

**INVESTIGATION INTO THE DESIGN AND PERFORMANCE OF
THE VOLKSWAGEN OR GERMAN PEOPLE'S CAR**

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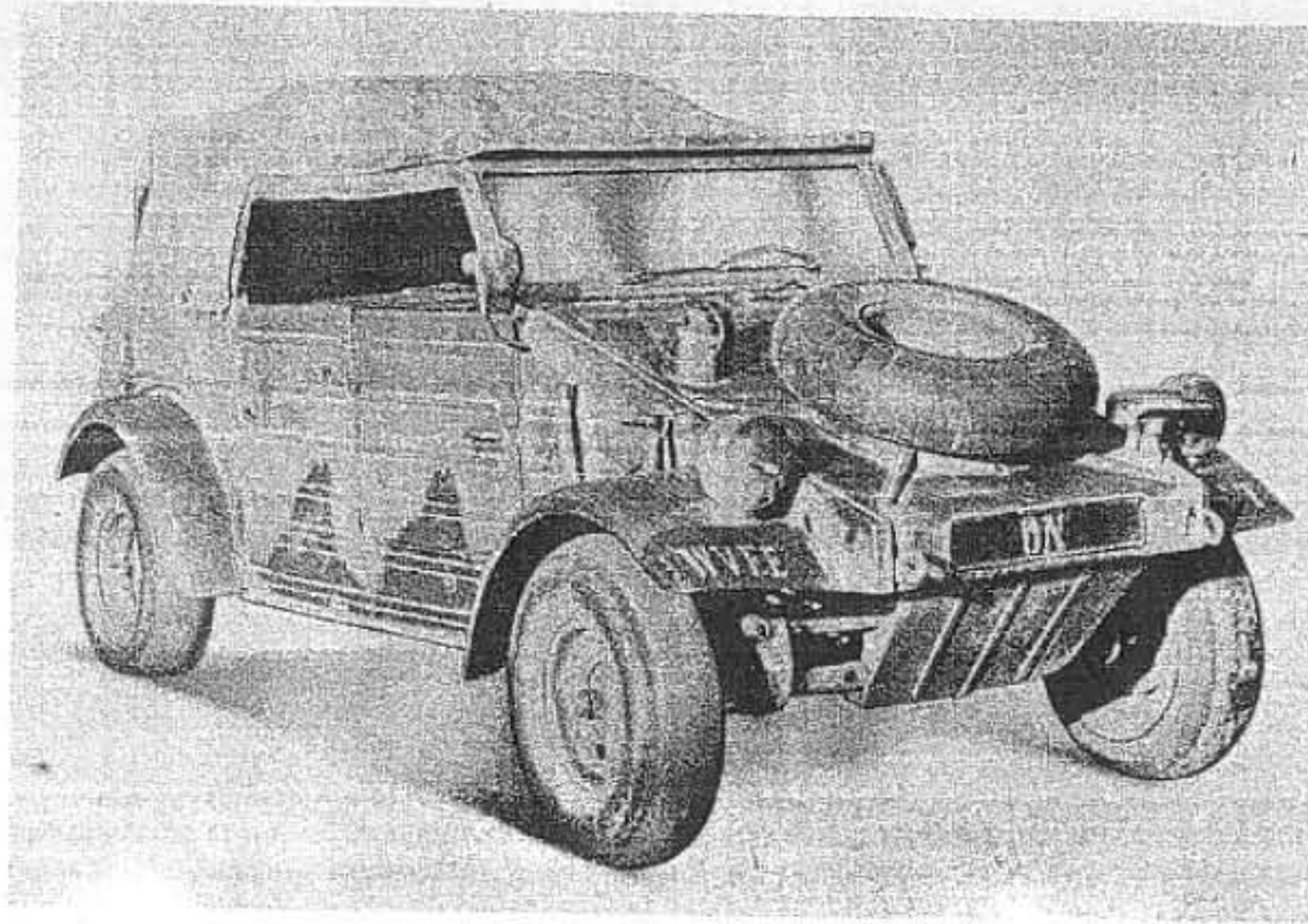


