PREFACE

Definitions adopted in the current Manual

The Company ASTRA VEICOLI INDUSTRIALI, Via Caorsana, 79 - 29100 PIACENZA (Italy) is hereinafter called *Manufacturer.*

The current WORKSHOP MANUAL is hereinafter called *Manual.*

The equipment dealt with in the current Manual is hereinafter called *vehicle*.

The operator directly or indirectly involved in vehicle repair is hereinafter called *operator.*

Introduction

The current Manual applies essentially to authorised workshop technical staff.

This Manual provides technical information but cannot replace a thorough professional experience.

This Manual contains all data and information required to perform correct checking and setting up operations as well as repair and overhaul operations.

Read this Manual right through before performing any operation on the vehicle.

Compliance with the provided information and the use of the recommended tools guarantee correct repair and avoid damages to operators.

You will frequently see that parts of the text are highlighted as shown below:

Failure to heed and/or correctly carry out procedures, technical information and precautions given may cause injury.

Failure to heed and/or correctly carry out procedures, technical information and precautions given may cause damage to the vehicle.

Procedures, technical information and precautions which must be highlighted.

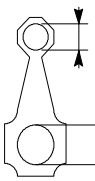
Failure to heed and/or correctly carry out procedures, technical information and precautions given may cause environmental damages.

This Manual has been divided into Sections, each of which has a number and its relevant contents are indicated in the Index of Sections.

Each section features a main Unit (e.g.: engine, gears, etc.)

Where possible, the same sequence of procedures has been followed for easy reference.
Diagram and symbols have been widely used to give a clearer and more immediate illustration of the subject being dealt with (see next page) instead of giving descriptions of some operations or procedures.

Example:



Ø 1 = Housing for connecting rod small end bush

Ø 2 = Housing for connecting rod bearings

Tighten to torque
Tighten to torque + angular value

MEASURES (INTERNATIONAL SYSTEM)

Force in N (Newton)

Conversion:

1 N	=	0,1019 kg
1 kg	=	9,81 N

Power in kW (kilowatt)

Other units in use:

HP (Horsepower)

Conversion:

1 kW	=	1,36 CV
1 kW	=	1,34 HP
1 CV	=	0,736 kW
1 CV	=	0,986 HP
1 HP	=	0,746 kW
1 HP	=	1,014 CV

Torque in Nm (Newton/metre)

Conversion:

1 Nm	=	0,1019 kgm
1 kgm	=	9,81 Nm
1 kgm	=	10 Nm *

Specific consumption in g/kWh (grams per kilowatthour)

Other unit in use:

g/CVh (grams per horsepower-hour)

Conversion:

1 g/kWh	=	0,736 g/CVh
1 g/CVh	=	1,36 g/kWh

Pressure in kPa (kilopascal)

Other units in use:

kg/cm^2 (kilograms per square centimeter)

Atm (metric atmosphere)

psi (pounds per square inch)

Conversion:

1 kg/cm^2	=	1 Atm
1 kg/cm^2	=	98,1 kPa
1 kg/cm^2	=	0,981 bar
1 kg/cm^2	=	1 bar *
1 kg/cm^2	=	14,22 psi
1 bar	=	100 kPa
1 bar	=	1,02 kg/cm^2
1 bar	=	14,51 psi
1 psi	=	6,9 kPa
1 psi	=	0,069 bar
1 psi	=	0,0703 kg/cm^2
1 kPa	=	0,145 psi
1 kPa	=	0,0102 kg/cm^2
1 kPa	=	0,01 bar

Conversion values for British units

0,1 mm	=	3,937 mils
1 mm	=	0,039 inch
1 m	=	3,281 ft.
1 km	=	0,621 miles
1 cm^3	=	0,06 1 cu. in.
1 l	=	1,759 pts (0,88 imp.qts)
1 bar	=	14,5038 psi
1 g	=	0,035 oz. (0,564 dr.)
1 kg	=	2,205 lbs.

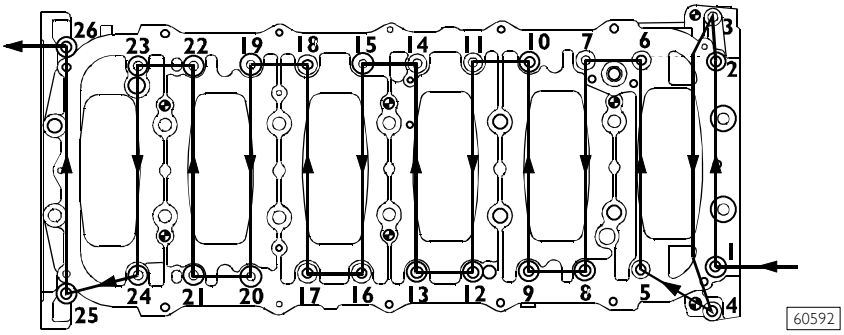
(in case of differences in temperature 1 °C = 1.8 °F)

(*) Nm and bar are converted according to the ratios 10:1 and 1:1.

TIGHTENING ORDER OF GEARBOX TO ENGINE BLOCK FASTENING SCREWS

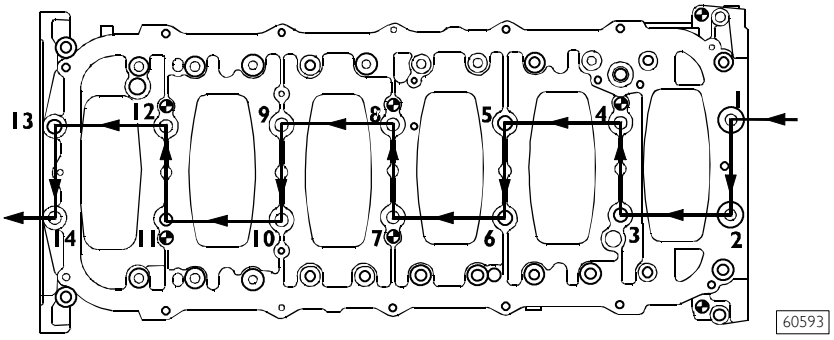
Figure 8

FRONT SIDE



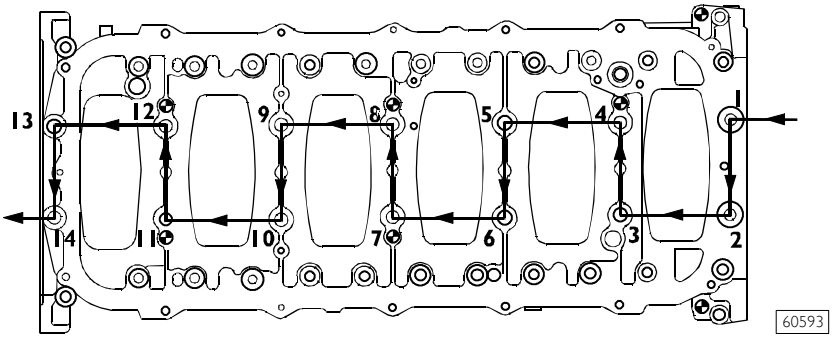
stage 1:
pretightening,
outer screws
30 Nm

