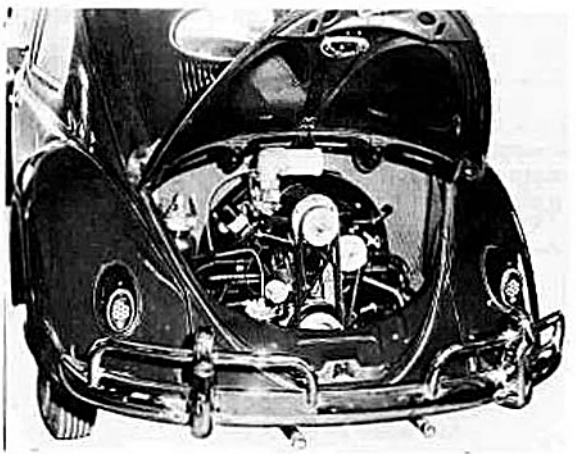
SUPERCHARGING

Here is another efficient bolt-on speed tuning device for the VW owner. The supercharger method is especially attractive because power output increase is considerable while the cost of the boost is relatively low. Installation is attractive because the engine may remain in the chassis, taking only a few hours to complete.

Superchargers made for the VW generally are designed to be used with the standard cylinder heads and manifolding. The resistance in the narrow intake ports still has to be overcome, of course, but as was taken into account when these superchargers were designed, a worthwhile bmep boost is achieved even with the stock heads. If the blower is used in combination with special large-port cylinder heads, then its beneficial effects will be even more emphatic.

Supercharging is mainly a torque boosting procedure and does not rely on excessive rpm to obtain a high power output. This is fortunate in the case of the stock VW engine since this crankshaft is not designed to be run at high rpm for prolonged periods.

Various makes of superchargers available for the VW will be described later.



The Judson supercharger installed in a sedan. Stock carburetion is used with a smaller (size 140) air correction jet. Note also photograph at left.

SUPERCHARGING BOOSTS COMPRESSION RATIO

With a supercharged engine, as observed, the combustible mixture is admitted to the cylinders at pressures above atmospheric. By pumping in more gas per revolution (with wide open throttle) than the actual displacement of the charged cylinders, supercharging effectively "increases the displacement" of the engine. Since the volume of the combustion chamber remains the same, an *increase in the compression ratio* is the result.

The power output of an engine is directly proportional to both brake mean effective pressure (bmep) and rpm. Due to breathing deficiencies at higher engine speeds (meaning that the bmep falls off), there is a definite limit to the maximum power output of the engine. If bmep falls off at the same rate as engine speed goes up, power output will remain the same. If bmep falls off more rapidly than the rate of increase in rpm, power will fall off despite the fact the engine is spinning faster.

As explained before, it is possible to minimize this tendency toward decreasing bmep by improving the breathing of the engine. Among the more popular avenues used are: opening up the ports, improving cam timing, increasing compression ratio, or a combination of these methods. All these methods, though effective, are costly and time consuming —mainly because the engine must be taken out of the frame, torn down, rebuilt, and reinstalled. That is the reason why installing a supercharger is such an easy method of attaining a higher power output.

Design of the Volkswagen engine is favorably suited to supercharging for several reasons. It has a very low compression ratio and a relatively large piston area. It is rugged and because it is lightly stressed in stock form it can readily absorb increased bearing and thermal loads. Finally, there are a number of good superchargers available which are easily installed.

It has already been established that in the VW engine bmep falls off sharply at high engine speeds due to the small manifolding and small carburetor. This is why, in this speed range, it is very responsive to a mild supercharge effect.

POWER TO DRIVE SUPERCHARGER NOT A LOSS

While a considerable amount of power is required by the engine to drive the supercharger at high rpm, this power is not a total loss, as many people seem to think. The supercharger is nothing more than a pump. The pressure it builds up in the intake manifold actually drives the piston during the intake stroke, so that the breathing task of the engine is considerably relieved. This does away with the greater part of the so-called "pumping losses" of a normally aspirated engine. All the power required to drive the supercharger (mechanical and thermal losses) cannot be offset in this way but a substantial part of the power required to spin the blower is recovered. This small loss of power is amply repaid by the resulting high bmep all along the range, which in turn boosts the power output.

OTHER ADVANTAGES OF SUPERCHARGING

A further advantage of supercharging is found in the worthwhile horsepower output that can be achieved without having to contend with excessive peak bearing loads during the firing of the mixture.