Plate 1.—Complete vehicle, threequarter front view

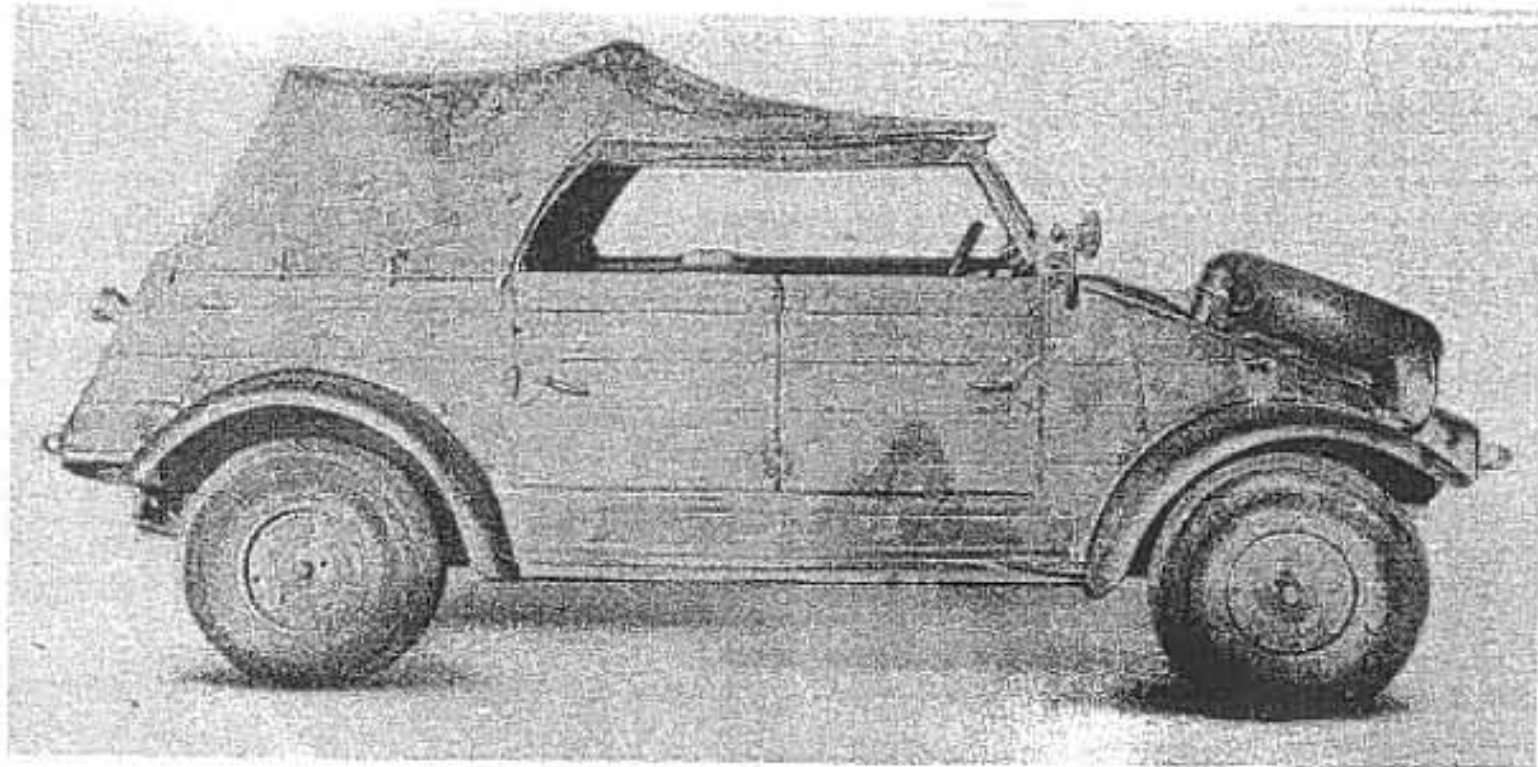


Plate 2.—Complete vehicle, side view

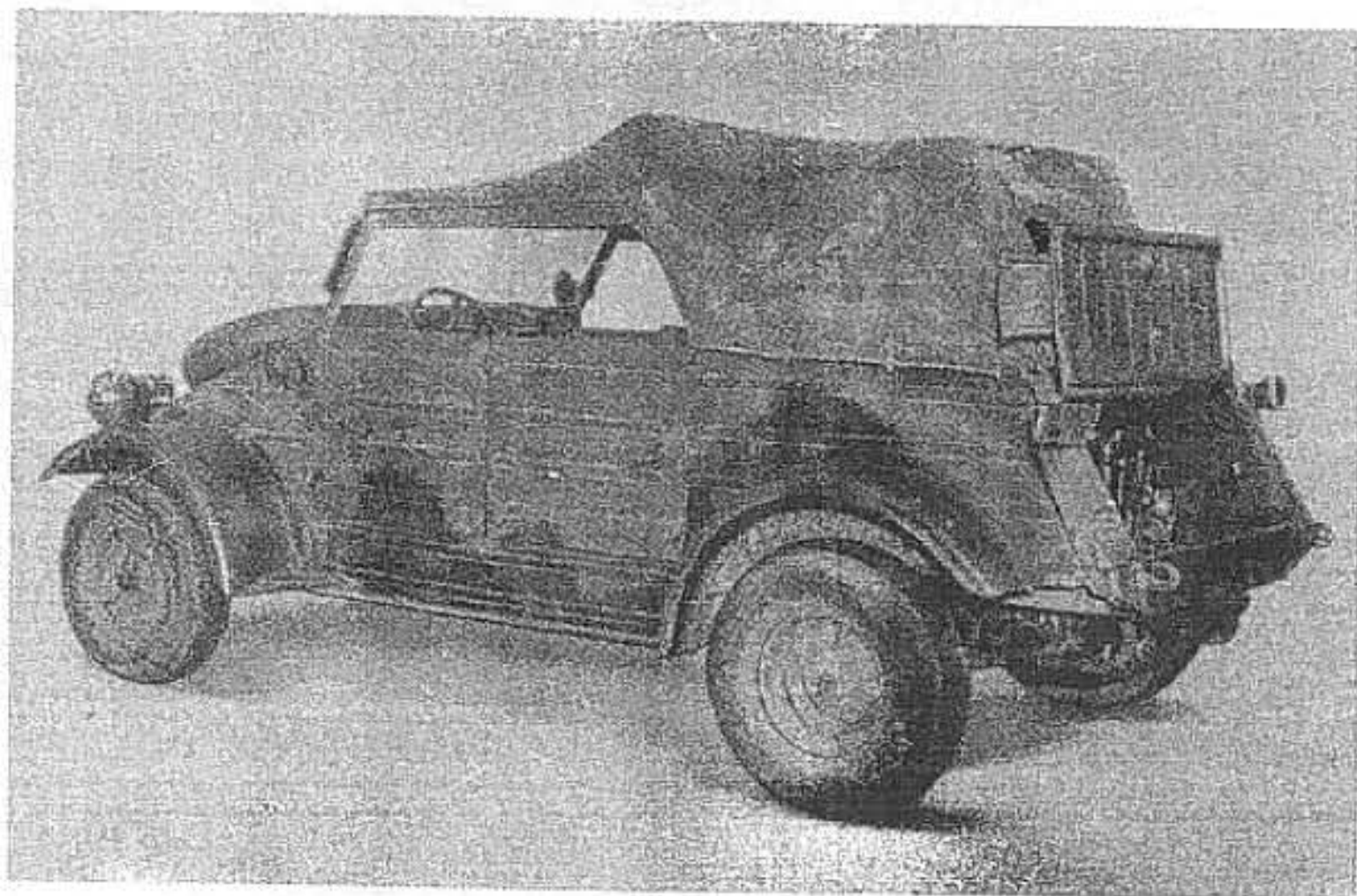


Plate 3.—Complete vehicle, threequarter rear view

INTRODUCTION

In January, 1943, a German light aid detachment vehicle (Volkswagen) was received by Humber Limited, who were instructed to make a complete examination and prepare a technical report. The vehicle was captured in the Middle East and it was ascertained that it was originally fitted with a gas welding kit for dealing with repairs to military vehicles.

Military Conversion of the Volkswagen Compared with the Original Design of People's Car

The vehicle under examination is based on the Volkswagen (German People's Car) and from the available descriptive matter the military version differs in the following respects.

The peacetime Saloon body is replaced by an entirely new open type tourer body which has obviously been designed to suit its military role.

Hub reduction gears have been added.

Special tyre equipment and wheels are also used.

Features of Noteworthy Interest

The engine is fitted at the rear of the vehicle, behind the axle.

A horizontally opposed, four-cylinder, air-cooled type of engine is employed.

The engine air cooling system incorporates a rotor and cowling arranged to circulate air to the cylinders and also to an oil cooler.

Independent wheel suspension is provided for all wheels, torsion bars being used. The front torsion bars are of unusual and ingenious design to obtain soft springing in a compact form. The front suspension, complete with the steering unit, shock absorbers and track rod system, forms a very compact assembly unit.

The speedometer drive is housed neatly within one of the stub axles.

Extensive use is made of aluminium and magnesium base alloys, and a very good finish imparted to the die castings.

Plain carbon steels are used in preference to alloy steels, except in special cases such as valves, etc. Nickel has not been used for the manufacture of any of the parts, and copper has been added to the cast iron components in order to produce a similar effect to nickel. The hardening elements used in the steels are manganese, chromium and molybdenum.

