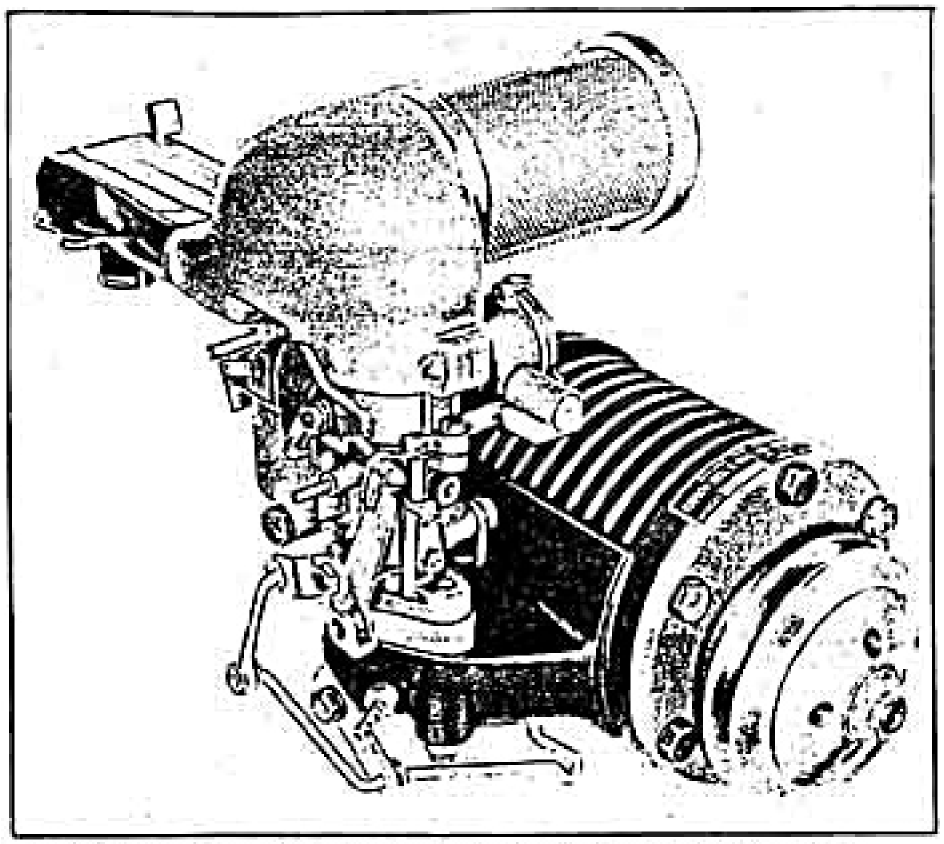
SUPERCHARGING PART 1
Magic Word Among the Performance Crowd

BY TEX SMITH



The Judson vane-type, positive displacement supercharger is perhaps best known of American blowers, and is particularly suited to smaller displacement engines.

Installed on the VW engine, the Judson will give up to 40-percent horsepower increase with an average of 5-percent gasoline mileage drop. Blower must be installed and serviced properly, however.

Centrifugal force keeps sliding vanes in near total contact with blower housing. Vane design is among quietest.

NOTHING CAN BREATHE super muscle into an ordinary automobile engine like a supercharger. Yet, to the average enthusiast, forced induction seems the private playground of a privileged few armed with cubic money. Yes, supercharging does cost money, but so do multiple carburetion, modified profile camshafts, and special exhaust systems. Dollar for dollar, however, supercharging is likely to give more dependable results than the traditional approach to power.

In the simplest sense of the term, supercharging is the increase in volumetric efficiency due to increased fuel mixture weight. It does not make the engine turn a significantly greater rpm; it does make it produce more power for a given rpm, something a modified profile camshaft does to a degree. In engineering terms, this becomes an artificially-increased atmospheric density (pressure, or forced induction), possible by augmenting the weight of the induced air charge. In lay terms, it means the engine is fooled into thinking there is more than normal atmospheric pressure. In buggy terms, it means you can put the trick on all the other machines.

First things being first, it is in order to dispell a widespread suspicion of supercharging, held by off-road buffs in general. A blower will not cause gasoline mileage to fall in half (about 5 to 8 percent consumption increase is normal). The bottom end does not suddenly fall through the oil pan because of supercharging (total life expectancy of mechanical components in good shape is shortened by less than 6 percent). Pistons and valves do not disappear because of a blower (they fail because the engine is not tuned to the supercharger and the owner fails to observe reasonable engine maintenance). A supercharger does not automatically "sand" an engine (silicon and foreign material will enter any engine with poor filtration, the amount in direct proportion to the level of pressure differential between combustion chamber and atmosphere).

