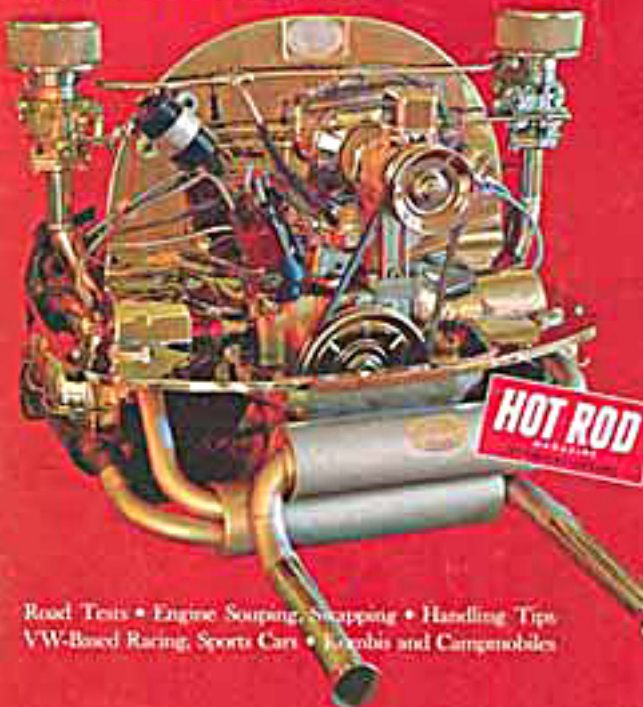


Volkswagen

HANDBOOK

By The Editors OF HOT ROD MAGAZINE



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SUPERCHARGING

Pro's and Con's of Blowing the Beetle

IN any discussion of the Volkswagen engine and what can be done to improve its output, there instantly arises a question: "Why go into a lot of mechanical alterations when there are superchargers available?"

This is a good point and the answer to it is complex enough to demand a separate treatment.

Having determined that the power output of an engine is a function of its volumetric efficiency—the ability to take in the fuel-air mixture and use it to best advantage—the only way to raise that output is to get more combustible material into it in the same period of time or squeeze more out of that charge. This is accomplished in the mechanical, or modification, way by eliminating restrictions in the induction and exhaust systems, using increased valve timing, employing a higher compression ratio and/or enlarging the capacity of the engine itself.

All this is done to overcome a physical condition which

exists in the normally aspirated engine: Seldom does it approach 100 percent efficiency because the cylinders are never filled to capacity with the fuel mixture. Inertia, the resistance of a stationary object to motion, is a characteristic of gases, just as it is of human beings. Consequently, as the piston descends on the intake stroke, there is a lag in time before the gases in the manifold follow it down into the cylinder. The descending piston creates a vacuum and atmospheric pressure pushes the fuel-air mixture in to relieve the vacuum. Thus the maximum pressure which can be exerted to get the gas moving, to overcome its inertia, is 15 pounds per square inch at sea level, a pressure which drops off with increased altitude.

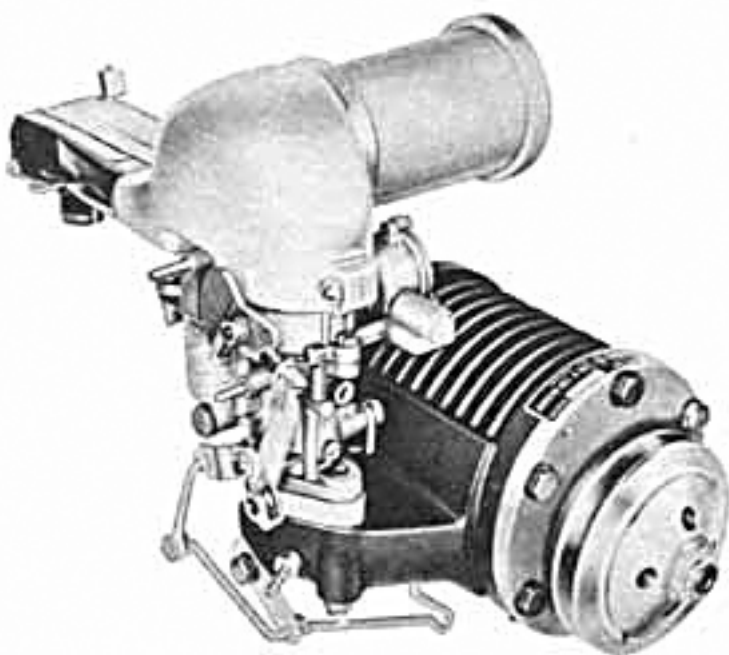
So, even with cleaned up ports and large valve overlap, the best breathing can only result in partially-filled cylinders. The higher the engine speed, with a given valve timing, the less the filling occurs, the more the compression ratio drops and the more the power curve assumes the droop of a piece of wet spaghetti.

