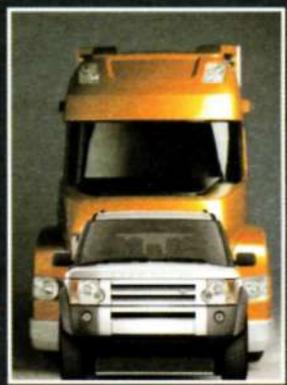


ИЗДАТЕЛЬСТВО
За рулем

ОСНОВЫ КОНСТРУКЦИИ АВТОМОБИЛЯ

УЧЕБНИК
ДЛЯ ВУЗОВ



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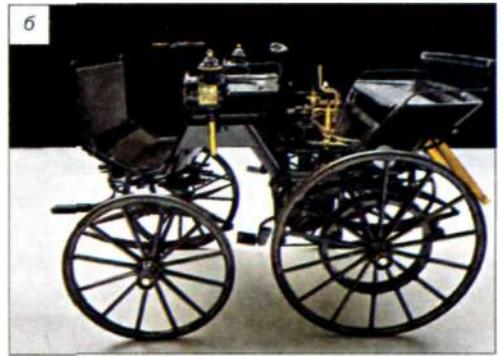
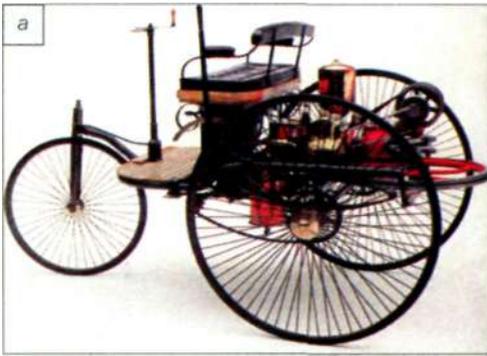
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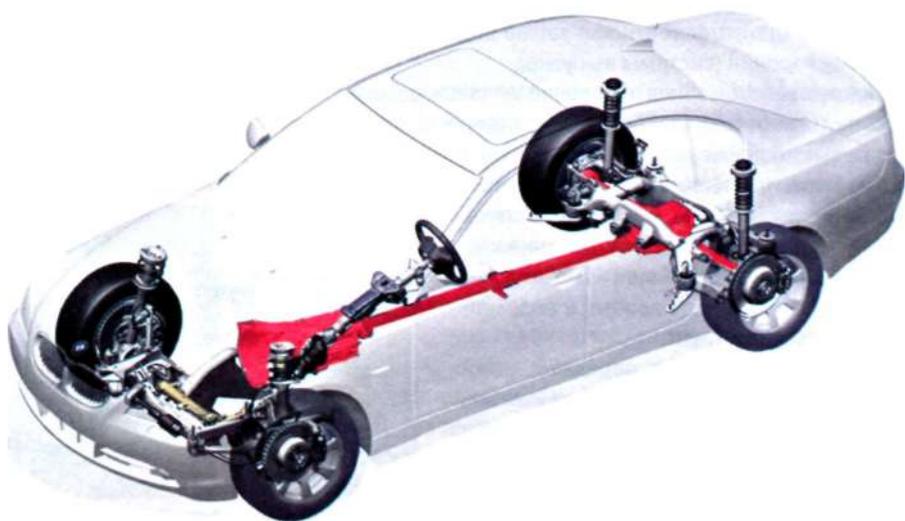
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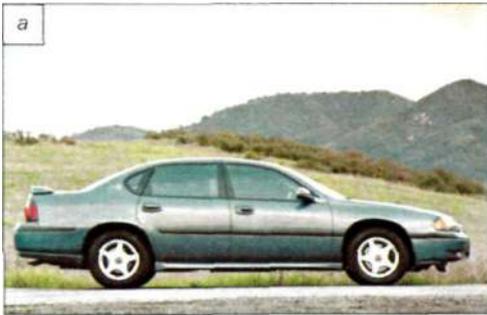
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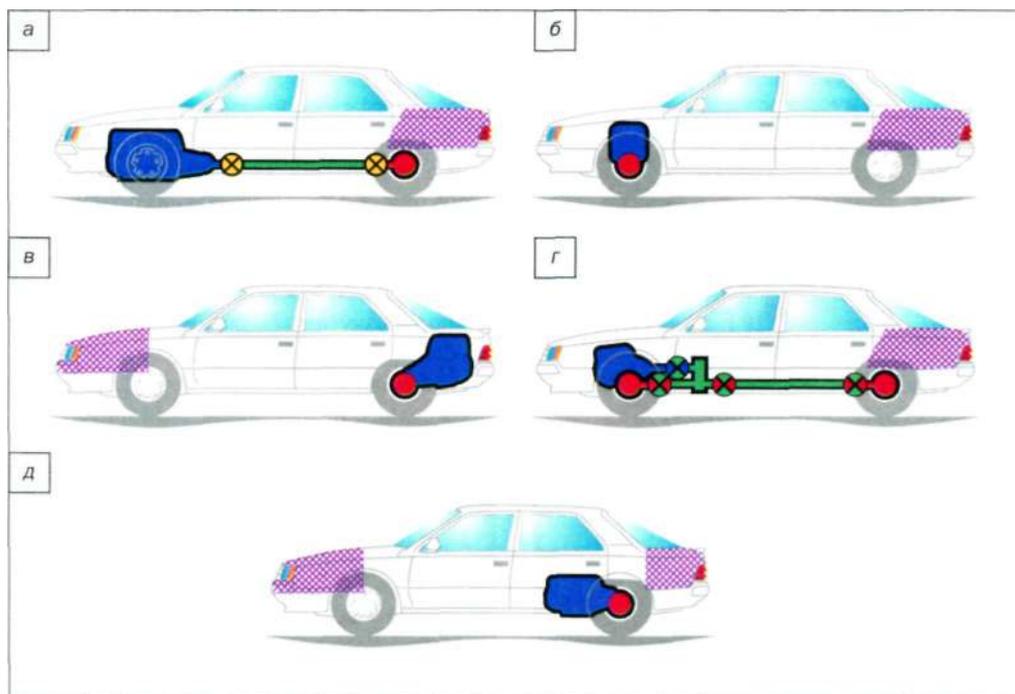
	3650	3600-3800	3800-4400
	2150-2450	2350-2500	2400-2700
	1450-1600	1550-1650	1670-1740
	1350-1480	1350-1480	1330-1440
	FIAT Uno	Peugeot 206	VW Golf4



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2500-2700	2500-2700	2700-3000	2700-3000
1670-1770	1670-1770	1800-1900	1750-1900
1360-1430	1360-1430	1400-1500	1650-1800
Nissan Primera	BMW 5	Mercedes S	VW Sharan

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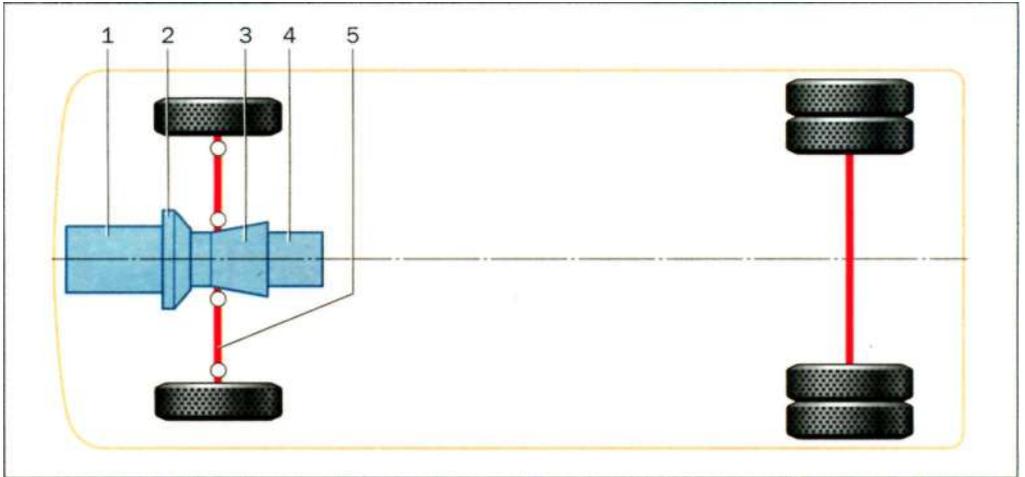
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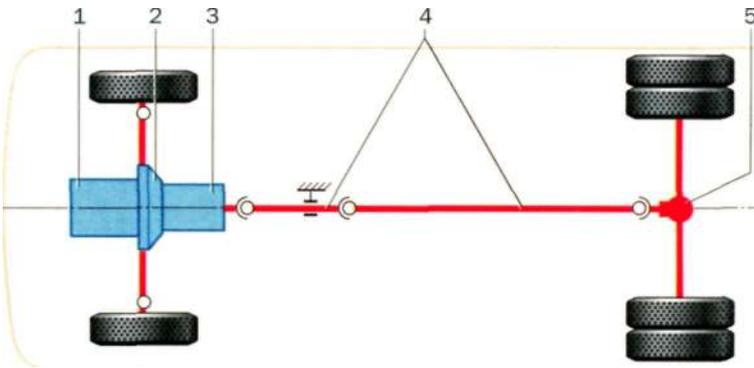
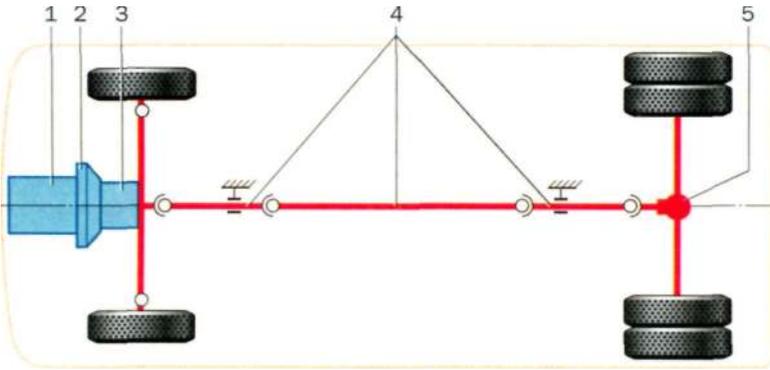
. 1.21.

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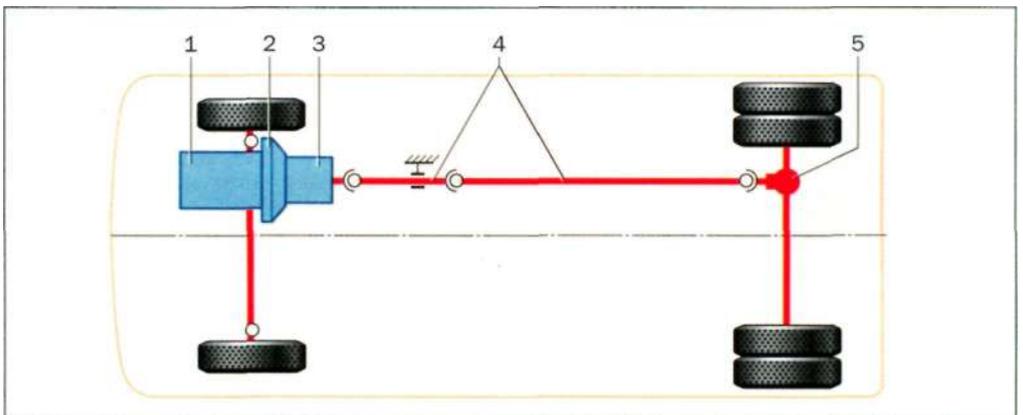
. 1.22.

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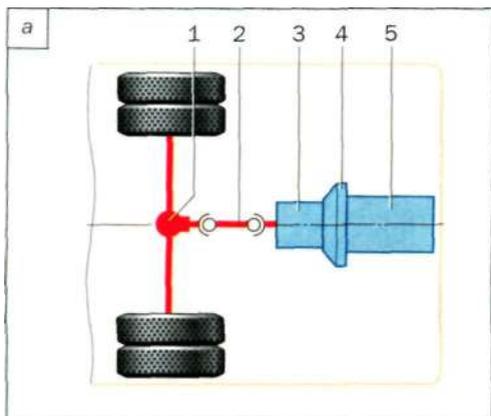
. 1.23.

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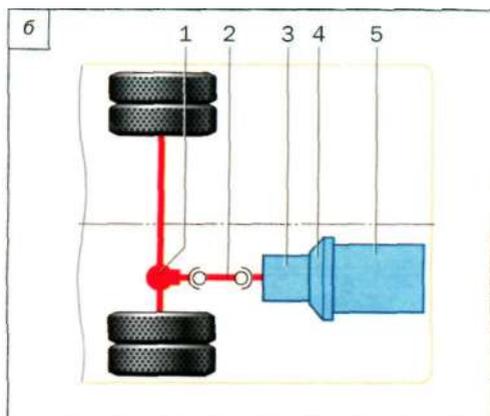
. 1.24.

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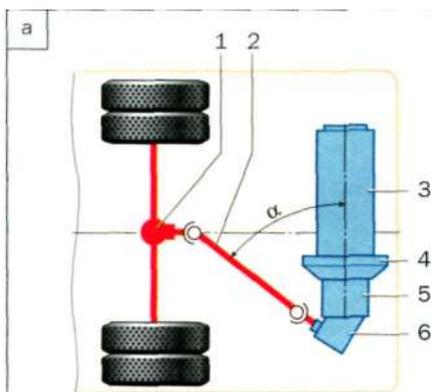


. 1.25.

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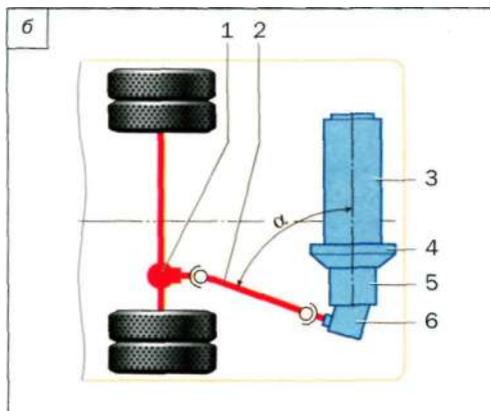
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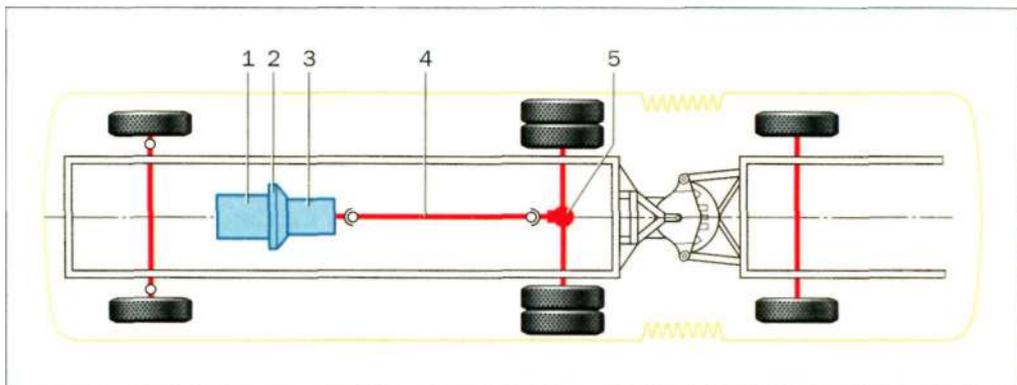
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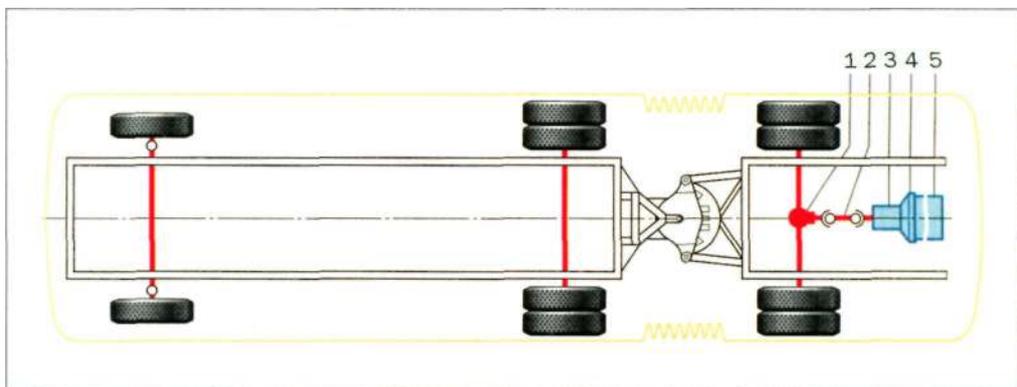
. 1.26.

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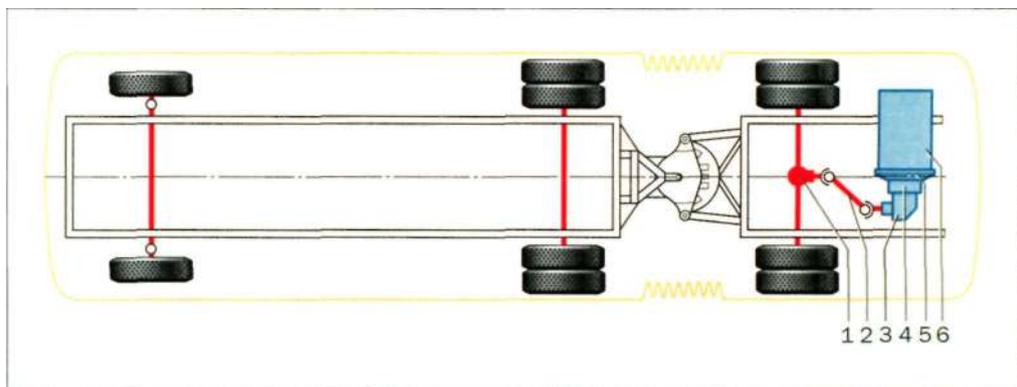
. 1.27.

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Таблица 1.5. Российская классификация автобусов по габаритной длине

Габаритная длина, м	Обозначение моделей
до 5 м	22хх
от 6 до 7,5	32хх
от 8 до 9,5	42хх
от 10,5 до 12	52хх
16,5 и более	62хх



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1,2	13	14	15	16	17	19
1,2-2,0	23	24	25	26	27	29
2,0-8,0		34	35		37	39
8,0-14	43	44	45	46	47	49
14,0-20,0	53	54	55	56	57	59
20,0-40,0		64	65		67	69
40	73	74	75	76	77	79

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Пример построения VIN

VIN																	
позиция																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
WMI			VDS				VIS										
J	M	B	S	N	E	5	5	A	P	Z	0	0	3	7	2	5	
1	2	3	4	5	6		7	9	10	11							
1	2							3									
4	5																
6	7																
8	9																
10	11																

1 Азия
 2 Япония
 3 MITSUBISHI
 В — для Европы (левостороннее управление)
 А — для Европы (правостороннее управление)
 4 Тип кузова:
 S — 4-дверный седан; L — 4-дверный хэтчбек
 5 Тип трансмиссии:
 N — 5-ступенчатая механическая, 5 передач
 R — 4-ступенчатая АКП
 6 Тип двигателя:
 E52 — 1800 - SOHC; E54 — 2000 - DOHC;
 E55 — 2000 - SOHC; E57 — 2000 - Дизель;
 E64 — 2000 - DOHC - 4WS; E75 — 2000 - SOHC - 4WD;
 E88 — 2500 - DOHC - 4WD
 7 А — пассажирский автомобиль
 8 Модель автомобиля:
 E55 — GALANT
 9 Модельный год:
 P — 1993
 10 Завод
 11 Серийный (порядковый) номер — 3725

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VIN (Vehicle Identification Number).