FRONT SIDE



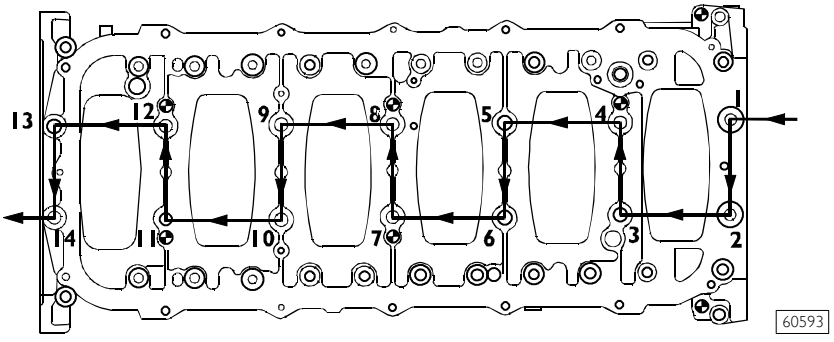
stage 2:
pretightenig,
inner screws
120 Nm

FRONT SIDE



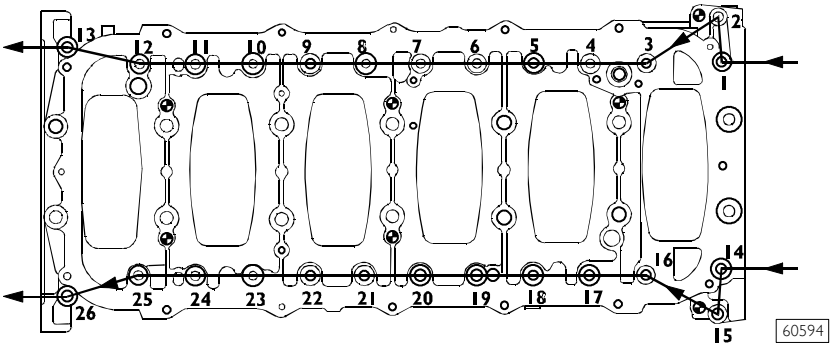
stage 3:
angle, inner
screws
60°

FRONT SIDE



stage 4:
angle, inner
screws
55°

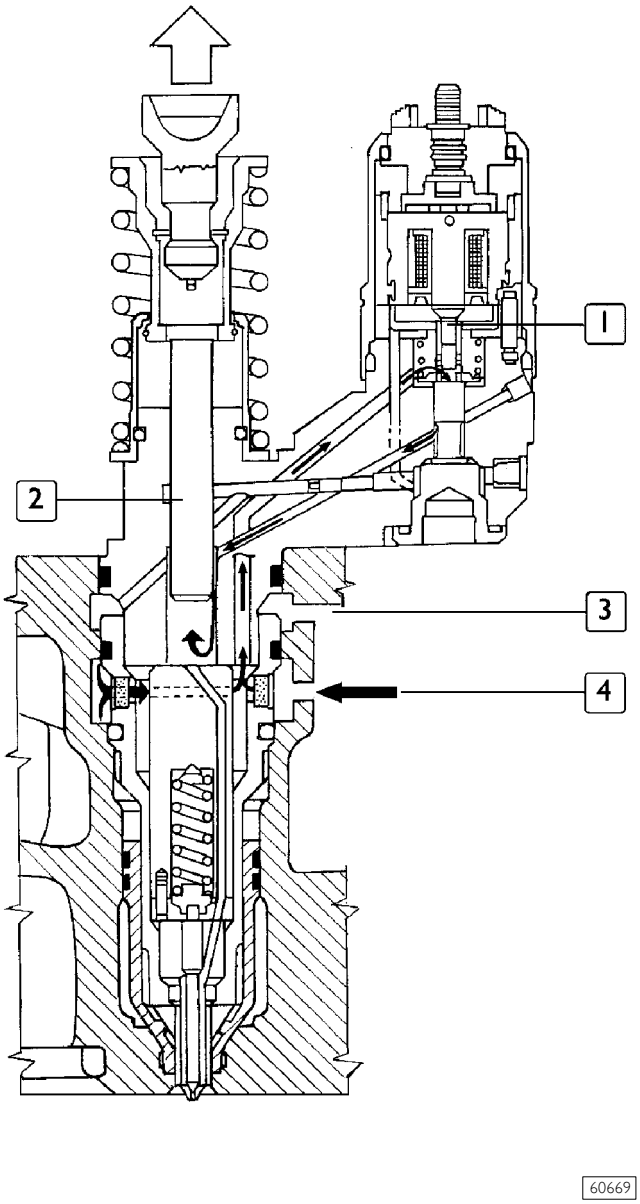
FRONT SIDE



stage 5:
angle, outer
screws
60°

Injection phases

Figure 227



1. Fuel valve
2. Pumping element
3. Fuel discharge
4. Filling and flowing back channel

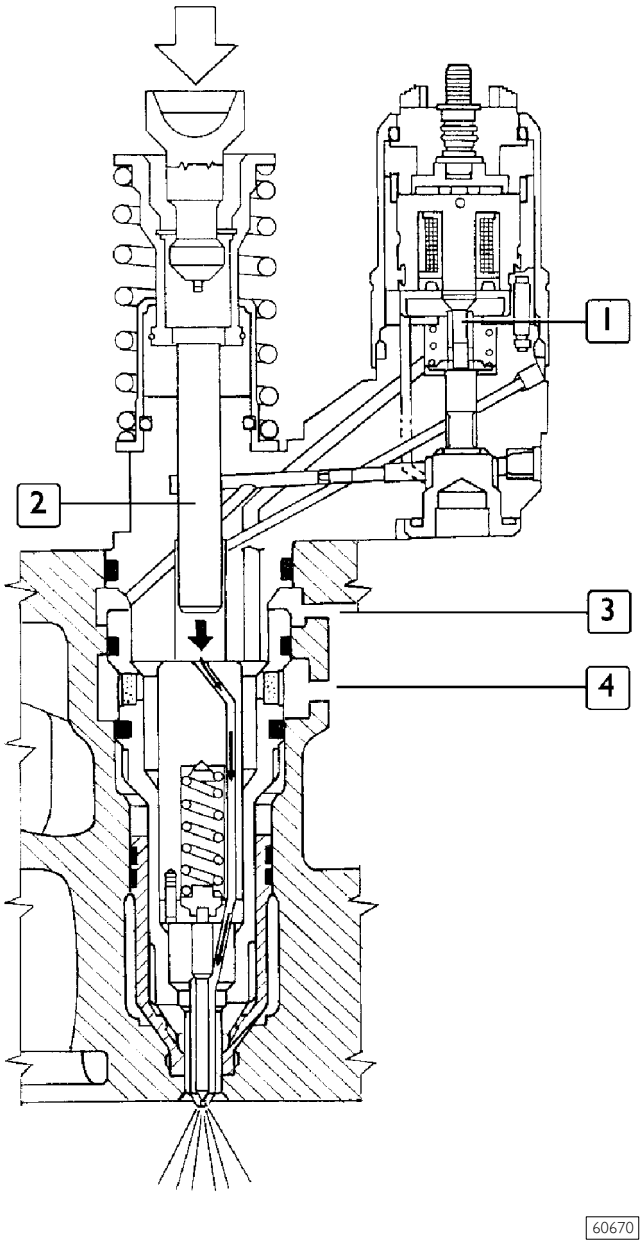
Filling phase

During the filling phase, the pumping element (2) moves to its upper position.
The highest cam position is passed and the rocker roller gets closer to the cam basic circle.