It can be seen that the answer is to get some more pressure behind the effort to move the incoming mixture. Hence the supercharger.

The supercharger, or blower, as it is more familiarly called, is merely a compressor capable of aspirating a quantity of air greater than that which the engine can take in at the normal rate. It forces a fuel mixture into the manifold and a greater pressure than that of the atmosphere is available to push right into the cylinders. A more complete filling of the cylinders results and, since the amount of power produced by an engine is in proportion to the amount of combustible mixture, the output goes up directly as the manifold pressure rises.

Since the supercharger is driven at a speed in proportion to engine speed, its output also rises as speed goes up, thus maintaining power past where it would fall off in the normally aspirated engine, at least up to the point where the efficiency of the blower itself begins to decline.

There are three basic types of blowers. One is the centrifugal which operates at high speeds to do what the name implies, throw air off the tips of its impeller blades through centrifugal force. Another is the Roots. It has a pair of lobe impellers which run at extremely close tolerances. As they revolve and mesh they trap a certain amount of air and expel it forcefully. A third type is the rotary vane wherein the



Judson supercharger for Volkswagen is sliding-vane type which operates efficiently at low speeds, helps torque in range needed by most drivers, is offered as substitute for hot rod techniques.

vaner rub along the wall of a cylinder which is not concentric with the rotor. The vanes are free to slide in and out of the rotor so they trap a given amount of air, compress it as the non-concentricity of the cylinder makes the space smaller, and expel it into the outlet.

The first type is familiar to Indianapolis racing fans, being a principal feature on the Novi Specials. The Roots type has been used on a great many European sports and racing cars, from Bentley to Maserati and is common as the GMC blower on trucks and all manner of hot rods. Of the rotary vane type, the Judson is the best known here, although a couple of others have been distributed from time to time.

The centrifugal blower is not suited particularly to low speed engine operation, although a variable-ratio drive is used to overcome this handicap and make it more amenable to street use. The Roots type is pretty expensive and its internal gears are prone to excessive wear where both acceleration and deceleration are a big factor so it is not truly practical for an economy package. On the other hand, the vane type is not too costly, works well at low speed and has been pretty widely promoted and sold. The Judson company's advertising mentions "65,000 Volkswagen owners," who are receiving complete satisfaction from its blowers so a considerable number must be in use overall, making service or installation fairly close at hand.

The Judson claim of 45 to 50 percent increase in horsepower is encouraging to the VW owner. So is the notion that the supercharger can be installed without going below the cooling shrouds and is basically a bolt-on effort.

Performance figures bear out the claims pretty well. Maximum speed goes up to 83/85 mph; zero to 60 acceleration time drops from about 27 seconds to approximately 14 and a big jump in flexibility occurs in the mid range where using the shift lever is ordinarily the cure for sluggishness.

The Judson provides a maximum pressure boost of six psi, which is not excessive and contributes to the life of the unit

as well as not imposing extreme loads on the crank. In fact, the blown engine should be less susceptible to crank failures since the piston is coming up against a cushion of air at the top of the exhaust stroke (because of positive pressure and valve overlap), rather than being jerked to a sudden halt as the crank reaches top dead center and begins its descent.

As an item which retails for about \$150 and does not involve excessive installation time, the blower seems a valid investment in performance increase.

To check out exactly what is involved, what can be expected and what the limitations of the supercharger are, we consulted Bill Corey of Pasadena, California, who is the Western Distributor for Judson.

Taking a stock VW to his shop on Colorado Blvd., we went through an installation, just like any customer. Initially we were told that the car would be tied up for about six hours and that the charge would be \$32.50 plus parts. The parts would be distributor points and spark plugs since a tune up is part of the installation.