VIN 17 (. 1.32)

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VIN

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-21099

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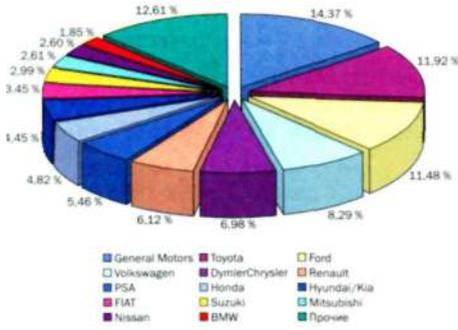
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	-21102	Audi A6	Porsche 911
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	1680	1810	1830
	1420	1453	1295
	2492	2760	2350
	4	4	6
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	116/3000	210/1750	560/2700
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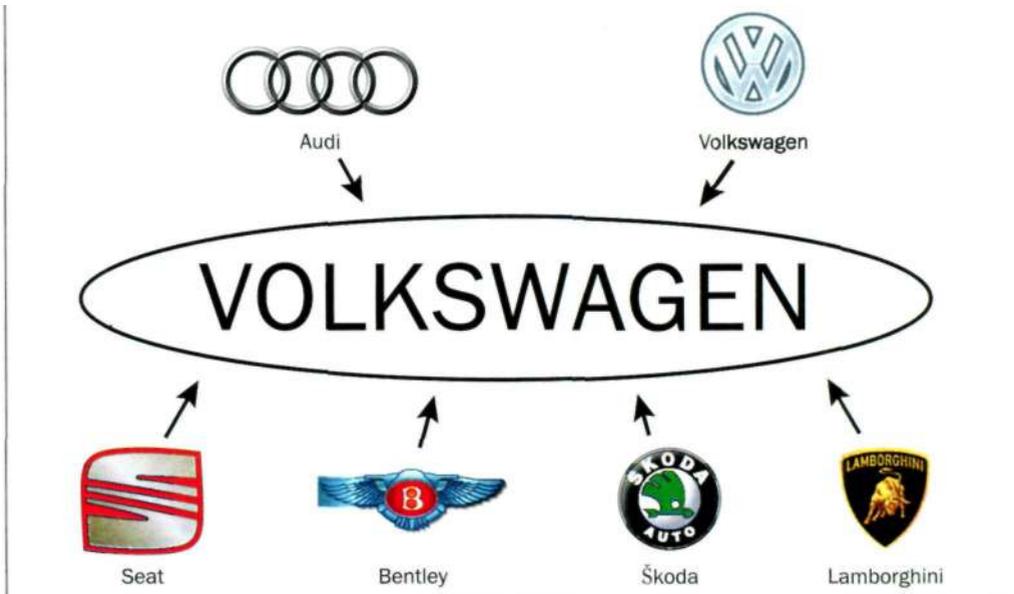


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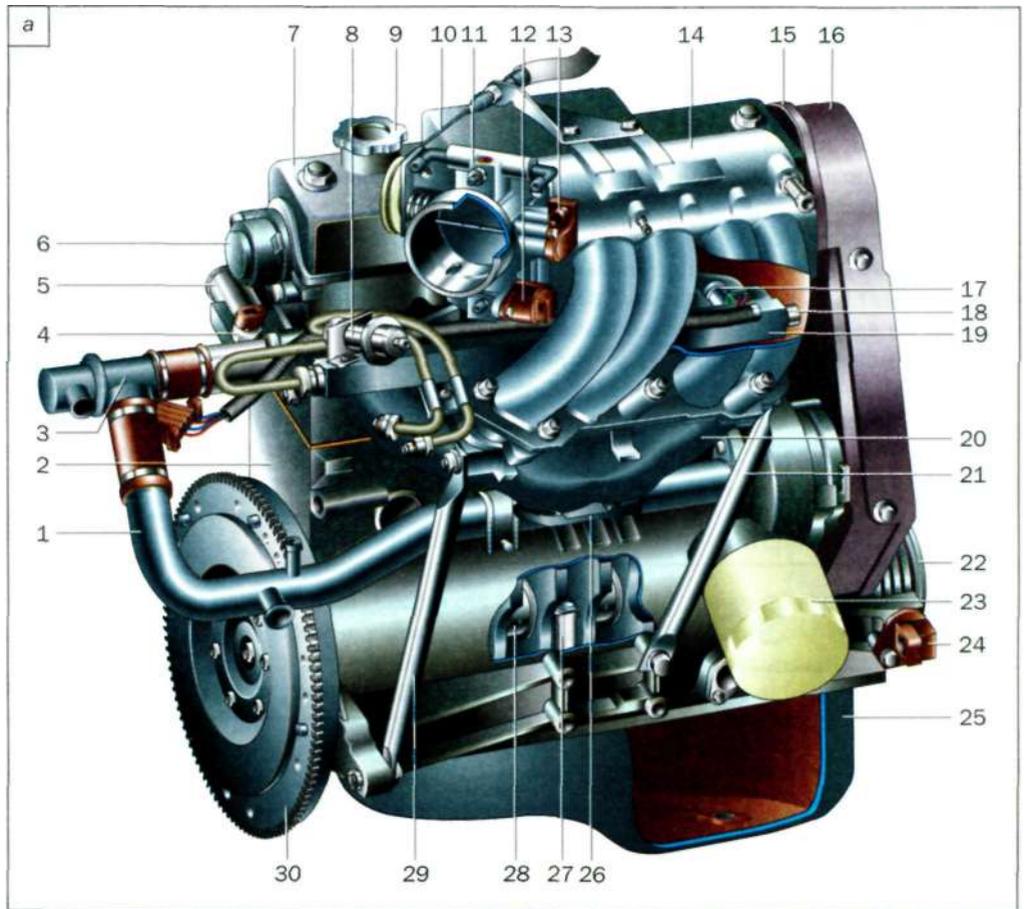
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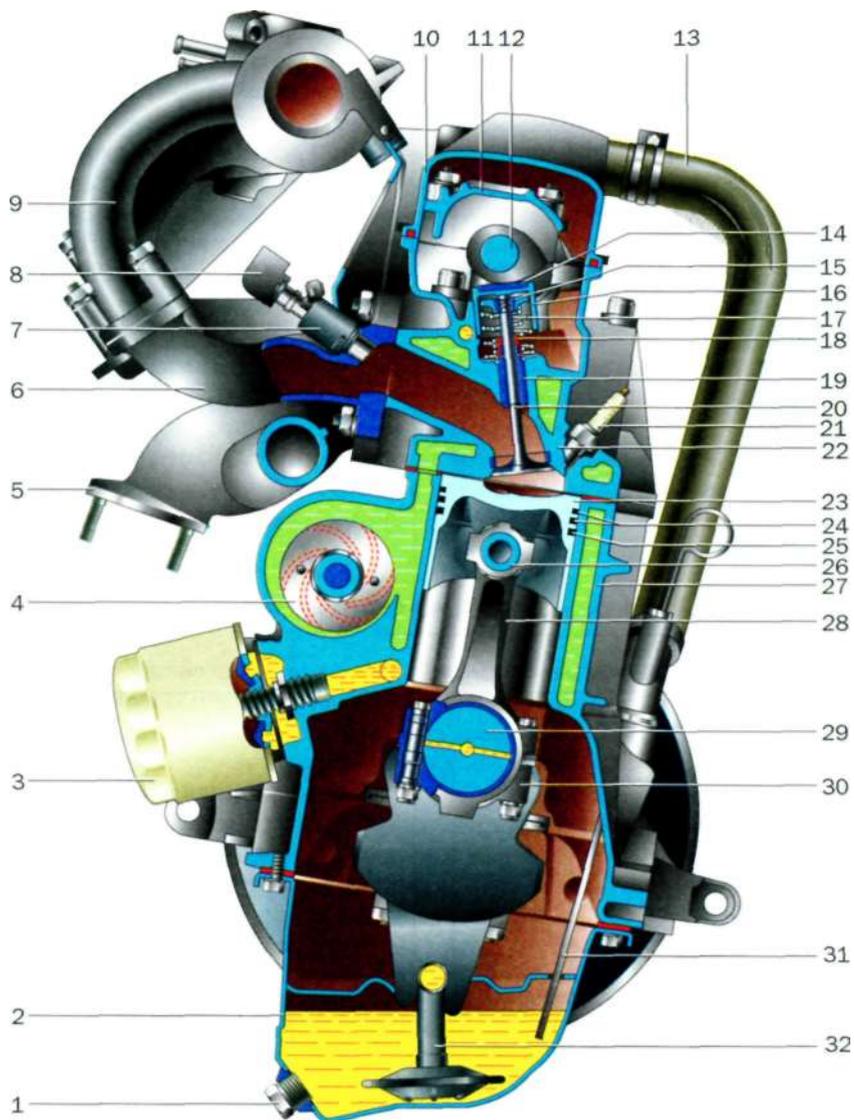
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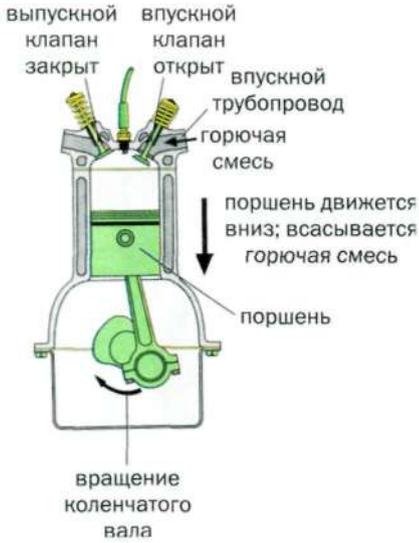


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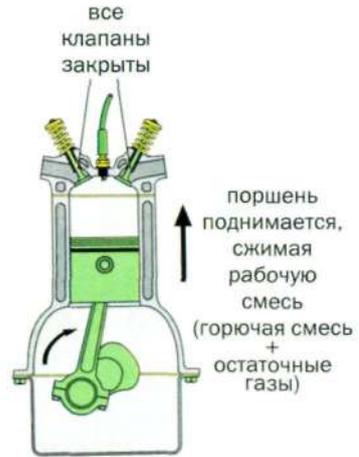
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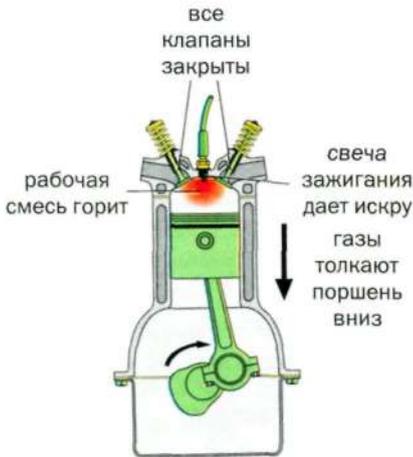
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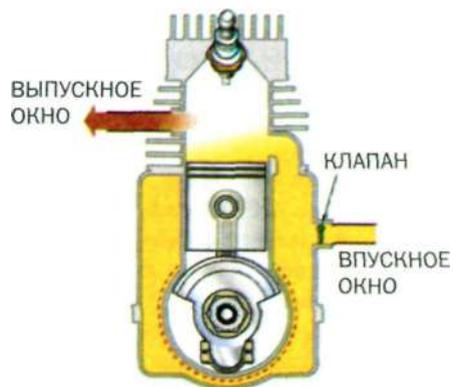


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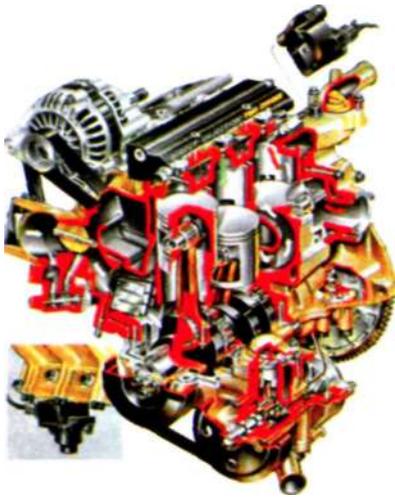


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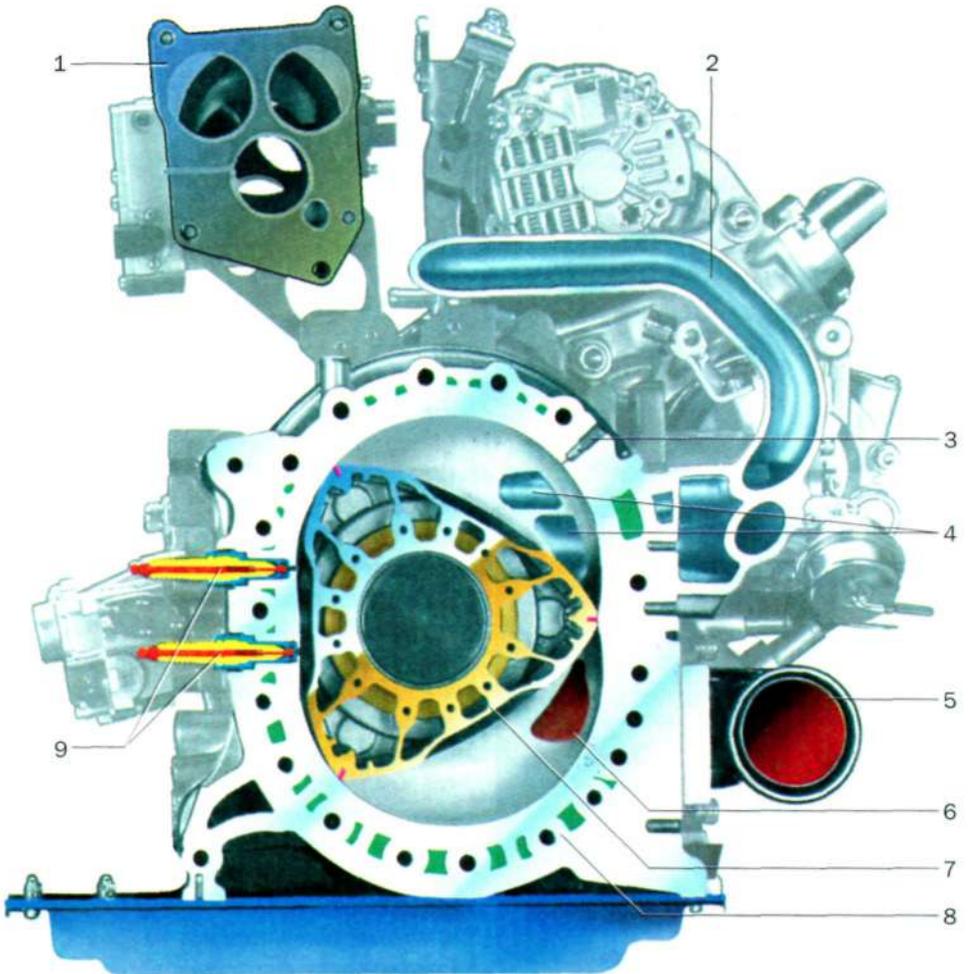
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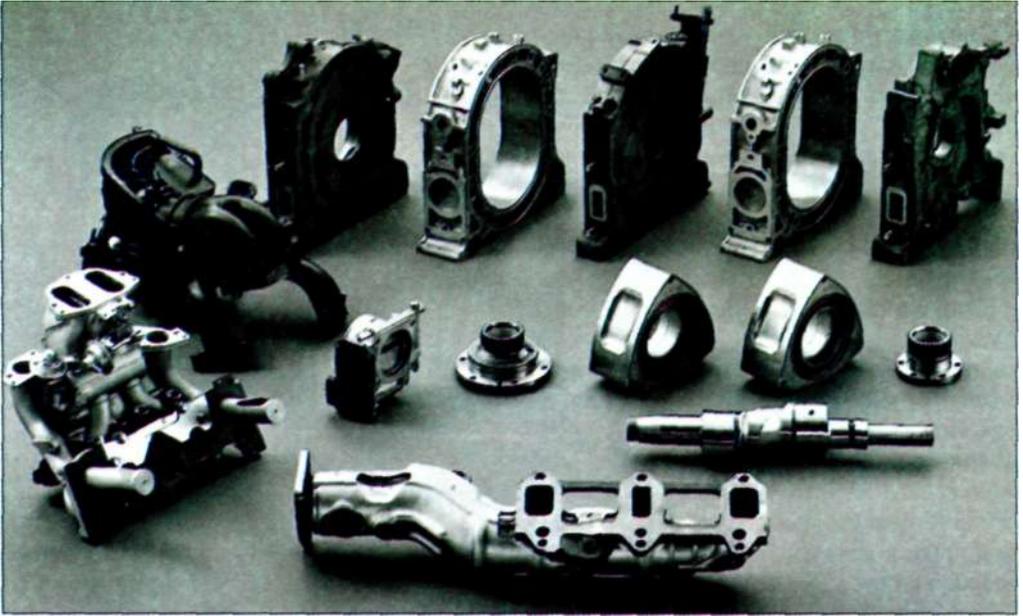
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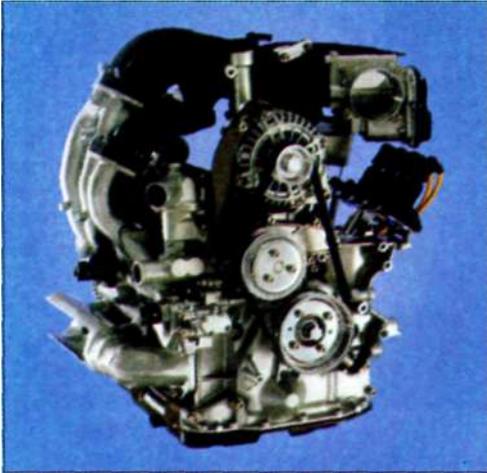


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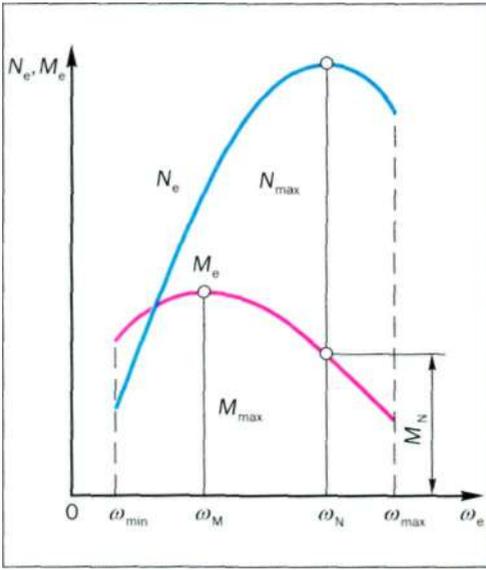
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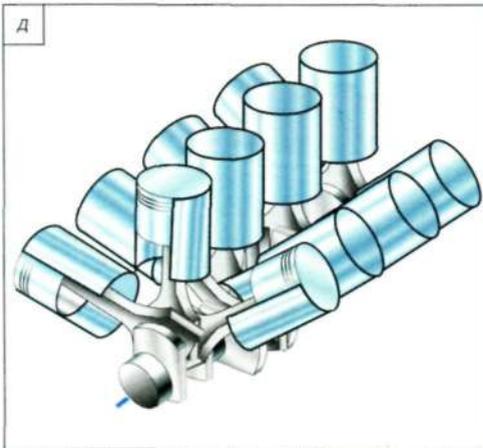
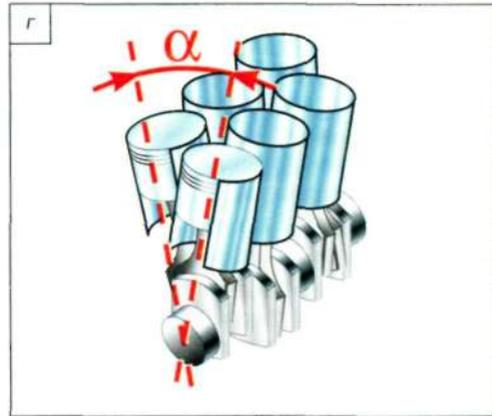
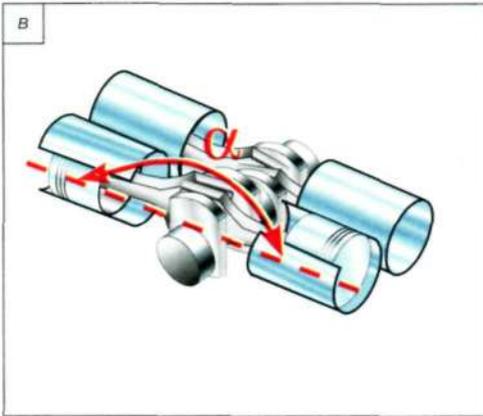
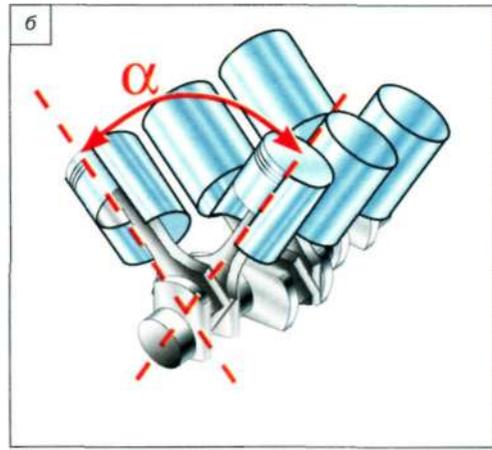
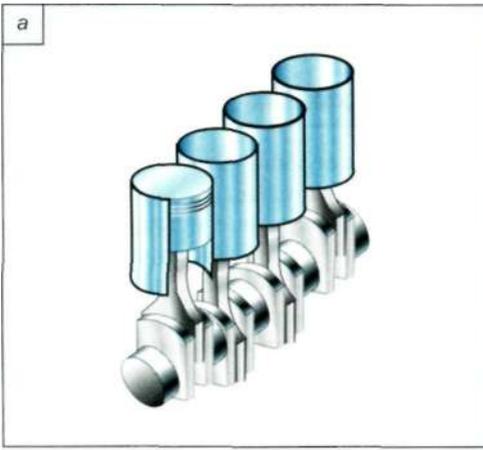
(. 2.9).

(. 2.10).

V-



. 2.9.



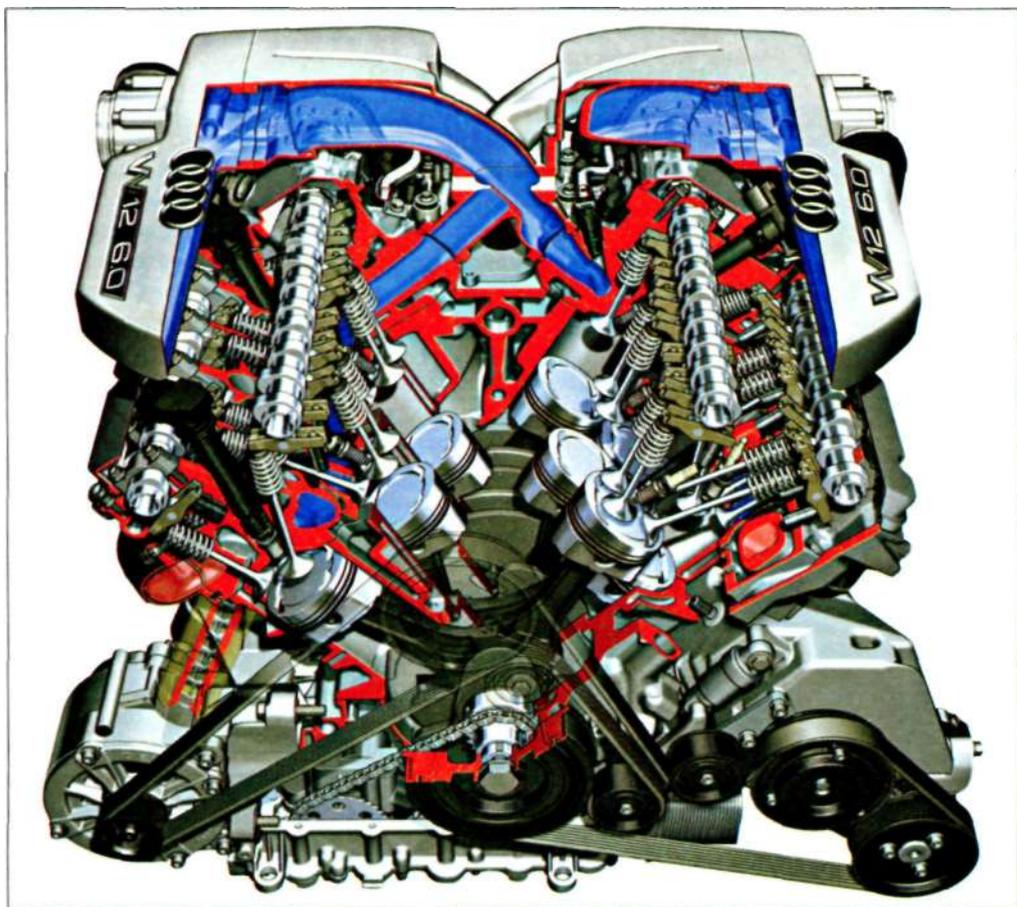
. 2.10.

— ; — V- ; — VR- ; — W- ; —

«boxer»),
W12,
V-

180°.
Volkswagen,

(. 2.11).



. 2.11.

