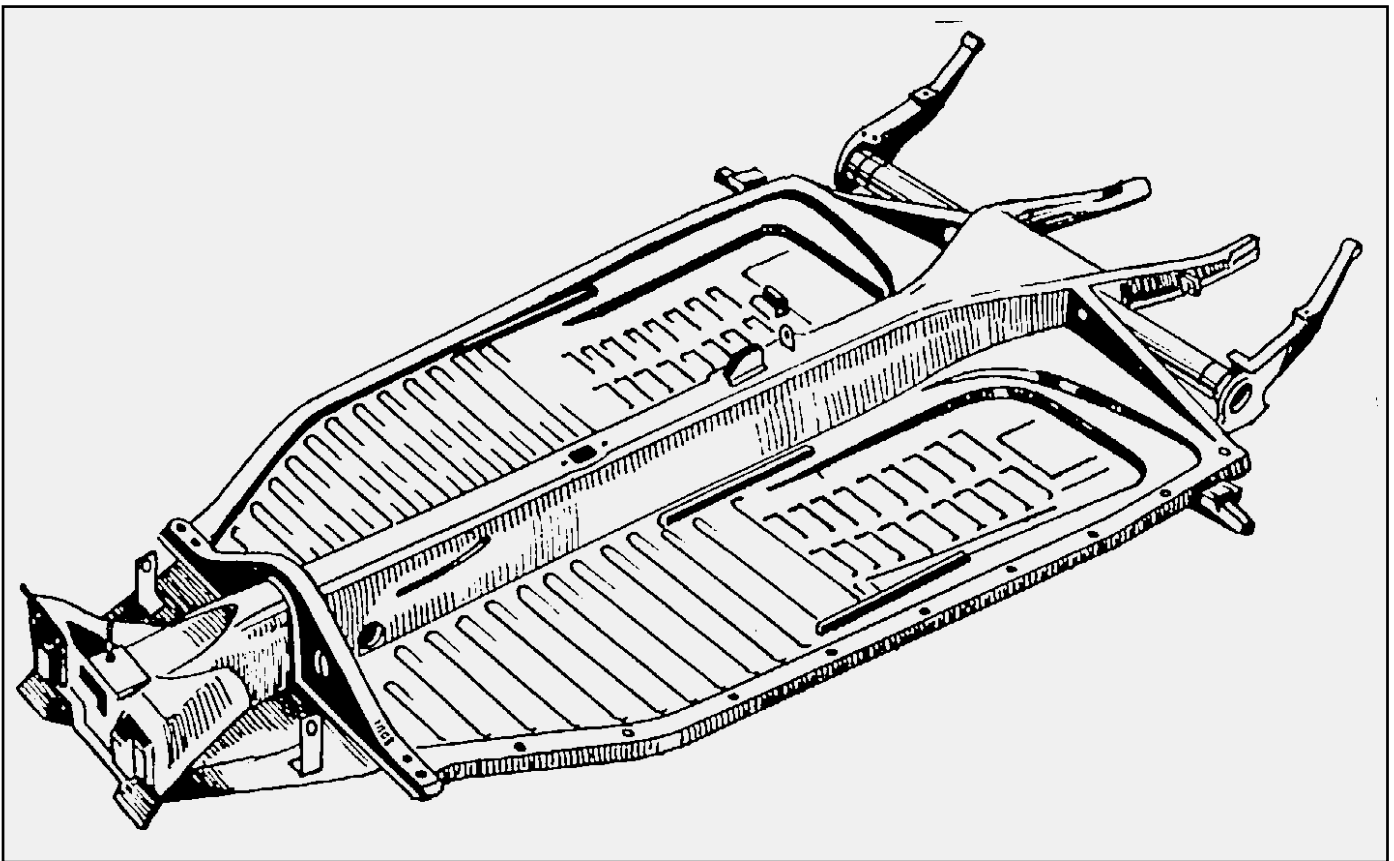


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BEETLE CHASSIS, SUSPENSION & BRAKE DESIGN

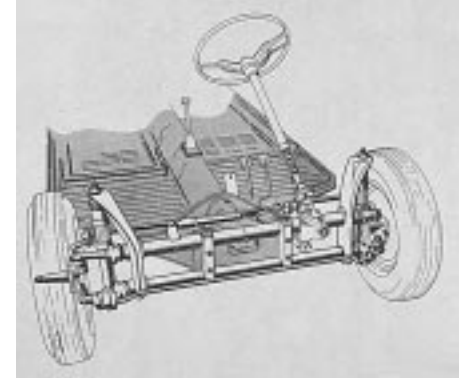


The classic 1960s Beetle with king and linkpin front suspension, and swing-axle rear suspension. Many of the components can now be upgraded with high performance parts. (Courtesy Beaulieu Picture Library).