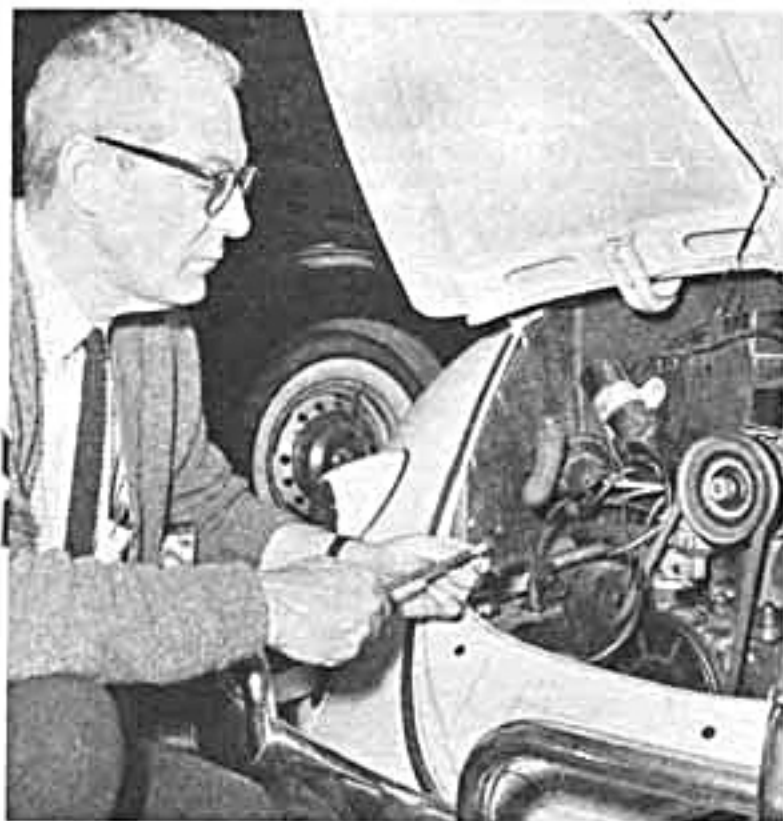
"If a customer is not entirely happy with the car's performance after he installs some new gadget on it, the gadget invariably gets the blame," says Bill. "So, we try to make sure the automobile is in reasonable condition when we add the blower. If an engine is entirely too ratty, we won't touch it. The owner is simply not going to realize the performance he should."

On the other hand, Bill also advises against installing a blower on a brand new car. It should be correctly broken in and have about 3,000 miles on it.

As part of the installation, Bill and his mechanics look for intake manifold leaks, check all wiring, remove the distributor, clean it, lubricate it, make sure the vacuum advance is working properly, and put in the new points. They also make sure the fuel pump is delivering rated capacity and that the fan control ring and its thermostat are operating correctly. The owner who contemplates home installation should do

Bill Corey, Western Distributor for Judson, advocates engine tune-up as part of blower installation. Hundreds of conversions have been made in his shop with few owner complaints.

VW specialist Rudi Cali prepares engine for blower. Contrary to popular misconception, blower does not impose extra load on crank but actually contributes to engine reliability.



likewise, since the increased output of the engine will intensify any overheating symptoms caused by faults in the ignition, cooling or fuel supply.

The VW carburetor is removed and should be disassembled for cleaning if it is dirty. Included in the Judson kit is a new main jet which is to be installed before the carburetor is mounted on the blower.

Also included are a second pulley, to be mounted on the crankshaft in front of the existing pulley, and a new outer half for the generator pulley which will allow the supercharger belt to clear.

It might be mentioned at this point that there are two different kits—one for the 36-hp engine and one for the 40-hp model. They are not interchangeable but installation procedures are substantially the same with the exceptions noted.

In the 36-hp engine supercharger kit, there is a replacement spring for the fuel pump which brings its capacity up to an amount sufficient for the increased demand of the carburetor with the blower. This is not required with the 40-hp model. Other minor differences with the 40-hp kit include attaching the heated air intake from the stock VW air cleaner to the inlet of the Judson air cleaner and fitting in the crankcase vent tube. It is also necessary to re-position the coil on the fan housing and change the position of the tail light wire slightly to provide clearance.