A special dog-type gear engagement is incorporated in the gearbox, using steel rods in grooves; this is fully described in the text. The design of differential is ingenious, having only a partial slip, thus obviating wheel spin and therefore very suitable for cross country and muddy conditions. This is patented under German Pat. Spec. No. 639876, and British Pat. Spec. No. 431020, both patents taken out by Gottfried Weidmann.

Hub reduction gearing is used to obtain a lower overall ratio by a simple conversion of the original design of Volkswagen, and this also gives the increased ground clearance required for traversing across country.

Chassis consists of a light gauge pressed steel underframe; this is arranged in a "back-bone" construction and also provides the floor. A comparatively strong chassis, especially torsionally.

The location of the rear suspension swing arms or struts above the axle enables a cheap and light form of strut to be used according to claims stated in Patent No. 544748 F. Porsche. Ground clearance is also increased by raising the torsion bar relatively.

The body was of open tourer type fitted with a collapsible fabric hood and provided with a steel trunk designed to carry the welding plant. It is thought that a study of the sections and methods of construction described in this report will be valuable.

In order to ascertain full particulars of the design, technical data, weights and dimensions, the vehicle was dismantled and assembly drawings, together with a detail description of the design and construction, prepared. Photographs (Plates 1, 2, 3 and 4) were taken on receipt of the vehicle and show its general appearance when it arrived at these works.

From the condition of the vehicle as received for examination it was apparent that it had covered a considerable mileage—unfortunately the speedometer was not functioning and the exact mileage could not therefore be verified.