W12,
V6

Audi A8 2001 „

0,8

0,5

(

Lancia, -968),

V-

(

VW Beetle,

)

(Porsche 911

Subaru.
Subaru)

. V-

V-

V-

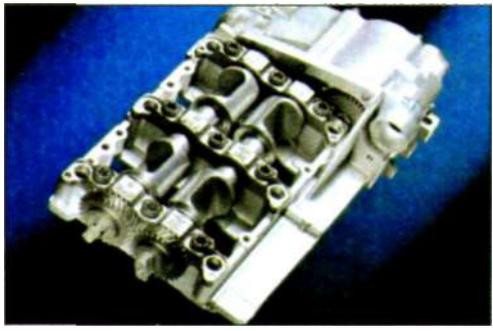
120° (180°) . « » - 60°

V12, V8, 90°



. 2.12. GM Vortec 2004 .

Ford Cosworth DOHC, (BMW) (. 2.13).



. 2.13.

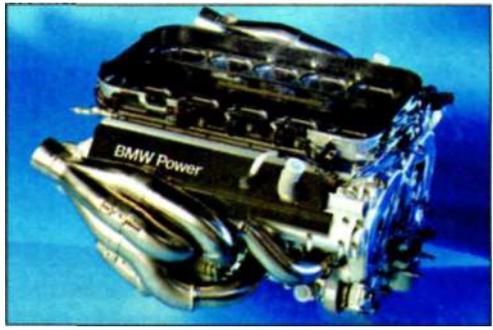
Volkswagen FIAT.

Volvo,

BMW Valvetronic

Rover TD6

Range



. 2.14. BMW V10

-1

V10 (.2.14),

-1,

72°.

(.2.15) —

(.2.16).



. 2.15.

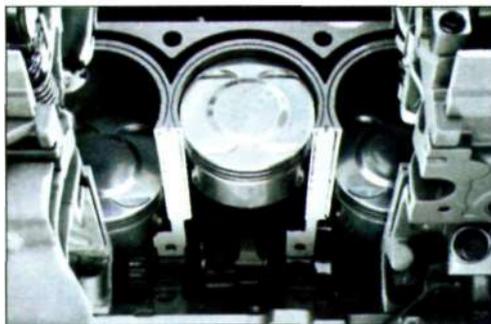
V8



. 2.16.

(. 2.17).

», — « ».



. 2.17.
Nordstar GM « »

« »

« »

(. 2.18).

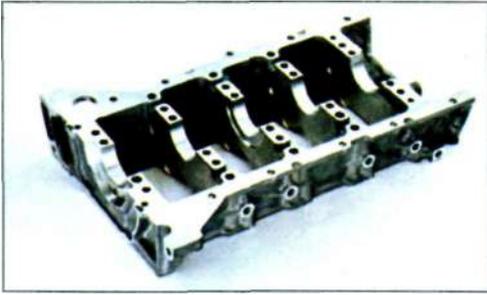


. 2.18.

Jaguar
V-

24-

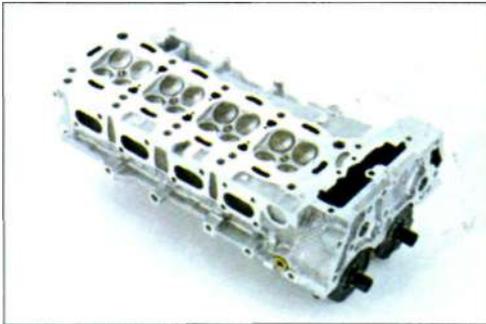
Jaguar X-type,



. 2.19.

().

(. 2.19).



. 2.20.

().

(. 2.20)

(. 2.21)

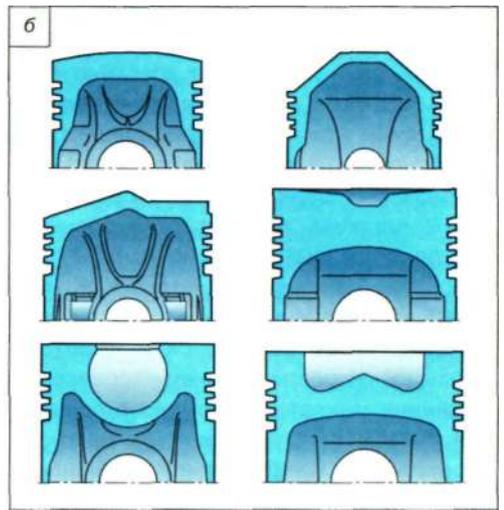
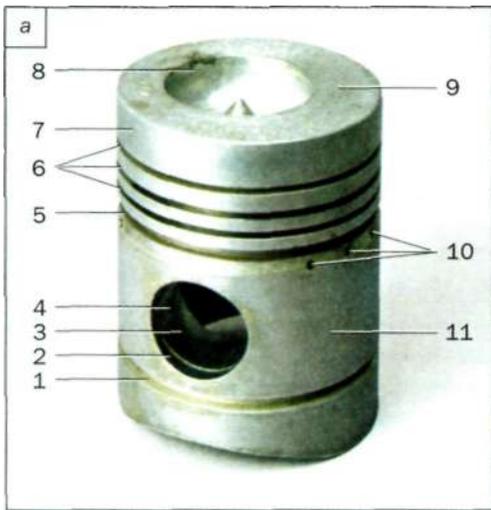


. 2.21.



. 2.22.

Ford Duratec



. 2.23.

()

(): 1 —

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(. 2.22)

(. 2.23)

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(

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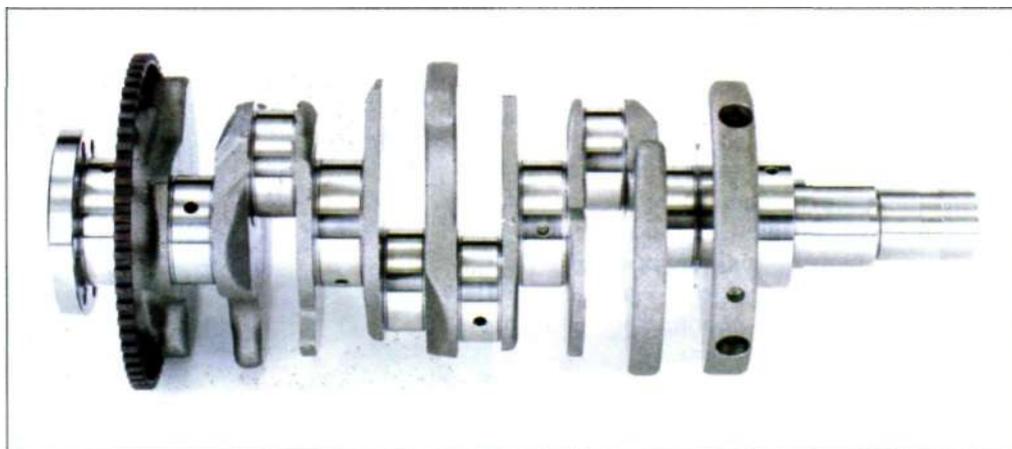


. 2.24.

V8 BMW,

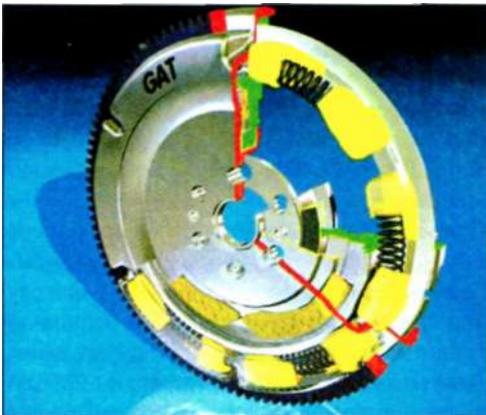
(. 2.24).

(. 2.25)



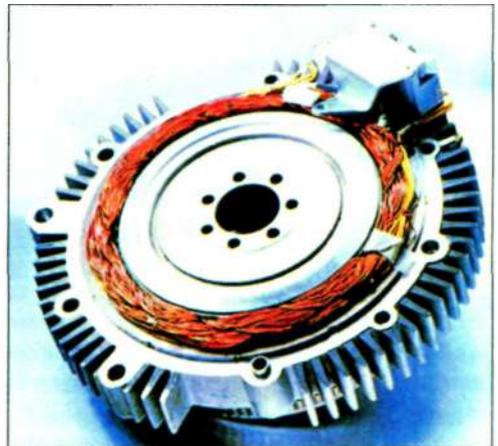
. 2.25.

V6



. 2.26.

Ford Mondeo



. 2.27.

§9

()

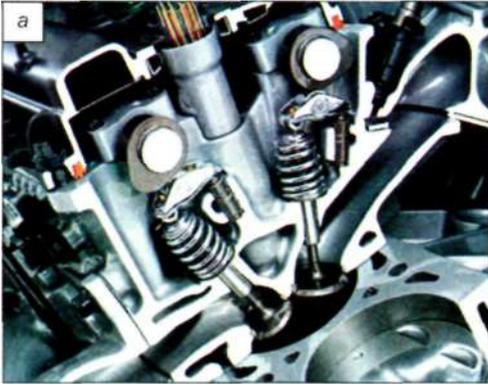
()

(.2.28).



.2.28.

(.2.29 ,).



. 2.29.

()



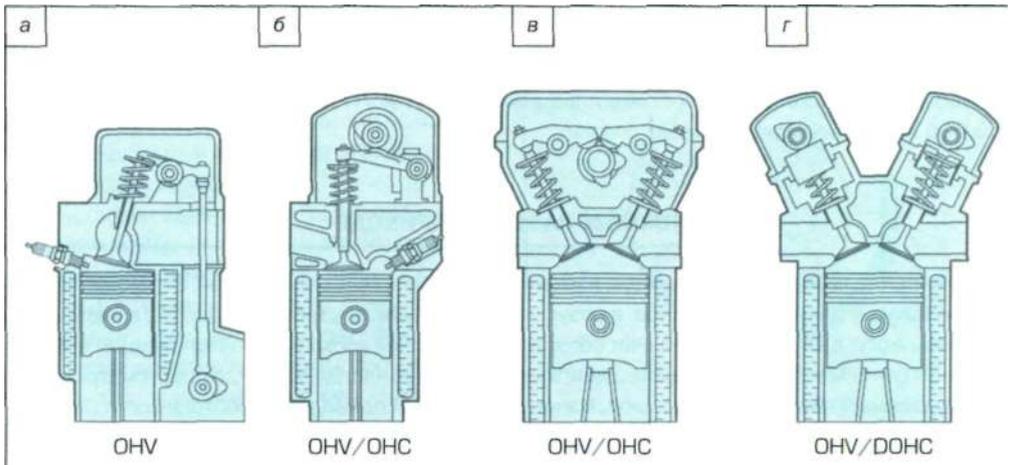
()



. 2.30.



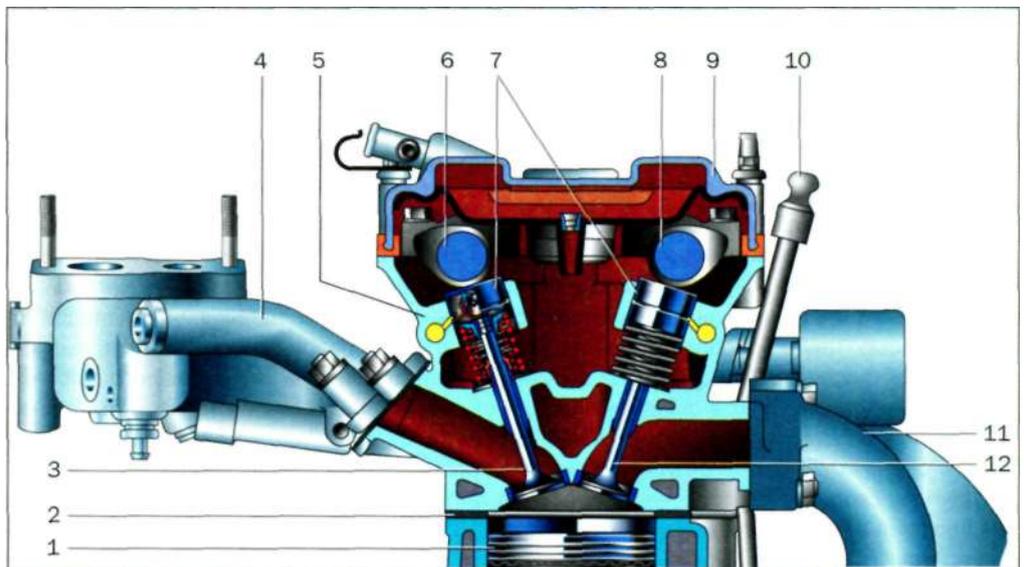
. 2.31.
DaimlerChrysler



. 2.32 .

OHV —

; DOHC —



. 2.32 .

-4063:1 —

3 —

; 4 —

; 7 —

11 —

; 9 —

; 12 —

; 2 —

; 5 —

; 8 —

; 10 —

; 6 —

150 000

V8, 16-

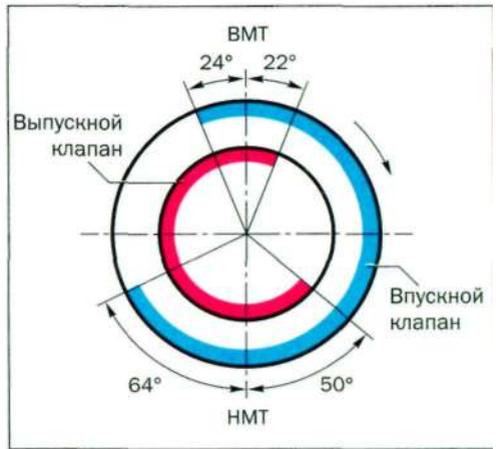
AJ-V8

Jaguar

32-

(50°).

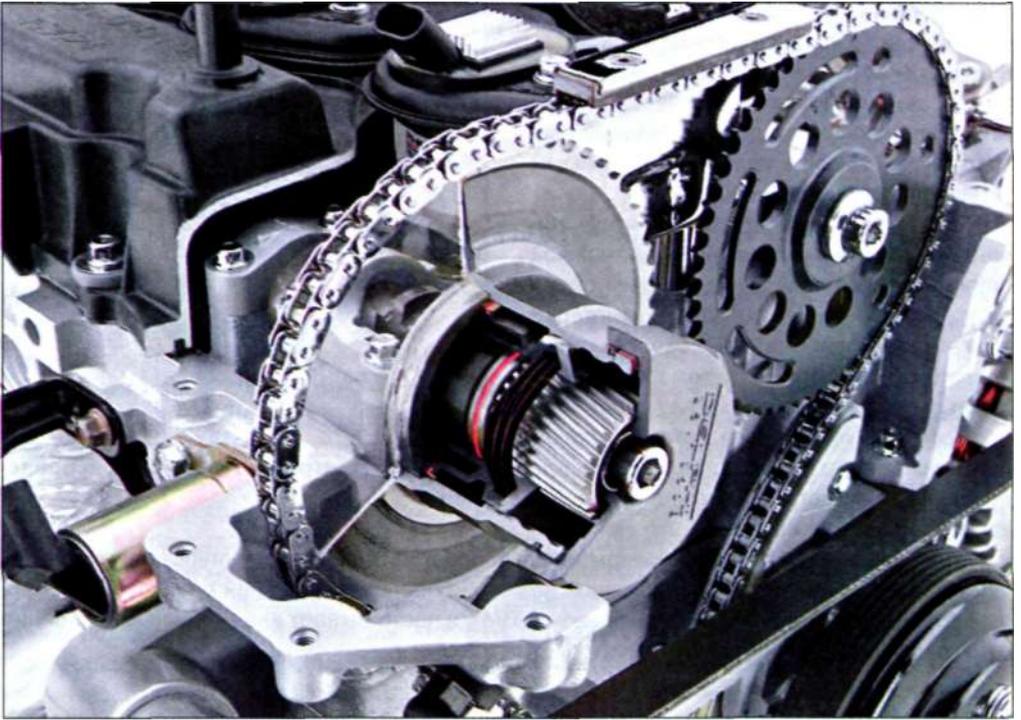
(. 2.33).



. 2.33.



. 2.34.



. 2.35.

(. 2.35),

BMW,

VVT (Variable Inlet Valve Timing)

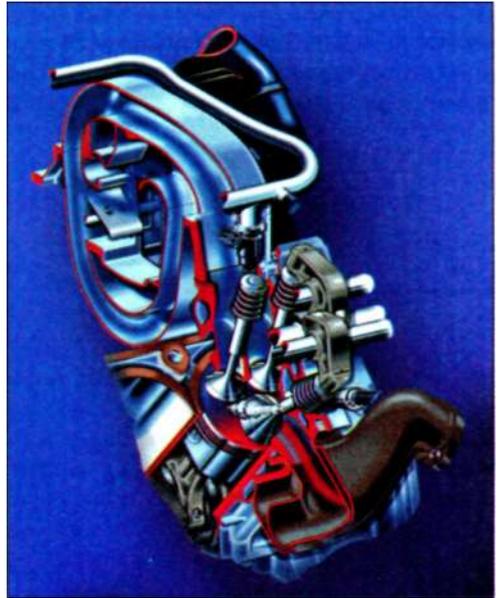
Honda

CVT.

Toyota,

(. 2.36).

BMW (. 2.37).

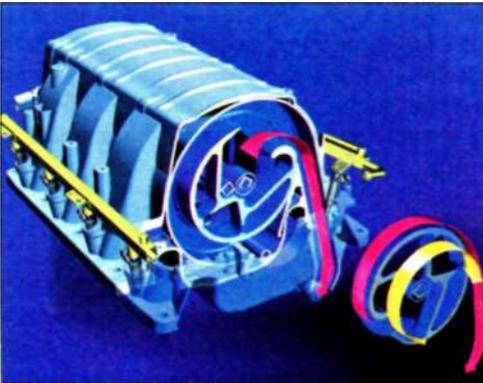


. 2.36.

Mercedes

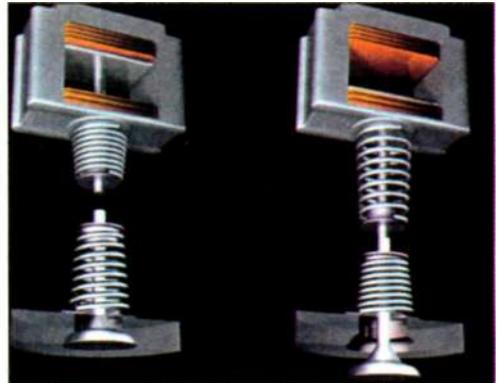
()

(. 2.38)
20 %).



. 2.37.

V8 BMW

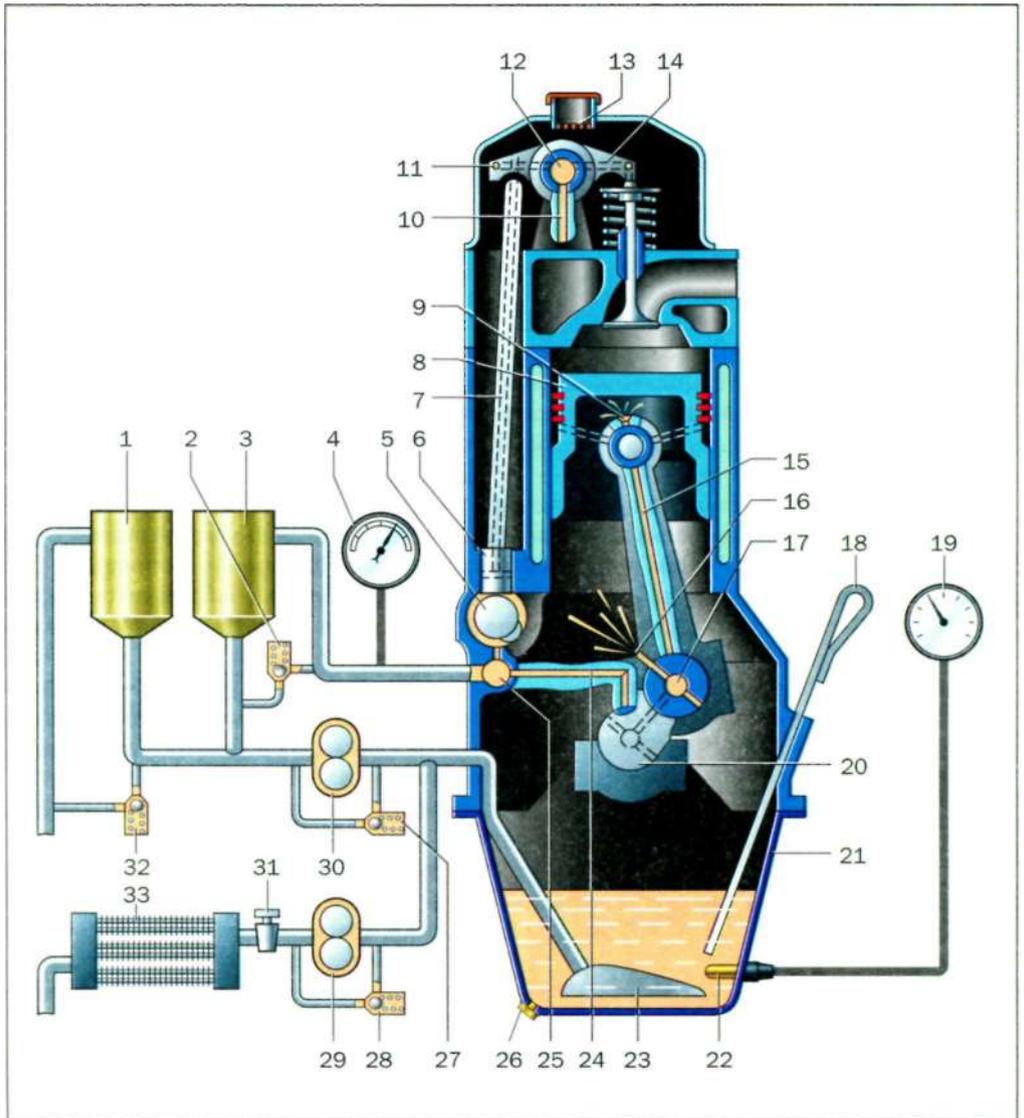


. 2.38.