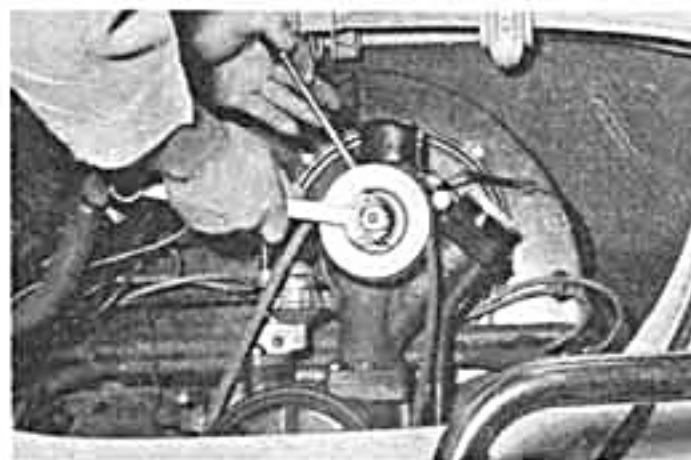
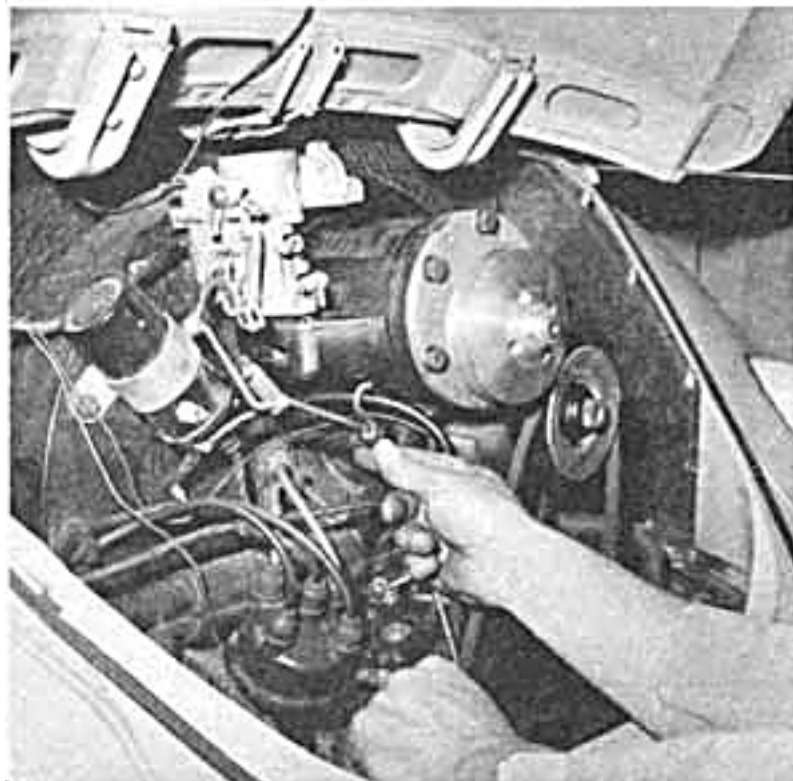
With the 36-hp kit, drilling a new hole in the fan housing for the choke cable is required and moving the relay on top of the generator is necessary in some cases.

None of this calls for excessive mechanical skill or time. The throttle linkage is all furnished and is bent to mate with the throttle cable of the VW with only slight fudging. The original fuel line and vacuum lines need only to be bent slightly with the 36-hp kit. New lines are furnished with the kits for the later models.

The supercharger mounts directly onto the intake manifold in the position formerly occupied by the carburetor. The outlet of the blower mates with the manifold port with a thick gasket between. This gasket (or gaskets) controls the belt tension, so it is sometimes necessary to add thickness here to compensate for a stretched belt.

The inlet manifold of the blower is positioned at the bottom left hand side and the carburetor sits atop it.

Throttle connection for carburetor is provided in linkage which accompanies Judson blower. Coil must be moved on fan housing.



Fitting of alternate fan-generator pulley is necessary in order to provide sufficient clearance for supercharger drive belt.

the air cleaner is added, it is somewhat higher than the original air cleaner and clearance is critical. On the sedan, the cleaner must be pointed just so, to avoid rattles. The method used by installers to make sure that the cleaner is properly shoved down on the carburetor is to put it on, close the deck lid slightly and then tighten the clamp bolt.

On the convertible it is necessary to remove a small portion of the air baffle on the inside of the deck lid. The Karmann Ghia requires some deck lid modifications, not, happily, very involved. An air scoop is included with the kit along with a template for trimming the hole it covers. With Transporters and Kombis the engine compartment clearance does not permit mounting the air cleaner directly atop the carburetor unless a small section of the inner panel is removed. This is a hammer and chisel job and nothing is affected by slicing out the metal.

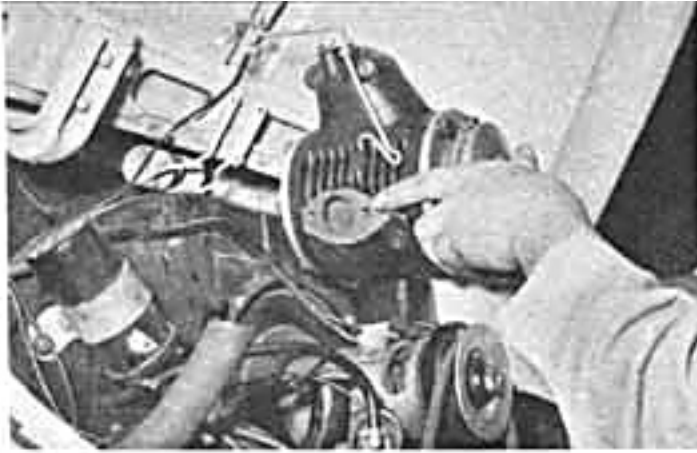
With the blower mounted, fuel and vacuum lines connected, along with throttle and choke wire or cable, the remaining step is in fitting and regulating the automatic oiler which is to be hung on the firewall.