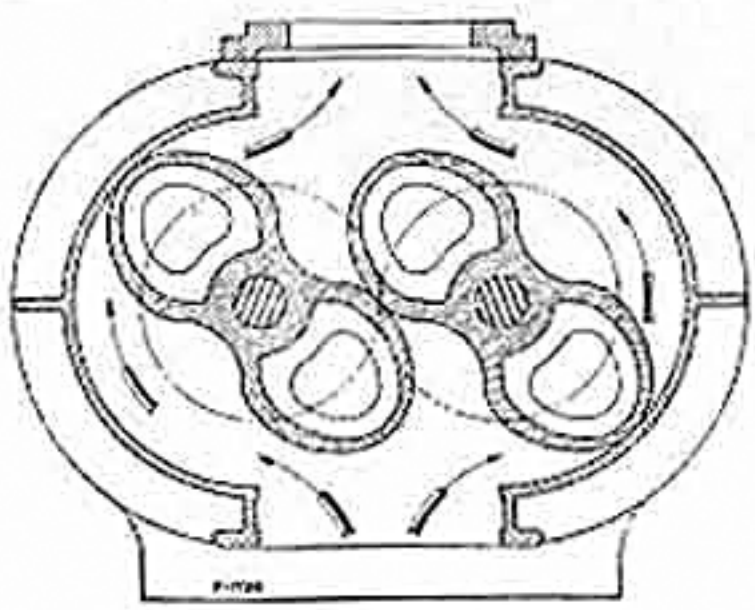
Excessively high peak pressures sometimes occur when compression ratios are raised too high, but the resulting increase in power output would be the same when a supercharger is installed.

Another advantage of supercharging is that a worthwhile gain in output is possible without resorting to excessively high engine rpm.

Supercharging then is a safe, effective, and comparatively cheap method of increasing engine output. For normal, reliable VW engine operation excessive manifold pressures—over 8 psi—are not recommended. Most superchargers available for the VW give a maximum boost pressure (pressure above atmospheric) of about 4 to 7 psi.

SUPERCHARGER TYPES

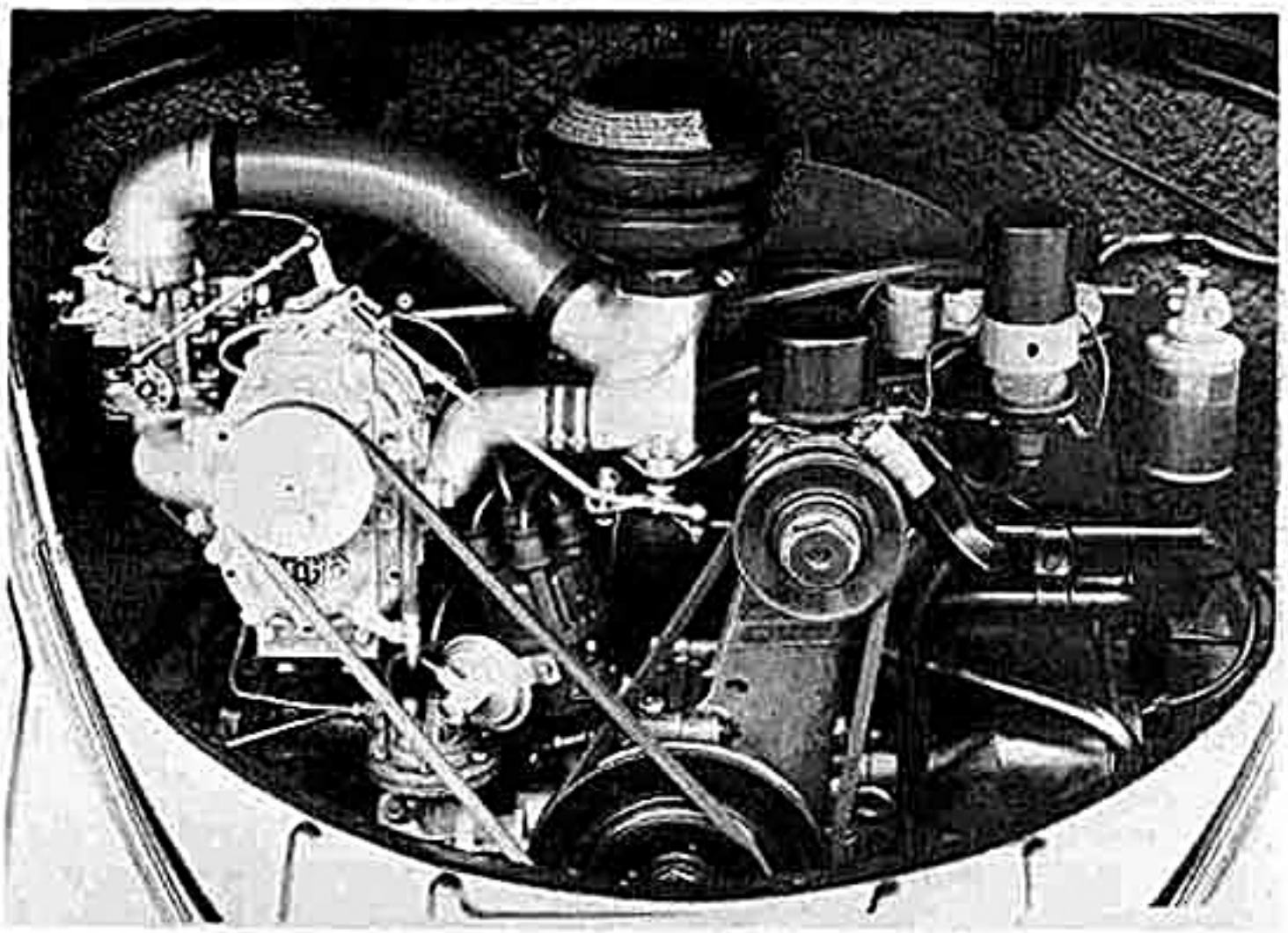
Superchargers available for the Volkswagen include the *Roots* type, and the sliding, or rotary vane type. While both are so-called positive