The following identification plates were fitted inside the engine compartment at the rear of the body:—

Identification Plate relating to the Chassis.

Volkswagen Wks. Ltd. (People's Car Factory Ltd.)

Type VW.82.

Engine capacity 985 cu. cms.

Year of manufacture, 1941.

Weight of vehicle (unladen) 685 kilograms (1,510 lbs.).

Weight of vehicle (max. laden weight) 1,175 kilograms (2,590 lbs.).

Weight on Front Axle (max. laden weight) 450 kilograms (992 lbs.).

Weight on Rear Axle (max. laden weight) 724 kilograms (1,598 lbs.).

Chassis Number 001339.

Identification Plate relating to the Body.

Ambi Budd Pressworks, Johannesthal, Berlin.
No. 1777. Year 1941.

Identification Plate relating to the Electrical Equipment.

Screened, based on Group III Bosch.

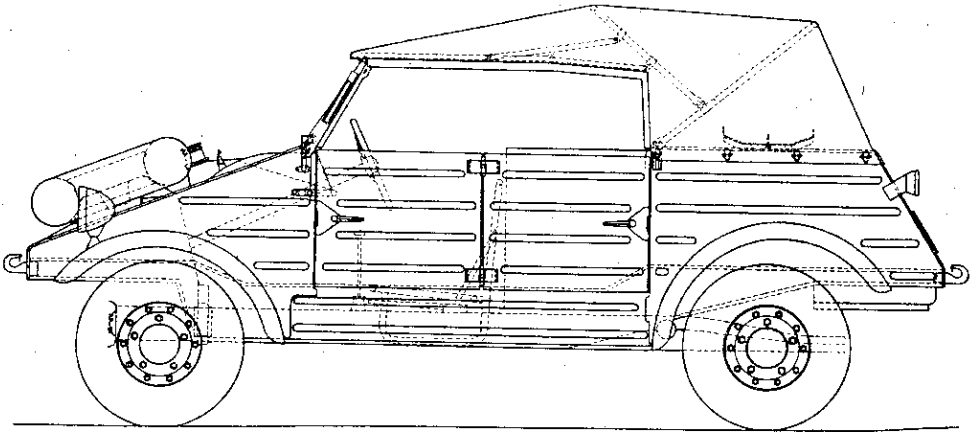


Fig. 1.—Body, side elevation

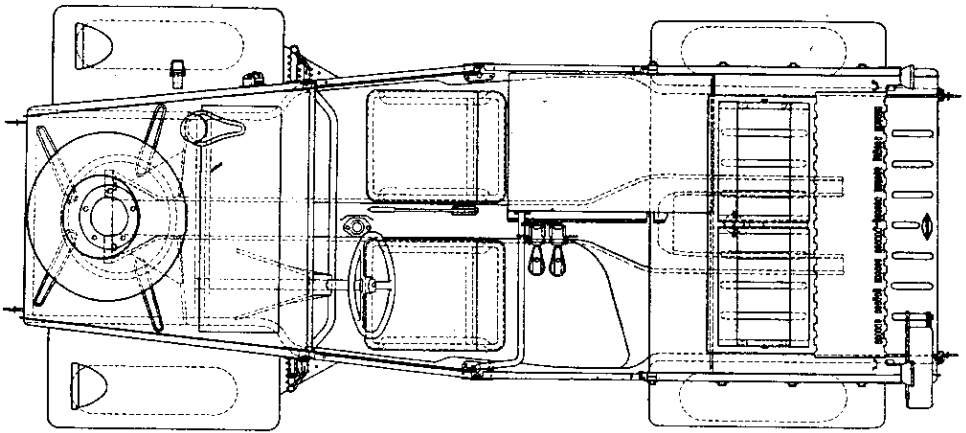


Fig. 2.—Body, plan

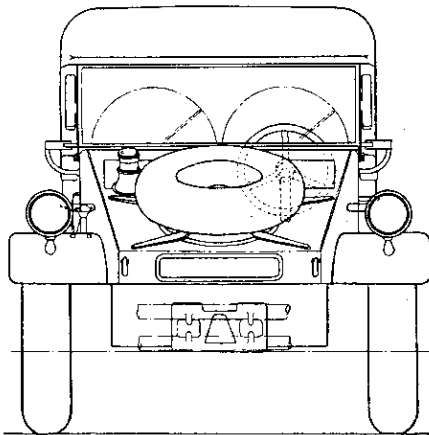


Fig. 3.—Body, front view

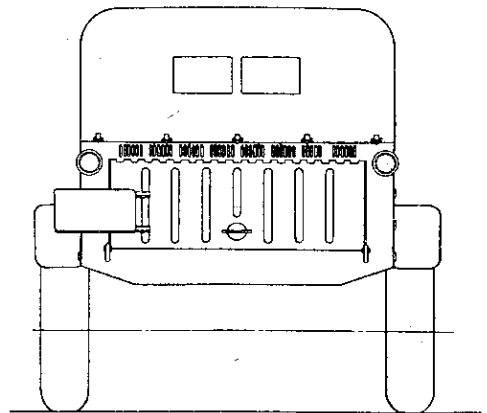
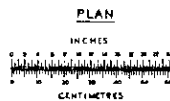


Fig. 4.—Body, rear view



The actual weights of the vehicle as received were as follows, which it will be noted are in excess of those given on the identification plate.