The fuel valve (1) is open and the fuel can flow into the injector from the lower channel (4) of the cylinder head.

The filling phase continues until the pumping element has reached its upper end-of-stroke position.

Figure 228



1. Fuel valve
2. Pumping element
3. Fuel discharge
4. Filling and flowing back channel

Injection phase

The injection phase starts when, during the pumping element descending phase, the solenoid valve is energized and the fuel valve (1) closes. Delivery start time, properly processed by the electronic control unit, depends on engine operating conditions. Through the rocker, the cam continues to activate the pumping element (2) and the injection phase continues as long as the fuel valve is closed (1).

DESCRIPTION

The ZF 16S 1620 and ZF 16S 2320 TD version consist of:

- a central box containing the primary shaft, drive input shaft, secondary shaft and the cogs of the four forward and one reverse gear;
- a rear casing containing the Epicyclical Reducer Group (G.R.E). The function of this is to double the number of forward gears by means of epicyclical gears with helical teeth.
  This gives a range of gears that starting with four input ratios permits eight different output ratios (four normal ratio and four low ratio gears);
- a front casing containing the "splitter", that gives a further double selection for each of the eight forward gears and for the reverse gear.
  The "splitter" halves the difference between two successive gears, effectively splitting each gear into a slow ratio (L = slow ratio) and a fast ratio (S = fast ratio).

These gearboxes therefore have a total of sixteen forward gears with finely scaled ratios, all engageable in succession, and two reverse gears.

The synchronisers are single cone type.

Lubrication is by means of a gear pump.

The double H type gear shift control is equipped with a pneumatically powered "servoshift" device to improve gear selection and engagement.

The servoshift is a device consisting of a mechanical/pneumatic functional unit and a dual action cylinder.

The advantages of this device are:

- gear selection and engagement more rapid and with less effort;
- it dampens the vibration of the control linkages, reducing noise;
- less strain to the synchronisers.

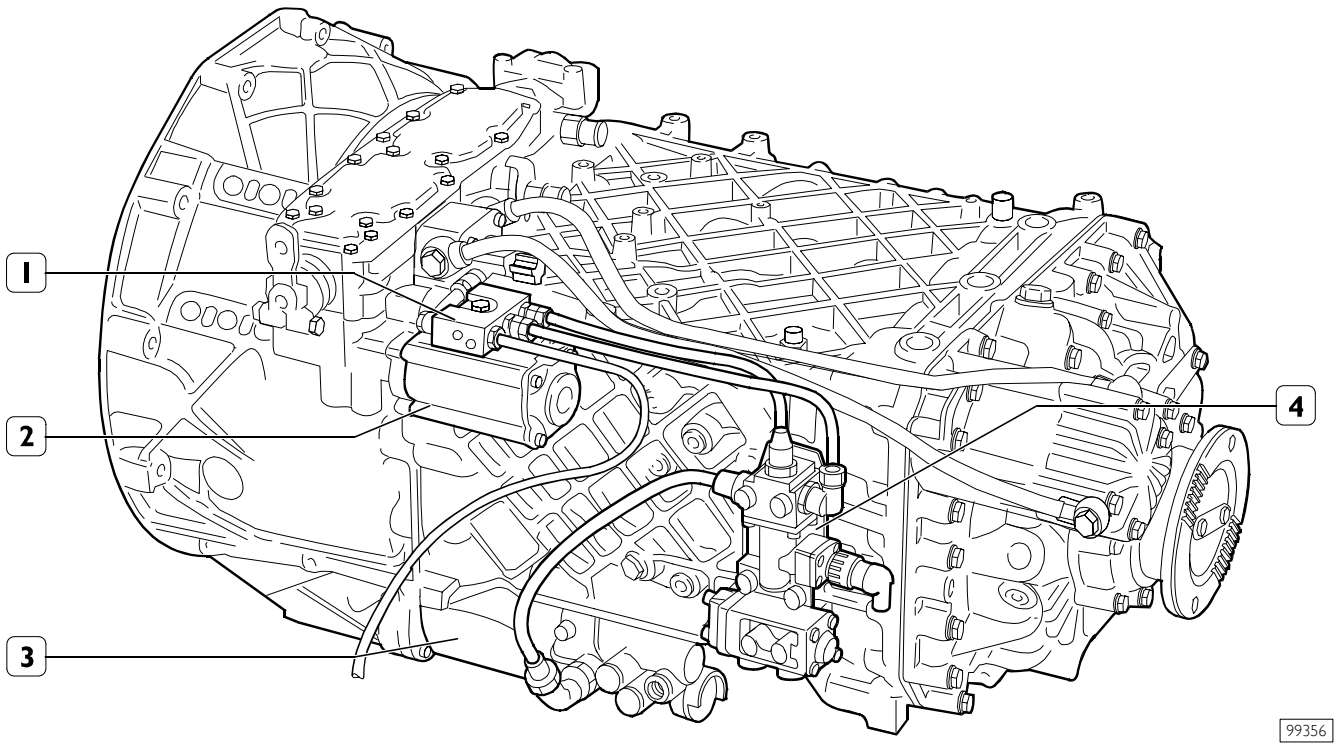
The device functions mechanically in case of pneumatic system failure.

The gearboxes mounted of vehicles with F3B engines are fitted with a synchro protection device.

This permits pneumatic power to the servoshift for gear engagement only after the clutch pedal has completed 70% of the disengagement stroke.

It consists of an electrovalve controlled by a proximity switch mounted on the clutch disengage master cylinder.

