CARL F. W. BORGWARD GMBH

AUTOMOBIL- UND MOTOREN-WERKE

RE

Air Suspension
General Introduction

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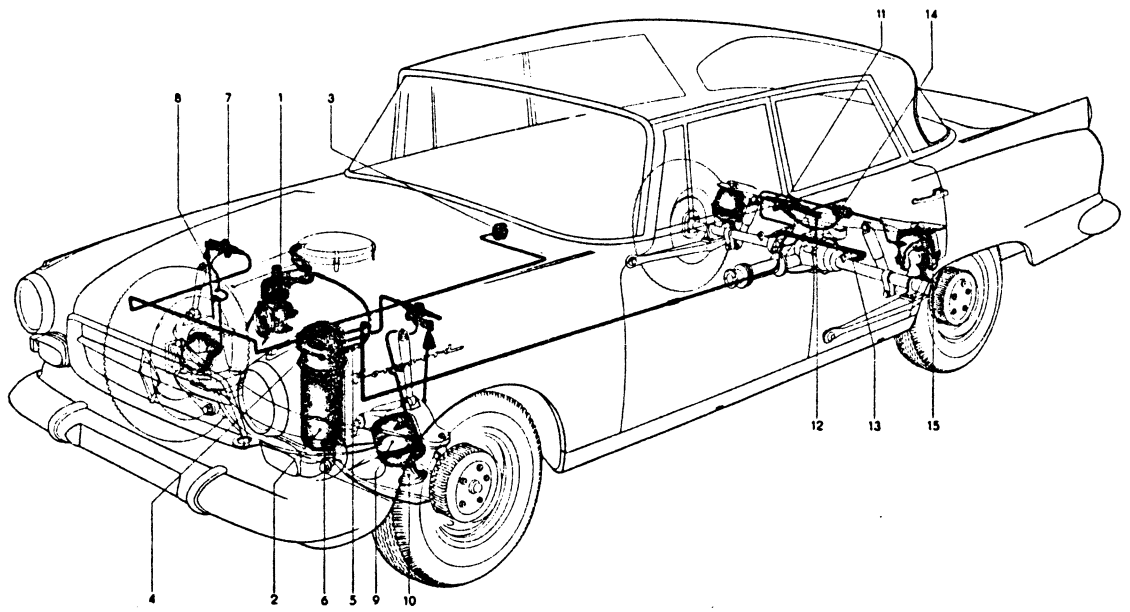
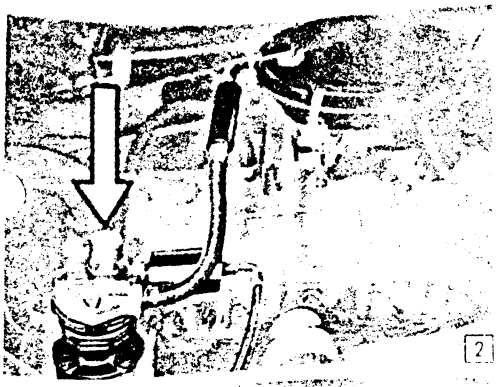
AIR SUSPENSION LAYOUT



1. Air compressor with silencer and muffler (Fig. 2)
2. Air-storage tank (Fig. 3)
3. Air-pressure gauge (Fig. 4)
4. Safety valve (Fig. 5)
5. Non-return valve (Fig. 6)
6. Air bleed screw (Fig. 7)
7. Control valve (right front) (Fig. 8)
8. Control link (front right) (Fig. 10)
9. Air suspension body (Fig. 14)
10. Diaphragm piston (front left) (Fig. 15)
11. Control valve (rear) (Fig. 9)
12. Control link (rear) (Fig. 11)
13. Swing traverse (rear) (Fig. 13)
14. Air distributor (Fig. 18)
15. Air-spring bellow (Fig. 16)



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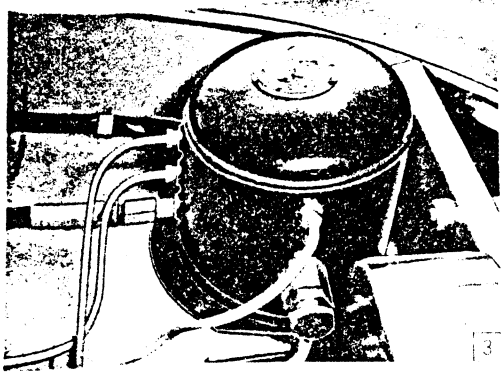
The single-cylinder piston-type air compressor (Fig. 2) driven by a "V" belt from the engine sucks in clean fresh air through the engine air cleaner and supplies an optimum operating pressure of max. 214 psi (15 kg/c.c.) from an output of 342 psi (24 kg/c.c.) at 4,800 rpm. The inlet from the air cleaner is equipped with a silencer.