Actual weight of vehicle (unladen) 14 cwts.
3 qrs. (1,652 lbs.).
Actual weight on Front Axle (unladen) 5 cwts.
3 qrs. (644 lbs.).
Actual weight on Rear Axle (unladen) 9 cwts.
0 qrs. (1,008 lbs.)

General Observations

The following general observations are made by Humber Engineering and should be treated purely as their views.

The design is particularly interesting because it is quite uninfluenced by any previous traditions, and it is doubtful if the question of whether the public would or would not like a car with an air-cooled engine positioned at the rear was considered by the designer. This model has departed almost entirely from the conventional motor-car and features of interest have already been referred to above.

In spite of the assumed freedom of the designer and the unconventional vehicle produced, little or no special advantage has been obtained in production cost, neither does it appear

that any improvement in performance or weight compared with the more conventional type of vehicle known in this country has been achieved.

So far as materials are concerned, no signs of the use of any ingeniously applied materials have been found, in other words the material specification is, with few exceptions, very parallel with what is already well known in this country. The use of plastics is not apparent. The tyres are, however, manufactured from synthetic rubber.

A study of the engine indicated that the unit was, in certain details, most inefficient. The design of the inlet manifold makes it clear that the designer did not intend the unit to produce power proportionate to its capacity, and from a study of both the design and condition of the crank bearings it is very doubtful whether it was even capable of giving reliable service had it produced a performance commensurate with its size.

Looking at the general picture, we do not consider that the design represents any special brilliance, apart from certain of the detail points, and it is suggested that it is not to be regarded as an example of first class modern design to be copied by the British industry.

GENERAL DATA OF COMPLETE VEHICLE

Dimensions

Chassis No. 001339.

Overall length : 147.5 ins. (12 ft. 3½ ins.).

Overall width : 63 ins. (5 ft. 3 ins.).

Overall height (top of hood) : 63.5 ins. (5 ft. 3¼ ins.).

Wheelbase, normal, static laden condition : 94 ins. (7 ft. 10 ins.).

Wheelbase variations under pitching conditions :—

(a) Front Wheel at full rebound position and Rear Wheel at full bump position : 95.40 ins., 5 ins. engine clearance.

(b) Front Wheel at full bump position and Rear Wheel at full rebound position : 93.40 ins.

Track : Front Wheels : 54.625 ins. (4 ft. 6⅝ ins.).

Rear Wheels : 55.125 ins. (4 ft. 7⅛ ins.) laden.

Turning circle. R.H. lock : 30 ft. 5 ins.

L.H. lock : 36 ft. 8 ins.

Weights

Chassis : 7 cwt. 0 qrs. 21 lbs.

Rear Axle : 4 cwt. 3 qrs. 21 lbs.

Front Axle : 2 cwt. 1 qr. 0 lbs.

Engine

Engine No. 001346.

Make : Volkswagen.

Type : Four-cylinder, air-cooled, horizontally opposed, overhead valves.

Capacity : 0.985 litres (60 cu. ins.).

R.A.C. Rating : 12.2 H.P.

Air Cleaner : Oil Bath type.

Clutch

Make : Fichtel & Sachs — Komet.

Type : K.10 Single Plate Dry Clutch.

Size : 180 mm. (7.09 ins.) O/Dia.

Gearbox

Type : Constant mesh helical—Top and third speeds. Straight Spur—First and Second Speeds. Special dog engagement on Top and Third Speeds.

Gear engagement on First and Second Speeds.

Control : Remote control. Ball change type gear lever.

Ratios. Four forward speeds and one reverse.

Top : 0.8 : 1.

Third : 1.25 : 1.

Second : 2.07 : 1.

First : 3.6 : 1.

Reverse : 6.6 : 1.

Rear Axle

Type : Enclosed swinging half axle. Spiral bevel drive and final hub reduction gear.

Axle ratios : Spiral Bevel : 4.43 : 1.

Hub gears : 1.40 : 1.

Overall ratio : 6.2 : 1.

Transmission Unit Weight

Gearbox, Clutch, Rear Axle, Reduction Gear and Starter less Brake Shoes and Drum : 147 lbs. weight.

Overall Ratios

Fourth speed : 4.96 : 1.

Third speed : 7.75 : 1.

Second speed : 12.83 : 1.

First speed : 22.32 : 1.

Reverse speed : 40.92 : 1.

Suspension

Type : Independent wheel springing on all wheels.

Longitudinal link type on front wheels. Swinging half axle and longitudinal arm on rear wheels.

Springs : Front torsion bar ; rectangular section ; multi-blades.

Rear torsion bar ; round section.

Shock Absorbers

Front : Hydraulic, direct, single-acting telescopic type.

Rear : Hydraulic, piston-operated, double-acting type and lever arm.

Wheels and Tyres

Make of Tyre : Continental.