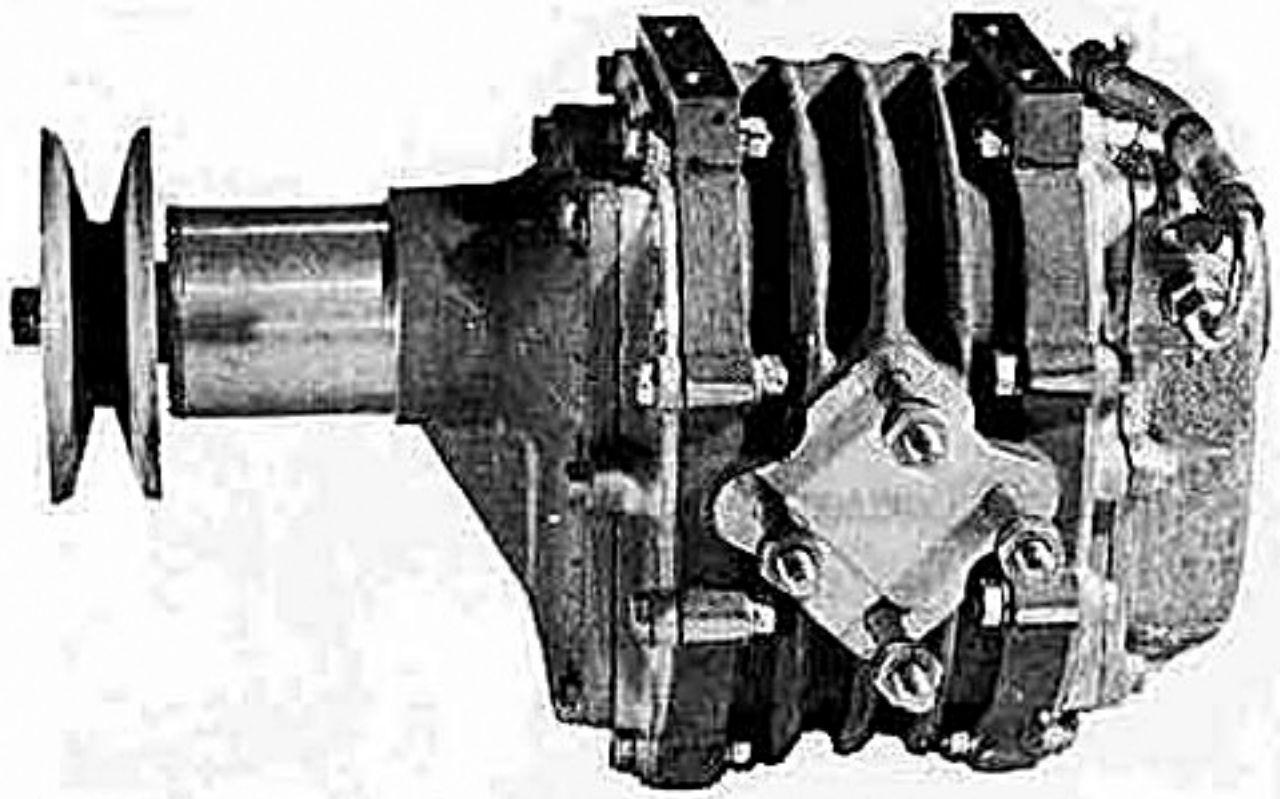
Principle of Roots supercharger. Two lobes are geared together and rotate in exact phase with very little clearance, without actually touching each other. The The Roots supercharges by displacing, not by internal compression.