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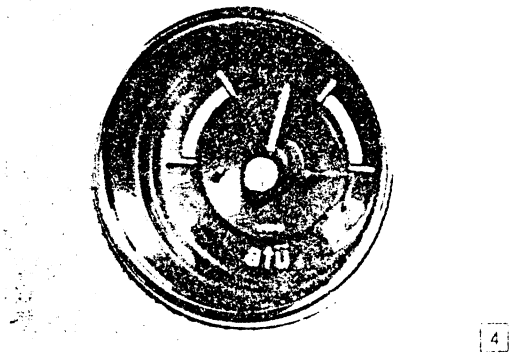
The 519 cu.in. (8 1/2 litres) of compressed air necessary for the trouble-free operation of the suspension system which is supplied by the compressor, is stored in an air-storage tank (Fig. 3). A silencer to reduce the amount of noise of the outgoing air is screwed into the cylinder head on the outlet support.



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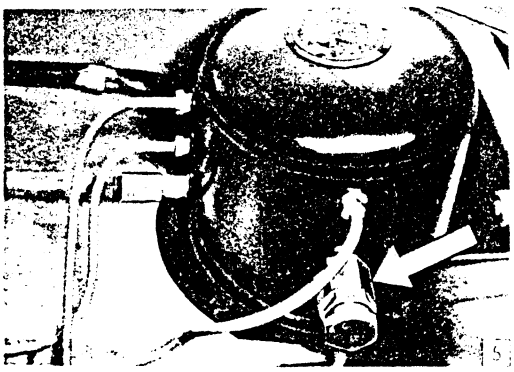
An air-pressure gauge (Fig. 4) visible to the driver is mounted on the dashboard and is connected by a pipe-line to the storage tank. It shows the pressure prevailing in the air tank. The two-colour scale enables the driver to take in at a glance, the air pressure available in the system. The three sections of the scale cover the following ranges: -

Red	0 - 100 psi (0 - 7 kg/c.c.) Operating pressure too low
Yellow over	214 psi (15 kg/c.c.) Operating pressure too high
In between	100 - 214 psi (7 - 15 kg/c.c.) normal operating pressure



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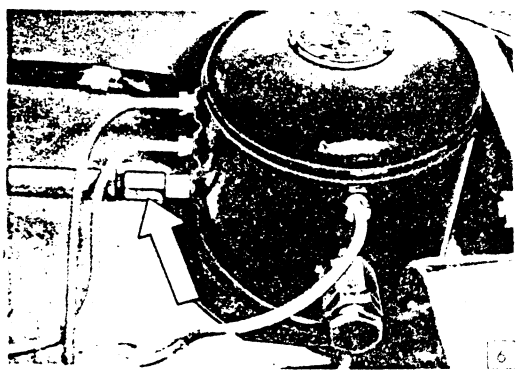

