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Vim and Vigor for the VW

By Don Francisco

Photos by Francisco, Medley, Creitz

With 24 extra horses—Volkswagen's four-barrel packs a punch

THERE ARE MANY PERSONS who have suspected as much but now it has been proven that there isn't anything with four wheels that escapes the notice of hot rodders. This eager and ingenious group has made practically every make of automobile manufactured in the United States respond to its attention and now many of its members are directing their efforts toward imported cars. It doesn't seem to make any difference to them that a large percentage of cars imported into this country are small economy models that are bought by people who are interested more in transportation and fuel mileage than they are in acceleration and speed.

The very purpose for which small cars of foreign manufacture were designed would seem to make the application of hot rodding methods to their engines at cross-purposes to their reason for existence. However, many of these miniature power plants have been reworked in degrees that range from minor to all-out to make the cars in which they are installed perform better. The latest of the little chuggers to join the club is the Volkswagen.

Volkswagen is rapidly becoming the nation's most popular imported car. In fact, it has probably already attained this distinction. A junior version of the Porsche, which without doubt is one of the finest small cars in the world, the Volkswagen has attained its stature in the imported field by being outstandingly practical from the standpoints of reliability, operating expense, quality, and driving ease.

Volkswagen engines built in 1956 and later have a cylinder displacement of 72.74 cubic inches. This displacement is stuffed into four cylinders that have a bore of 3.031 inches and a piston stroke of 2.520 inches. Early engines of this displacement have a compression ratio of 6.10 to 1 and later versions have a ratio of 6.60 to 1. These ratios enable the engines to operate satisfactorily on fuels that have octane ratings between 74 and 80.

Compared to the compression ratios of 10 and 10½ to 1 in current domestic engines and the 100 plus octane fuels now available, these compression ratios and their fuel requirements are almost primitive. However, it must be remembered that the fuels available in West Germany, where Volkswagens are built, are not nearly as high in quality as those available to Yankee motorists. From an economy standpoint the Volkswagen fuel requirement is another point in the car's favor because the octane ratings of our lowest priced grades of gasoline far exceeds its demands.

The engines are horizontally opposed and built around a cast-magnesium crankcase. Two individual cylinders of grey cast iron bolt to each side of the case. Each pair of cylinders has its own light-alloy cylinder head that has combustion chambers of a modified hemispherical shape. Intake and exhaust valves are in the heads and they are actuated by rocker arms. Push-rods and solid valve lifters, actuated by a camshaft supported in bearings below the crankshaft, actuate the rocker arms. The engines are air-cooled and, as a point of interest, they weigh only 198 pounds, ready to run. The horsepower rating of engines that have the 6.10 to 1 compression ratio is 31 at 3700 rpm and the rating of engines that have the 6.60 to 1 ratio is 36 at 3700 rpm.

Some of the more popular pieces of special equipment available in the Los Angeles area for VW engines are Okrasa cylinder heads, Judson rotary vane superchargers, Weber stroker kits, and various reground camshafts.

Okrasa heads are made in Germany. They were designed originally for European customers who wanted to rework their stock VW's for racing. They are of aluminum alloy and they provide a compression ratio of 7.5 to 1 on a stock displacement engine. They have an intake port for each cylinder and oversize intake valves. Stock VW heads have one port for the two cylinders on each side of the engine. Each of the intake ports in Okrasa heads is larger in diameter than the single port in stock heads. Okrasa intake valves are 1.250-inch in diameter, compared to the 1.100-inch diameter of stock valves. Okrasa exhaust valves have the same head diameters as stock valves. In the kits supplied with the heads are two Solex carburetors made originally for Porsche engines, special air cleaners, throttle linkage, a fuel line for the two carburetors, and all the nuts and bolts required to install the heads and carburetors on the engine.

Superchargers are becoming more and more popular for road engines of all makes. The Judson blower made for VW engines is a small, compact unit that uses the stock VW carburetor and intake manifold. It is driven by two narrow V-belts by means of a special pulley that bolts to the engine's crankshaft.

Weber stroker kits are designed around special crankshafts manufactured by Harry Weber, owner of Weber Tool Company in Los Angeles. Harry is a hot rodder from way back and these crankshafts are only one of the many engine conversion parts his company manufactures. The shafts are nodular-iron castings and they are available with strokes ¼-inch and ½-inch longer than standard. They differ from stock cranks in that the arms between their main bearings and crankpins are full circles. They have main bearing journals and crankpins of standard diameters but ground to the small side of the factory tolerance to provide the maximum clearance allowed by stock specifications. The shafts are dynamically balanced in Weber's shop.