Figure 1



1. Distributor – 2. Servoshift – 3. Servoclutch – 4. *Servoshift power electrovalve

* only for vehicles with F3B engine

Figure 10

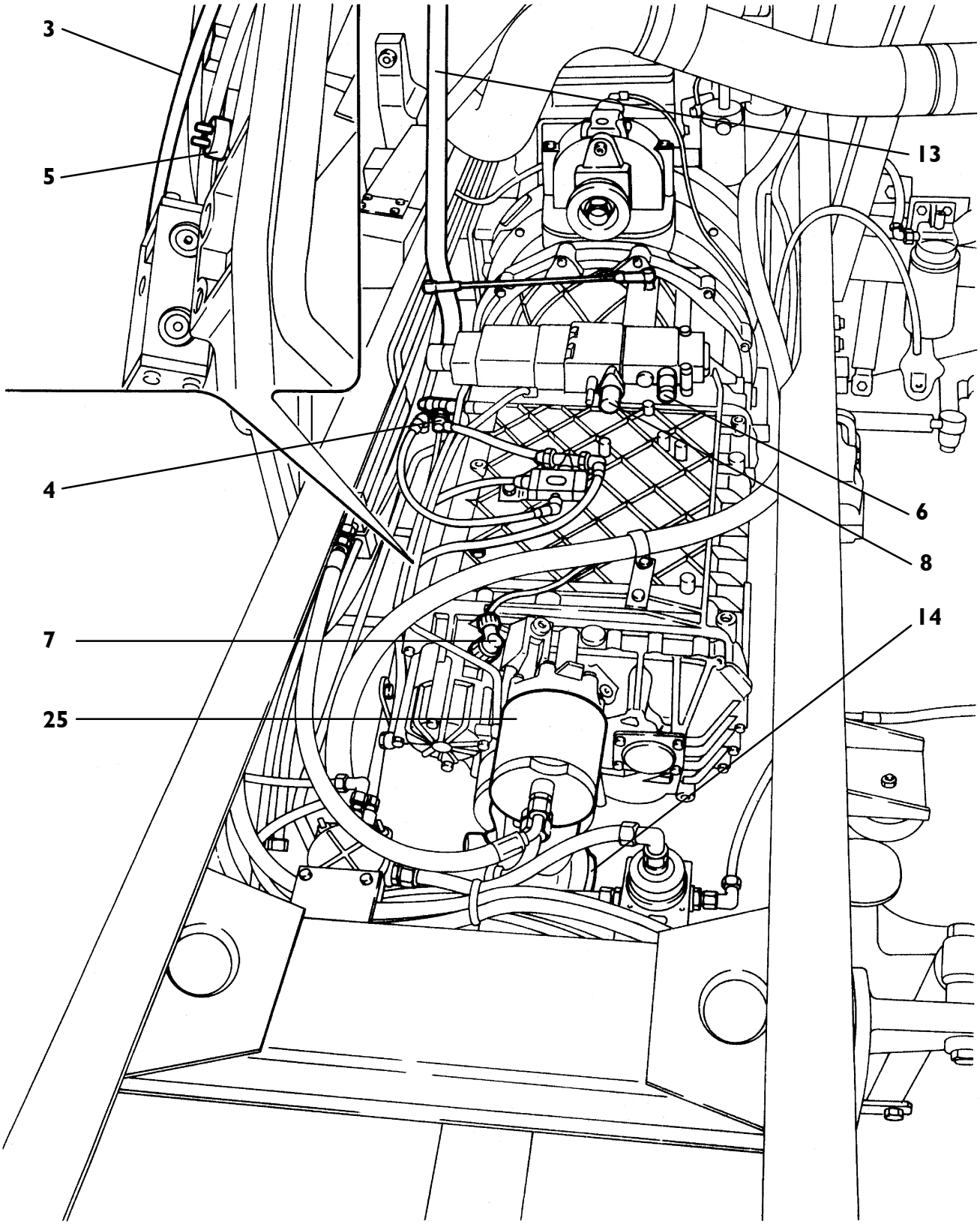
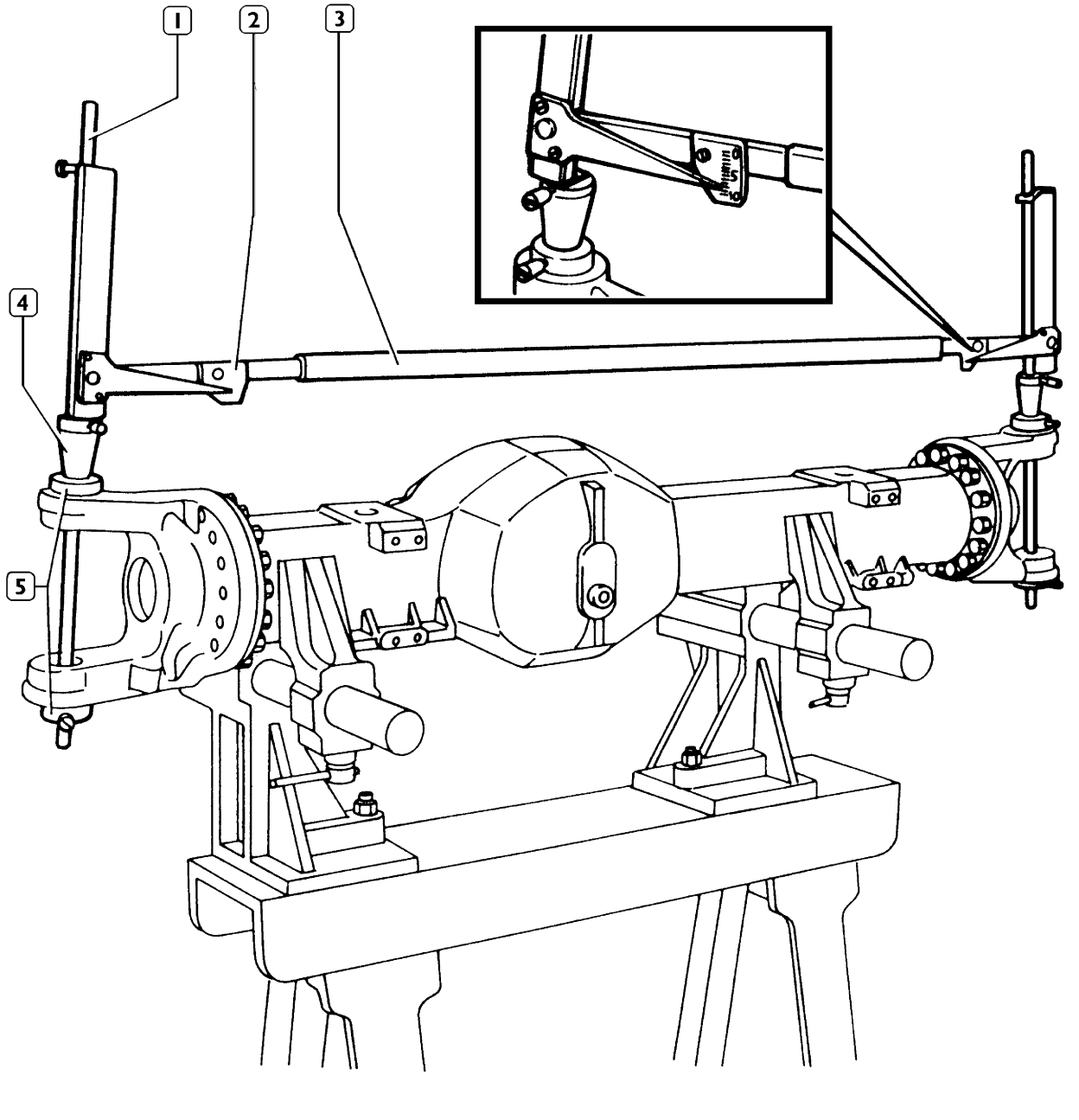


Figure 37



CAMBER ANGLE CHECK
1. Support - 2. Goniometer - 3. Cross bar - 4. Centering cones - 5. Spacer

DIAGNOSTIC

Main axle faults:
1 - Wheel hubs noisy
2 - Noise
3 - Noise at release
4 - Noise during acceleration
5 - Cornering noise

1 WHEEL HUBS NOISY

Insufficient lubrication – YES → Check there are no leaks from gaskets or the axle casing and top up oil to correct level.

NO ↓

Wheel hub bearings inefficient – YES → Remove the hub and replace inefficient parts.