Steering gear

The steering gear was designed on the worm and sector principle (later changing to a worm and roller), with the steering gearbox mounted by a clamped section to the upper front torsion tube. Turned by the steering wheel, the steering column operates on the gearbox shaft via a flexible coupling. Inside the box, the helical thread on the shaft gives forward or backward motion to a splined sector shaft, and thus to the drop arm beneath the unit. Unequally divided track rods, with adjustable ball-jointed ends, transmit the steering movement to the steering arms of the stub-axle assemblies.

hydraulic system, operating on all four wheels. Pressure applied to the foot brake – part of the pedal cluster situated to one side of the central tunnel – acts on hydraulic fluid in a



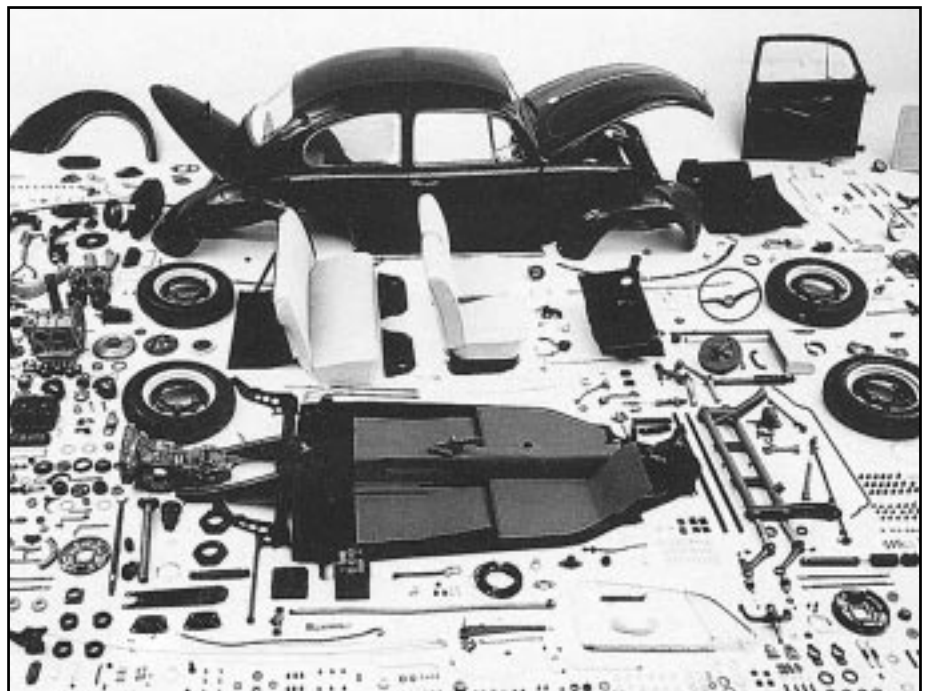
In 1966, the Beetle received a major overhaul in terms of body design, and suspension. Disc brakes appeared on the new 1500 model and were transferable to any other ball-jointed front suspension model.

closed system of rigid and flexible pipes via a master cylinder. In turn, this operates individual wheel cylinders within each brake drum, forcing a leading and trailing brake shoe within each drum against the metal drum friction surface. A cable-operated handbrake acts on the shoes within

BRAKES

Apart from the very earliest Beetle chassis, which used cable-operated brakes, braking is courtesy of a

This VW advertisement shows the number of separate parts that went into the making of a Beetle. (Courtesy Walter Bach).





Linkpins use shims to set the correct suspension geometry. This JaTech setup allows the use of disc brakes, and lowers the suspension by 2 inches (51mm).



CB Performance forged 2in/51mm dropped spindles are available for both the king and linkpin suspensions (top) and ball-joint suspensions (above), and allow the fitment of high performance disc brakes.



Autocavan supply a 11in/280mm disc brake kit (using Golf GTi calipers) for early and late Beetle suspension types. This design retains the early five-bolt wheel pattern. (Courtesy Autocavan).



This Custom & Speed Parts disc brake design (for the early Beetle suspension) uses CNC-machined alloy hubs and brake caliper brackets, and modern ATE calipers. (Courtesy CSP).



This cross-drilled disc brake set up (for early Beetle suspension) from Neal, features race-quality Wilwood calipers and lightweight billet aluminium hubs.

design were the reasons for the ultimate demise of this part of the earlier Beetle suspension.