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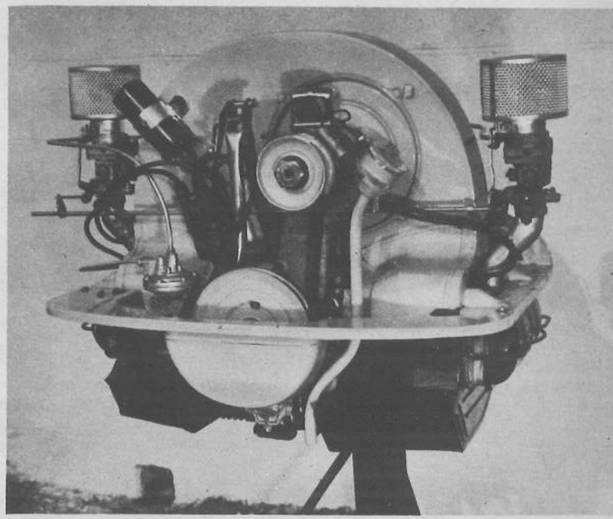

VW engine with dual carburetors on special intake manifolds. This engine was built by ex-midget race driver Norm Holtcamp, who now is a VW and Porche specialist in the L.A. area. Dual carburetion by itself doesn't help a VW too much because of restriction created by engine's small intake ports.

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Pistons in the kits are made by JE Engineering, Alhambra, California, and in top center position in the cylinders the top surface of their heads is the same distance from the top of the cylinders as the tops of the heads of the pistons in a stock engine. They use stock piston pins and have grooves for a 3/16-inch oil ring and two 3/32-inch compression rings—Grant rings are supplied in the kits. Also in the kits are reworked connecting rods, new connecting rod bearing inserts and a ¾ or full-race grind camshaft.

The connecting rods are reworked by grinding the sides of their big-ends that are parallel to the crankpins, the webs on the outer circumference of their caps, and chamfering the heads of their cap bolts. This reworking is necessary to prevent the lower ends of the rods from hitting the inner surfaces of the crankcase as the rods are rotated by the special crankshaft. Due to the longer stroke, the rod big-ends follow paths of larger diameter than normal and there isn't sufficient clearance in the cases for this greater range of movement unless the rods are altered.

Another possible point of interference in the engine as a result of the longer stroke is between the connecting rods and some of the lobes on the camshaft. Clearance at these points is adequate for a quarter-inch shaft but when a half-inch shaft is installed it becomes necessary to install a camshaft that has smaller cams. This means that the stock camshaft must be reground. Weber can supply camshafts ground for this purpose. Valve timing provided by these shafts with running valve clearance is as follows: Intake valve opens 30 degrees before TDC, intake valve closes 71 degrees after BDC, exhaust valve opens 71 degrees BBC, exhaust valve closes 30 degrees ATC. Valve lift is .300-inch. Lash setting is .006-inch for all valves. Valve timing provided by a stock camshaft, with .040-inch valve lash, is as follows: Intake valve opens 2 degrees 30 minutes before TDC, intake valve closes 37 degrees 30 minutes ABC, exhaust valve opens 37 degrees 30 minutes BBC, exhaust valve closes 2 degrees 30 minutes ATC. Valve lift is .293-inch. Lash for all valves is .004-inch, cold.

Weber's stroked cranks and the other parts in his stroker kits may be bought separately if one so desires. Old parts—connecting rods and camshaft—may be traded in for credit on the new parts. Prices of the kits are $237.50 for a half-inch shaft and $199.50 for a quarter-inch shaft, with your connecting rods and camshaft in exchange. Crankshafts, alone, are $125.00. Weber will install either of the crankshaft and rod assemblies in your crankcase for $30.00. This would be money well spent because you would be sure that the installation was correct and that points of interference in the case had been taken care of correctly.

Installation of a stroker kit in an otherwise standard engine or one fitted with an Okrasa kit is fairly simple. The crankshaft, reworked connecting rods, and the pistons are installed in exactly the same manner as stock parts. The only special work that must be done involves either machining ⅛-inch from the lower ends of the cylinders or grinding ⅛-inch deep slots in the ends of the cylinders in line with the connecting rods to provide clearance for the upper ends of the rod cap bolts and the areas around them. Slots for this purpose must be slightly wider than the rod big-ends.