NO ↓

Bad adjustment of wheel hub bearings – YES → Adjust bearings

NO ↓

Half-shaft splines to fit planetary gears of epicyclic gears are worn – YES → Overhaul and replace worn or damaged parts

2 NOISE

Lubricating oil level low – YES → Check there are no leaks from gaskets or axle casing and top up to correct level

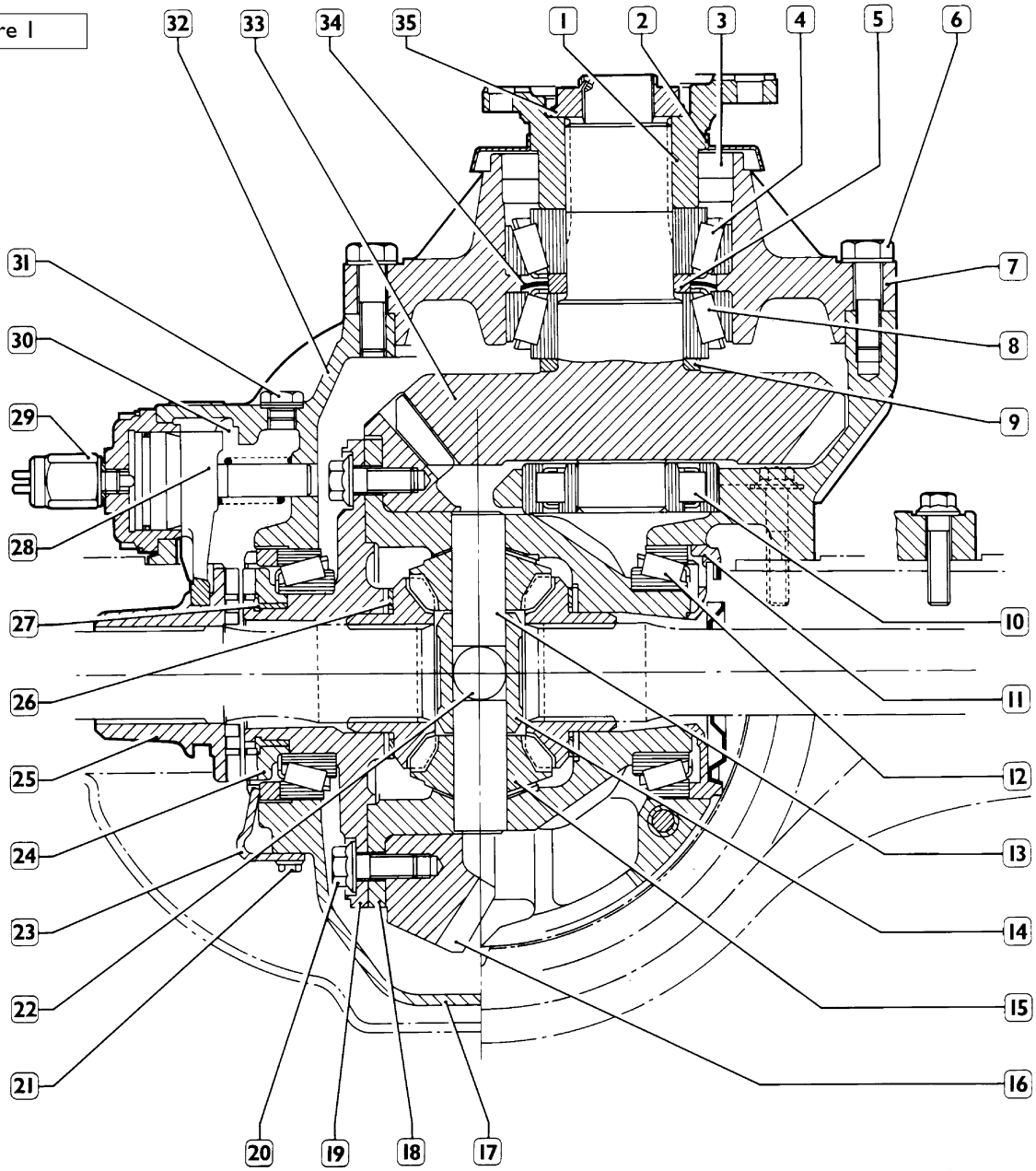
NO ↓

Half shaft splines to fit the differential crown wheels damaged – YES → Overhaul the axle and replace worn or damaged parts.

DESCRIPTION

The rear axle is a double reduction type: the first reduction is by means of the pinion - ring bevel gear unit and the second is obtained through an epicyclic unit in the wheel hubs.
The differential housing, with the ring bevel gear , is supported by two taper roller bearings that can be adjusted through two threaded ring nuts.
The pinion is supported by two taper roller bearings and a third straight roller bearing.
The bevel pinion unit is adjusted through adjusting rings that are fitted between the the two taper roller bearings.
The axle is equipped with a pneumatically controlled device to lock the differential.
The half shafts coming from the differential transmit the motion to the epicyclic gears.