Size of Tyre : 690 × 200 (8 × 12) smooth tread, aeroplane type.

Size of Wheel : 4.25 × 12, flat base rim.

Steering

Make : Volkswagen steering box.

Type : Worm and rocker shaft (segment nut interposed).

Number of turns of handwheel (lock to lock): 2.75

Connections : Divided track rod, directly coupled.

Brakes

Make : Volkswagen.

Type : Internal expanding ; two shoes ; floating operation.

Control : Cable operated, non-compensated type.

Petrol Tank

Capacity : 9 gallons.

Electrical Equipment

Dynamo : Bosch type, RED 130-6 2600 AL.89.

6 volt. Ventilated.

Speed : 1.75 times engine speed.

Starter : Bosch type, EEDD 4-6 L3P 6 volt. Screw push type.

Drive : Pinion, 9 teeth ; Ring, 109 teeth.

Ignition : Bosch ignition, coil type TL6. Bosch distributor, type VE4BS276. Screened.

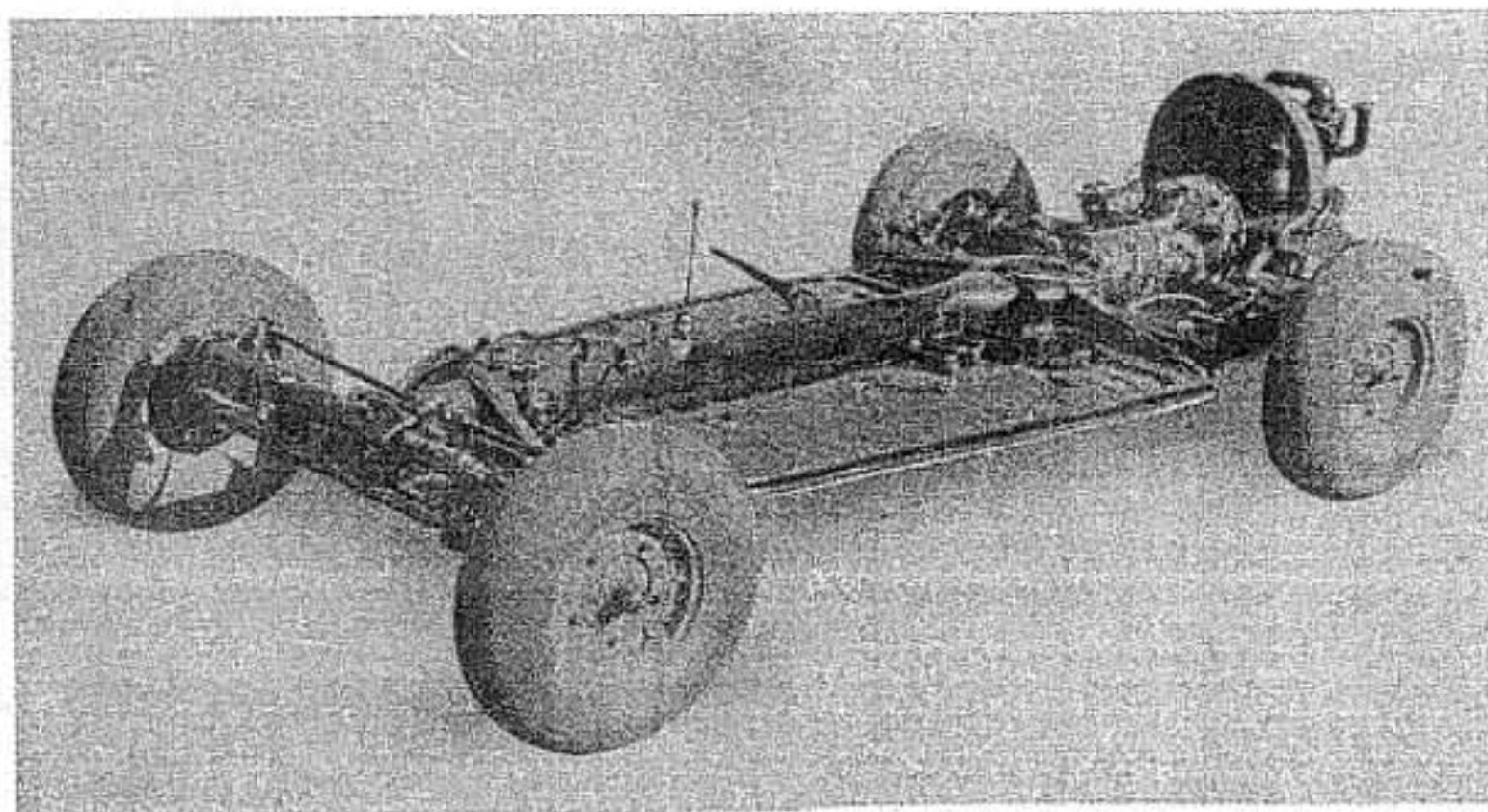


Plate 4.—Chassis

GENERAL DESCRIPTION

The engine was originally designed for the "Volkswagen," which was exhibited at the International Motor Show held in Berlin in 1939, the manufacturers being Volkswagen, Fallersleben, near Hanover, Germany.