It's possible to use stock pistons with a quarter-inch crank but when this is done special spacers equal in thickness to one-half the stroke increase must be installed between the crankcase and the cylinders. These spacers move the cylinders away from the crankshaft so that when the pistons are at top dead center in the cylinders their heads will be the same distance from the top surfaces of the cylinders that they were with the stock crankshaft. The skirts of stock pistons used for such installations must be shortened an amount equal to one-half the stroke increase to prevent their striking the crankshaft when they are in bottom center position in the cylinders. There is an ample range of adjustment in the valve lash adjusting screws in the rocker arms to compensate for the distance the cylinders are moved away from the crankcase by the spacers.

Actually, Weber crankshafts don't lengthen the stroke a full ¼ or ½-inch. A quarter-inch shaft lengthens the stroke to 2.750 inches which is an increase of .230-inch instead of the .250-inch of a full quarter, and a half-inch crank lengthens the stroke to 3.00 inches, which is an increase of .480-inch insted of the .500-inch of a full half. With cylinders of stock diameter, a quarter-inch shaft increases an engine's displacement from its stock 72.73 cubic inches to 79.36 inches, and a half-inch shaft increases the displacement to 86.58 inches.

Increasing the piston displacement of any engine automatically raises its compression ratio if the pistons rise to the same height in relation to the top surfaces of the cylinders that they did originally and if the combustion chambers in the cylinder heads aren't altered in any way. In engines that have a standard compression ratio of 6.10 to 1, a quarter-inch shaft raises the ratio to 6.56 to 1, and a half-inch shaft raises the ratio to 7.07 to 1. In engines that have a standard ratio of 6.60 to 1, a quarter-inch shaft raises the ratio to 7.11 to 1 and a half-inch shaft raises it to 7.66. The smaller combustion chambers in Okrasa cylinder heads raise the ratio of engines with both standard ratios to 7.50 to 1. With a quarter-inch shaft the ratio jumps to 8.09 to 1, and with a half-inch shaft it is 8.73 to 1.

There are two ways to determine the value of special engine equipment. One of these is by installing the equipment on an engine in a car and then conducting performance tests with the car. The other is to install the equipment on an engine and then measure the engine's torque

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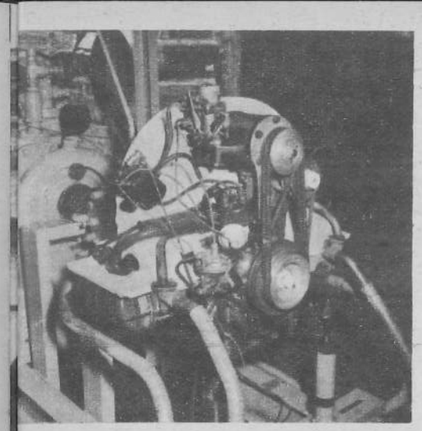
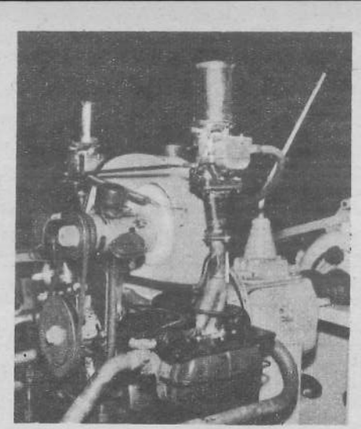
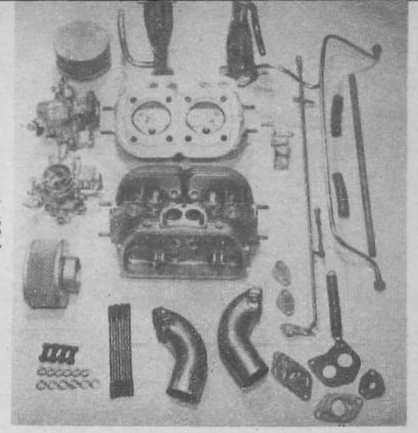
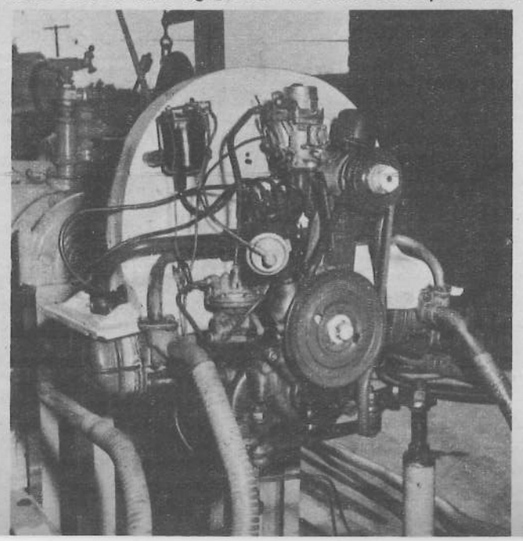