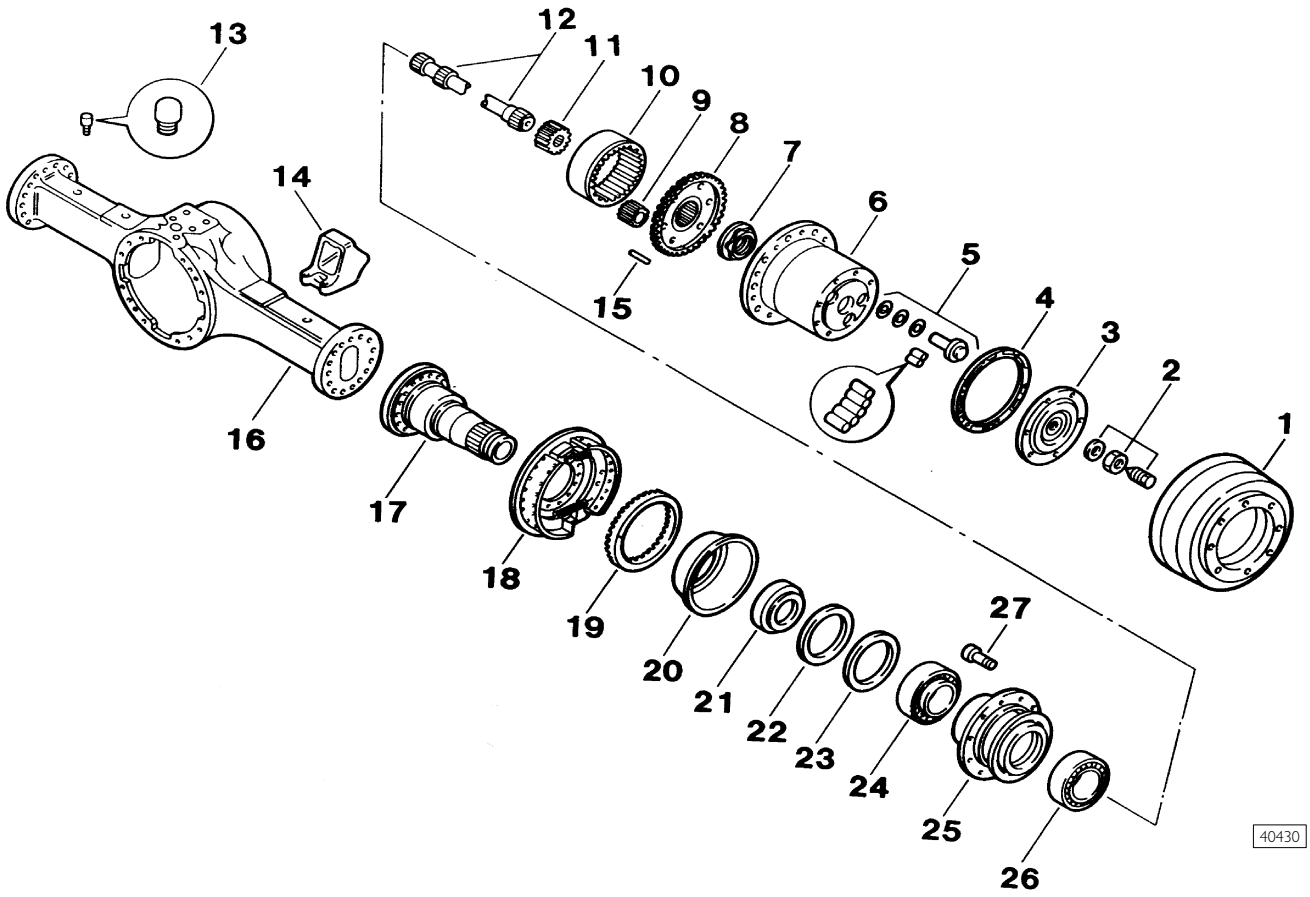
Figure 1



PICTORIAL CROSS SECTION OF THE DIFFERENTIAL

1. Coupling flange - 2.Oil seal - 3. Outer seal ring - 4. Front bearing - 5. Adjusting ring - 6. Screw - 7. Bevel pinion support - 8. Intermediate bearing - 9. Adjusting ring - 10. Rear bearing - 11. Adjusting ring nut - 12. Differential housing bearing - 13. Short pin - 14. Spider - 15. Planetary gear - 16. Crown wheel - 17. Cover - 18. Gear housing - 19. Cover - 20. Screw - 21. Screw - 22. Long pin - 23. Safety plate - 24. Engaging sleeve - 25. Sliding sleeve - 26. Shoulder washer - 27. Split ring - 28. Engaging fork - 29. Transmitter - 30. Spring - 31. Plug - 32. Differential housing - 33. Taper pinion - 34. Oil baffle - 35. Lock nut

Figure 9

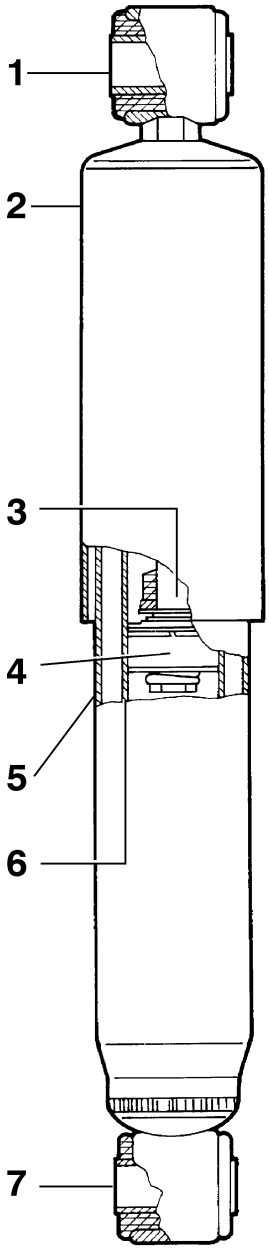


WHEEL HUB COMPONENTS

1. Brake drum – 2. Adjusting screw and nut – 3. Cover – 4. Gasket – 5. planetary gear pin and rollers – 6. Planetary gear carrier – 7. Adjusting nut – 8. Crown wheel carrier – 9. Planetary wheel – 10. Crown wheel – 11. Crown wheel gear – 12. Half-shaft – 13. Bleeder – 14. Bracket – 15. Shoulder pin – 16. Axle casing – 17. Bearing shaft – 18. Braking unit – 19. Phonic wheel – 20. Oil cup – 21. Supporting ring – 22. Seal ring – 23. Seal ring – 24. Bearing – 25. Wheel hub – 26. Bearing – 27. Bolt

Hydraulic shock absorbers

Figure 4



The hydraulic shock absorbers are of the telescopic double acting type.

These shock absorbers are also defined "direct acting" since their braking action is directly performed on the suspension elements without levers.

They are fitted with thermostatically controlled valves, thus ensuring that there are no noticeable differences in their performance, even following sharp changes in temperature.

Shock absorbers are divided into three different parts:

1. the cylinder part located above the piston (always filled with oil);
2. the cylinder part located under the piston (always filled with oil);
3. the oil reserve, i.e. the compartment between the cylinders (5 and 6) (never completely filled with oil).

During the bouncing stage, i.e. when the shock absorber extends, the oil pushed by the piston (4) passes through the compartment, from the upper part of the piston to the lower part of the cylinder.

During the compression stage, i.e. when the shock absorber lengthens and piston goes downwards, the oil located under the piston passes directly to the upper part of the cylinder.

For oil passing from one part of the piston to the other, a forcing pressure intervenes acting on the piston and opposing piston movement thus causing suspension braking.

Noise

This defect, which is often laid to shock absorbers, can have different origins. It is therefore recommended to inspect suspensions carefully, including shock absorber connections to chassis or leaf spring.

Check whether no shock absorber part is in "metallic" touch with the leaf spring or the chassis.

Shock absorber dust protection distortion, due to wheel rotation, or short oil due to accidental leaks, can cause noise; in this case the shock absorber must be replaced.