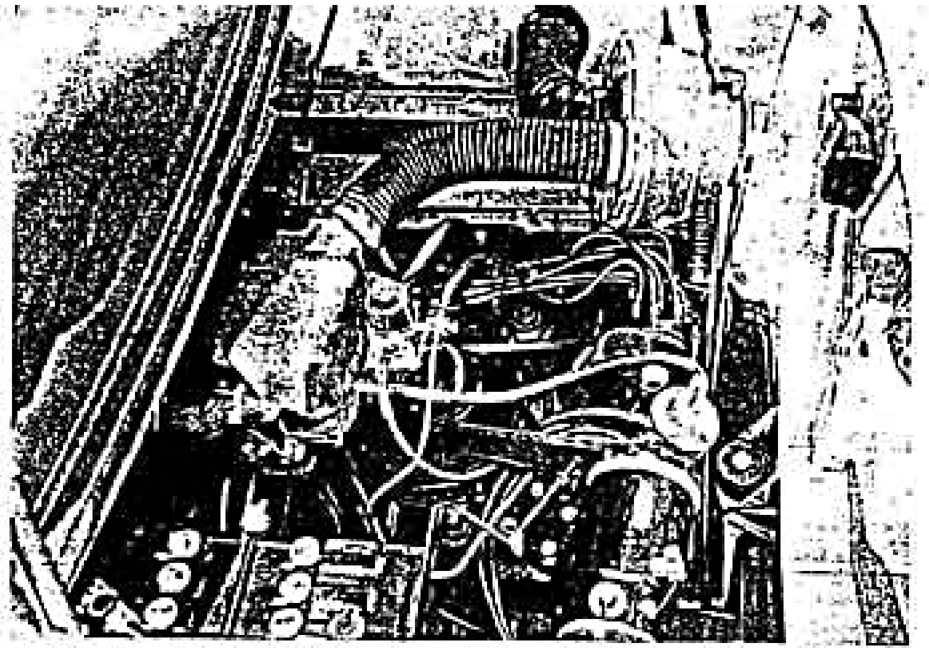
There are just so many things possible to make an engine run better, and improvement of volumetric efficiency is an integral part of most. The normal hop-up procedures are all aimed at this secret of power, with an increase in the atmospheric pressure available considered the ultimate possible improvement. However, the modern internal combustion engine has long since been refined until the difference between what once was hot and what now is stock is a fine line. Most engines include running production engineering changes to upgrade quality of the mechanical components as horsepower requirements increase. The 36-bhp VW engine is a far cry from the modern VW 1600, yet it is basically the same design. Chrysler's 440-c.i. B-series wedge engine may be the same general concept of the original 361-c.i. version, but horsepower is almost tripled! These are examples of engines refined and refined again, using atmospheric pressure of 14 psi plus as the constant. If that constant is changed, there is room for additional refinement.

Discounting the problems of energy release by this or that fuel mixture, which includes the amount of total "burn" and total energy possible, the point has been reached where movement of a specific mass of mixture into the combustion chamber can be improved upon only slightly. This doesn't imply that a great deal of improvement can't possibly be made to certain engines. Of course, the VW engine can have its power increased with normal hop-up techniques, but keep in mind that the best way to achieve gasoline economy is to restrict the breathing capacity. The VW, therefore, is not a good example of powerplant refinement. The Porsche engine, almost a carbon copy in its basic design, is a better example. The solution is to move the inlet charge (overcoming inertia) by pushing harder.