Makers' identification marks: No. 001346 (stamped on the crankcase); No. 0402 (cast on each of the cylinder heads).

Other markings: Firing order, 1, 4, 3, 2 (cast on the crankcase), No. 1 Cylinder being nearest the flywheel.

The complete unit includes a sheet metal cowling mounted above the engine, and incorporating a blower: this circulates air for cooling the cylinders, and the oiling system. The blower consists of a rotor, mounted on one end of the dynamo armature shaft, which is driven at the opposite end by a "V" belt drive from the crankshaft.

The engine is of the overhead valve, horizontally opposed four-cylinder type, consisting of two banks, each bank having two cylinders which are separately cast and interchangeable. Detachable cylinder heads of aluminium silicon alloy are fitted; these are cast in pairs and located in the cylinders by means of spigots formed on the latter. Both these are secured to the crankcase by long studs, screwed direct into the crankcase, the cylinder head joint being formed between the top face of the cylinder spigot and the head. Bronze alloy valve seat inserts, phosphor bronze valve guides, and steel sparking plug inserts are employed.

The crankshaft is supported by three main bearings, and an additional bearing which acts as a steady for the auxiliary drives; the thrust loads are taken by the bearing nearest

to the flywheel. The crankshaft main journals consist of thick steel shells lined with lead bronze; all the bearings are exceptionally narrow, especially the centre one, which is split for assembly purposes.

The connecting rods are made from steel stampings, a relatively thick layer of bearing metal being run direct into the big end. The bolts securing the connecting rod caps have hexagon socket-type fittings on the heads.

The aluminium crankcase is made in two halves, and is split on the vertical centre line through the main bearings; the halves are secured together by means of bolts and studs. An oil sump is formed integral with the crankcase; the underside is generously finned. In addition, the casing serves as a mounting for the various accessories such as the dynamo, oil cooler, blower equipment, etc.

A single camshaft driven at half engine speed by single helical gears from the crankshaft runs direct in the aluminium crankcase, and actuates the overhead valves through push rods, each cam operating two rods. The whole of the valve gear is pressure lubricated.

The distributor is mounted on top of the crankcase, and is driven by spiral gears from the rear end of the crankshaft. The driven shaft consists of the spindle, and gear and cam for operating a petrol pump, and is made from a steel stamping, which is hardened and ground. It is supported at both ends and runs directly in the crankcase, the gear end thrust also acting against the crankcase facing.

The petrol pump is an AC diaphragm type, mechanically operated, mounted on the left-hand of the crankcase, on a neat moulding which also houses the operating rod.