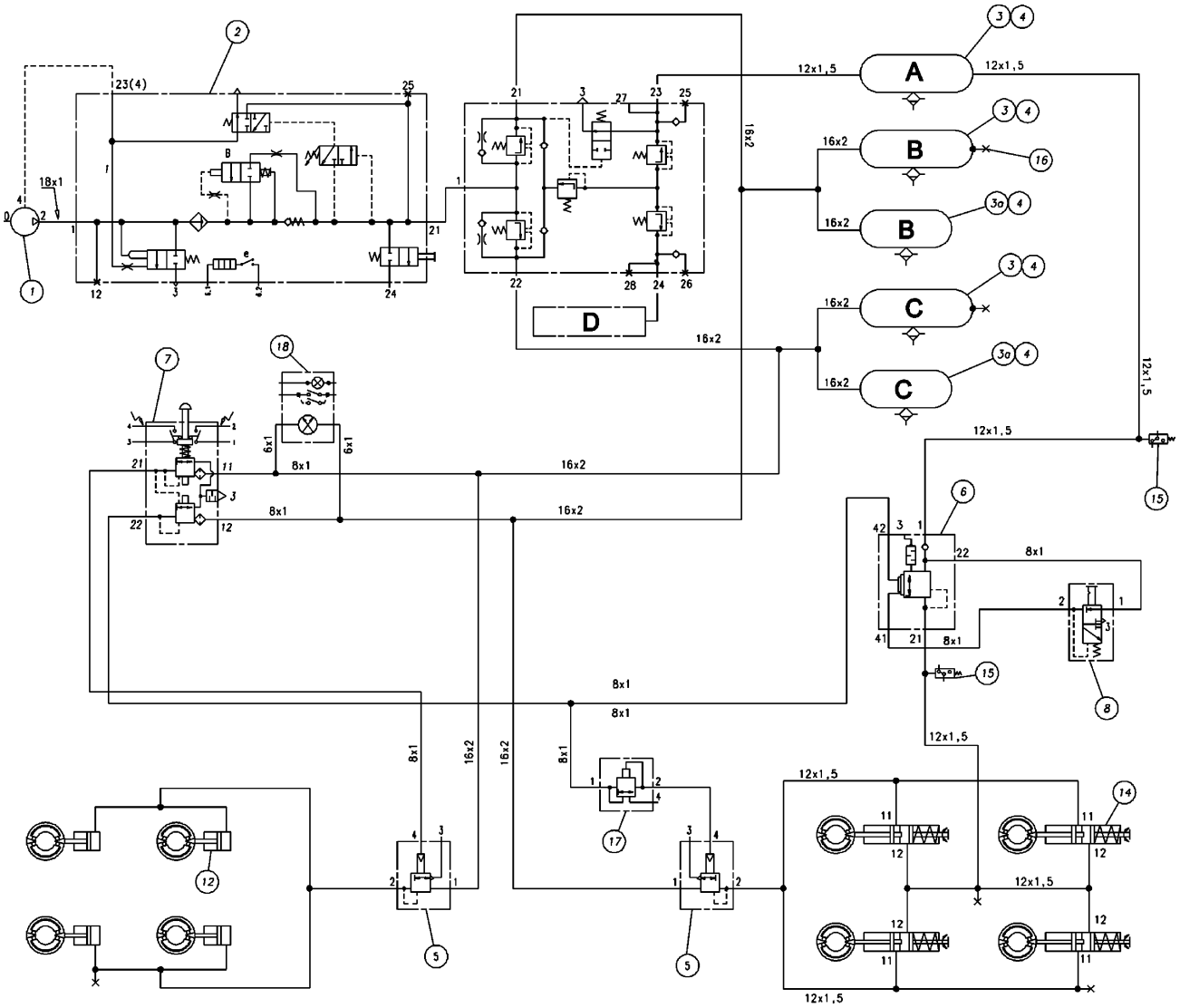
Changes in braking effect

A change in the braking effect can take place accidentally.

The decrease of the braking effect can be due to breakage of internal parts, short oil or jams.

Replace the shock absorber in any case.

BRAKING SYSTEM DIAGRAM
8x4 vehicles without tow hook

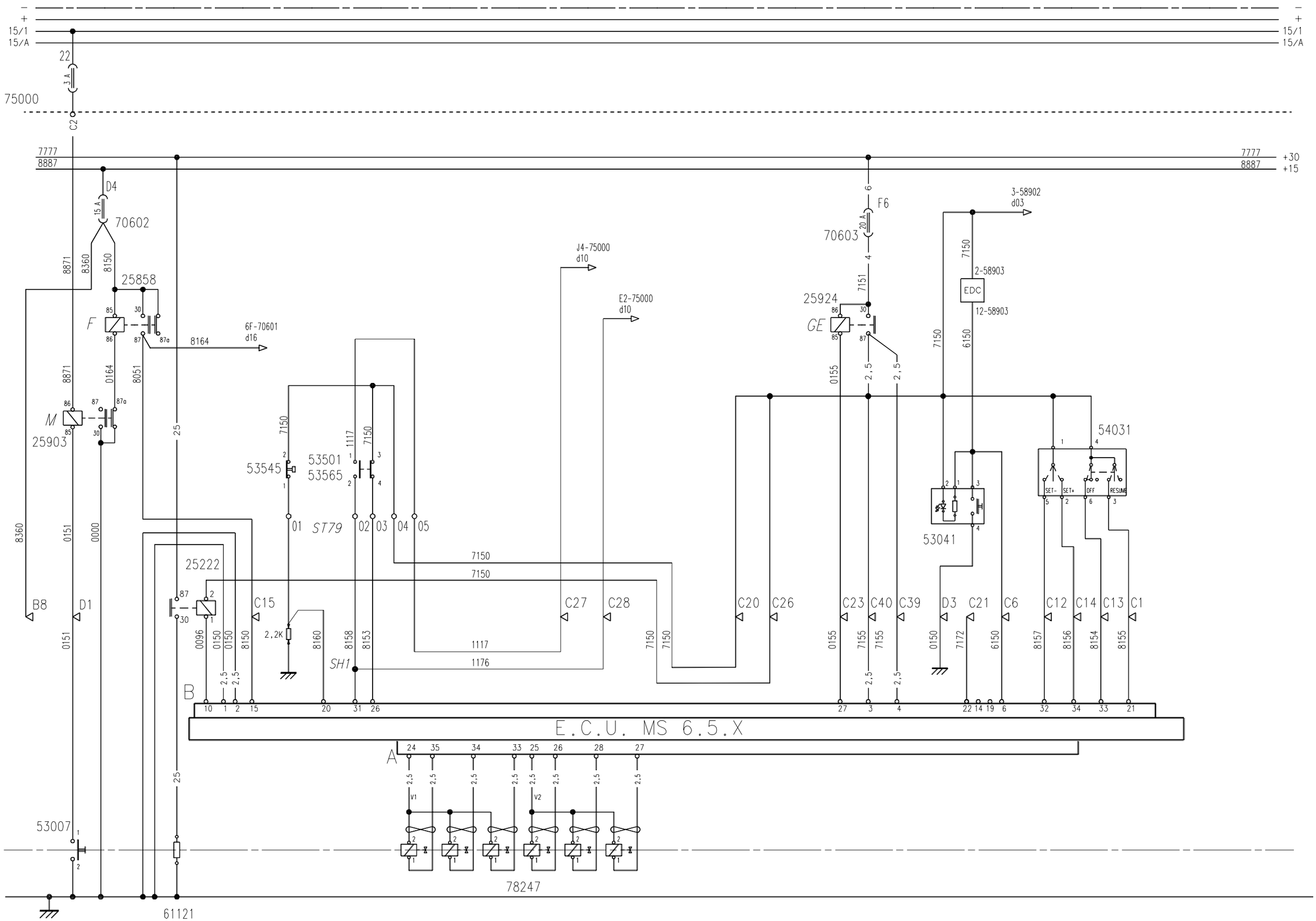


1 Air compressor
2 Air drier
3 Tank (30 l)
3a Tank (20 l)
4 Condensation drain valve
5 Relay valve
6 Anticompound relay valve
7 Duplex distributor 7.6 bar
8 RVM cock
9 Not used
10 Not used
11 Not used
12 Brake cylinder (24"x 275) 8x4
13 Not used
14 Combined brake cylinder (16"X190/7300N)
15 Pressure switch (6.6 bar)
16 Test union
17 Pressure control
18 Pressure gauge (6.5 bar)