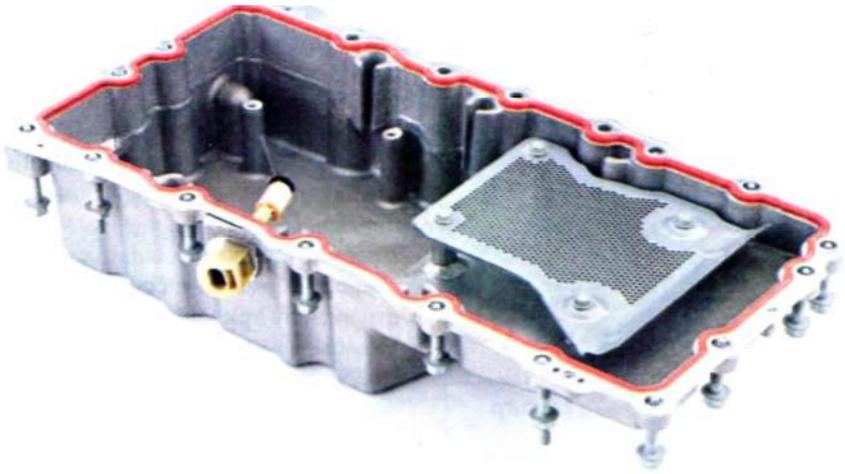
(Renault)

§10

(. 2.39)



- 2.39. ; 1,3 — ;
 2, 27, 28, 32 — ; 4 — ; 5 — ; 6 — ;
 ; 7 — ; 8 — ; 9 — ; 10, 24 — ; 11, 14 — ;
 ; 12 — ; 13 — ; 15 — ;
 ; 16 — ; 17 — ;
 ; 18 — ; 19 — ; 20 — ; 21 — ; 22 — ;
 ; 23 — ; 25 — ; 26 — ;
 ; 29, 30 — ; 31 — ; 33 —



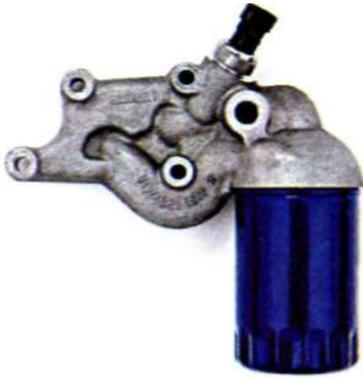
. 2.41.

(. 2.42)

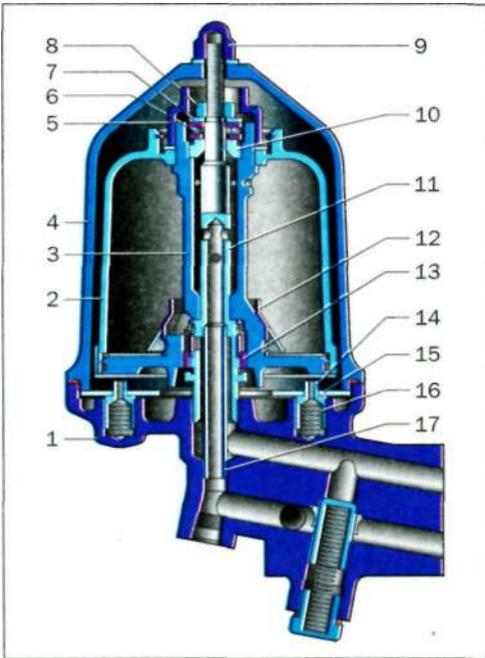


(. 2.43),

. 2.42.



. 2.43.



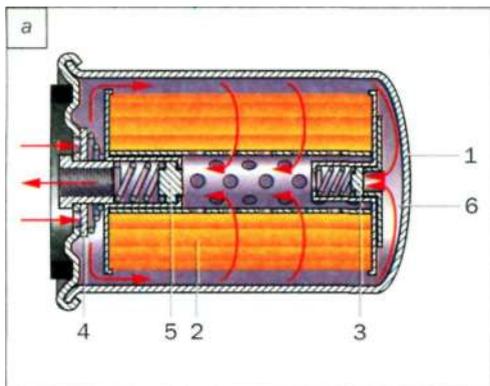
. 2.44.

- ():
- I — ; 2 — ; 3 — ;
 4 — ; 5 — ;
 ; 6 — ;
 ; 7 — ; 8 — ;
 ; 9 — ;
 ; 10 — ;
- II — ; 12 — ; 13 — ;
 ; 14 — ;
 15 — ; 16 — ;
 ; 17 —

() (. 2.44).
 ()

(),

(. 2.45)
 ().

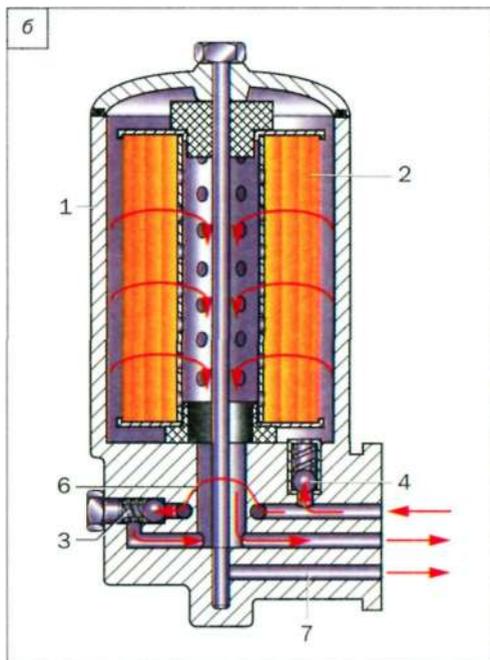


. 2.45.

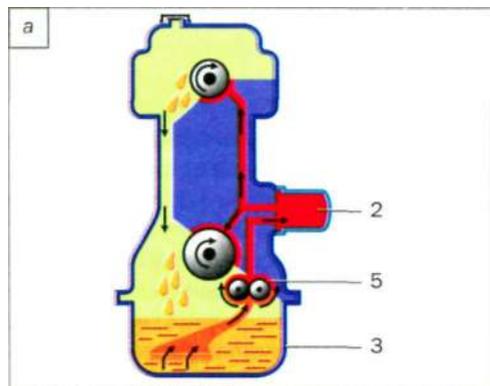
()

()

1 — ; 2 — ()
); 3 — ; 4 —
 ; 6 — ; 7 —



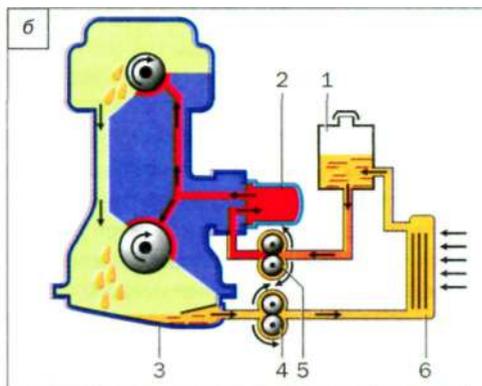
(. 2.46).



. 2.46.

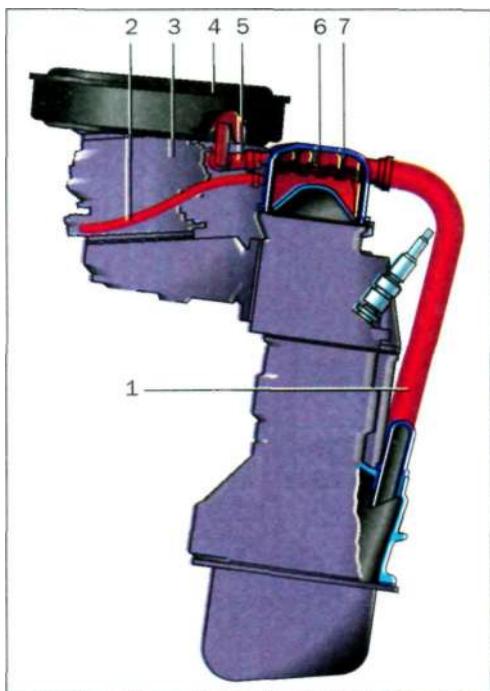
()

(; 2 — ; 3 —
 ; 5 — ; 6 —



() : 1 —

; 4 —



. 2.47.

: 1, 2, 5 —
 ; 3 — ; 4 —
 ; 6 — ; 7 —

(. 2.47).

§ 11

(2 500 °).
 20-35%

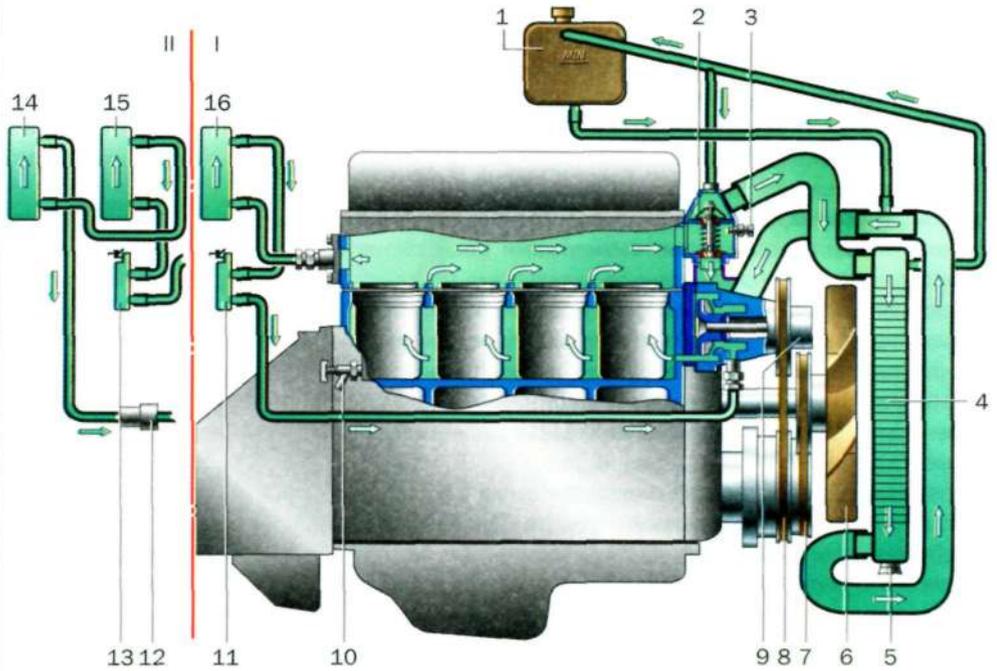
« »
(. 2.48).

()

(100).

80-110 °
120 ° ,

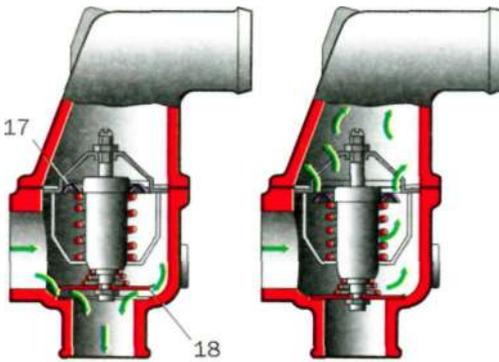
() .



. 2.48.

-402 **-4215:** I —
; II —

(



Термостат закрыт

Термостат открыт

1 — ; 2 —

; 3 — ;

4 — ; 5 —

() ; 6 — ;

7 — ;

8 — ;

; 9 —

; 10 —

; 12 —

; 11; 13 —

; 14 —

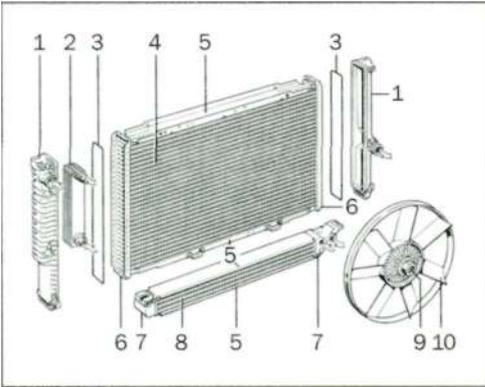
; 15, 16 —

; 17 —

; 18 —

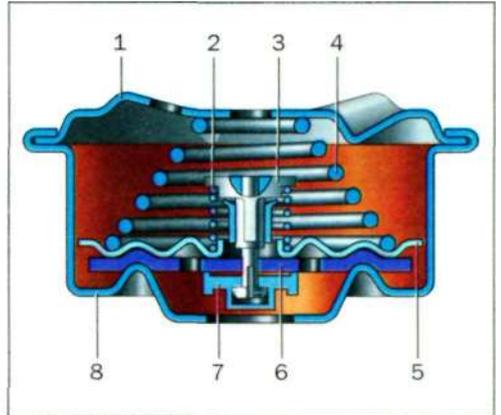
(. 2.49).

(. 2.50).



. 2.49.

; 2 — ; 3 — ; 4 — ; 5 — ; 6 — ; 7 — ; 8 — ; 9 — VISCO; 10 —



. 2.50.

2 — ; 3 — ; 4 — ; 5 — ; 6 — ; 7 — ; 8 —

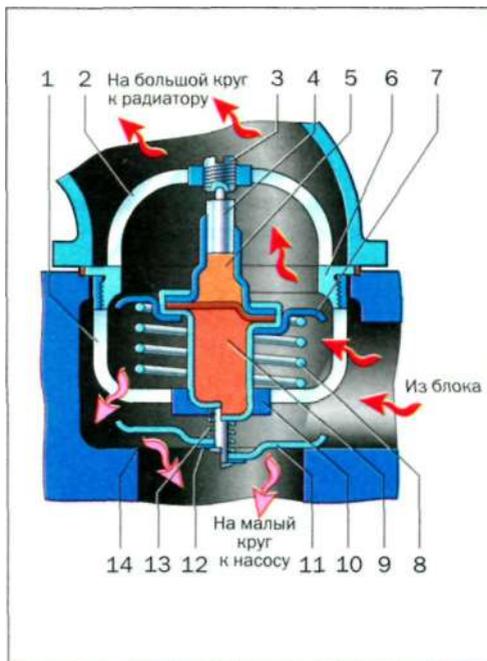


(.251).

. 2.51.

Valvetronic BMW

(.252)



()

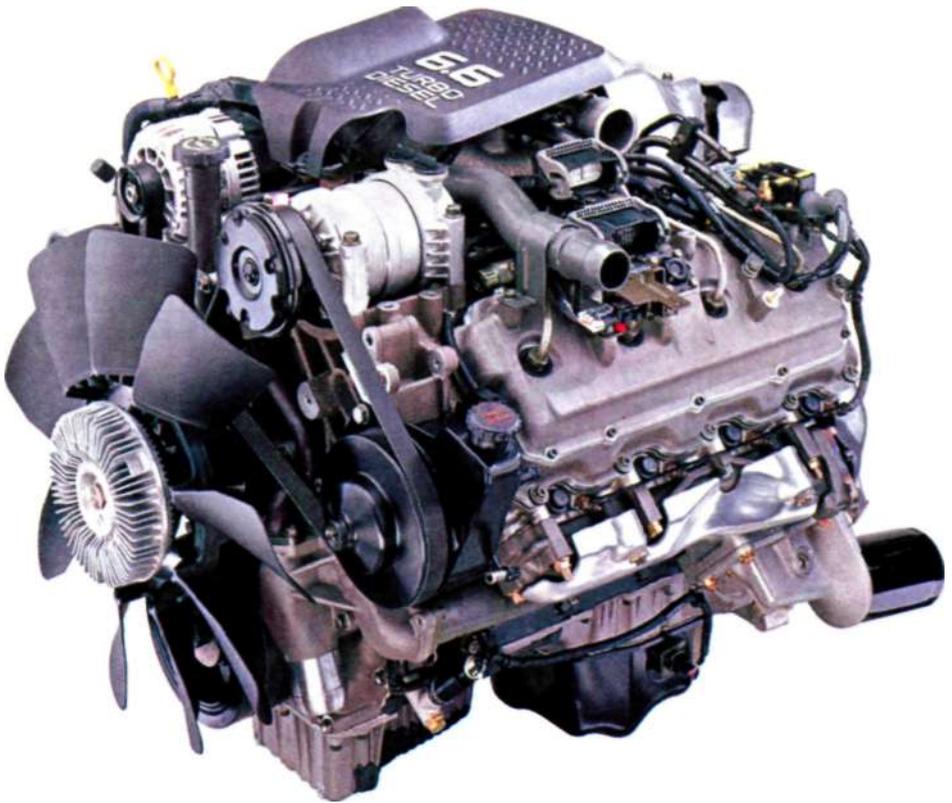
()

70 °

80 " ,

. 2.52.

- 2 — ; 1 — ;
- ; 3 —
- ; 4 — ; 5 —
- ; 6 — ; 7 —
- ; 8 — ; 9 —
- 10 — ; 11 —
- ; 12 — ; 13 —
- ; 14 —



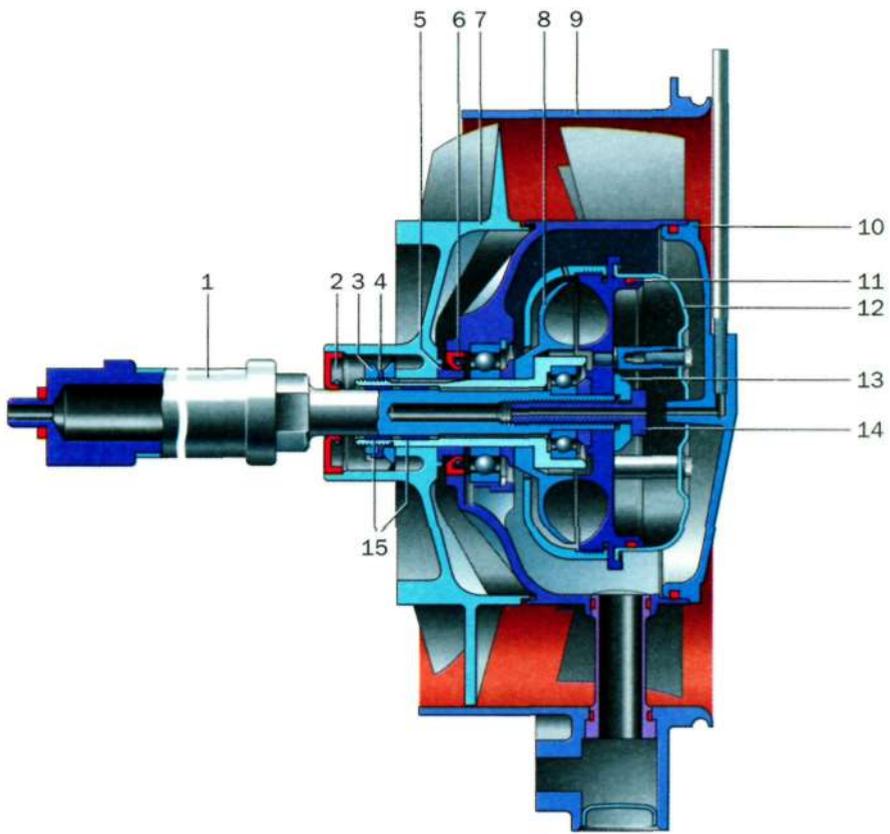
. 2.53.

V8 Duramax

GM

(. 2.53).

80 °



. 2.54. ; 2, 6 — (); 3 — ; 4 — : 1 — ; 5 —
 ; 7 — ; 8 — ; 9 — ; 10 — ;
 11 — ; 12 — ; 13 — ; 14 — ;
 ; 15 —

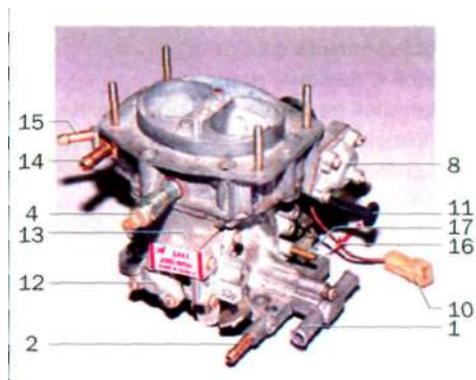
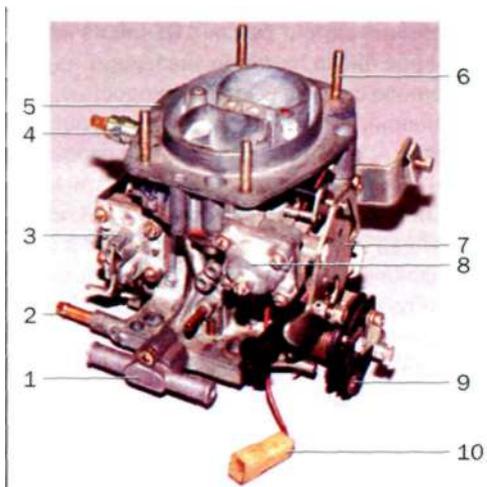
(. 2.54),

New Range Rover,

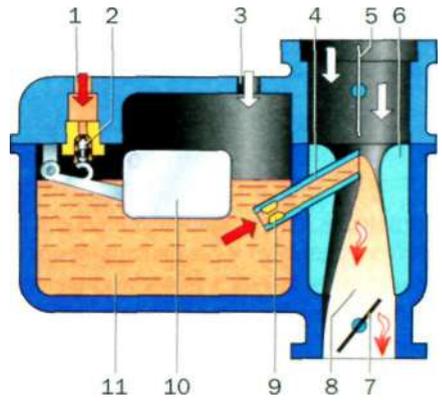
(. 2.56)

(. 2.55).

« ».



. 2.55. : 1 — ;
 2 — ; 3 — ; 4 — ;
 ; 5 — ; 6 — ;
 ; 7 — ; 8 — ;
 9 — ; 10 — ;
 ; 11 — ; 12 — ;
 ; 13 — ; 14 — ; 15 — ;
 ; 16 — () ; 17 —



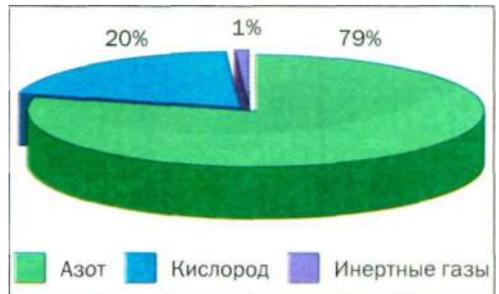
. 2.56.

- : 1 — ; 2 —
- ; 3 — ; 4 — ; 5 —
- ; 6 — ; 7 —
- ; 8 — ; 9 —
- ; 10 — ; 11 —

14,7-15,0

<1 —

15,0-16,5



. 2.57.

() () « »

()

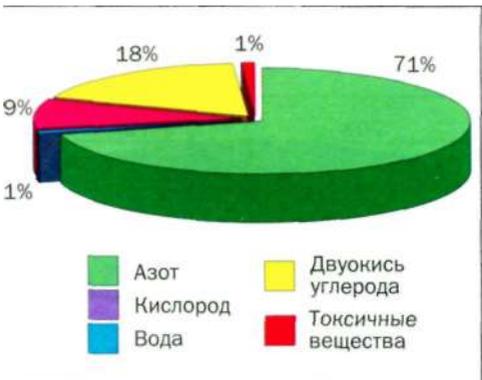
:

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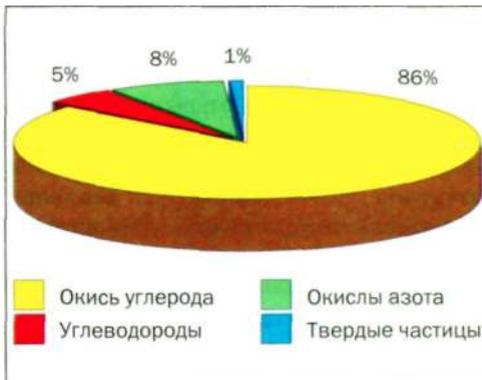
(1).