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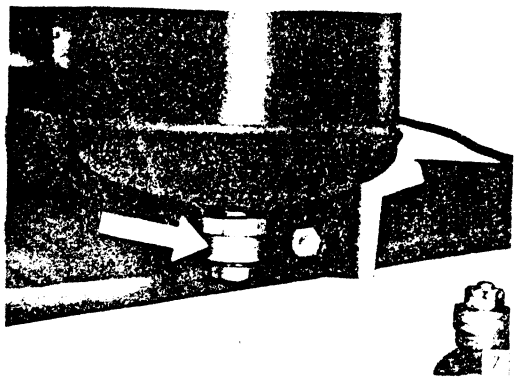
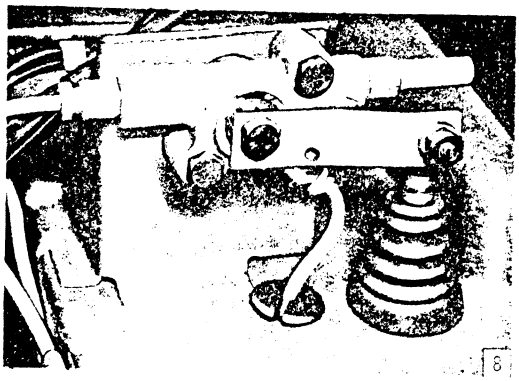
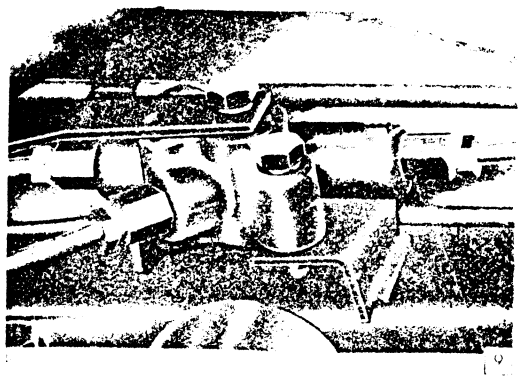
You should ensure that the needle of the instrument always moves in the section between 100 and 214 psi (7 and 15 kg/c.c.), as frequent driving at pressures below the recommended minimum can cause damage to the air-spring bellow, and this in turn may lead to damage to the rubber. Too high an operating pressure will adversely affect the sealed air safety valve which is situated on the side of the air-storage tank (Fig. 5) and which is set to blow off at 214 psi (15 kg/c.c.) and permit surplus air to escape. Should the gauge indicate an increasing build-up of pressure, then there is a fault either in the safety valve or in the gauge itself. In either case, both items should be checked by qualified mechanics as soon as possible. A non-return valve (Fig. 6) situated in the pipe-line between air compressor and storage tank prevents the escape of air stored in the tank by way of the compressor valves whilst the car is stationary.

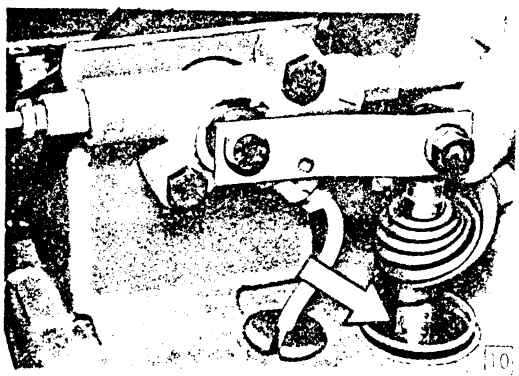
Due to there being a constant changeover in direction of airflow, varying temperatures are set up in the air-storage tank which can lead to condensation. The effect of powerful sunshine in summer and cold wind due to the car's motion in winter, together with the giving off of heat by the engine also encourage condensation in the air compressed in the tank. Water condensed in the air tank should be drained regularly every 2,500 miles (4,000 km). For this purpose, a drain plug (Fig. 7) is fitted at the base of the tank. It is easily accesible and simple to operate. Unscrew lower screw until condensed water begins to drain. After draining, tighten drain plug firmly.



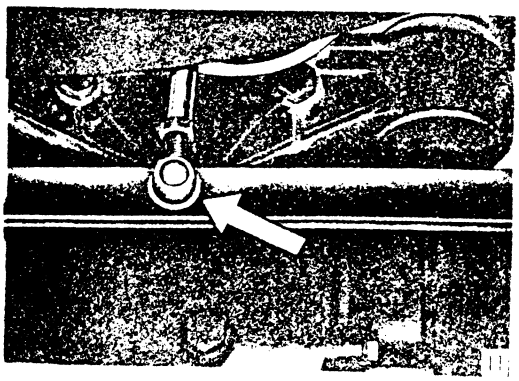


Fed by the air-storage tank, the whole air-suspension system is kept under pressure. With the vehicle stationary, this remains constant. In motion however, the independent front and rear suspensions are subjected to continuous variations in pressure. Three valves control the level of the sprung mass independent of the loading upon the car, but however remaining free from reaction with small movements of the suspension. Independent of the air suspension, the four hydraulic telescopic shock-absorbers fitted with mechanical stabilizers fulfil their normal function - the damping out of body movement due to road surface irregularities - in the shortest possible space of time.