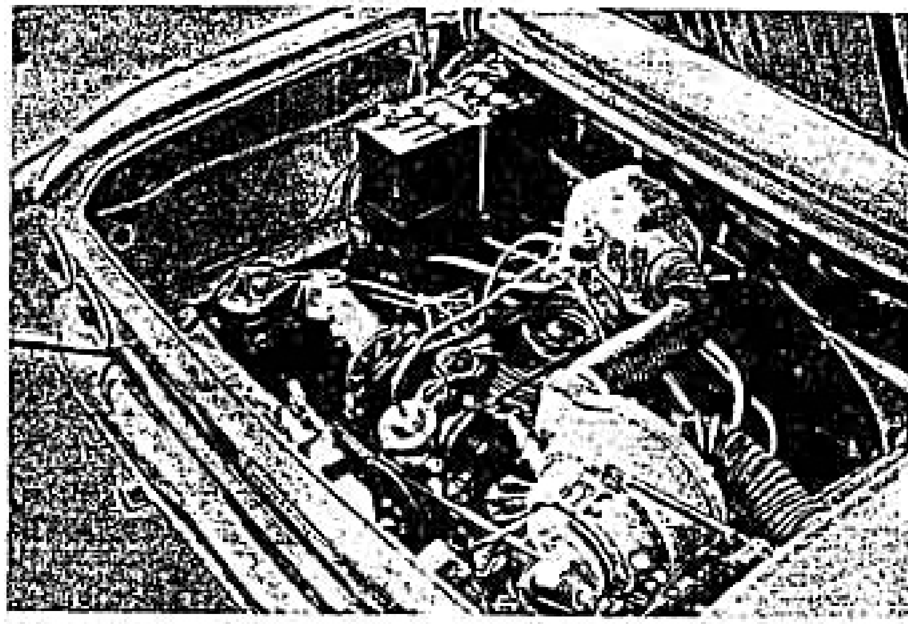
There are four basic types of superchargers, three considered most relative to automobile engines. An early method of forced induction was the simple piston compressor (like an air compressor), which can give a high volumetric efficiency, but is not ideally suited to high-speed automotive engines. This type of blower is generally restricted to marine and industrial engines. The buggy enthusiast must then turn to one of the remaining three: positive displacement; centrifugal; or turbo-supercharging.

Of the three, centrifugal supercharging is the most noted in American car history. Perhaps the first real attempt at gaining public acceptance of the supercharger was made with the Graham automobile in the 1930s. Although performance from the 3 psi boost was excellent, and gasoline mileage quite high (the Graham won the Mobil Economy Run many times), owners weren't of a nature to maintain the extra mechanical gadget. Thus was born an axiom that remains today: the supercharger will do great things for an engine, but it's difficult to get the owner to take care of it.

Some tremendous applications have come from these early experiments with centrifugal supercharging—the famous Novi racing cars, WWII high-speed fighter planes and, to an extent, even the modern turbo-superchargers.



On the Corvair engine, the Paxton supercharger is mounted opposite the generator, pumps only air to the pressurized carburetor.



Drive belt of the Paxton blower is twisted 180 degrees to get proper rotation, is quite effective. Pressure for small engines is maintained at 5-6 psi for normal driving.

The centrifugal supercharger is not ideally suited to an automobile engine, because the boost/rpm curve is wrong (where pressure is roughly proportional to the square of the engine speed). In essence, the centrifugal blower is an enclosed fan that can displace a great deal of air at high rpm, but not at lower rpm. This means that such a design is permissible on a racing engine that must operate most of the time near its upper rpm limit, but it's detrimental at lower speeds.

Of all the centrifugal superchargers that have been tried, the most successful was developed by the McCulloch Corporation. Working from a design for Ford flathead V8s similar to the old Graham, McCulloch engineers created the VS →

supercharger (and later, the VR). This type of blower used a variable-ratio, V-belt drive, with the supercharger pulley automatically increasing or decreasing in diameter. This way, engine speed may drop below the limits of about 3500 rpm, but the automatic pulley changes ratio and keeps the supercharger working near a desired 30,000 rpm. These blowers stay in the 5 lb. boost category most suited to typical street engines, which means an increase of about 40 percent in horsepower at the top end. About 40,000 of these early VS superchargers were used–some as production options on early Kaisers and later Studebakers.

The VS supercharger was self-oiled, with a special oil reservoir. For those owners who maintained this blower, the lubrication was no problem; otherwise, it was a headache. McCulloch overcame this with the VR design, which used engine oil, in addition to a stronger variable drive. The VR was used by Ford in 1957 and took all the big races. Finally, the McCulloch design became the Paxton supercharger, which it remains today. Because owners wouldn't keep the engine oil clean, however, Paxton changed the Corvair blower again to a recirculating lubrication (self-contained). Unlike other Paxton models, the Corvair blower does not use the variable pulley, but employs pulley ratios to gain acceptable boost at lower rpm.

My first experience with a Paxton-blown Corvair came a few years ago, when Andy Granatelli had one set up for his own experiments. The Granatelli brothers had just become involved with Paxton, and claimed a stock-bodied Corvair with nearly 150 mph under the deck lid. Skeptical, I had to see it for myself. And I saw. We never went that fast, because there weren't any satisfactory places available for testing, but the speedometer did register 130 mph with throttle left (I'm basically a chicken when a corner looms up!). It had clocked 142 mph at Bonneville, though, with just minor engine refinements.