(NO_x) ()

60-



. 2.58.

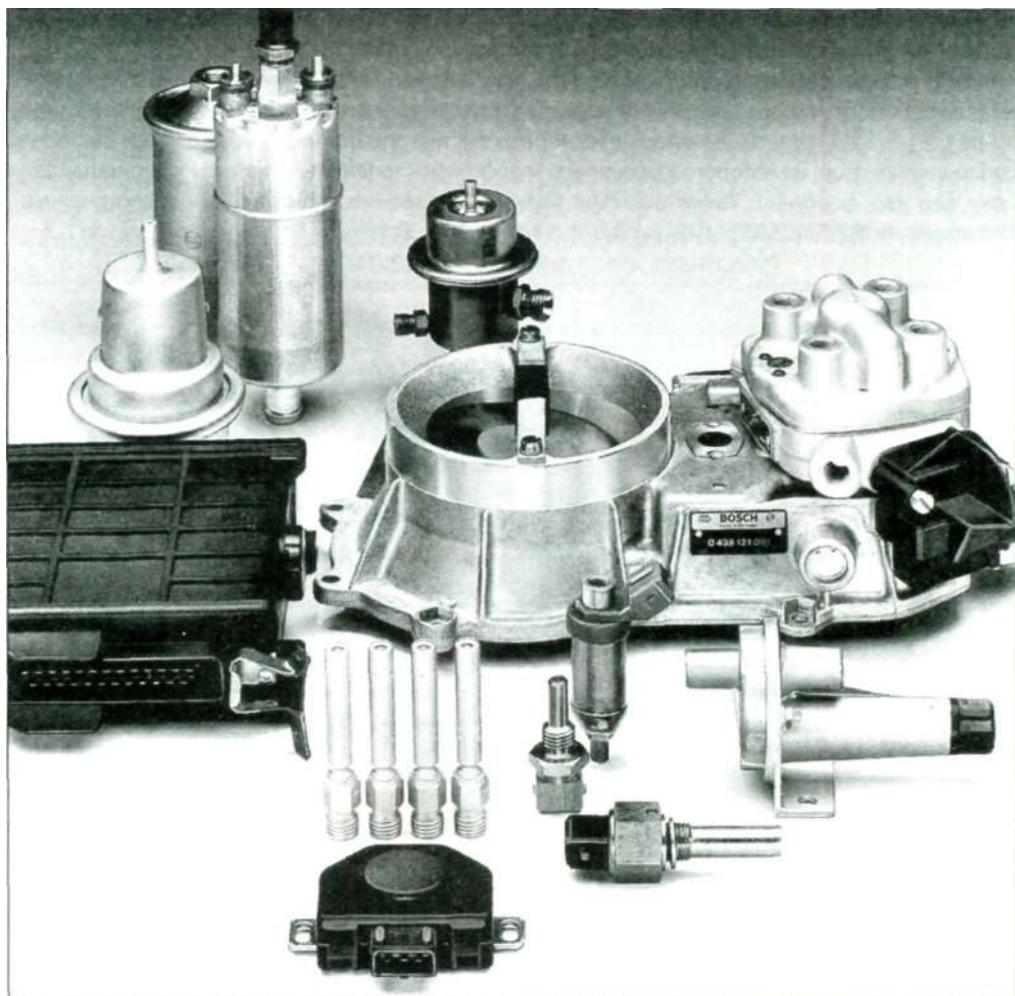


. 2.59.

2.60.

(LEV, ULEV, SULEV)

			NOx		NOx	CH+NOx	
III, 2000 .	2,3	0,2	0,15	0,64	0,5-0,56	0,05	
IV, 2005 .	1,0	0,1	0,08	0,5	0,25-0,30	0,025	
LEV 2,1	0,2	0,15					
ULEV 1,0	0,02	0,03					
SULEV, 2004 .	0,62	0,006	0,0125			0,006	



.2.61.

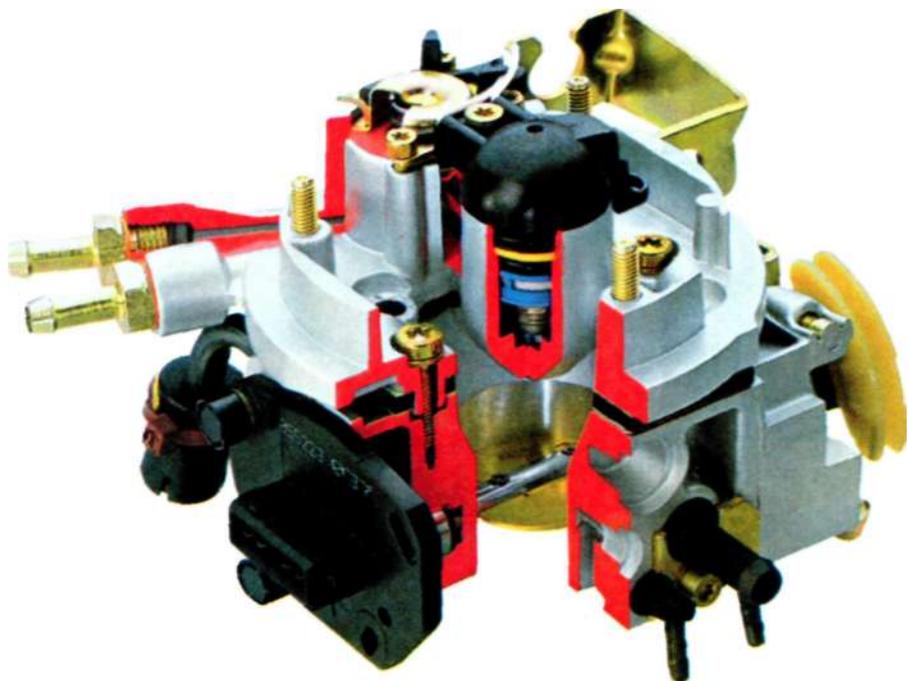
-Jetronic Bosch

§13

(. 2.61),
BOSCH)

Daimler Benz,
1954 .

» (. 2.62 2.64).



. 2.62.

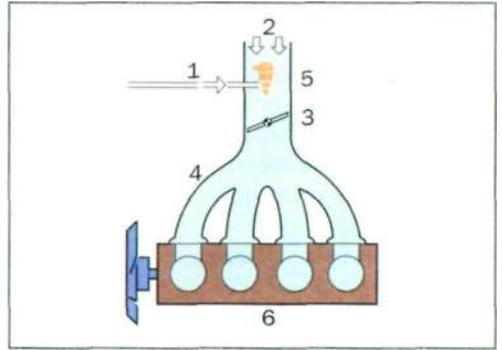
()



. 2.63.

Valvetronic BMW

()



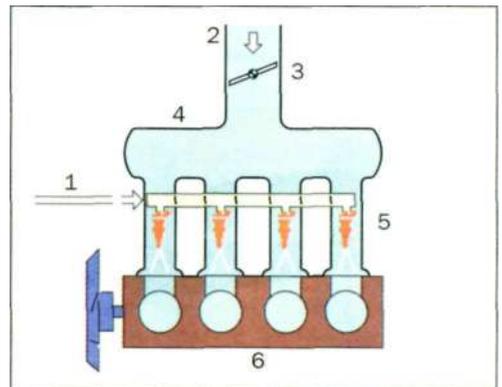
. 2.64.

1 — ; 2 — ; 3 — ; 4 — ; 5 — ; 6 —

(MOTRONIC)

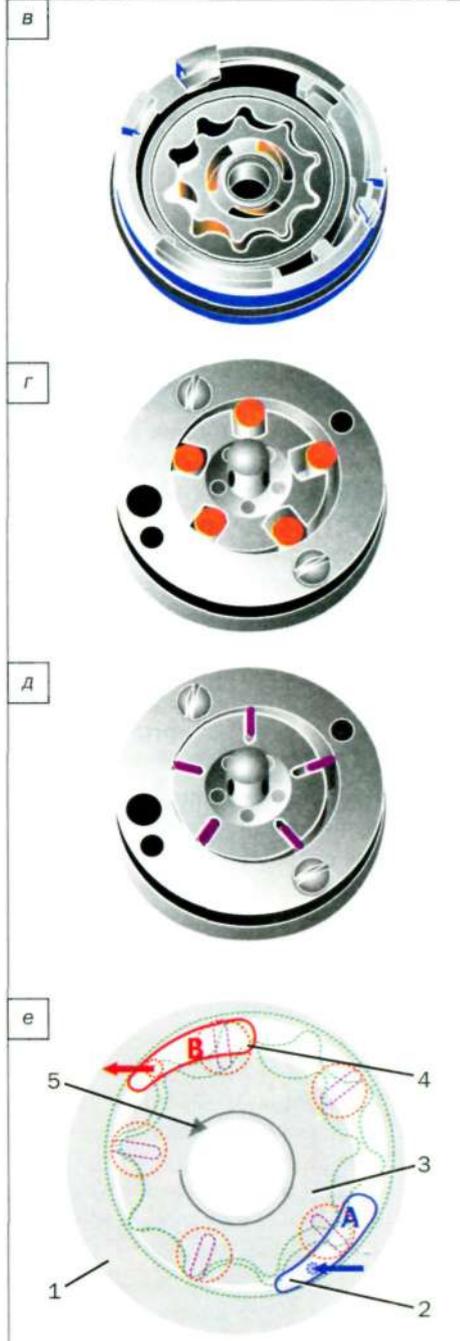
(. 2.64).

() (. 2.63),



. 2.65.

Motronic: 1 — ; 2 — ; 3 — ; 4 — ; 5 — ; 6 —



. 2.66.

3 — ; 4 — ; 5 —

; — ; — ; 1 — ; 2 — ;



. 2.67.

(. 2.66), ()

280

(. 2.67)

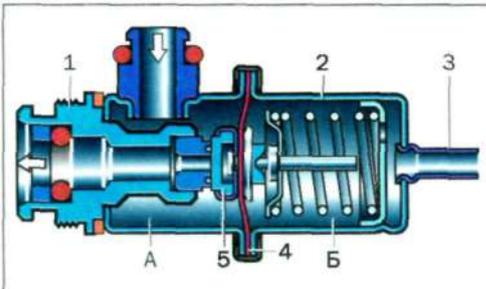
(. 2.68)



. 2.68.

— Bosch

— GM,



. 2.69. :
 1 — ; 2 — ; 3 —
 ; 4 — ; 5 —
 ; — ; —



. 2.70. -

(. 2.69)

V8

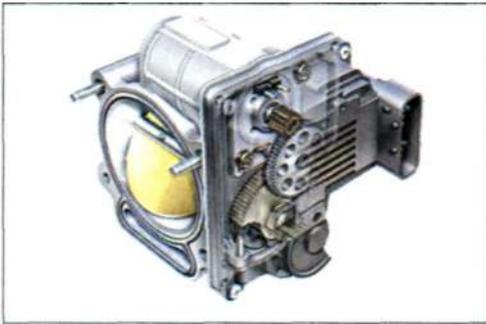
New Range Rover

(. 2.70).

« ».

(. 2.71).

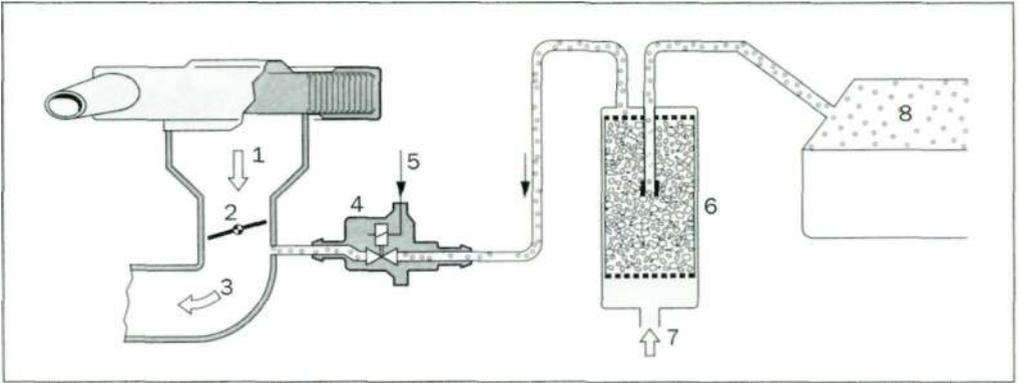
« »



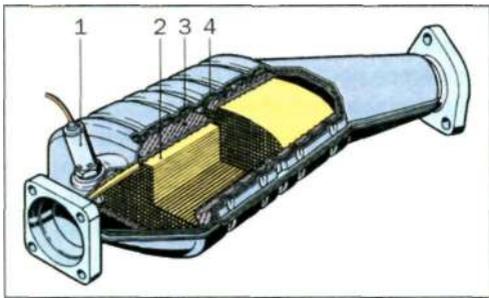
. 2.71.



. 2.72.



. 2.73. : 1 — ; 2 — ;
 3 — ; 4 — ;
 5 — ECU; 6 — ; 7 — ; 8 —



. 2.74. - 2.75)
 : 1 —
 2 — ; 3 — ()
 4 — ()
 ()



. 2.75.

()

NO_x

14,7:1

(. .

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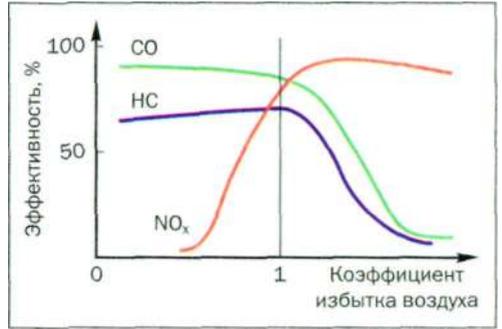
()

NO_x

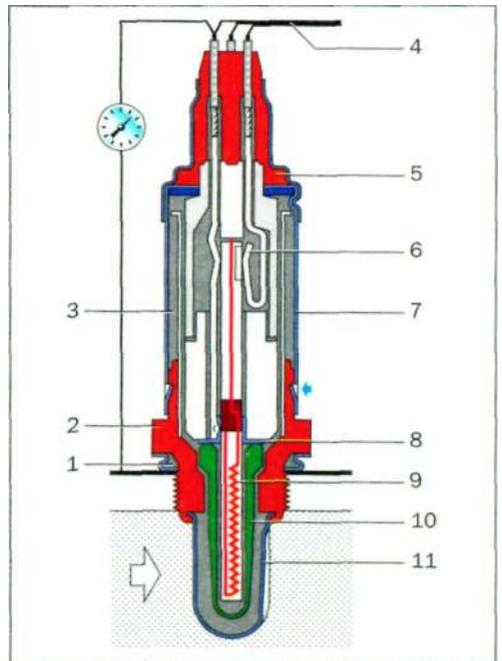
=1

(

)(. 2.77),



. 2.76.



. 2.77.

: 1 —

; 2 —

« »; 3 —

; 4 — ; 5 —

; 6 —

7 —

; 8 —

; 9 —

; 10 —

; 11 —

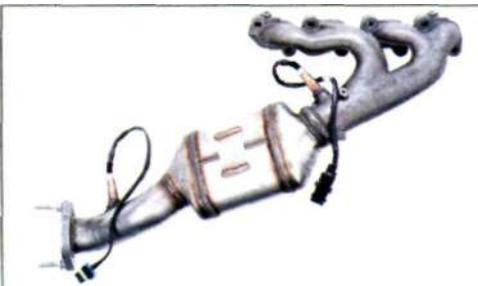
90 %

300 "

(. 2.78),

« »,

NO_x



. 2.78.

XX

40-

XIX

Mitsubishi,

Mitsubishi Galant

1,8 GDI (Gasoline

Direct Injection —

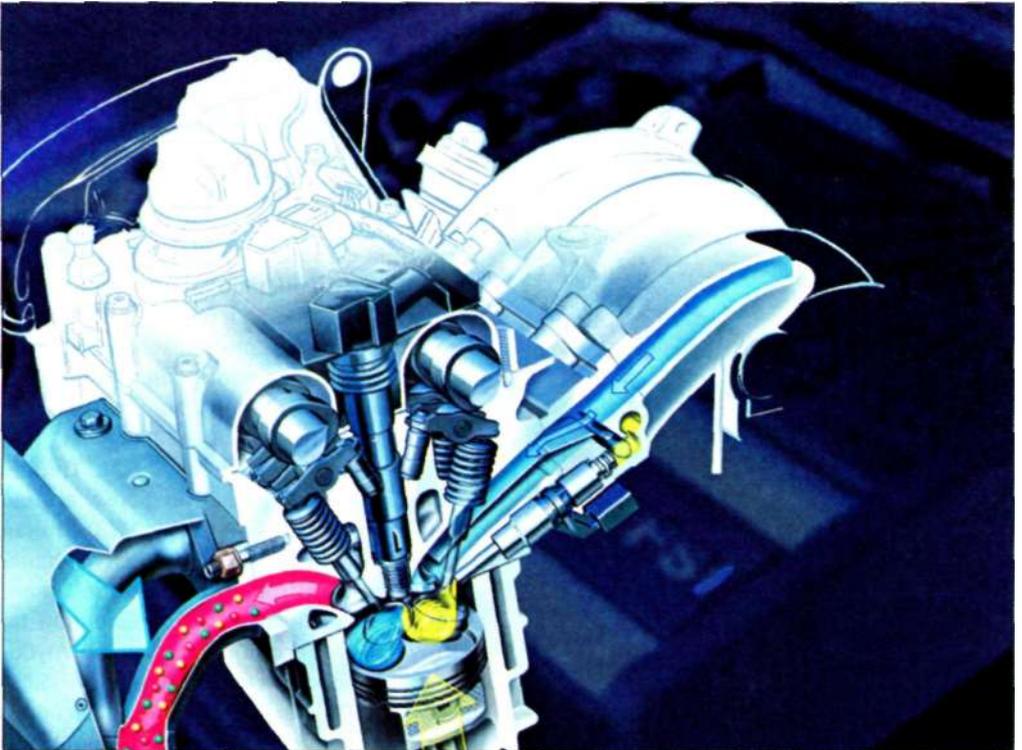
)

1996 . (. 2.81).

Peugeot-Citroen, Renault,

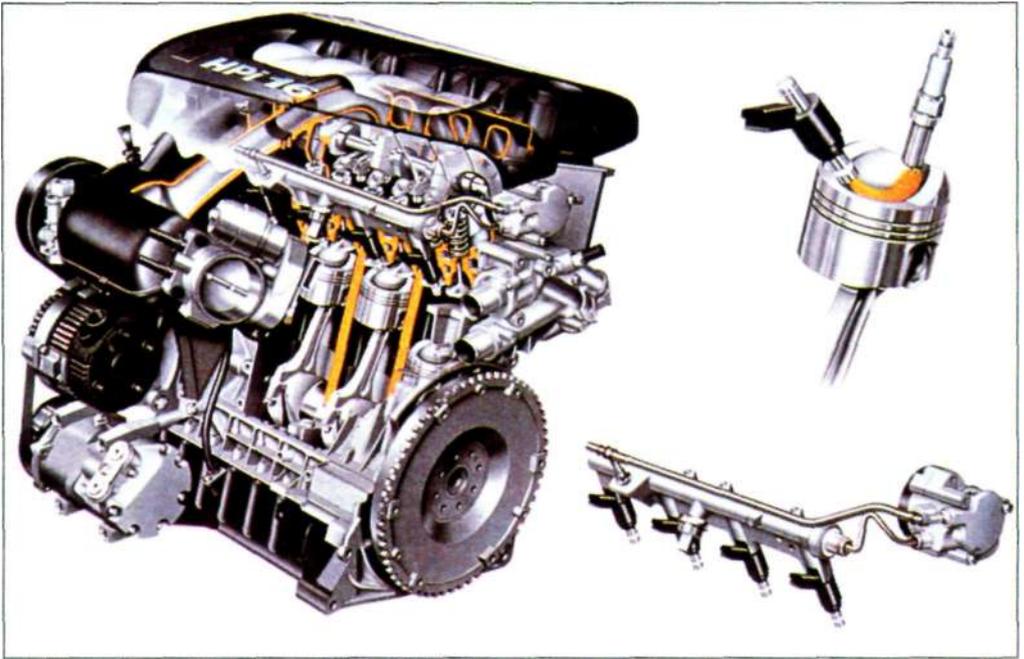
Toyota, DaimlerChrysler

(. 2.79; 2.80; 2.84).



. 2.79.

Volkswagen FS1



. 2.80. 2000 . PSA Peugeot-Citroen
HPI

12,5 (

10 -

).

GDI

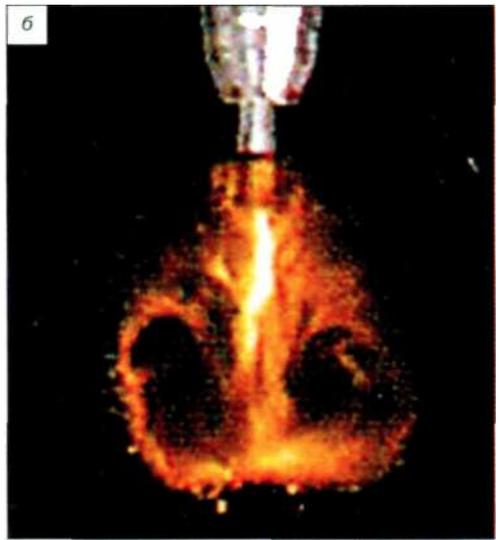
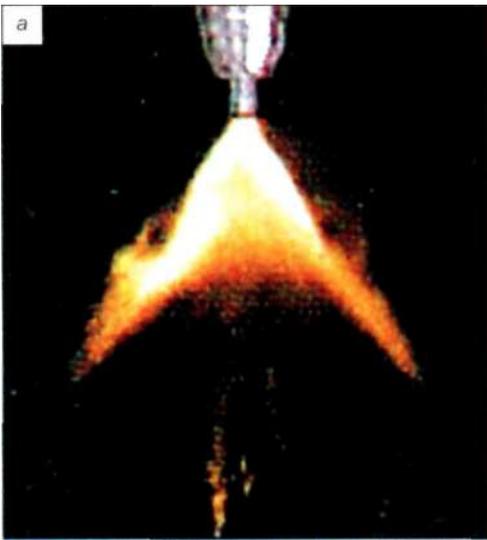
5



. 2.81. Mitsubishi GDI —

(. 2.82).