displacement blowers there is a distinct difference in operation between the two.

The *Roots* type does not operate with internal compression — it merely displaces a certain volume of gas mixture. If this displaced volume is in excess of the normal requirements of the engine, pressure builds up in the manifold. The accompanying illustration shows the principle of a *Roots* type blower. The two-lobe rotors (some have three-lobe or four-lobe rotors) are so shaped that they intermesh without actually touching each other as the supercharger revolves. Efficiency depends on precision in manufacture: the smaller the clearances between the individual rotors (normally between .004 and .008 in.) and between the rotor tips and the housing, the less the gas leakage and blow-back and the higher the efficiency. This type is very popular for its reliability.



The MAG supercharger of the Roots type installed in a sedan. Manufactured by Motosacoche in Switzerland it uses a 32 mm Solex carburetor. Note throttle linkage and lubricator.



The MAG Roots-type supercharger. For VW adaption the driving pulley is closer to the supercharger housing than shown, as appearing below.

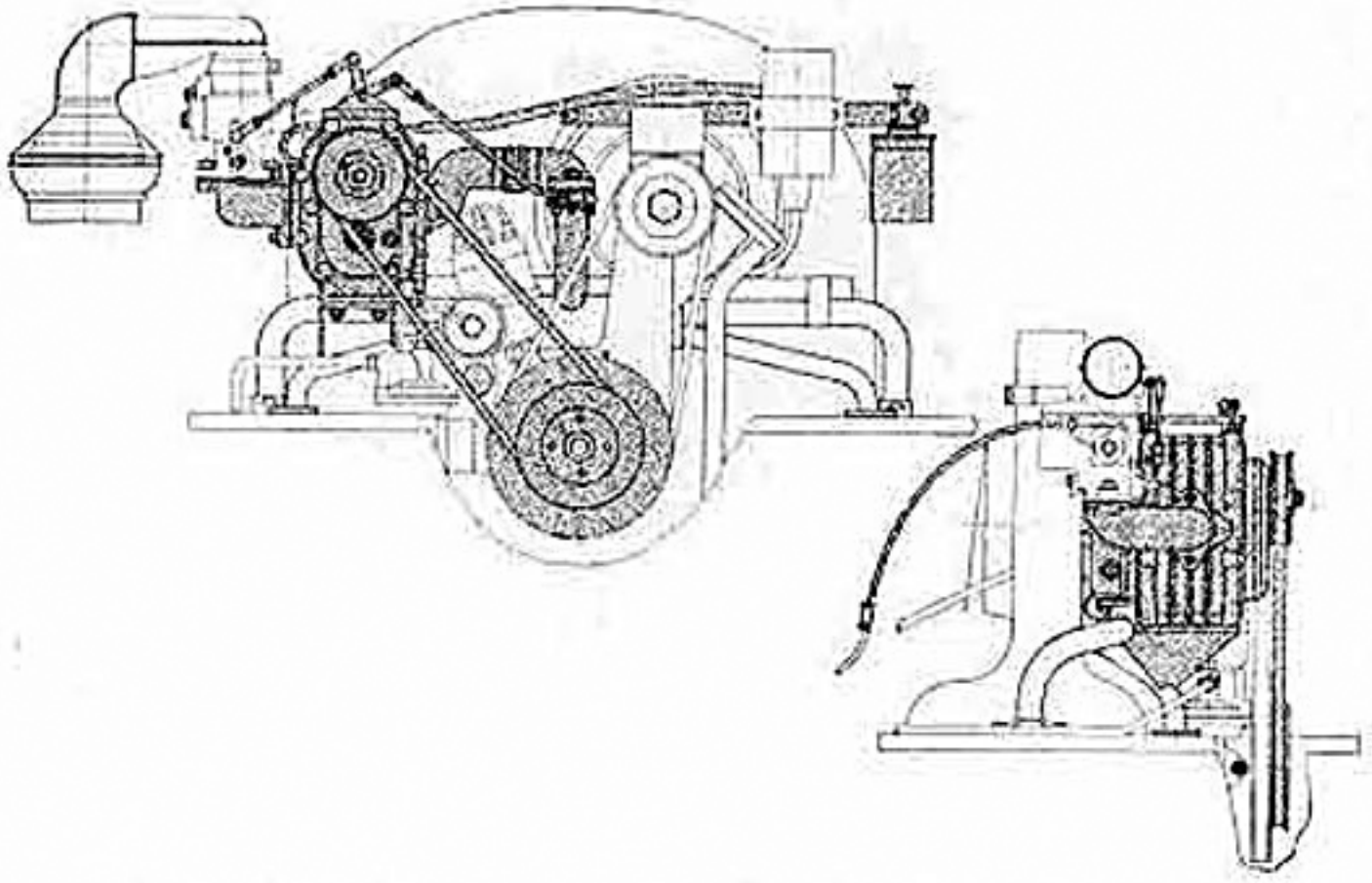
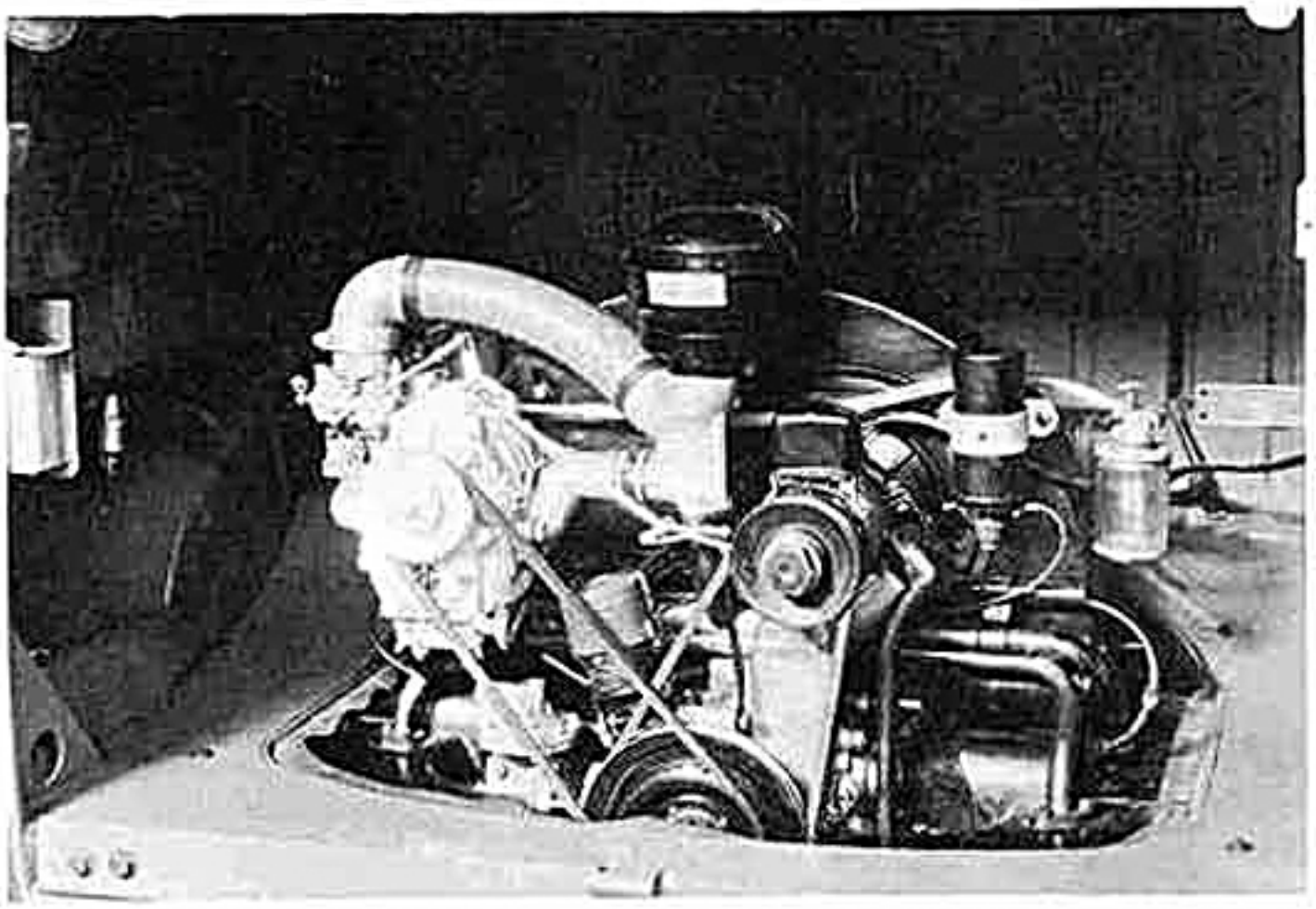