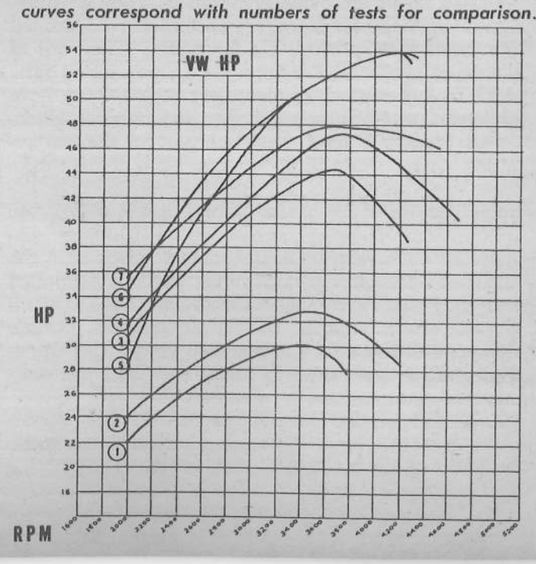




VW engine on Weber's dynamometer for its preliminary test. Horsepower and torque figures obtained on this test were used as base figures for all of the subsequent tests.



On this graph are the horsepower curves for each of the dynamometer runs described in the text. Numbers on the curves correspond with numbers of tests for comparison.

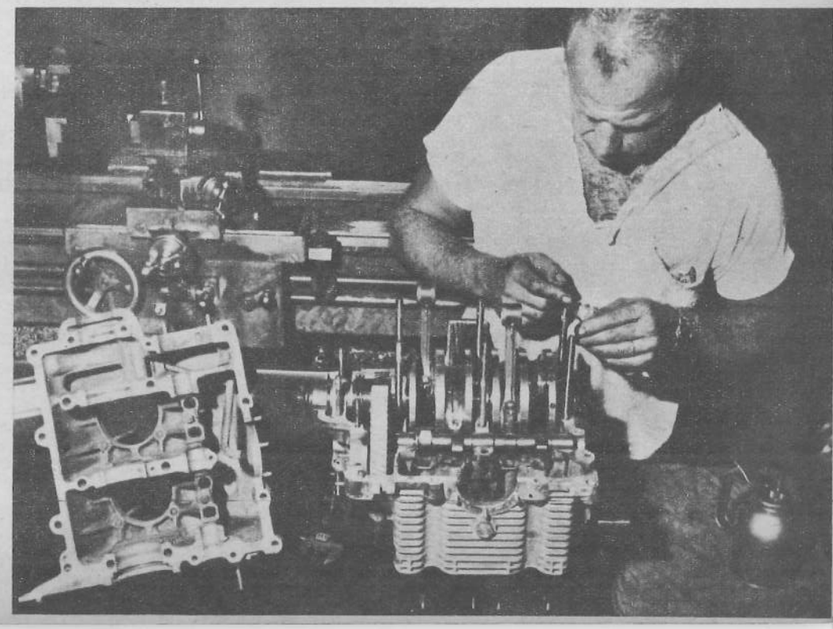


ABOVE, LEFT • Stroked VW engine fitted with vane-type Judson supercharger, as it was set up during test number five.

ABOVE CENTER • Engine fitted with Okrasa cylinder heads and dual Stromberg 81 carbs. Adaptors were necessary between carbs, Okrasa manifolds.

ABOVE, RIGHT • Pictured above are complete parts supplied with Okrasa kit. In addition to high compression cylinder heads are two Porche carbs.