(. 2.83).



. 2.82.
()

GDI

()

- 1)
- 2)
- 3)

100-120 / .

2,7.

() .

GDI



. 2.83.

()



. 2.84.
Audi 2.0 FSI

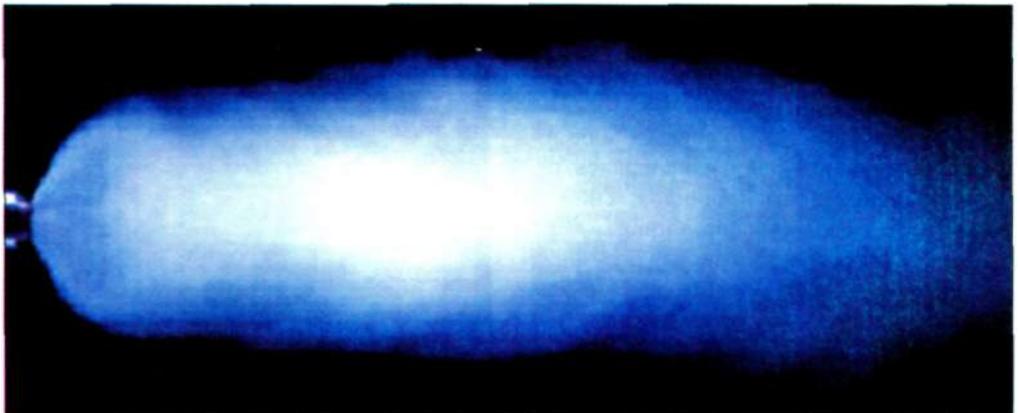
(=4,1).

10 % 20 %

GDI 10 %

Orbital.

Orbital



. 2.85. Orbital

0,65

0,8

(. 2.85).

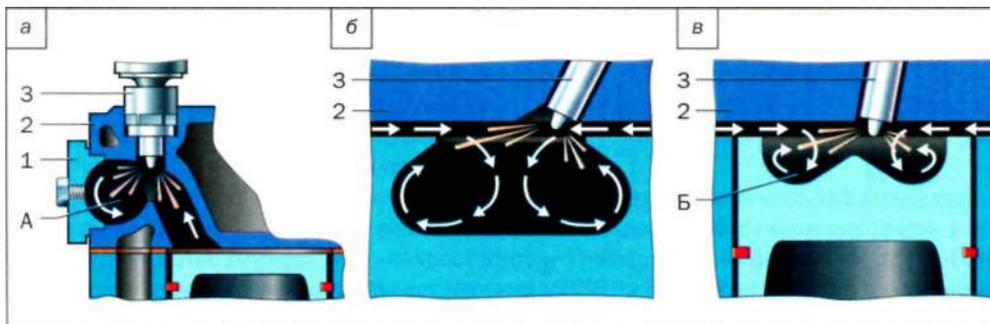
§14

1897

(700-900 °)

(3-5)

45-50;



. 2.86.

(6,)
-245); —

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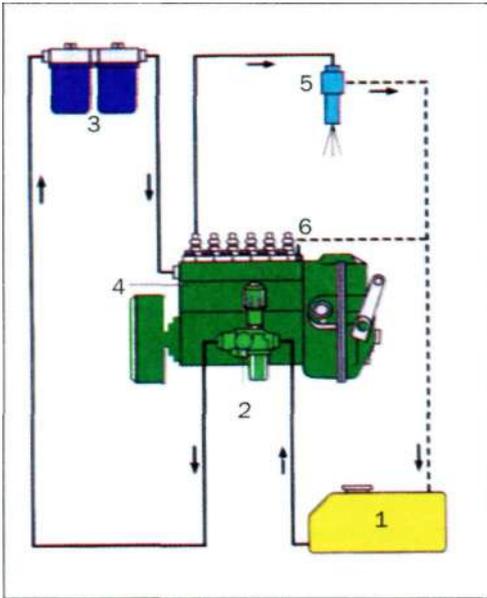
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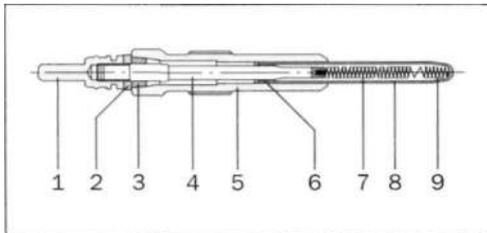
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IDI (In Direct Injection),

— DI (Direct Injection).

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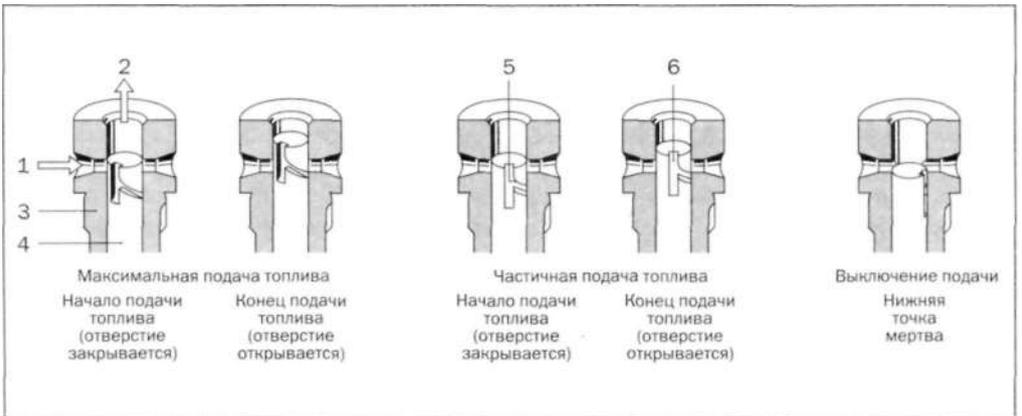
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.288.
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(. 2.89). 1960 .



. 2.89.

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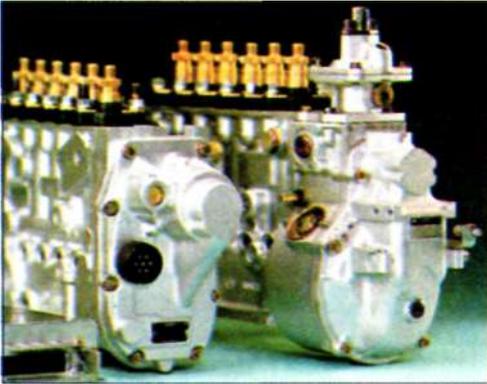
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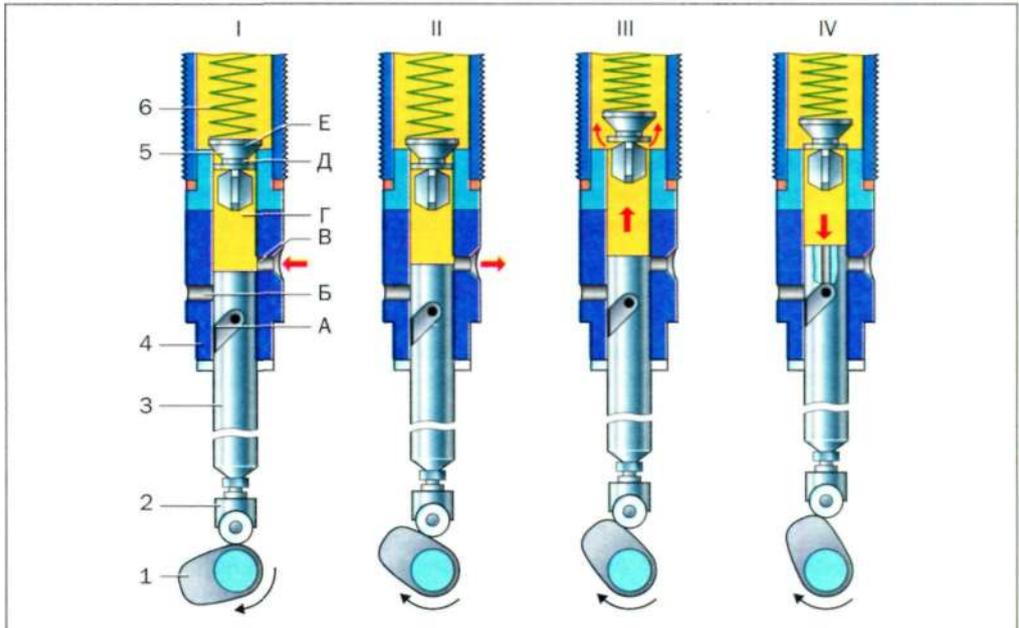
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. 2.90.

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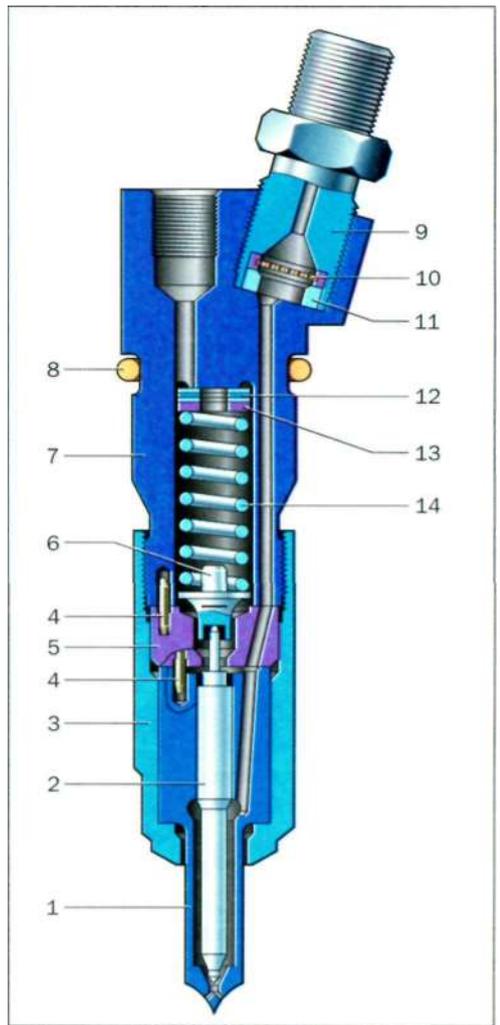


. 2.91.

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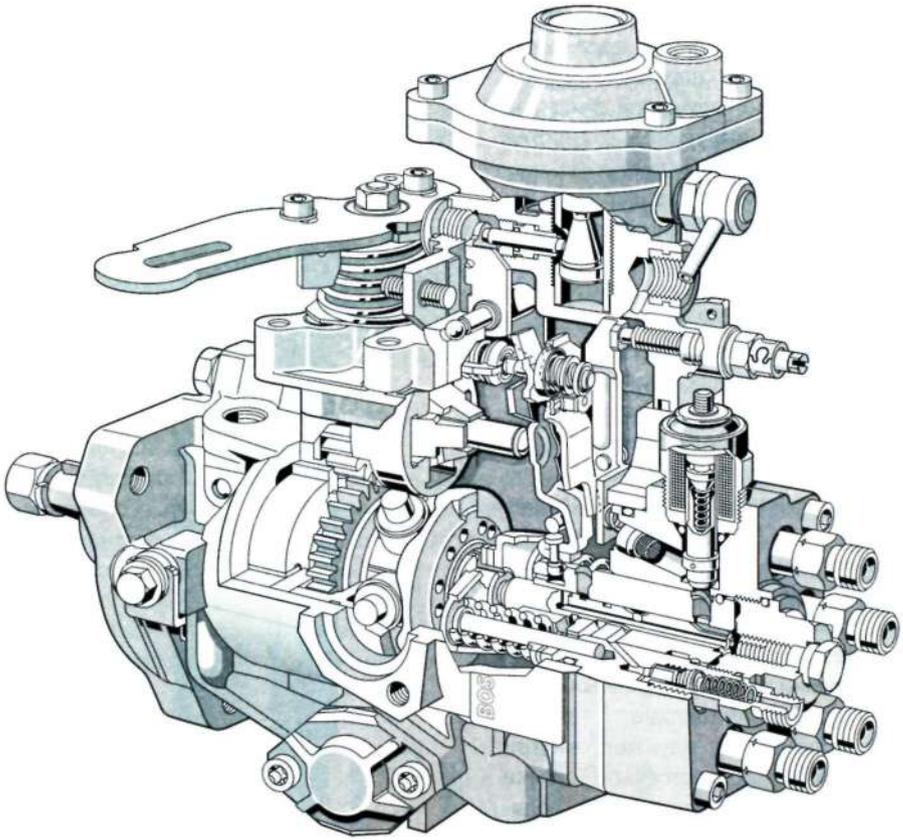
(. 2.91).

(. 2.92).



. 2.92.

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. 2.93.

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COMMON RAIL

Rail (. 2.94).

Common

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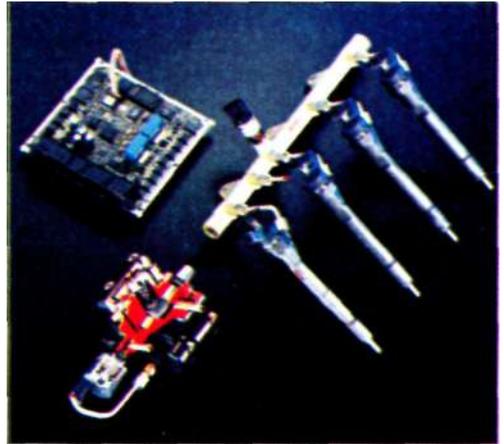
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(. 2.95).

Common Rail,
Bosch,

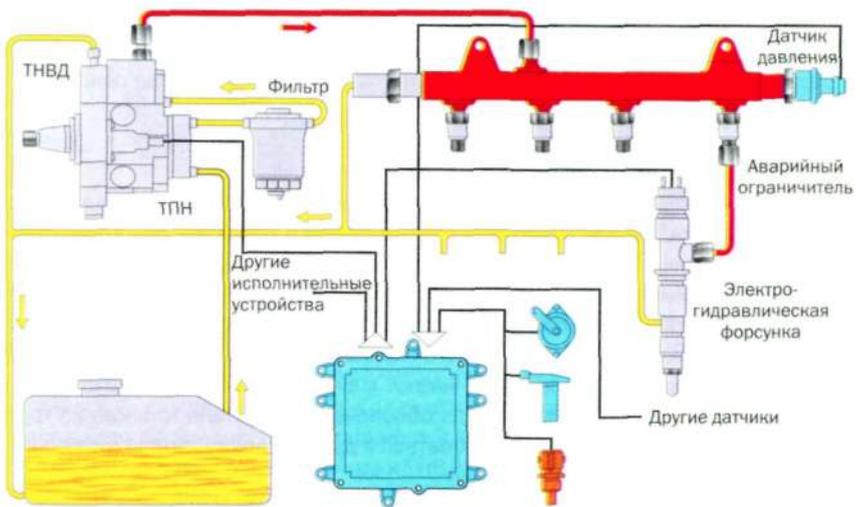


2.94. Common Rail

135

Common Rail
Common Rail

(Rail).



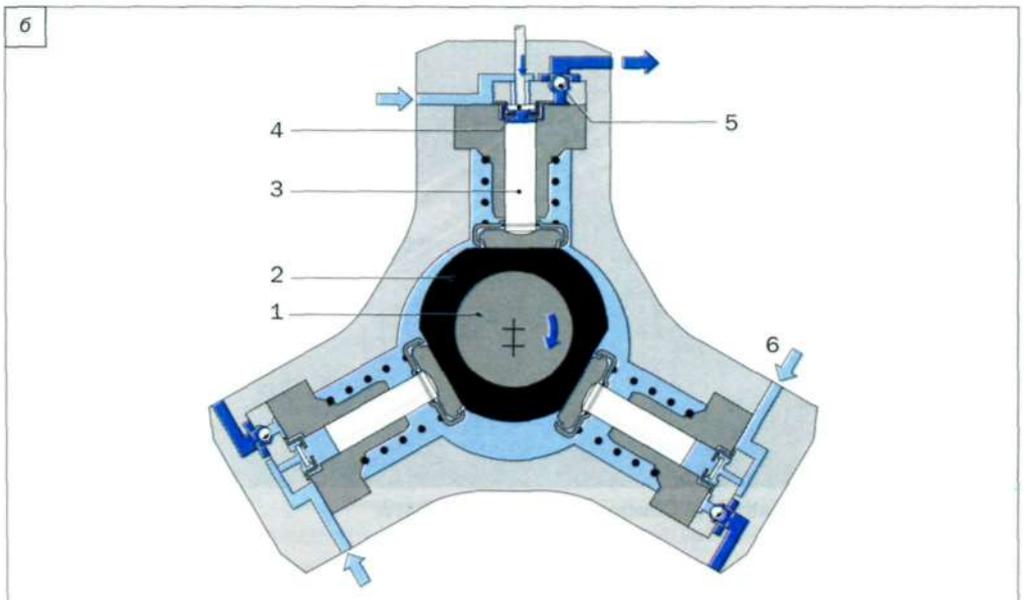
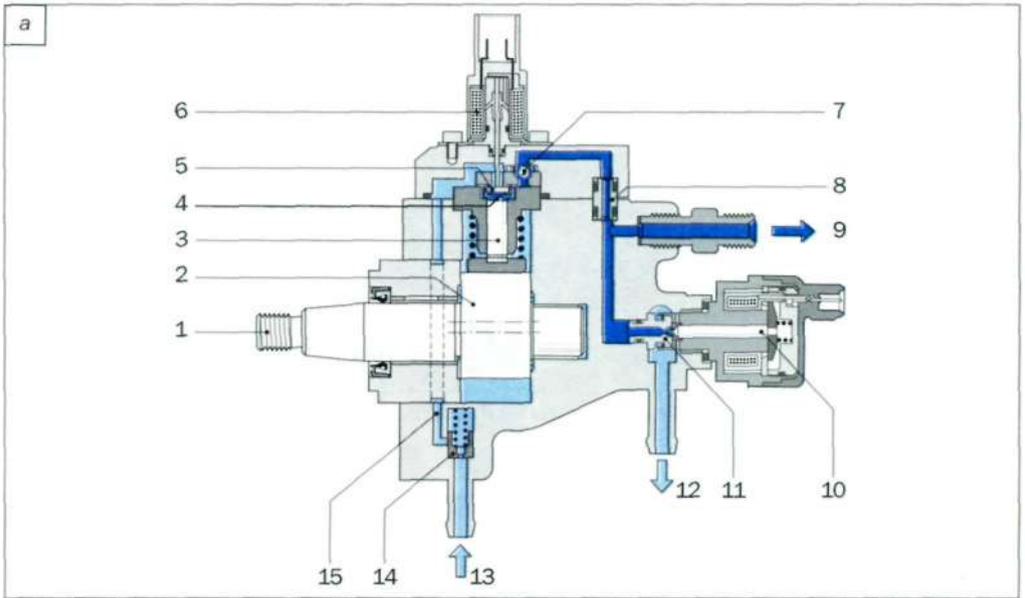
2.95.

Common Rail

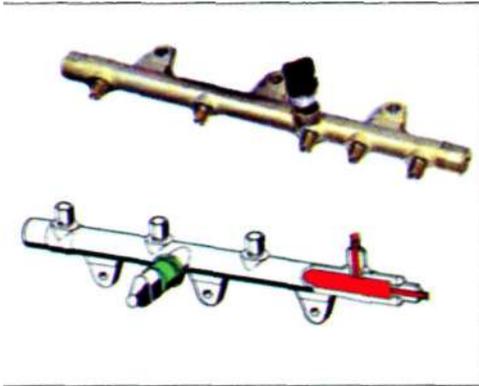
Common Rail

135

COMMON RAIL



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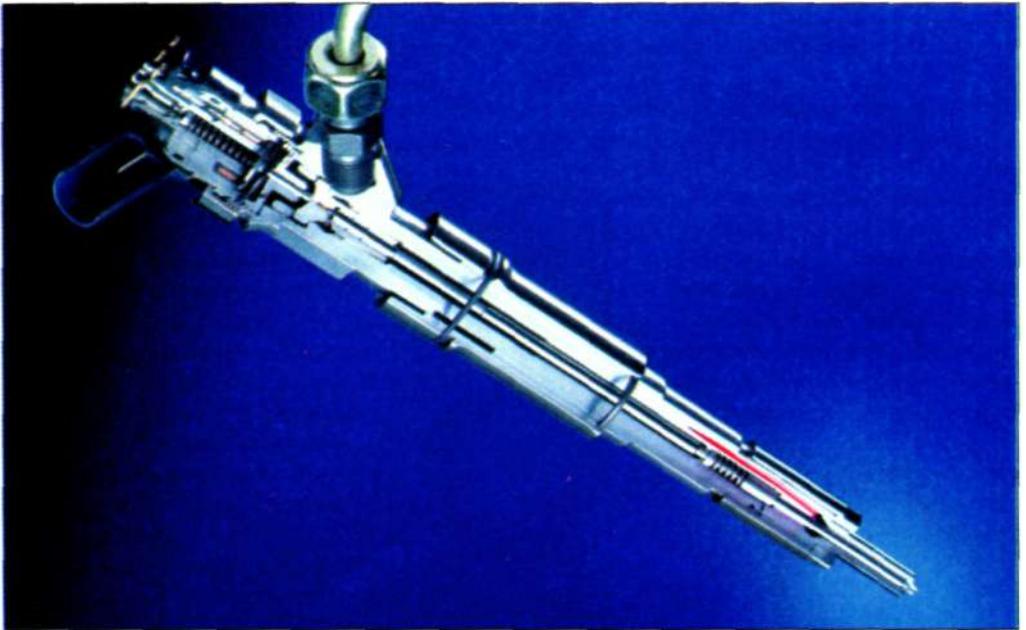


. 2.97.

Common Rail



. 2.98.