Such engine changes might be noted by Corvair owners wanting to maintain maximum performance factory equipment. Pistons should be loosened by an additional 0.003-in. overbore. Use heavy-duty valve springs and caps, and definitely use a premium speed shop flywheel, clutch disc, and pressure plate. At 7000 rpm, factory parts tend to come unglued.

An interesting feature of the Paxton

(Continued on page 62)

Effects of supercharging a Corvair Monza with Paxton blower.

PERFORMANCE: Stock 98 hp engine

0-30	4.2 sec.	0-70	19 sec.
0-40	6.1 sec.	0-80	24 sec.
0-50	9.3 sec.	0-90	—— sec.
0-60	13.5 sec.	0-100	—— sec.

Standing ¼ mile 19.8 sec. @ 68 mph. Top Speed (av. two-way run) 90.5 mph

Speed Error	30	40	50	60	70	80	90
Actual	29	39	50	59	69	78	88

Fuel Consumption Test: 19 mpg
Average 24 mpg

PERFORMANCE: Supercharged Engine

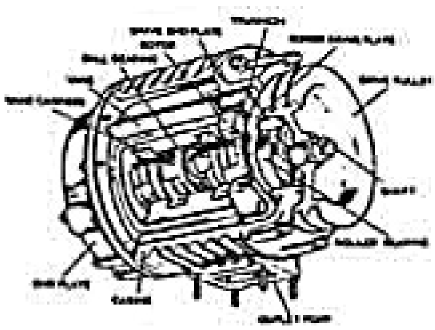
0-30	2.8 sec.	0-70	11.0 sec.
0-40	4.5 sec.	0-80	13.9 sec.
0-50	6.1 sec.	0-90	16.5 sec.
0-60	7.8 sec.	0-100	21.9 sec.

Standing ¼ mile 16.5 sec. @ 90 mph. Top Speed (av. two-way run) 142 mph

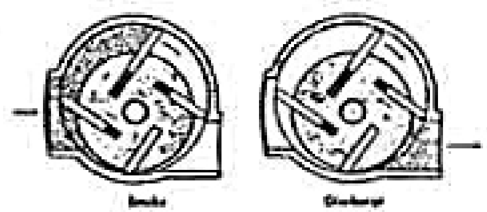
Speed Ranges in gears:

1st	0 to 32 mph	3rd	28 to 58 mph
2nd	12 to 60 mph	4th	43 to top mph

Cutaway drawing of Shorrock blower.



Operational principle of vane-type supercharger.

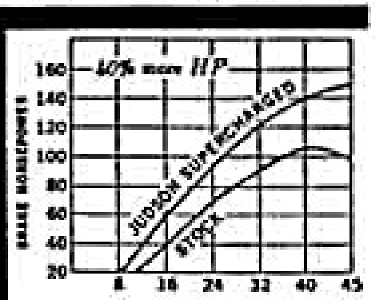


Fits		Stroke	Comp.	Bore	Displ.	Approx. HP
40 hp	Shorrock Supercharger #PS3Y-500	64	7.5:1	77	1192	72
40 hp	Shorrock Supercharger with Big Bore Kit #BBV 100	64	7.7:1	82	1352	78
40 hp	Shorrock Supercharger with "1500" Stroker Kit #PSKY 4011	69.5	7.5:1	82	1468	82
40 hp	Shorrock Supercharger with "1600" Stroker Kit #PSKY 4009	74	8.0:1	82	1566	85

performance data JUDSON model CO supercharger

Performance figures for standard 1962 Monza 102 HP, 4 speed transmission. Comparative performance is proportional for other models.

Acceleration in seconds	Unsupercharged	Supercharged
0 - 30 mph	4	3.8
0 - 40 mph	7	6
0 - 50 mph	11	8
0 - 60 mph	14	11
0 - 70 mph	23	16
0 - 80 mph	36	21
Top	92	108
Fuel	19/36	18/30
Horsepower	102	145
HP INCREASE OTHER MODELS		
Horsepower	95	135
Horsepower	84	120
Horsepower	80	115



performance data JUDSON model VW supercharger

	36 HP engine 1954 – 1960 Unsupercharged	Supercharged	40 HP engine 1961 – Unsupercharged	Supercharged
Acceleration in seconds:				
0–30 mph	7.5	4.2	6.5	4.
0–40 mph	13.5	7.0	11.0	6.
0–50 mph	20.0	10.3	17.	9.5
0–60 mph	30.5	15.5	28.	13.
Maximum speed	70	85	71	85
Maximum HP at rear wheels	24	42	31	49
Rear wheel HP @3,000 RPM	14	23	19	30
Maximum engine brake HP	36	57	40	59
Weight to power ratio	44	30	41	26
Fuel consumption, mpg	31	29	34	29
Noise level (Decibels)	88	85	89	85

All performance figures are averages of several runs.