RIGHT • Johnny Price, of Weber Tool Co., Los Angeles, installing one of Weber's stroker kits in a VW crankcase assembly. Care must be taken during this part of job to eliminate points of interference of rotating parts and case.



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and horsepower outputs on an engine dynamometer. Each of these testing methods has its own individual merits. When Harry Weber recently began a series of VW engine tests to determine the effectiveness of his and other VW special equipment, he chose to start by running an engine on the dynamometer his company maintains for this sort of thing. The results of the tests point out with clarity the limitations of stock VW engines and the advantages to be gained with the special equipment now available. These tests were conducted by Johnny Price, who has been with Weber for many years. Premium gasoline was used for the tests involving the blower and the Okrasa kit and regular was used for all other tests.

The engine used for the series was a 1956, 6.1 to 1 compression ratio model. Tests with seven different setups were made. The engine's condition for each test and the maximum horsepower and torque it developed on each test were as follows:

Test #1. The engine was completely stock in all respects. Horsepower was 30 at 3500 rpm and torque was 58 pounds-feet at 2000 rpm. The horsepower curve between 2500 and 3700 rpm was very flat. Total spread over this speed range was only 2.2 horsepower.

Test #2. The stock Solex carburetor was replaced with a Stromberg 81 carburetor made originally for 60 hp Ford V8 engines. This is a two-throat carburetor and it was necessary to make an adaptor for it to enable it to be fitted to the stock intake manifold. The carburetor had .035 main metering jets and a number 72 pump jet. Mixture supplied to the engine by the carburetor with these jets was on the rich side, but as they were the smallest available, the mixture was made leaner by lowering the float level in the carburetor. Maximum horsepower was 33 at 3500 and maximum torque was 63 pounds-feet at 2000 rpm.

Test #3. A half-inch crankshaft and piston assembly and a camshaft reground to provide clearance for the longer stroke were installed in the engine. The additional stroke increased the engine's displacement to 86.5 cubic inches and raised its compression ratio to 7.07 to 1. In other respects—carburetion, ignition timing, etc.—the engine was stock. Maximum horsepower was 44 at 3700 rpm and maximum torque was 81 at 2000 rpm.

Test #4. The engine was exactly the same as for test #3 with the exception that its carburetor was replaced with the Stromberg 81 carburetor jetted and adjusted as before. Maximum horsepower was 47.5 at 3700 rpm and maximum torque was 85 pounds-feet at 2200 rpm.

Test #5. The engine was the same as for test #4 with the exception that a Judson supercharger fitted with a stock carburetor was installed and the initial ignition timing was retarded to provide a maximum advance of 30 degrees. Maximum horsepower was 54 at 4200 rpm and torque was 81 pounds-feet at 2700 rpm.

Test #6. The stock carburetor on the Judson supercharger was replaced with the Stromberg 81 carburetor jetted and adjusted the same as for previous tests. Maximum horsepower was 54 at 4200 rpm and maximum torque was 90 pounds-feet at 2000 rpm.

Test #7. The engine was the same as for test #3 with the exception that a set of Okrasa heads and dual Stromberg 81 carburetors jetted and adjusted as for previous tests were installed. Ignition timing was adjusted to provide 32 degres total advance. With the Okrasa heads the engine's compression ratio was boosted to 8.73 to 1. Maximum horsepower was 47 at 3700 rpm and torque was 85 pounds-feet at 2500 rpm.

Horsepower curves on the accompanying graph show some interesting things about the tests. The curve for test #1 shows the lowest power of all the curves throughout the entire range of engine speed. Test #2 shows a slight horsepower increase at low engine speeds with a wider margin of increase at the engine's peaking speed, which was the same as for test #1. This additional horsepower is attributable to the approximately double venturi area provided by the Stromberg two-throat carburetor over the stock Solex.