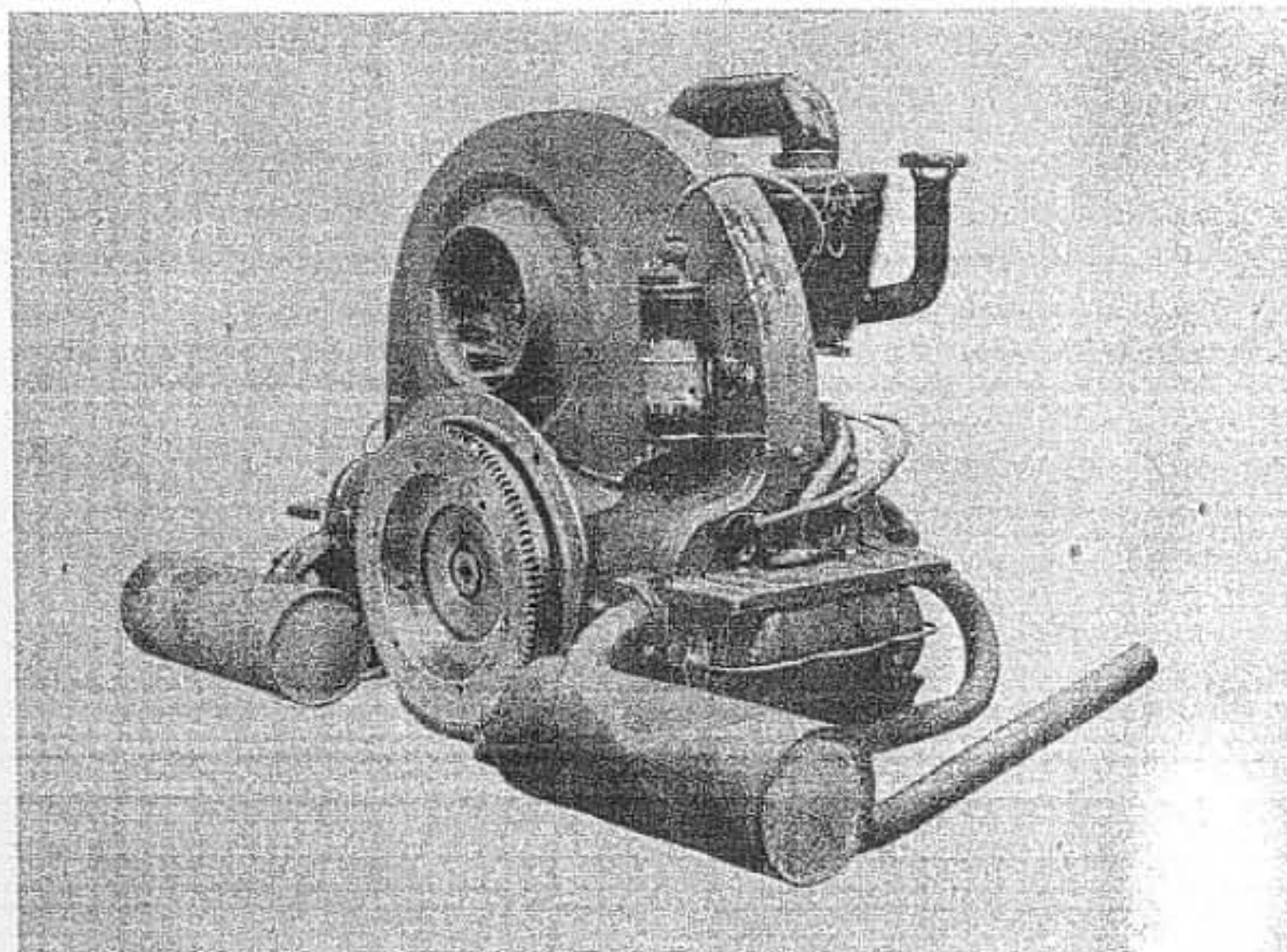


Plate 5.—Engine, threequarter rear view

PART III.

BODY ENGINEERING

of the

VOLKSWAGEN SALOON, TYPE 11.

Report by:-

HUMBER LTD.

HEATER AND DEMISTER SYSTEM.

The system is of considerable interest; it utilises the hot air from the engine and the pressure built up by the air cooling fan for maintaining its circulation. The ducts for this system, as already mentioned, are built into the bodyshell structure, and the control of it is by means of a "butterfly" valve operated by means of a cable with push-pull knob situated on the centre tunnel between the front seats. Four heating vents are provided at either side of the body alongside the front and rear passenger's feet. As previously mentioned the de-froster slots are incorporated in the facia panel at the windscreen corners. (See illustration No.17).

TRAFFICATORS.

Provision is made for these in the body side panels and a raised surface is provided on the facia pressing for the fitting of the switch, together with red and green tell-tale lamps at the R.H. of the instrument panel. No trafficators or switch, however, are actually fitted on the vehicle inspected.

GENERAL.

The car is painted entirely in Army Green, and this is an exceedingly poor finish. No adequate measures seem to have been taken either for cleaning and de-greasing the pressings before priming, or any steps taken for rustproofing, with the result that the paintwork is peeling away from the metal.

It is our considered opinion that from the Body Engineering point of view the design of this vehicle is exceptionally good, and shows a great advance on previous constructional methods, but workmanship and general finish of the vehicle leave much to be desired and could be improved.

PART V.

GENERAL IMPRESSION OF THE VOLKSWAGEN MILITARY VEHICLE,

TYPE 21.

Report by:-

A. C. CARS LTD.

This vehicle has been fully investigated and described by Humber Ltd., from a technical angle, therefore these remarks are confined to general handling, characteristics, etc.

1. The first impression gained in starting up is the extreme noise of the engine, this is immediately blamed on to the cooling fan, which however, is not responsible for more than 10% of the noise, tests carried out with the fan belt removed proved this point.

Examination of the rear end of the vehicle shows that no attempt has been made to reduce engine noise, in fact the design is such that the whole bodywork is acting as a diaphragm and amplifies the normal engine noise.

2. On moving off from stationary a peculiarity is noticed, one might easily be in trouble if gear changing is carried out with any lock on the steering wheel, this is due to the instant response from the engine, accounted for in our opinion, to the absence of a propeller shaft, together with low gear ratios.

This lack of cushioning between the engine and driven wheels is definitely a feature that one has to be educated to, although this feature is not unpleasant when experience is gained.

3. The road holding quality is excellent due no doubt to all round independent suspension.

The swinging arm suspension for the front wheels is, in our opinion a valuable feature, since gyroscopic forces are eliminated.

The vehicle has the ability to keep a straight course "hands off" even on a comparatively rough surface, although for town work it is not so good, as the steering is definitely heavy for any appreciable lock.

The weight distribution could be improved, although the vehicle in its present form does not show any pronounced tendency to tail heaviness, this is probably the result of a generous track in relation to the wheelbase.

4. The forward position of the driver together with lack of bonnet line makes the aiming of the car difficult but this objection is soon overcome with a little practice, and the excellent forward visibility is then appreciated.

5. Summing up we would state that this vehicle is a useful education for those who think there is a future for the rear engined car, also the case for all round independent suspension is clearly demonstrated to be a valuable feature.

From the general construction one gets the impression that the designer has given just enough but no more, therefore as a war vehicle this is no doubt acceptable, but as a civilian vehicle considerable modification would be required to conform to the standard expected.

—ooOoo—