A = Hand brake
B = Rear
C = Front
D = Services

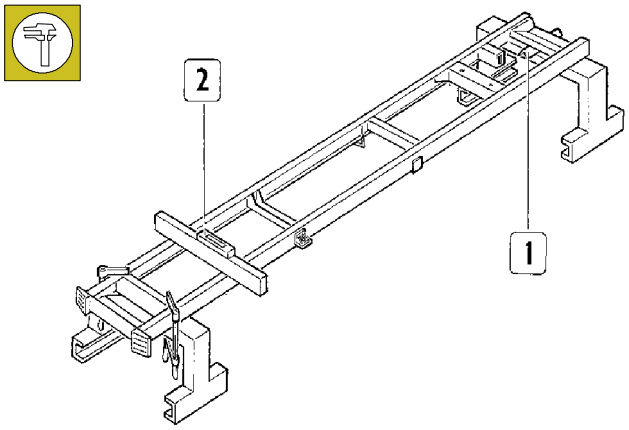
4 - DIGIT CABLE COLOUR CODES

0300 6-diode self-rectifying alternator
0000 General earth
0001 Radio set insulated earth
0002 Hazard lights earth
0003 Earth of ceiling lamp switch on device (door post switch)
0004 UNIC project: parking lights insulated earth (dangerous cargo vehicles)
0005 Earth of trailer brake/exhaust brake interlock relay
0006 Earth of rheostat connected optical indicators
0007 Earth of stop rerequest optical indicator switch off relay
0008 Earth of starter motor relay
0009 Earth of windshield wiper unit fixed stop
0010 Earth of ceiling lamp switch on device (switch/lamp)
0011 Earth of rear door open optical indicator
0012 Earth of main current relay
0013 Earth of exhaust brake enablement relay
0014 Earth of ventilation motors operation relay
0015 Earth of auxiliary heater water recirculating pump motor
0016 Earth of relay for windshield heater/defroster operation (water auxiliary heater)
0017 Earth of front door open optical indicator
0018 Hydraulic braking system signal
0019 Earth of MS6 control unit terminal 8
0020 Earth of heater mirror relay excitation device (relay control unit)
0021 Insulated earth of MS6 control unit terminal 25
0022 Auxiliary heater insulated earth
0023 Earth of flasher light optical indicators
0024 Earth of optical indicators connected to lamp test pushbutton
0025 Earth of emergency optical indicator (central safety unit)
0027 Terminal 85 of Retarder/ABS operation relay
0028 KICKDOWN signal
0030 Earth supply for engine rpm diagnosis sensor no. 1 (n=1/1) and engine rpm electronic sensor
0031 Earth supply for engine rpm diagnosis sensor no. 2 (n=1/1)
0032 Earth supply for engine rpm diagnosis sensor (n=1/2 injection pump)
0033 Hydraulic brake solenoid valve control
0034 Hydraulic brake reducing solenoid valve control
0035 Thermometric switch controlling relais for gas oil heating
0036 Earth of centre door open relay
0037 Earth of belt warning lamp excitation relay
0038 Earth of key rotation inhibiting solenoid valve
0040 Cross differential lock switch off control
0041 Cross differential lock switch on control
0043 Insulated earth on exhaust brake control circuit
0044 Earth of belt control warning lamp
0045 Insulated earth for exhaust brake "R2" resistor


15/1
15/A
22
3 A
75000
C2
7777
8887
D4
15 A
70602
8871
8360
8150
25858
F
85
30
86
87
87a
8164
6F-70601
d16
M
25903
0164
8051
0151
0000
8360
25
53545
53501
53565
1117
7150
01
ST79
02
03
04
05
J4-75000
d10
E2-75000
d10
25222
2,2K
0096
0150
8158
8153
SH1
1117
1176
7150
B8
D1
C15
C27
C28
C20
C26
B
10
1
2
15
20
31
26
F6
20 A
70603
6
4
7151
25924
GE
0155
2,5
3-58902
d03
7150
2-58903
EDC
12-58903
6150
53041
54031
SET-
SET+
OFF
RESUME
C23
C40
C39
D3
C21
C6
C12
C14
C13
C1
0150
7172
6150
8157
8156
8154
8155
7155
27
3
4
22
14
19
6
32
34
33
21
E.C.U. MS 6.5.X
A
24
35
34
33
25
26
28
27
V1
V2
53007
78247
61121

Finding chassis twist

Figure 27



17357

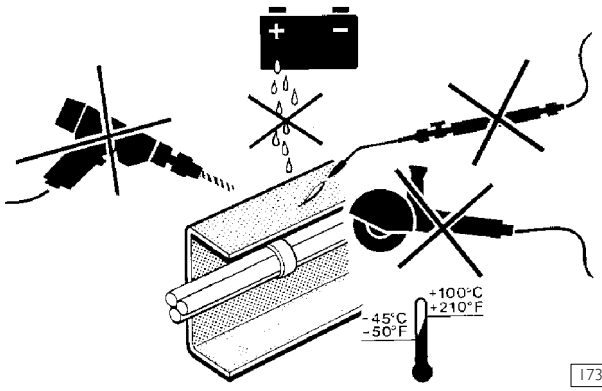
Slight torsion may only be detected with the cab and mechanical units removed. To make the check, proceed as follows:

- ❑ place the chassis on two stands;
- ❑ fasten one side of the chassis to the stand with two clamps;
- ❑ set the other side of the chassis on the knee of an "L" iron (1, Figure 27) in central position under the rear cross member;
- ❑ place a ruler in cross position and a spirit level (2, Figure 27) on the ruler and check the readings.

The same value should result at each check point, otherwise the chassis is deformed.

PRECAUTIONS

Figure 28

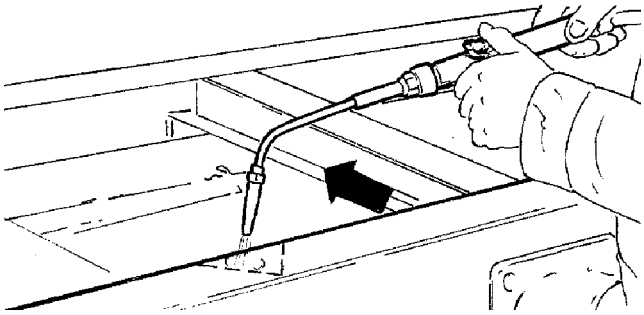


17358

When welding, drilling, grinding or cutting near the pipes of the braking system, especially near plastic parts or electrical wiring, take adequate precautions to protect them, and if necessary, remove them. All parts of the chassis that are reconditioned are to be protected from oxidation and corrosion.

Protection and painting operations are to be carried out accurately on all the parts involved, following any instructions, methods, and preventive precautions indicated by the paint manufacturers.

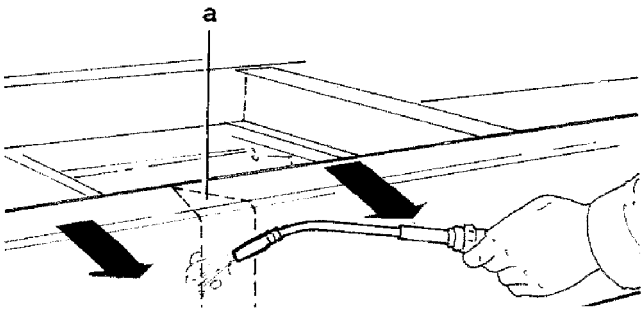
Figure 29



17359

The chassis reconditioning is obtained by wedge heating the part concerned with a torch.
During this operation the metal must become cherry red coinciding with a temperature ranging between 600 and 680°C.
The points already heated must not be re-heated.
Let the heated points cool slowly without using water, compressed air or other cooling agents.

Figure 30



17360

Straighten chassis lateral bending by wedge heating the upper and lower edge of the chassis length concerned.
The wedge point must in the desired bending direction.

If the base (a, Figure 30) of the two wedges is on the upper edge plate of the side member, the plate must also be heated, but last.