The curve for Test #3 shows greatly increased power at low speeds with the increase growing progressively greater as engine speed goes up. Peaking speed for this test was 200 rpm higher than it was for previous tests. This additional horsepower is attributable to the combination of displacement increase, which

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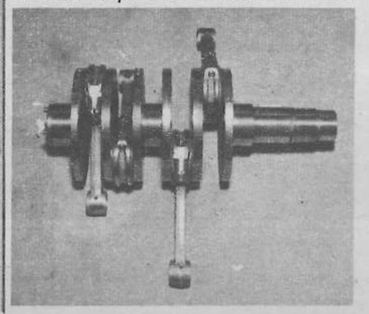
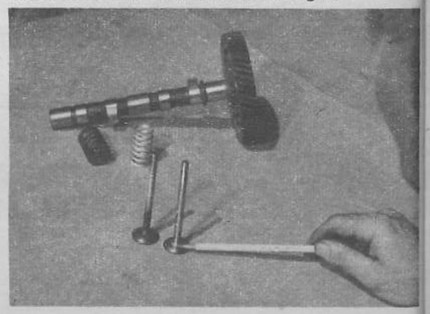
Weber Tool Co. stroked crankshaft for VW engine has circular arms between its crankpins. Rods on shaft were reworked to provide clearance in case.



Weber reground camshaft, stock and special valve springs, and standard VW valves. Head on valve at right was undercut to aid mixture flow to engine.



Standard VW piston at left and special stroker piston. Compression height and skirt of special piston are shorter than on stocker because of additional stroke.

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resulted from installation of the stroked crankshaft, the higher compression ratio that automatically resulted from the larger displacement, and the improved valve timing provided by the reground camshaft.

The curve for test #4 follows the curve for test #3 quite closely but it is slightly higher at 2000 rpm and the difference increases to the peaking speed of 3700 rpm. This follows the trend set by the curves for test #1 and #2, and the higher power of test #4 is also the result of the additional venturi area of the Stromberg two-throat carburetor over that of the Solex.

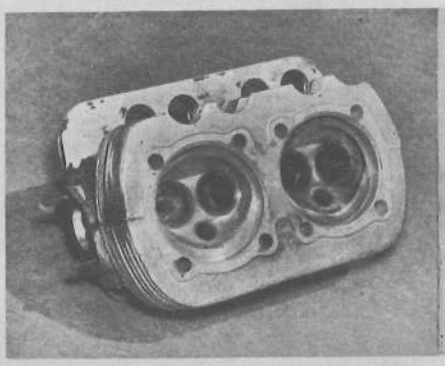
The curve for test #5 starts at a lower rating than the curves for tests #3 and #4, although it is considerably higher than those for tests #1 and #2 . This low initial output is undoubtedly due to the breathing restriction imposed by the supercharger and the small venturi of the Solex carburetor. The curve climbs rapidly as engine speed increases, indicating that the blower has taken effect, until it reaches the maximum horsepower developed during the series of tests.

The peaking point for curves 5 and 6 is 700 rpm higher than for curves 1, 2, and 7, and 500 rpm higher than for curves 3 and 4. The curve for test #7 represents the engine's best output in an unblown condition. It starts at the highest output of all and climbs rapidly to its peak at the same rpm as the curves for tests #1 and #2.

As can be seen by the curves, the horsepower for all tests except numbers 6 and 7 dropped rapidly after the peaking speed was reached. This was caused by the limited breathing of the stock cylinder heads and the Solex carburetor. The drop in test #6 was much less rapid due to the additional breathing capacity of the Stromberg carburetor. For test #7 the curve was quite flat from the peaking speed of 3500 rpm to 4500 rpm. This is where the additional breathing capacity of the Okrasa heads and the Stromberg carburetor made it possible for the greater piston displacement resulting from the longer stroke, and also for the higher compression ratio and longer valve timing, to be used to advantage. The higher peaking speeds for curves 5 and 7 were made possible by the forced breathing effected by the blower. Forcing the fuel and air mixture into the cylinders overcame some of the breathing restrictions inherent in the stock heads.

On-the-road experiences with one of the quarter-inch shafts in the VW that Tom Medley, who is advertising sales manager for one of our companion magazines, drives every day are quite enlightening. A certain hill in the Los Angeles area that Tom's VW would climb at 45 mph in stock form can now be stormed at 60 mph in the same gear. This is an increase of 33 percent in speed, which is almost unbelievable but true. Acceleration throughout the range from rest to top speed is much improved and top speed is five miles per hour higher than it was before. Tom wouldn't go back to stock now for the price of the car.

Stock cylinder head for VW engine is an aluminum casting. It has intake and exhaust valves of the same diameter, a single intake port for the two cylinders.



Weber stroked VW crankshaft above a stock shaft. Special shaft is a nodular-iron casting. It differs from the stock shaft in the shape of its crank arms.