve was selected to replace the Ducati valve. As a matter of fact, the largest Ducati 250s have an intake falve only a few "thou" smaller than 1 5/8" and the Ducati valve is made of excellent steel. Unfortunately the Ducati valve is horribly heavy. The Matchless valve, with its smaller diameter stem and deeply tuliped head, is ligh and has a shape well suited to the port we were planning.

Ah, yes. The intake port. Here was where all the sliderule work came to a grinding halt and we embarked on a long and frustrating excersise in what is sometimes called "the art of the possible". In other words, making the best of a bad situation. Indeed, we did not fully realize how sticky the situation was until we sawed a cylinder head apart - cutting along the ports. The exhaust port is fine, but the intake port is, according to our Technical Editor, dreadful. While no doubt very easy to cast, being perfectly straight, it directs the gas flow across the valve head, and our tests indicate that only half of the valve circumference is effective to any worthwhile extent. An entirely new port shape would have to be carved into the cylinder head.

In the end, the job was done by milling a new port at 6-degrees downdraft (measured from the plane of the lower cylinder head face), to replace the original 9-degree port. The new port's upper edge starts at the upper edge of the original, out at the port mouth, but because it is slightly larger in diameter, the cut overlaps the bottom of the port. As the cutter moves in, it begins to remove material from the port roof, raising it about .250" above the valve. Hand-finishing (with rotary-files) created a pocket above the valve head to direct flow downward at the point, rather than diagonally across the valve.

All this lifting of the port roof improves flow, but it also brings problems. These originate from the scanty amount of material between the port and the valve-spring/rocker-arm cavity. The port we have described breaks through into this cavity, and the break must be welded Also, it leaves what may eventually prove to be too little metal around the valve guide, and this is rather poorly supported after the porting work is completed. Frankly, we fear that after some hours of running, the intake guide in our modified cylinder head may come adrift. If it does not, we will have gained a wonderfully smooth port. Should the worst happen a boss to support the guide will have to be welded into the port.

It has become standard practice, when building a "hot" Ducati engine, to replace the stock hairpin springs with coils. Whatever inclination we might have had toward this was removed by the port shape used. To get room for coil springs, it is necessary to cut a relief in the spring-cavity floor at almost precisely the point where we had to weld on aluminum to close a breakthrough in the port roof. Thus to get a good port shape, one must be prepared to use hairpin springs. As we have found, this is not the handicap it might seem. If the valve gear is light enough, the hairpin springs will do the job and we had reduced the weight of our intake valve to only 53.9 grams - substantially lighter than a stock Ducati intake valve. (As a matter of interest, we used the original intake valve for an oversize exhaust valve, trimming it to 1 3/8" diameter. It is made of the same steel as Ducati's exhaust valves and was thereby suitable for its change of jobs).

Machine-shop work, apart from the milling of the intake port, included making special valve clearance caps, as the Ducati caps do not come in a size thick enough to work with the cam we used, and one had to be made to fit the smaller intake valve stem in any case. The camshaft is a Ducati part, and opens the intake valve 65-degrees before top center; closing it 75-degrees before bottom center and closes 50-degrees after top center. Lift is .380" for the intake valve, and .360" for the exhaust. The valve clearance problem arises because the extra lift has been obtained by going to a smaller base circle on the cam.

We also machined an intake manifold. This part was machined from the solid, with a flange at one end to bolt against the head, and the other end flanged to match the carburetor. Length is 3" from face to face, as this spacing gave us the correct overall tuned-length for the intake tract. The manifold's bore is tapered from 1 3/8" to 1 3/16" between carburetor and port.

With the valve lifts and diameters we had, the piston-crown clearance pockets were deep enough, but had to be made slightly larger. More depth might have been recquired, but we used the stock valve seats, and in cutting these for the bigger valves, we also moved the valves deeper into the head. Incidentally, the intake valve seat area was re-cut to give a larger radius, or rolled effect to improve flow when the valve is just off its seat. We might add here, too , that if you attempt to use larger valves than we have recommended, the piston's valve clearance pockets may become so large that there will be too little metal left above the upper right groove.

Little work is required down below the cylinder head joint. The stock piston was used, as it is a high-quality aluminum-alloy forging, and we did not feel that nay of the alternatives offered any particular advantage. A higher piston crown would have been appreciated, as we lost some of the original 10.0:1 compression ratio by sinking the valves in the head, and cutting larger pockets in the piston crown. With those changes,the compression ratio drops to about 9.5:1 and we would prefer 10.5:1. In the future, we may machine the cylinder slightly shorter to move the piston farther into the head and boost the compression ration up to the desired 10.5:1. A higher compression ration would yeild little gain in power, and with good breathing 10.5:1 will bring the engine near the point of detonation in any case.

One major modification we made that is not, in the strictest sense, entirely necessary, was to install a Swedish-made Stefa magneto. This unit is a standard fitting on the Greeves Challenger, and consists of a small rotor/generator coil/breaker-point assembly that feeds a low-tension output to a separate spark coil. Although primarily intended for two strokes, it has been used on 4-stroke engines, and its performance in both types of engines has been outstanding.

To install this magneto, we machined a new shaft to replace th one that normally drives the point breaker cam in the Ducati. The new shaft extends out past the timing case, and the magneto rotor is fixed to a taper at the shaft's end. The magneto's point plate fits into the recess provided for the stock point plate - after the recess is machined to a slightly larger diameter. We added a sleeve just behind the recess, and it holds a ball bearing that supports the shaft. With the added load imposed by the magneto rotor, we did