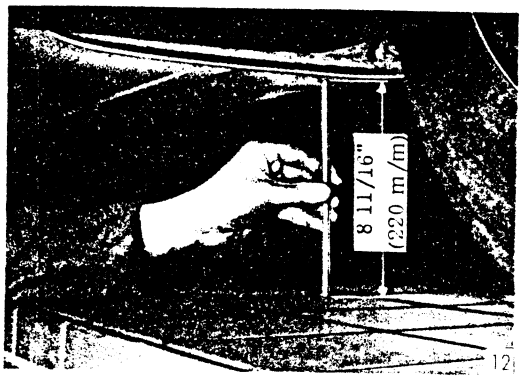


Whilst the independently sprung front axle is controlled by two control valves - right and left (Fig. 8 left), the rear axle is controlled by a single control valve (Fig. 9). Each valve is connected to its wheel or axle mounting by a ball-jointed control link (Fig. 10 front and Fig. 11 rear).



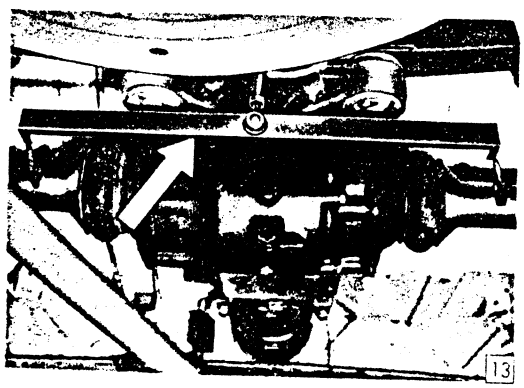
Thus the position is reached whereby the height of the body above the road always remains the same despite variations in the vehicle's loading (e.g. Varying number of passengers and/or varied amount of luggage) - a figure of 8 11/16" (220 m/m) between the road surface and the underside of both side sills, front and rear (as ascertained on a flat surface). In a similar fashion, the control valves through their control links make a material contribution to improving the roadholding of the vehicle, particularly on small radius curves and corners.

How is the figure of 8 11/16" (220 m/m) adjusted? The starting point is the control valve for the rear axle which is mounted on the cross-member:-



The distance between the ground and the underside of the side sill is measured with a measuring rod 8 11/16" (220 m/m) long placed under the rear of the side sill, left or right. (Fig. 12 shows a measurement being taken by the left-hand front wheel.) Should the clearance be other than the figure prescribed, the height must be adjusted by altering the length of the rear control link located exactly in the centre of the vehicle (see Fig. 11). It has the task of transmitting the up and down motion of both halves of the independent rear axle over a swing traverse (Fig. 13) to the control valve.

After loosening the lock-nuts on the upper and lower ball-joints, the connecting rod which is fitted with right- and left-hand threads can be turned at either the top or bottom (see Fig. 11) to effect the necessary exact adjustment, allowing a tolerance of 5/16" (2 m/m) either way, measured at the outer end of the control valve lever:-



Lengthening control link

increases ground clearance.

Shortening control link

reduces ground clearance.

When making these adjustments, care should be taken that the figure of 8 11/16" (220 m/m) is first of all exceeded and then gradually reduced to give the correct reading. Under no circumstances should it be adjusted in excess of the prescribed figure. This check should be carried out every 7,500 miles (12,000 km) in the course of normal servicing and corrected if necessary.

When the clearance has been correctly adjusted, both locknuts on the rear control link should be tightened securely. The ground clearance on both sides forward should be adjusted to 8 11/16" (220 m/m) in the same way by altering the length of the two front control links as may be necessary (see Fig. 10).

The fact that the vehicle remains at the same level height under all condition comes in very useful in many ways. e.g. The position of the headlamps with regard to the traffic safety.

The function of the control valves can be clearly followed from the above description. It controls the change in air volume in the air suspension body of the wheel in question consequent upon the change in loading due to the up-and-down motion of that wheel - i.e.

With an upward movement of the body through a decrease in the car's loading, it allows air to escape from the air suspension body via control valve to atmosphere.

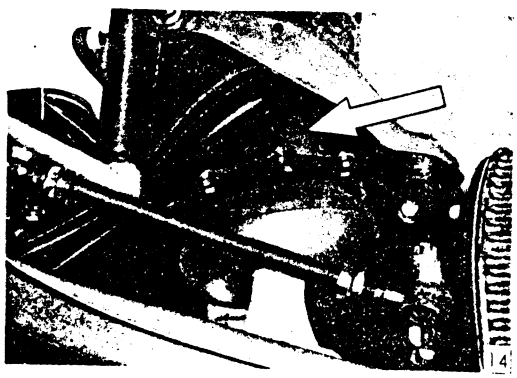
With a downward movement of the body through an increase in the loading, it provides an increase in pressure in the bellow by inlet of compressed air from the storage tank.