This is a transparent container holding a quart of lubricant for the blower. The vanes of the supercharger, rubbing on the inner wall of the housing as they do, require lubrication at the rate of one quart per 1,000 miles, about the same as an engine. The factory recommends SAE 10 engine oil as the medium. It can be a detergent oil but should not be a multiple-viscosity type (10-30, for example).

Corey's experiments with blower installations over a number of years have led him to a lubricant with a castor-oil base as being most suited. It has the advantage of being an excellent upper cylinder lubricant (as in two-stroke engine practice) and reduces blower operating temperature. In dynamometer tests, the power required to drive the supercharger was lowered 17 percent and a 10 percent gain in horsepower at the rear wheels was picked up when the castor base lubri-

Integral part of Judson supercharger is oiler which supplies lubricant for blower and top oil for cylinders and valves.





Blower mounts directly onto VW intake manifold in place of carburetor. Gaskets here are used to adjust drive belt tension.



Installation can be made by amateur mechanic but professional job has advantages from service and correct tune-up standpoint.

cant was used. It is somewhat more expensive, naturally, but the improvement is evidently worth the cost.

This discovery can go a long way toward ameliorating one of the objections to the supercharger as a hop up item. On a long, sustained high power demand operation, such as cruising at full chat for a hundred miles or so, the operating temperature of the blower rises considerably and power falls off commensurately. (This becomes quite noticeable and many owners are puzzled or begin to think that the engine is failing.) If you can ease off and cool the entire system down, power will come back up. But, it remains as a debit on the ledger.

It is also necessary to remember to crack the throttle open from time to time on long down grades so that the blower will be lubricated.

These are about the only operational hazards with the exception of stretched belts. As any VW owner knows, the fan belt needs an adjustment within 50 to 100 miles after it has been replaced and subsequently throughout its life. The Judson arrangement requiring additional gaskets under the blower is not made to order for the lazy driver who is more apt to go on with a slipping belt and getting partial power than he is to add a gasket. A simple tensioner or the use of a pulley on the blower like the one on the generator would seem to be a simple, worthwhile improvement.

It also seems that a larger carburetor could be tolerated on the VW when the Judson is employed. The use of two stock carburetors or a dual throat with 24-mm chokes has been shown to be a definite improvement on the stock engine and there is no reason to think that this additional breathing would not be helpful.

Of course, the idea of the Judson, and the basis of its tranquility and long life, is not to get into excessive boost. It does a fine job on the VW. More performance, perhaps, is not what the average car requires under the conditions. The

blower delivers only on demand, of course. That demand is regulated by the throttle butterfly and the driver's foot. It is probable that the average blown VW is "supercharged" only a small percentage of the time, when the throttle is opened and held open for a full surge of power. At idle or when cruising on part throttle it is merely free wheeling in the system. So, it is doubtful whether the median driver would actually call for maximum possible performance from such an instrument.

The blower's best contribution is that it gives additional torque in the normal operating range of the engine. It is not necessary to extend the rpm range in order to improve the aspect of the power curve.

This, of course, separates it as a hot rodding device from the ordinary modifications and makes an easier choice of what to do. Inasmuch as there are no readily available optional gears for the VW, a blower will not extend the top speed as much as some other methods. It also will not provide as much acceleration as substantial modifications, even though the horsepower gain may be the same on a dyno. The required acceleration of the blower itself is enough of a damper to make the difference.

On the other hand, reliability is certainly not sacrificed and the substantial boost in torque where the VW needs it for day-by-day driving is a tremendous recommendation.

Compared to the stock VW, fuel consumption goes up by about five percent if operated under the same conditions, says Judson. More vigorous use will be attended a drop in economy. Somewhere around 25 to 27 mpg would be a fair estimate of the blown VW driven by the enthusiast.

Driven in an intelligent manner, with the full realization that this is a valuable assist but not a device to transform the VW engine into a racing powerplant, the blown VW should be a thoroughly satisfactory machine over a long period of time. ■

Completed installation is neat, trim and allows normal servicing operations to be carried out without undue interference.



Close up of pulley arrangement shows how blower drive pulley is bolted behind stock pulley. No special tools are required.