Diagram showing MAG supercharger installation for a Karmann-Ghia. An elbow-type air cleaner adapter is used. Compare this with the sedan installation on page 62.



The MAG installation in a Transporter. A low boost compressor, its use does not affect engine reliability. Note lubricator.

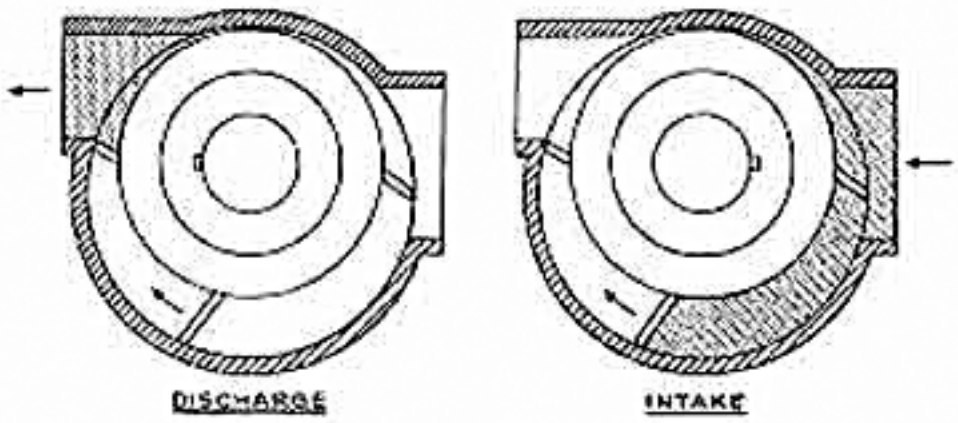
Roots characteristics of delivery are such that a positive manifold pressure can be maintained (with wide open throttle) throughout the usable speed range of the engine. The *Roots* supercharger usually is driven at about engine speed and does not require a great amount of internal lubrication. It is not noisy in operation but does have a characteristic whine, especially at higher rpm. Due to the very close manufacturing tolerances of both the rotors and the driving gears (which have to keep the rotors in exact phase to prevent them touching each other), this supercharger is somewhat expensive.