To summarize, the control valves have the three following basic positions: -

1. The "neutral" position. i.e. The loading upon the body remains unaltered and vehicle and control links are in a state of rest. Both supply of air from storage tank and exit of air from air-spring bellow are cut off.

2. Loading upon vehicle is increased; control links go up, air supply is opened and compressed air enters the spring bellows.

3. Loading on vehicle is reduced; control links go down, air supply is cut off and air from spring bellows is allowed to escape to atmosphere via the control valves. To deaden the sound of the escaping air, a silencer is mounted on the side of the control valve.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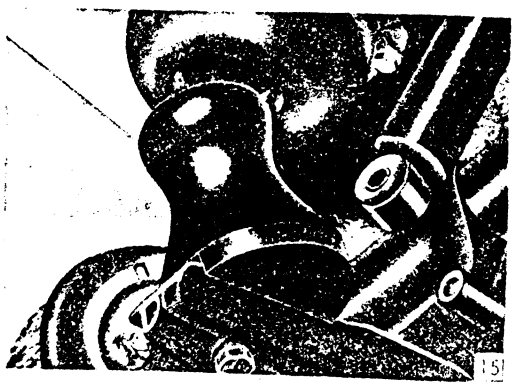
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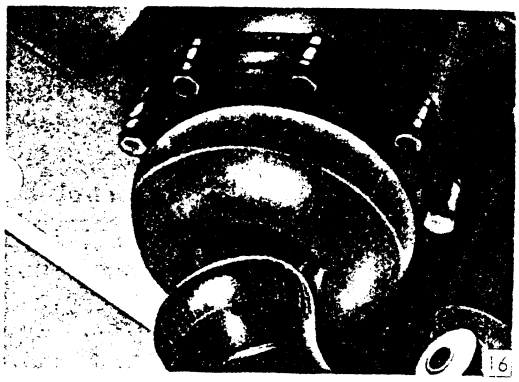
The air supplied by the control valve is led to the air-spring bellow of the independently suspended wheel in question.

Basicly, this consists of a steel "bell" - the so-called air suspension body (Fig. 14, left front) in which by up-and-down movement of the wheel axle, a conical diaphragm piston (Fig. 15, left rear) moves either upwards or downwards.



Around the diaphragm piston, which in the case of the front axle is screwed securely to the lower wishbone and in the case of the rear axle to the rear end of the radius arm - a loosely inserted air-spring bellow (Fig. 16, left rear) "rolls". It is attached to a circular retaining flange on the suspension body.

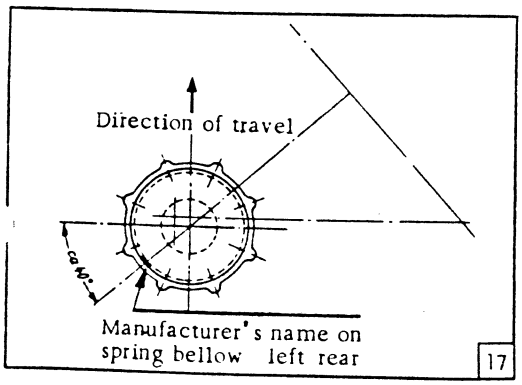
The varying pressures encountered demand different installation pressures in the case of the rear axle spring bellows as against those for the front axle. Because of the different axle loadings when the car is at rest, the system is set up with different pressures in the suspension bodies. e.g.

Front axle (empty)	each unit 64 psi (4 1/2 atm)
Front axle (Fully laden = 2 persons in front, 3 passengers rear and 99 lbs. (45 kg) luggage)	each unit 75 1/2 psi (5 5/16 atm)
Rear axle (empty)	each unit 35 1/2 psi (2 1/2 atm)
Rear axle (Fully laden = 2 persons in front, 3 passengers rear and 99 lbs. (45 kg) luggage)	each unit 42 1/2 psi (3 atm)

Due to the permanent pressure in the air-spring bellows, a pressure which can be increased by spirited driving or particularly bad road conditions, the material of which they are constructed is subjected to heavy demands. The most severe bending of the bellows takes place on the side towards the appropriate axle pivot. i.e. On the front axle at right angles to the direction of travel and away from the vehicle centre line and in the case of the rear axle, the resultant of the axle and radius arm pivot points. It works out to an angle of 41° 40′ to the centre of the rear axle. (Shown in diagram in Fig. 17).