DISC BRAKE CONVERSIONS FOR KING AND LINKPIN SUSPENSION

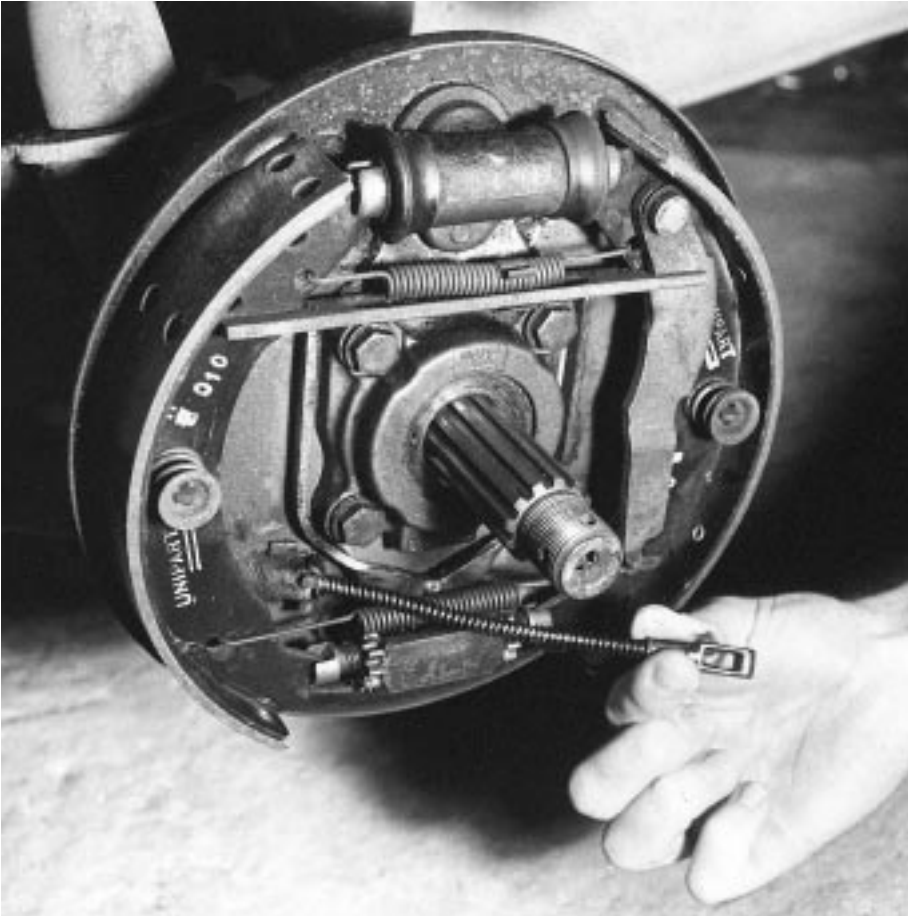
Owners of early cars can undertake most of the maintenance needed to keep this type of VW suspension in perfect working order, and can also

upgrade the design with modern components. In the 40-odd years since the VW king and linkpin suspension was first introduced, most modern vehicle designs have advanced with the addition of front disc brakes. This, however, was never an option on earlier Beetles, though aftermarket parts are now available to rectify this, and there are quite a few designs to choose from.

The designs can be divided into

two types: those that allow the fitting of disc brakes by mounting the caliper to a special bracket attached to the stub-axle; and those that require that the entire stub-axle assembly is changed to one that has an integral bracket for the mounting of the disc brake caliper. With the latter designs, it's necessary to disassemble the kingpin carrier to fit them, and it is worthwhile planning on making this change whilst undertaking other work

REAR SUSPENSION & BRAKES



Inside the Beetle rear drum, the wheel cylinder, brake shoes, adjusters, the handbrake cable and operating lever are all accessible. Early Beetle brake adjustment is through the face of the drum. On later models access is gained through the brake backplate. (Courtesy Robin Wager).

into the castellated nut at the end of the drive shaft, and turn your attention to these nuts, which are tightened to a terrific torque of 217lbs/ft. The easiest way to remove them is to apply a 36mm socket attached to a $\frac{3}{4}$ in drive bar, and levered by a 5ft length of scaffolding pipe slid over the bar. This latter 'tool' is a must for any VW owner, and will get you out of trouble with these rear nuts time and time again.

After slackening the nuts, lift the rear of the vehicle with a trolley jack and place it on axle stands before removing the wheels. Now the hand-

brake can be released and the axle nut finally removed. The brake drum will not slide off until the shoes are backed off. This is achieved by adjusting the brake shoe clearance by turning the brake (star) adjusters with an adjustment tool, or screwdriver, inserted through the backplate. These are accessed when plastic plugs are removed from the backplate, or through the front of the drum on earlier models. Careful use of a soft-faced hammer should be sufficient to tap the drums off the splines although, occasionally, a puller will be required.