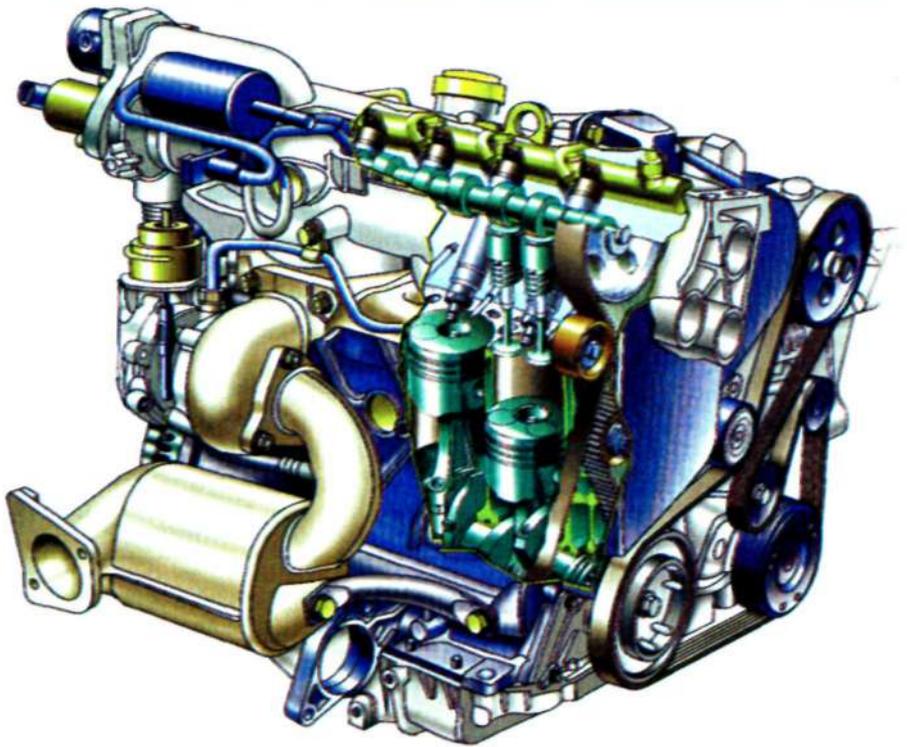
. 2.99.

Common Rail

BMW

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(. 2.97)



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2000 .

Renault
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Common Rail

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HEUT (Hydraulically Actuated Unit Ignition) —

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HEUT

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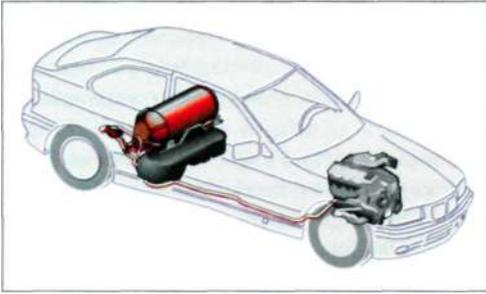
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BMW, FIAT, Rover).

(. 2.101).

(Volvo,



. 2.101.

BMW 316 g



. 2.102.

Ford Motors

(. 2.102).

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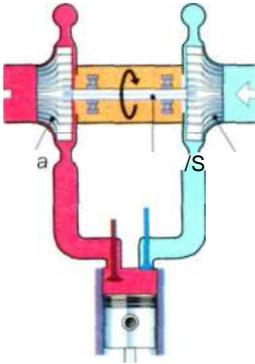
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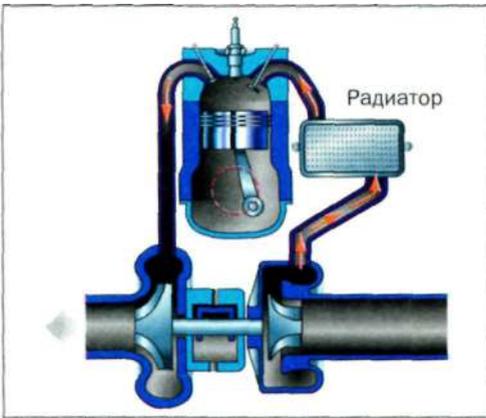
(. 2.103).

50-100 ⁻¹.

(60 000 ⁻¹),
(5 000-10 000 ⁻¹).



. 2.103.



. 2.104.

(. 2.104).

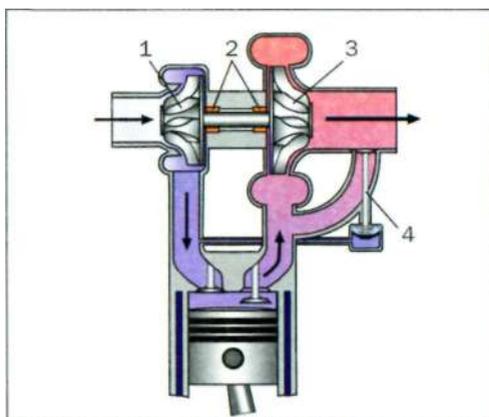
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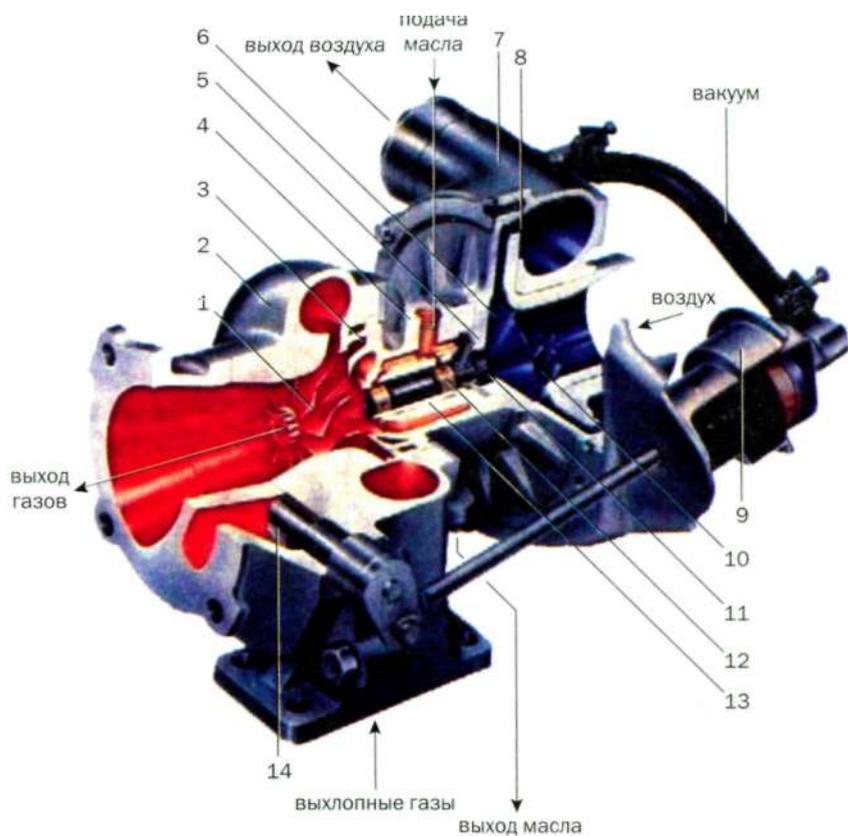
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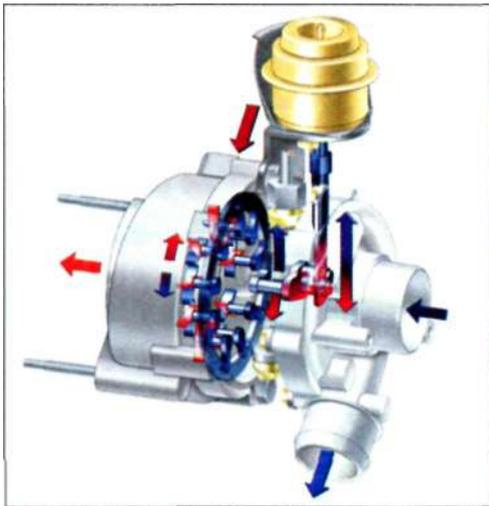
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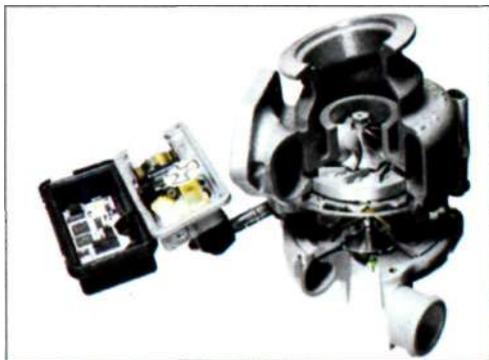
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. 2.107.



. 2.108.

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DaimlerChrysler,

Mercedes

(. 2.108).



. 2.109.



. 2.110.
Scania

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Ruts (. 2.111; 2.112).



. 2.111.



. 2.112.

Ruts

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(. 2.113).

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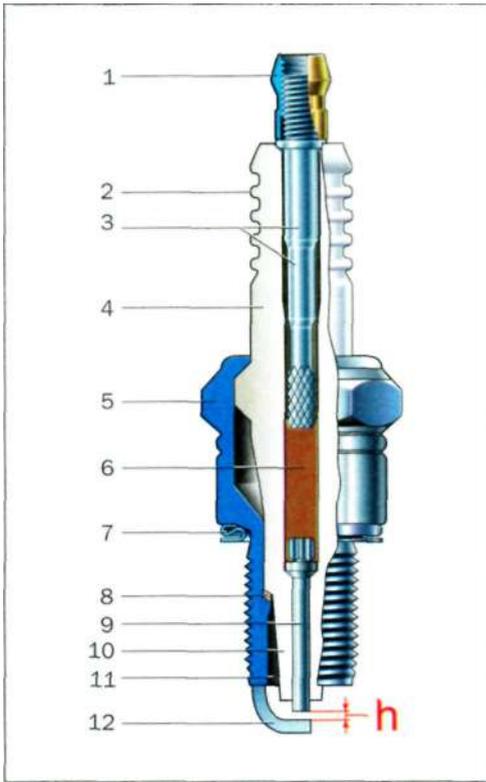
(. 2.114)

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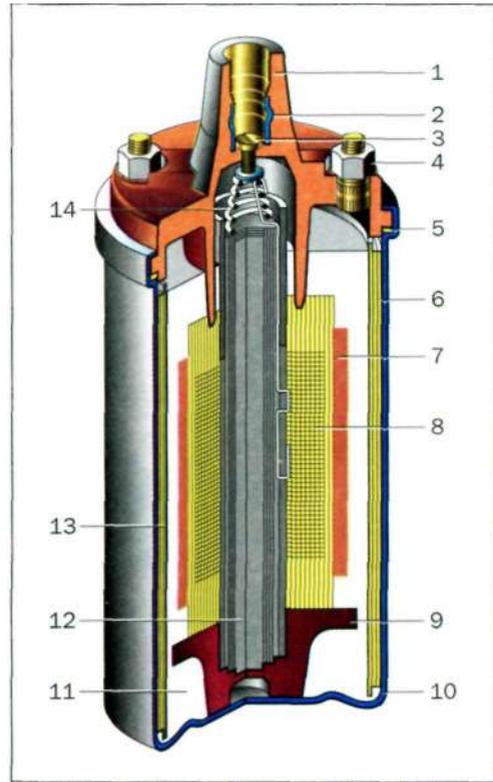
(. 2.115)

(. 2.116).



. 2.113.

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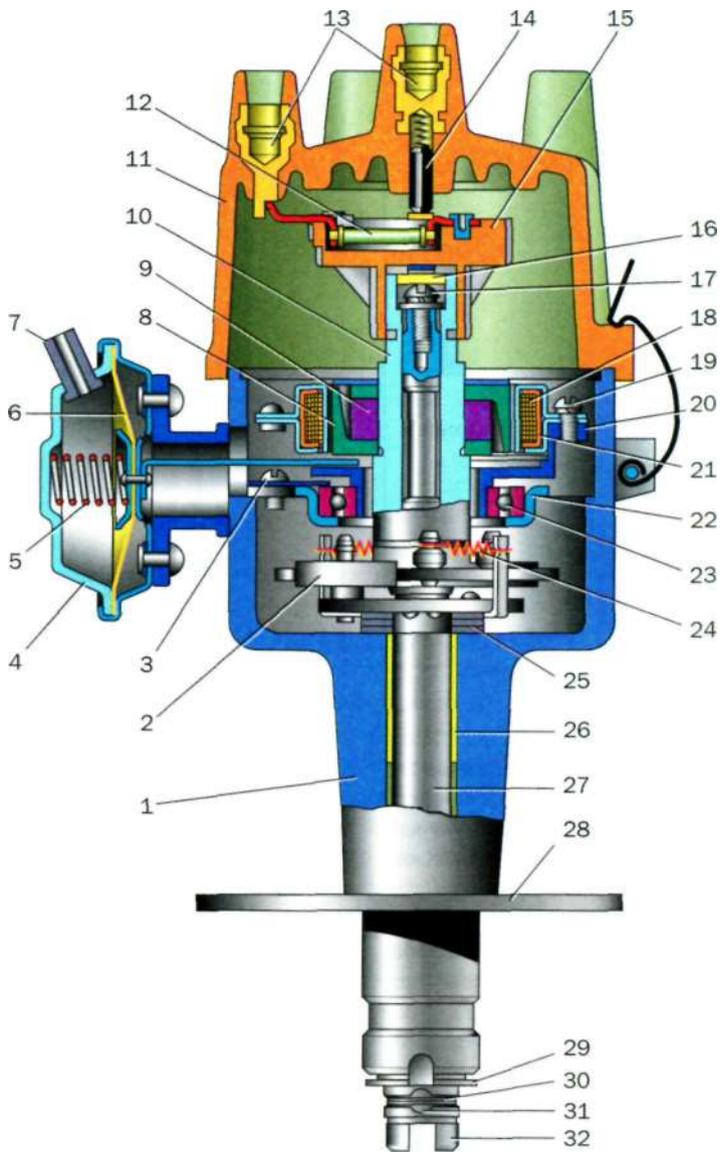


2.115.

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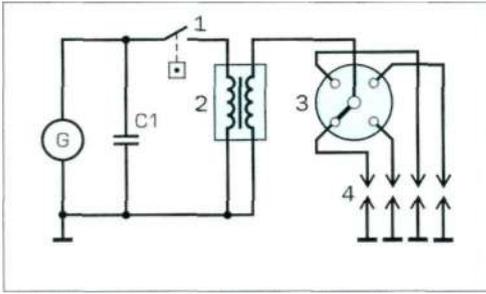


. 2.114.



. 2.116.

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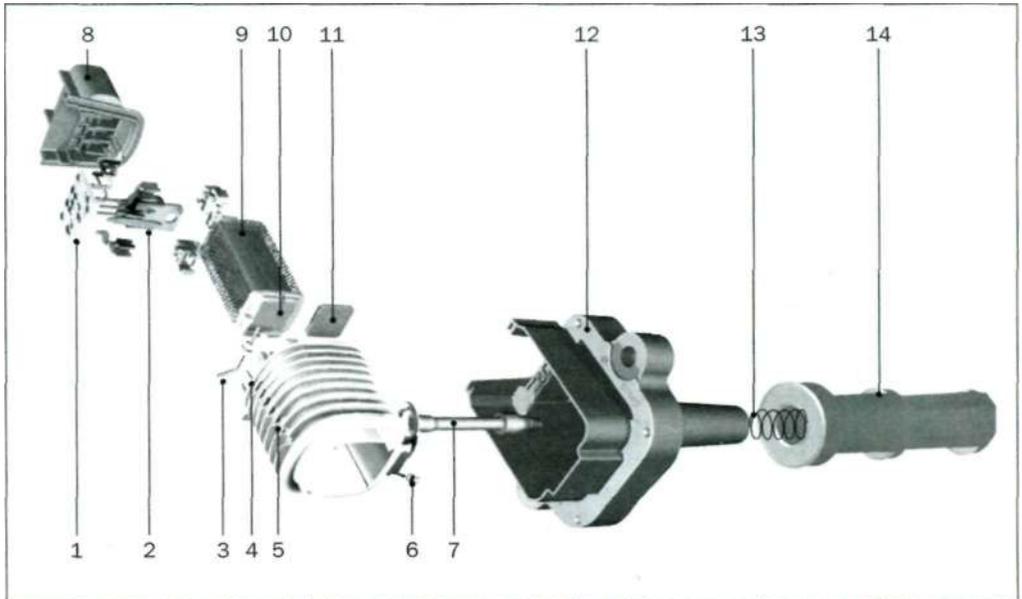


. 2.118.

Bosch

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(. 2.117).



. 2.119.

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(. 2.119).

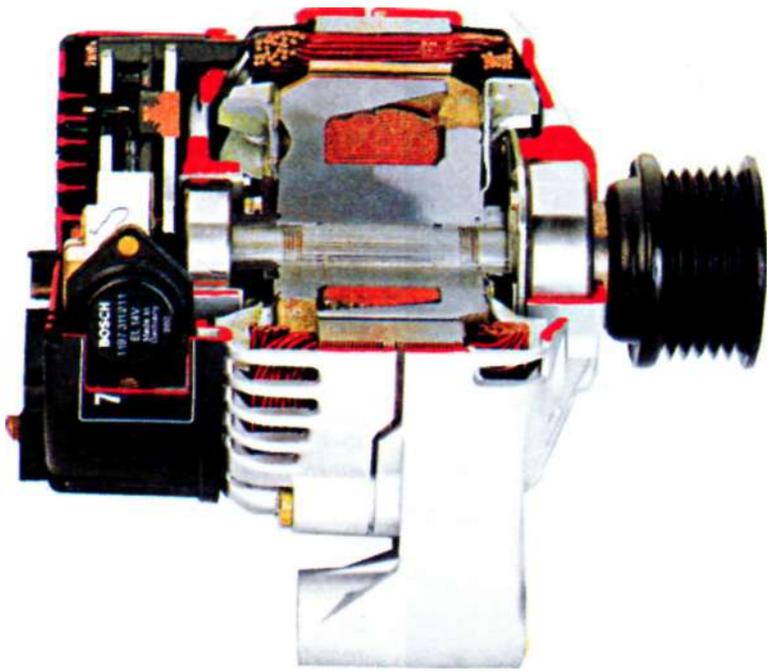
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(. 2.120).

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. 2.121.

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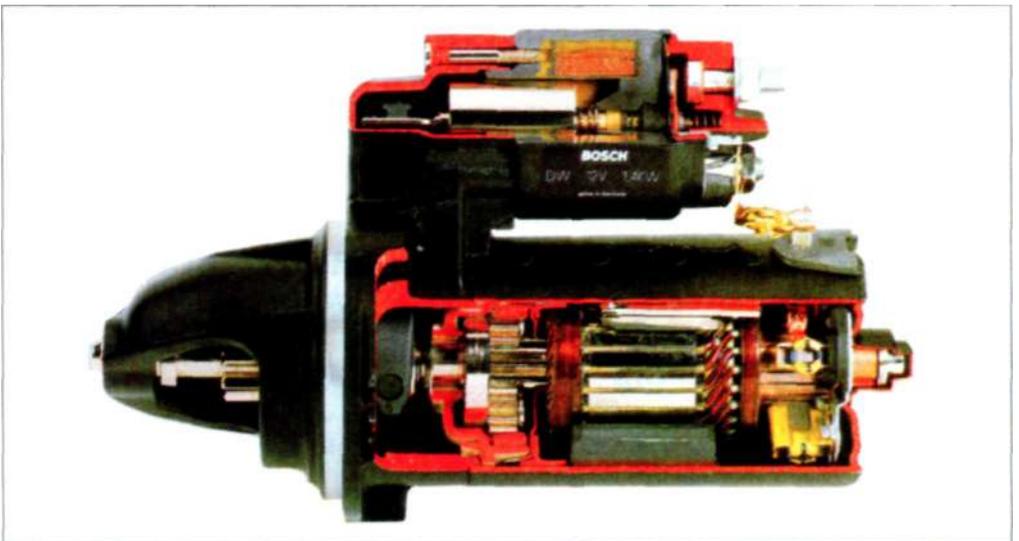
. 2.122.

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BMW

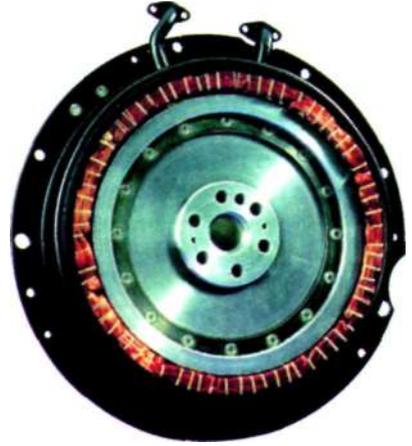
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42 36 12 ,
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. 2.123.

(. . . 8).

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(. 2.124),

(. . . 8).

36

(. 2.125).



Рис. 2.125. Сравнение автомобилей с разными типами электропроводки. Применение мультиплексных линий дает возможность существенно упростить электропроводку

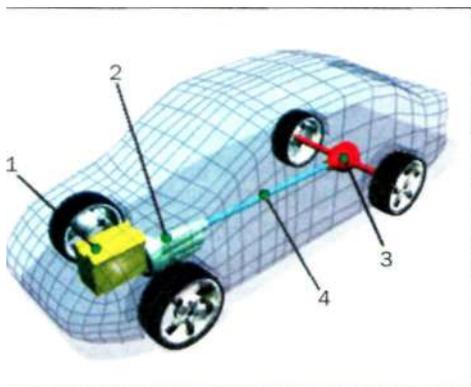
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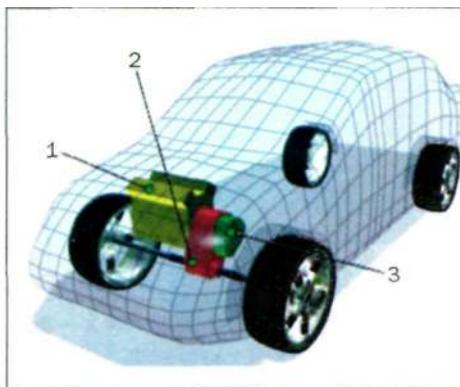
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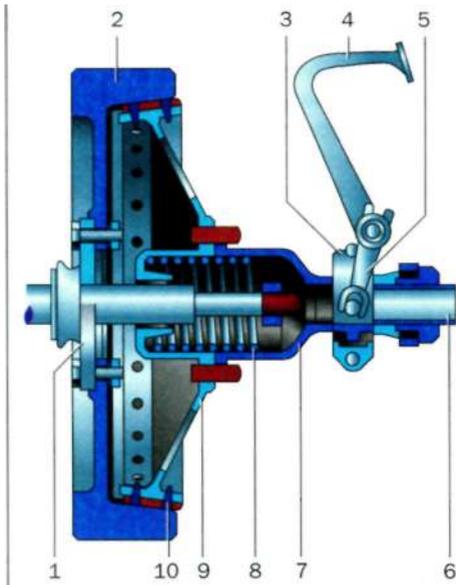
. 3.1.