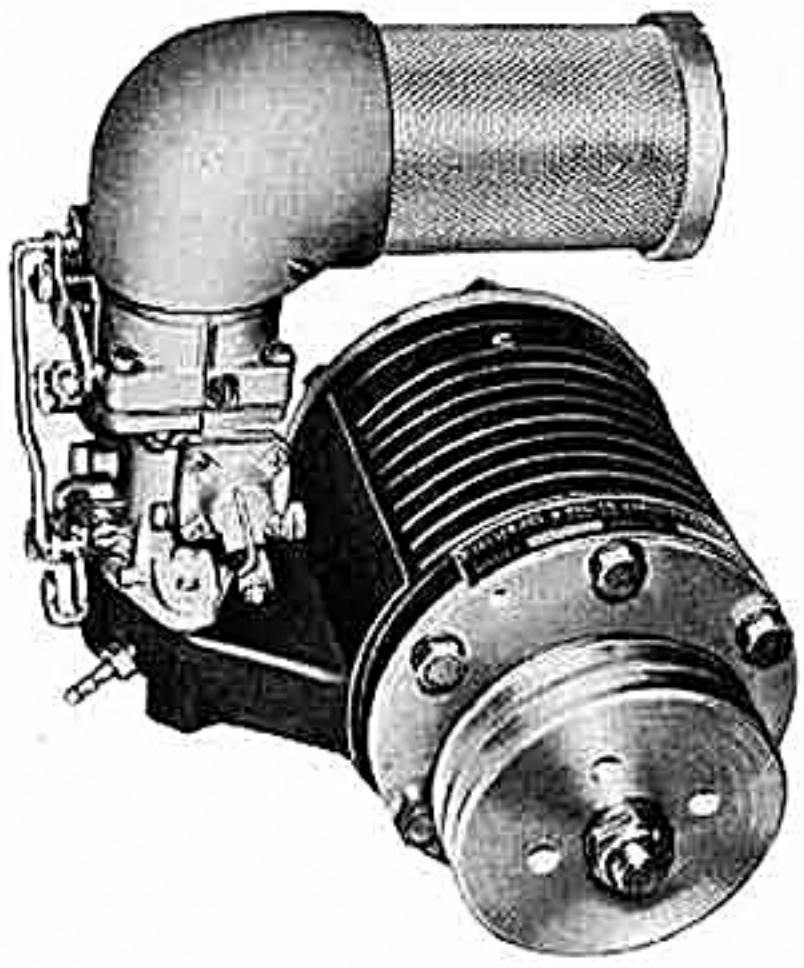
The *sliding-vane* type supercharger, which is also a member of the positive displacement group, is shown in the accompanying illustration. In contrast to the *Roots* type, it operates with internal compression. It is an efficient type especially suitable for high boost pressures and positive delivery at low speeds. The illustration shows how the vanes are driven around by a drum placed eccentrically in the main drum. After being drawn in, the mixture is compressed in the contracting chamber as it is carried around within the main supercharger casing.

These superchargers are especially suitable where high boost pressures are required. Usually driven at engine speed (or slightly higher),

they offer the advantage of being almost completely silent in operation. For trouble-free service and sealing, a certain amount of internal lubrication is required. Most superchargers of this type are built with their own separate lubrication systems.

Centrifugal and *axial flow* supercharges are types which do find some use on other automobiles, but so far have not been marketed for the Volkswagen.





The US-made Judson supercharger is a very popular sliding-vane type blower operating from internal compression as shown above. Carburetor setting is stock except for a smaller air correction jet.

measuring the amount of fuel injected per stroke, greater accuracy will be obtained by averaging the fuel injection of several strokes. For example, if ten full strokes yield from 2.5 to 3 cc of fuel, it follows that .25 to .30 cc is ejected per each stroke—which is within the limits cited.

In making this test, remove carburetor cover and fill float bowl to its normal level. Makers of the Express kit (Autotechnik) supply an adjustable accelerator pump rod. To accurately measure amount of fuel squirted by the accelerating pump, they also supply the measuring tube shown in accompanying drawing. This measuring tube is fitted to the projection of the accelerating pump tube. To get the fuel up to the lower marking, carefully operate the throttle lever with short strokes. Adjustment of the pump rod is correct if five full strokes lift the fuel level up to the top marking.

The manufacturer of the Express kit recommends the following adjustment settings for each 28 PCI carburetor (1192 cc engine):

Venturi	21.5 mm
Main jet	105
Air correction jet	200
Idling jet	50
Idling jet air bleed	1.2
Emulsion tube	8
Pump injection per stroke	.25 to .30 cc

They further recommend changing the emulsion tube carrier. Full instructions come with the kit. Choke control cables need not be connected with this installation.

JUDSON SUPERCHARGER

The Judson Company also recommends using the single 28 PCI carburetor with standard settings, except for a smaller air correction jet which they supply with their conversion kit (No. 140 *Solex* air correction jet).

It has been found that this provides the correct mixture ratio throughout the speed range and that altering the size of the air correction jet instead of the main jet is more effective in obtaining the correct fuel/air ratio.

The company further states that the use of a larger carburetor (such as the *Solex* 32 types) does very little in further increasing the performance, due to the restricted port size in the supercharger and the narrow manifolding.

ENGINE RUNNING HOT

If, after fitting the supercharger, the engine tends to overheat, investigate the following: leak in induction system (engine tends to stall at idling speeds); insufficient valve clearance; dirty carburetor; faulty air