SPECIFICATIONS

TYPE—Rotary vane, positive displacement
MANIFOLD BOOST PRESSURE—6 lbs. per sq. in.
DRIVE—"V" belt drive
DRIVE RATIO—1.3:1
CARBURETION—Single carburetor, vacuum pot
LUBRICATION—Independent lubricator uses ordinary motor oil which is fed to the supercharger in proportion to engine load.
AIR CLEANER—Special for supercharged induction
DIMENSIONS—5½" x 9" long
WEIGHT—17 lbs.

Effects of supercharging Corvair and VW with Judson blower.

blower installed on the Corvair engine is the full twist (180 degrees) in the drive belt. Because the blower was designed to turn in the same direction as most conventional engines, something ingenious was necessary to adjust for the Corvair rotation. This twisted belt works like a charm.

I've never seen a Paxton on a VW "traditional" engine, but I have seen one recently on a very unusual VW platform. The engine is basically a VW, but it has been changed to a two-stroke (sorry, I'm pledged to secrecy on greater details), and uses the blower to increase induction potential. That this banger is sensational would be a gross understatement and, obviously, the blower is doing its job. While the capacity is a bit large, it would seem the Paxton could be modified to work on larger displacement VWs quite well. Inquiries to the factory might just intrigue an engineer.

Another type of supercharger in great favor with racing car builders, especially the quarter-mile drag set, is that of the positive displacement design. Characteristics of this particular type, usually called a Roots or vane design, make it possible to increase useful torque over a wide engine speed range.

The Roots blower is exemplified by the GMC diesel blowers converted for drag racing use. Noisy and hot, these blowers pack a lot of wallop but are rather expensive (a good, used, 4-71 GMC will go for at least $100, and then it must be converted at even greater cost). To my knowledge, none of these units have been modified for air-cooled engines, and results must necessarily be speculative.

Many vane superchargers have made the scene; however, they're usually designed for smaller engines (a positive displacement blower is compact and well-suited for most automotive installations), where the powerplant is already workin on the ragged edge of its potential. Best known of the vane designs are the Shorrock from England and the Judson from this country. For the enthusiast looking for an immediate gain in engine performance, with retained economy and little engine work, a 40 percent power boost offered from such a blower is bound to be attractive.

Unfortunately, most blower purchasers immediately place their minds in neutral once the supercharger has been installed, usually never having read the instructions. Many dealers refuse to sell a supercharger kit over the counter, for this very reason, preferring to keep t customer happy with professional inst lation.

Both the Shorrock and Judsc blowers are small in outer measur ments, taking up very little roc (they'll fit under most fibergl bodies), and both work with under 6 l of boost. Drive is by V-belt, but t Shorrock uses a special carburetc while the Judson relies on a slightl modified VW carburetor. The Shorroc uses engine oil lubrication, the Judson self-contained. There are other diffe ences in basic design, of course, bu these are best left to the individual t weigh. The mere fact that there are ove 65,000 Judson VW units alone in th U.S. attests to the popularity of th vane design for small windmills.

Judson also makes a blower for th Corvair—belt driven—which bears care ful consideration. This unit mounts o the right (passenger) side, replacing th original carburetor. A crossover pip takes pressure to the opposite manifold with the entire kit taking little mor room than the original carburetors an air cleaners. Unlike the Paxton, this uni was designed expressly for the Corvai rotation, with no belt twist.

Similar to the Judson Corvair pack age, but of a completely different de sign, is the Latham, now out of produc tion (there are several thousand still ou there somewhere, and the factory ma be consulted for technical information) The Latham operates on a novel axia airflow principle. The incoming air in creases velocity as it is spiraled along the vanes of a rotating turbine—entering a one end, exiting at the other. As with other turbines, manufacturing precision is paramount—one of the reasons the unit is no longer available. Costs could not be made competitive to other designs.

The beauties of the Latham are the higher boost pressures, up to 9 psi, and a relatively simple method of mounting. The turbine must be turned faster, so it is driven 4.5 times crankshaft rpm.

All of the positive displacement superchargers offer better mid-range performance than either the static-ratio centrifugal or turbo-superchargers, but do not have quite the push on the top end. For ordinary dune boggling, they are perfect. The signal difference in the blowers considered so far is mixture transport—all but the Paxton pull the mixture through the supercharger itself; the Paxton blows only air *to* the carburetor.