To preserve the life of the air-spring bellows, it is absolutely essential that when fitted correctly, the manufacturer's name on the bellow should be at the point farthest away from the appropriate axle radius.

i.e. The manufacturer's name on the bellow should be:-

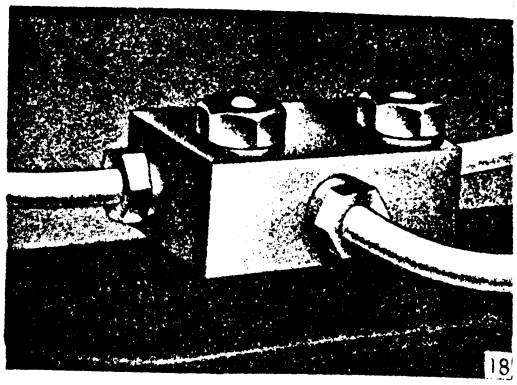


on the front suspension, readable from outside in the longitudinal direction of the front axle beam towards the axle fork.

on the rear axle, about 40° outwards and to the rear, facely approximately the outer end of the rear bumper.

After carrying out repairs, both diaphragm pistons and air-spring bellows must be free of grease and oil. Both items must be assembled dry.

A distributor is fitted in the compressed air line between the control valve and the air-suspension bodies for the two rear wheels (Fig. 18). It has three objects:-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1. To channel the compressed air coming from both rear suspension bodies through a single pipe. i.e. To conduct surplus air from both units through the same pipeline to the control valve.

2. To throttle volumetrically the varying air flow from 15/64" (6 m/m) in the pipe to .02" (1/2 m/m) diameter in the distributor body.

3. To throttle by sharp-angled bends the equalized pressure between left and right suspension bodies and thereby maintain the air in the rear axle suspension system as equal as possible on both sides.

Summarized, the air suspension as fitted to the new "BORGWARD Big Six" offers the following advantages over vehicles equipped with conventional semi-eliptic or coil springing:-

1. Satisfactory springing of the whole vehicle providing a ride free from vibration and oscillation.

2. Extraordinary good stability and road-holding, even on bad surfaces. Immunity to effects of uneven surfaces and side thrusts (e.g. side winds).

3. The body remains at exactly the same level and height, no matter what the loadings. e.g. Headlamp adjustment remains constant even when load is unevenly distributed.

4. Improved cornering due to satisfactory take-up of centrifugal effect relating to the axle. This cuts out cornering loadings of the passengers.

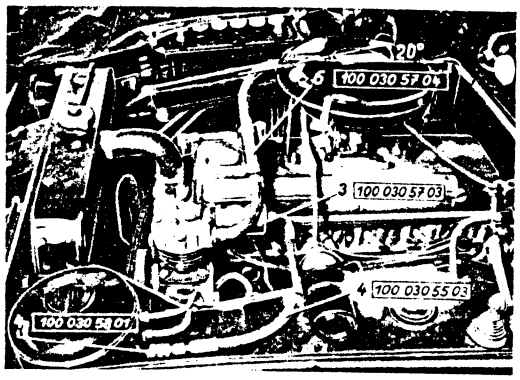
5. Trouble and virtually maintenance-free installation and thereby decrease in vehicle maintenance costs.

Please turn over!

Important! re subsequent installation of compressor silencers on engines up to No. 1 230 347

In order to suppress inlet and exhaust noise on compressors on the above-mentioned engines, a silencer is installed which needs no further modification. The procedure is as follows: -

1. Loosen drain plug in bottom of air-storage tank to release pressure from tank (see p. 3 Fig. 7).



2. Disconnect air pipe-line from compressor to storage tank, then unscrew valve from tank.

3. Fit silencer (part No. 100 030 57 03) to compressor.

4. Fit new non-return valve (part No. 100 030 58 01) to air-storage tank and re-connect compressor to tank with new air line (part No. 100 030 55 03).

5. Loosen inlet hose to compressor from air cleaner connection. Remove cover from air cleaner and modify connection as shown in accompanying illustration. Fit air cleaner cover in such a way that compressor inlet connection faces forward. Fit inlet hose.

6. Cut inlet hose in centre and shorten each half sufficiently to accomodate silencer.

7. Fit supplementary inlet silencer (part No. 100 030 57 04) so that the end with the smaller internal diameter pipe faces the air cleaner. Re-tighten drain plug in air-storage tank.