Inside the drum, the two brake

shoes are pivoted on central locating pins, and actuated by a wheel cylinder at the top of the drum, with the star-shaped adjusting nuts at the bottom. These are slotted into a central mount with small spring retainers at the base to prevent the adjusters backing off. The handbrake cable enters the drum via the backplate and attaches to a single lever pivoted at the top of the trailing shoe. The handbrake cable is held against the rear side of the backplate by a claw-shaped mount bolted to the plate. A single pushrod and two shoe return springs run horizontally between the two shoes and serve to return the shoes to a resting position when not in use. The first things to look for among the usually mucky components (caused by the dust from the brake lining material) are a leaking wheel cylinder, brake linings worn down to the rivets, and seized adjusters. Check that no oil is leaking from the bearing cover or the hub seal of the swing-axle tube. We will look at replacing this later.

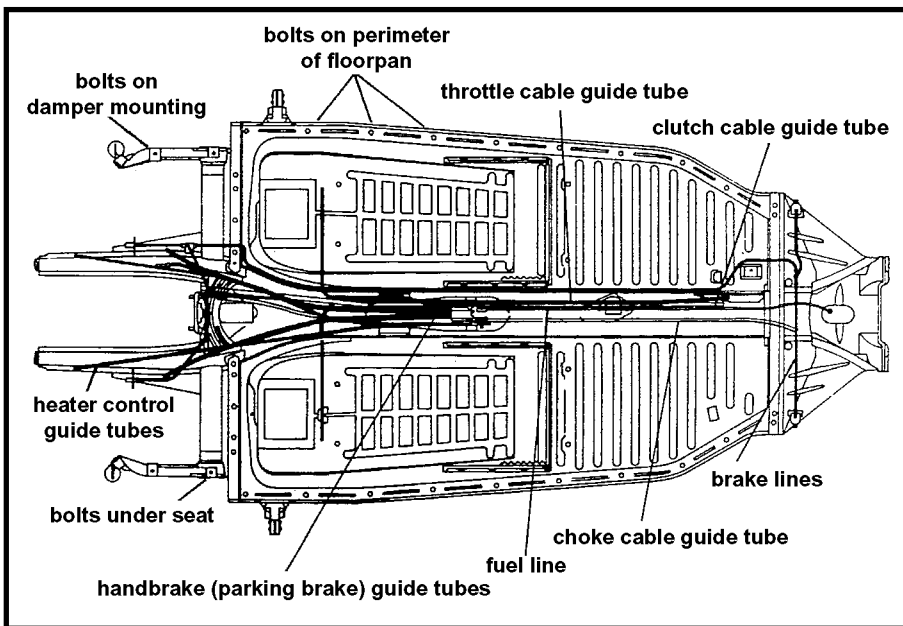
If the wheel cylinder is causing problems, it must be renewed. Although rebuild kits for wheel cylinders are available, this is something of a false economy as the internal bore of the cylinder will almost certainly be worn and, therefore, the cylinder will never work as well as a new one. 1968 and later Beetles use a 17.5mm rear wheel cylinder. This can be upgraded to a 19.05mm cylinder from 1958-1967 models, or even a 22.2mm front cylinder from a 1965 or later Beetle, but this will cause a rear wheel brake bias, unless work is also done on the front brakes as well. Always maintain the correct front/back ratio when the vehicle is used for street use. Removal is accomplished by releasing a nut behind the backplate. Once the cylinder is removed and renewed it means, of course, that the



A Beetle chassis prepared to accept a dune buggy bodyshell. The simplicity and strength of the rolling chassis design has made it ideal for building buggies. (Courtesy John Jackson).



The rear access plate is removed to allow the gearbox 'hockey stick' selector to be disengaged from the long gear selector rod which runs within the chassis backbone.



A diagram of the cable conduits within the central backbone of the Beetle chassis. (Courtesy Cars & Car Conversions magazine).

With the Beetle bodyshell removed from the floorpan, the basic running gear is still attached. To make the floorpan more manoeuvrable in the workshop, and to gain access to the various parts, it is necessary to remove the large assemblies such as

the engine, gearbox and front suspension from the floorpan. Also remove the pedal cluster, gear lever, gear coupling and gear selector rod within the backbone tunnel, front and rear tunnel access plates, and the clutch cable flexible guide tube.



With the gearbox and gear-shifter removed, the selector rod can be physically pushed from its resting place in the plastic support bush with a long rod inserted through the rear section of the chassis.

The reason for the removal of the access plates is that the gear selector rod has to be physically pushed from its resting place within a plastic support bushing inside a metal bracket mounted to the top of the tunnel. This is situated just behind the gear lever mounting, accessible when the gearstick itself, together with the spring and metal guide plate, is removed by releasing the two bolts. The selector rod, once freed from the coupling with the gearbox 'hockey stick' at the rear, can be pushed forward with a long metal or wooden rod through the round hole seen at the rear of the