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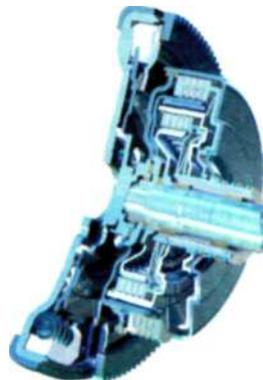
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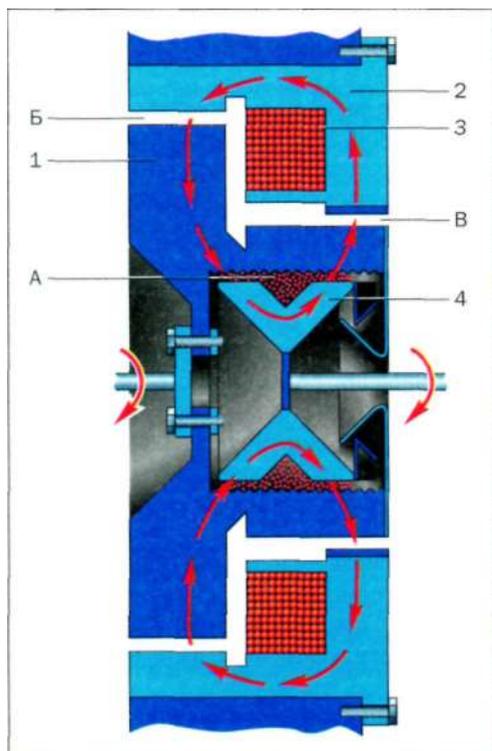
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(. 3.5)

. 3.4.



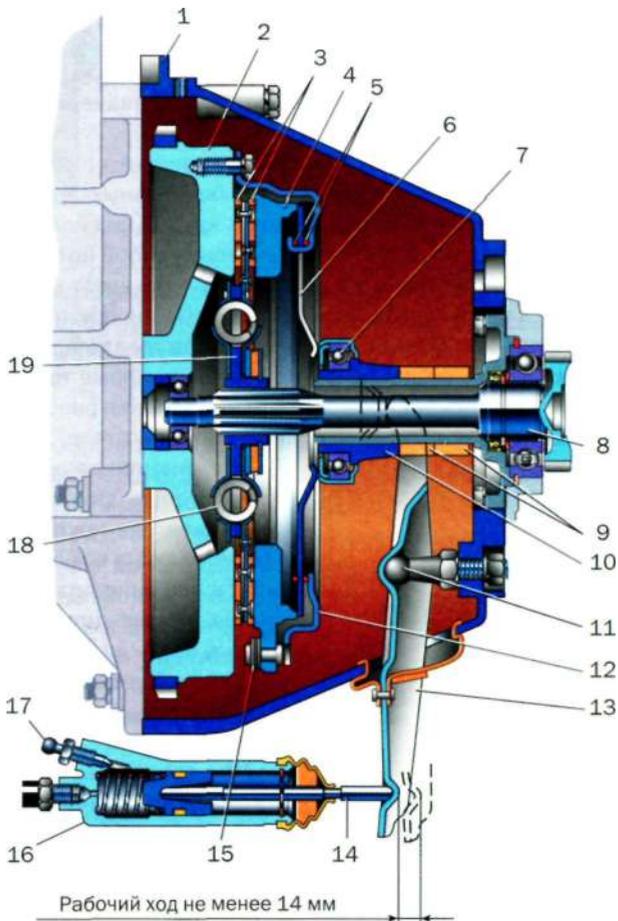


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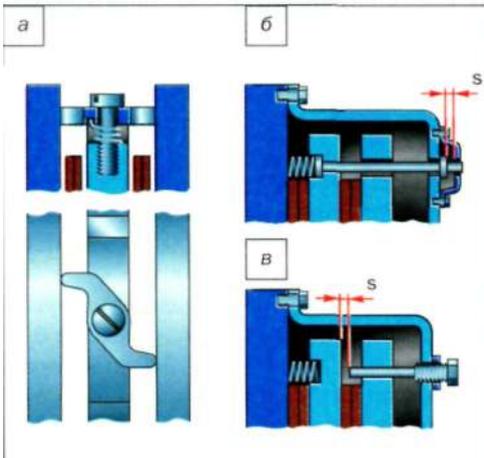
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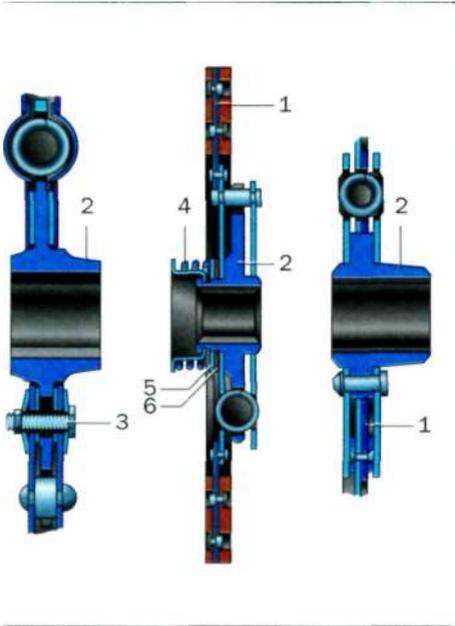
(. 3.8).



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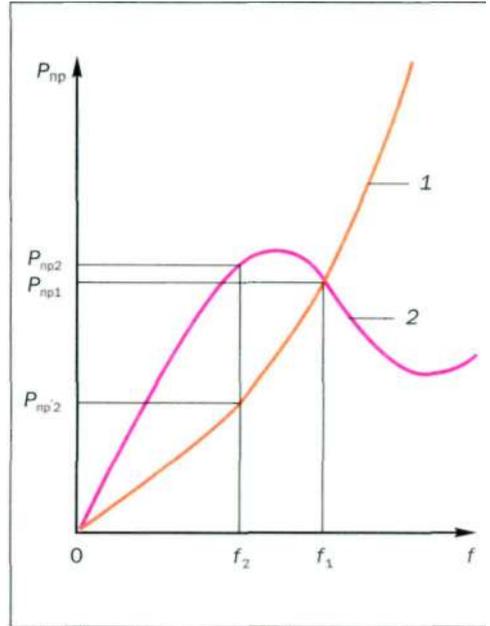
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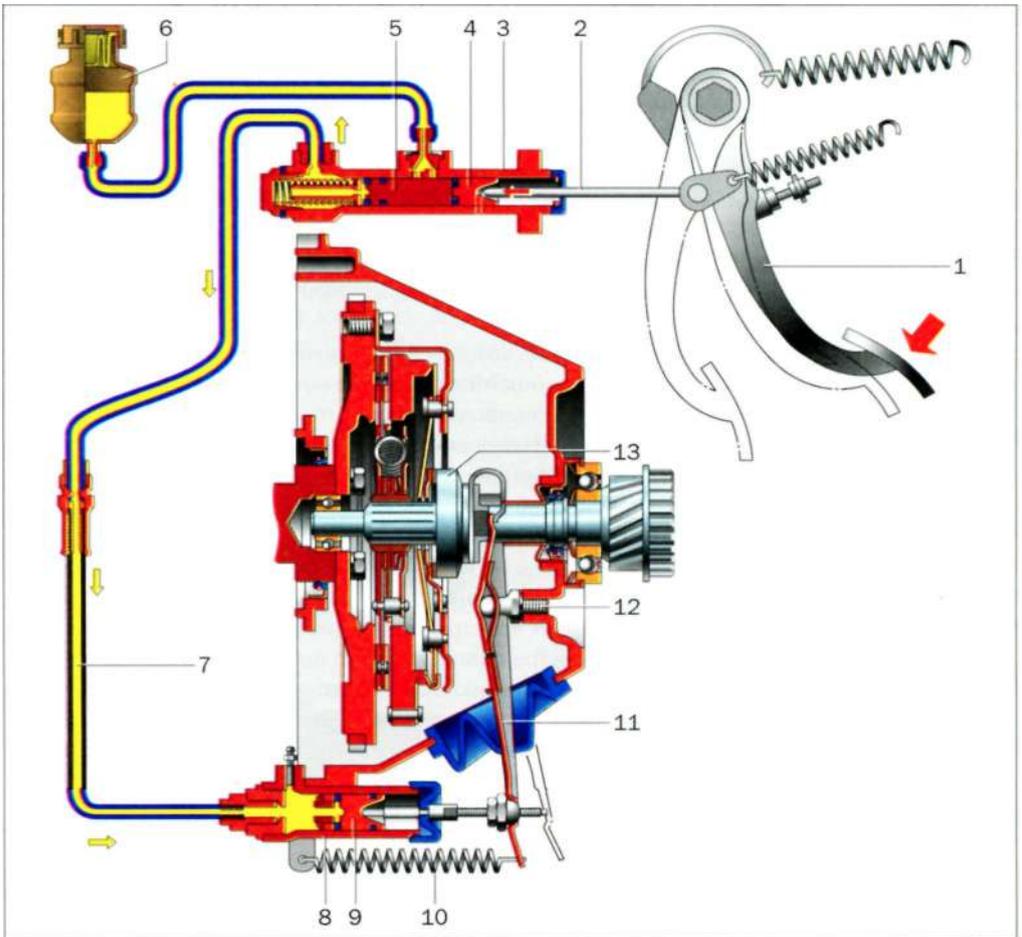
. 3.9.

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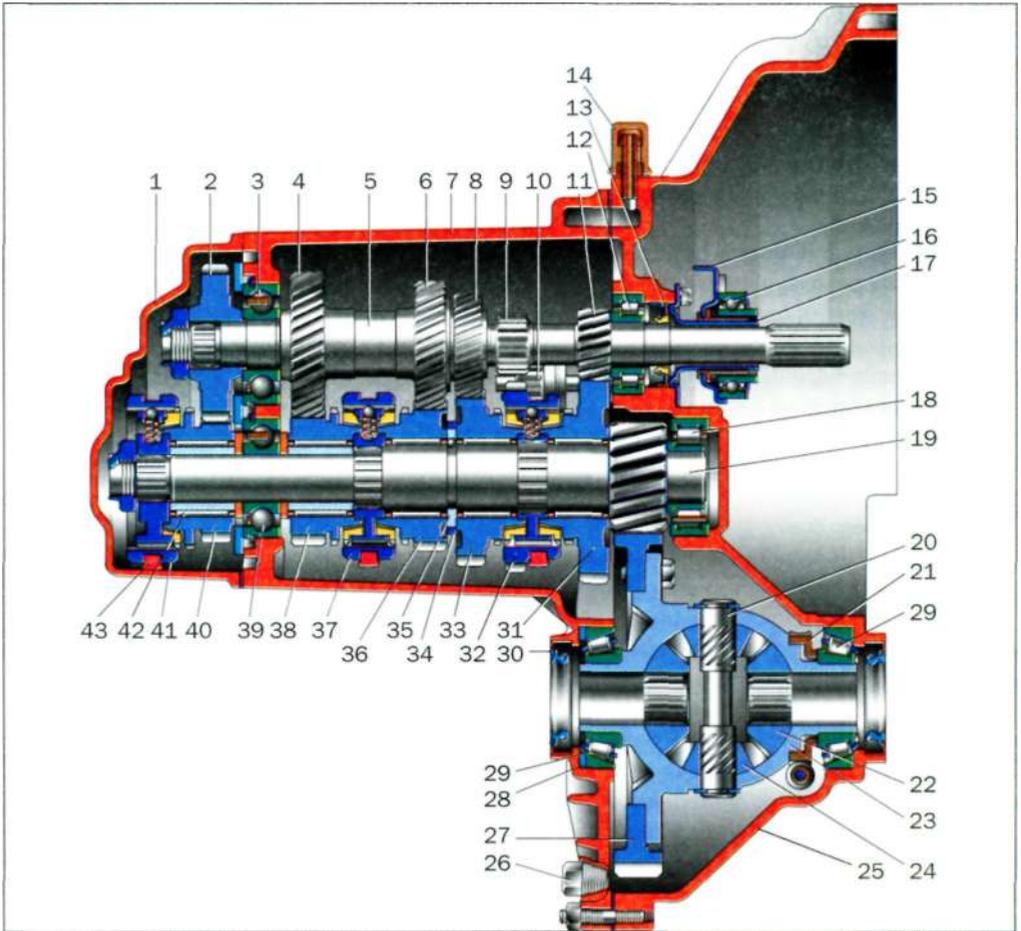
Volvo 850

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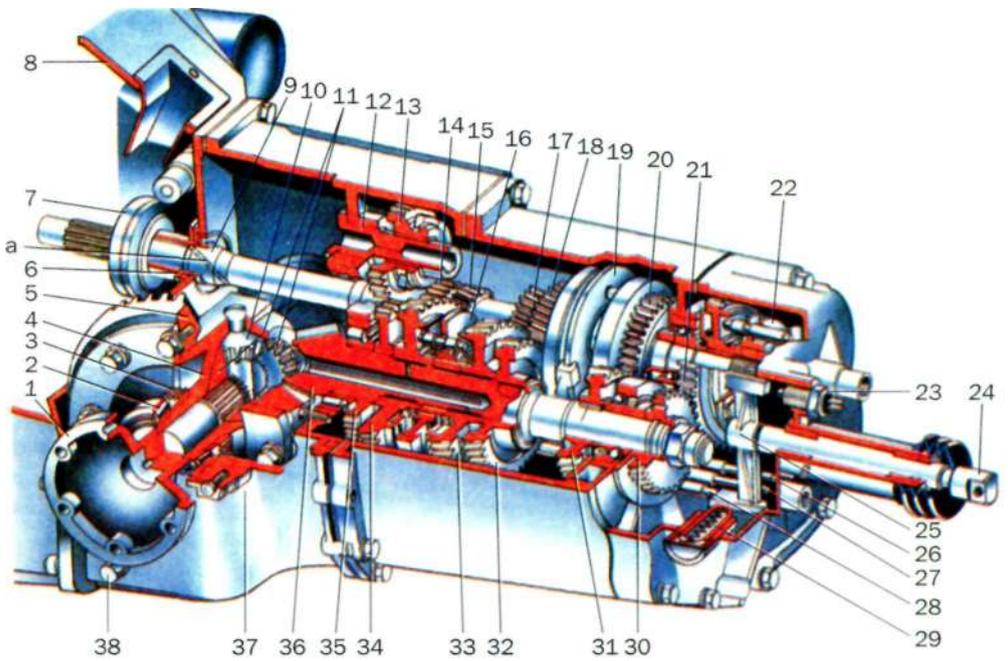
Volvo

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. 3.12.

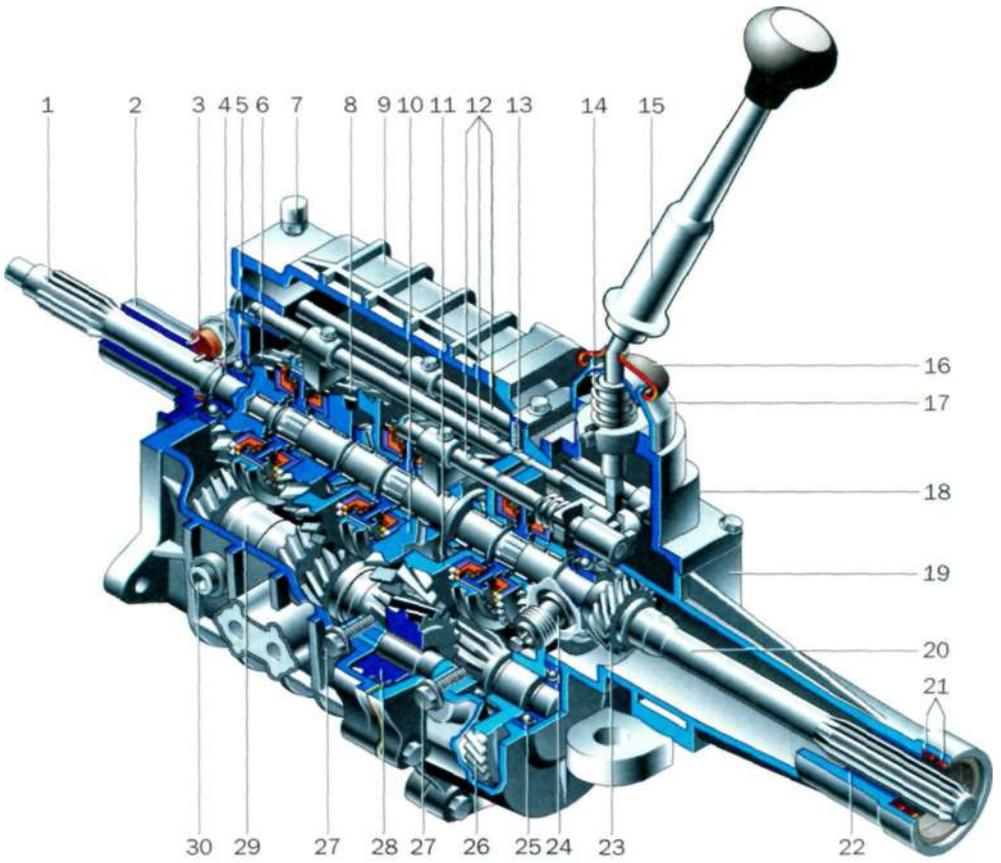
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- ; 38 — IV ; 39 —
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. 3.13.

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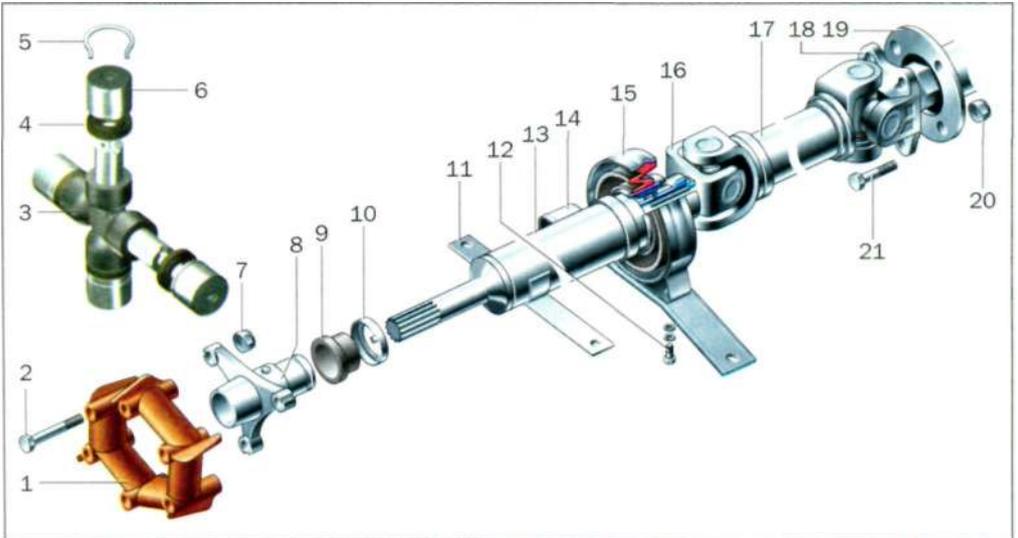
- 3.14.
- 3 — ; 4 — ; 5 — ; 6 — ; 7 — ; 8 —
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 - 19 — ; 20 — ; 21 —
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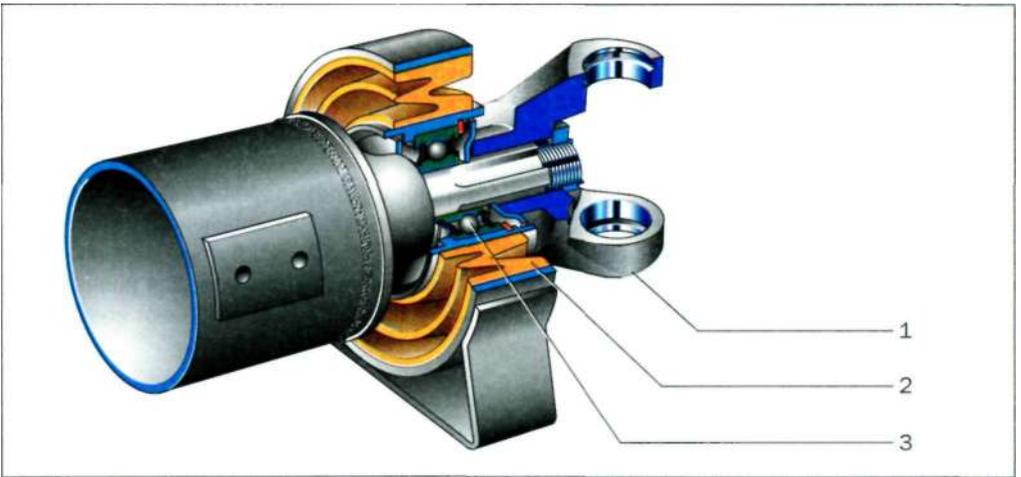
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. 3.16.

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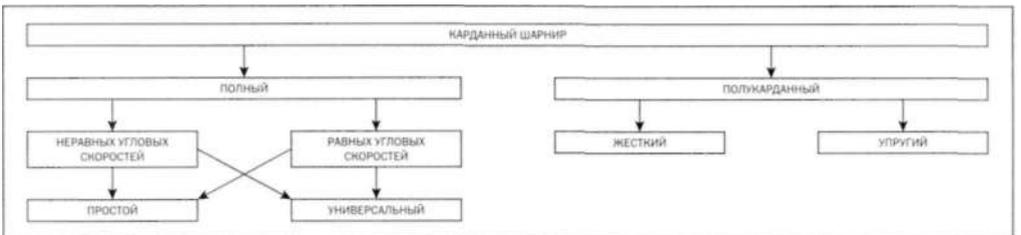
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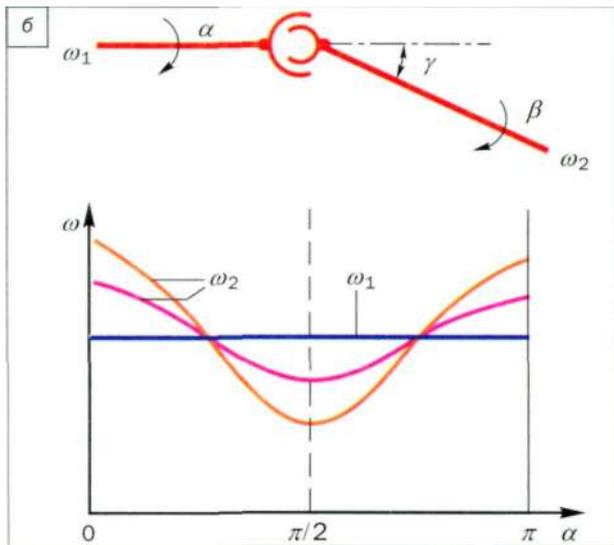
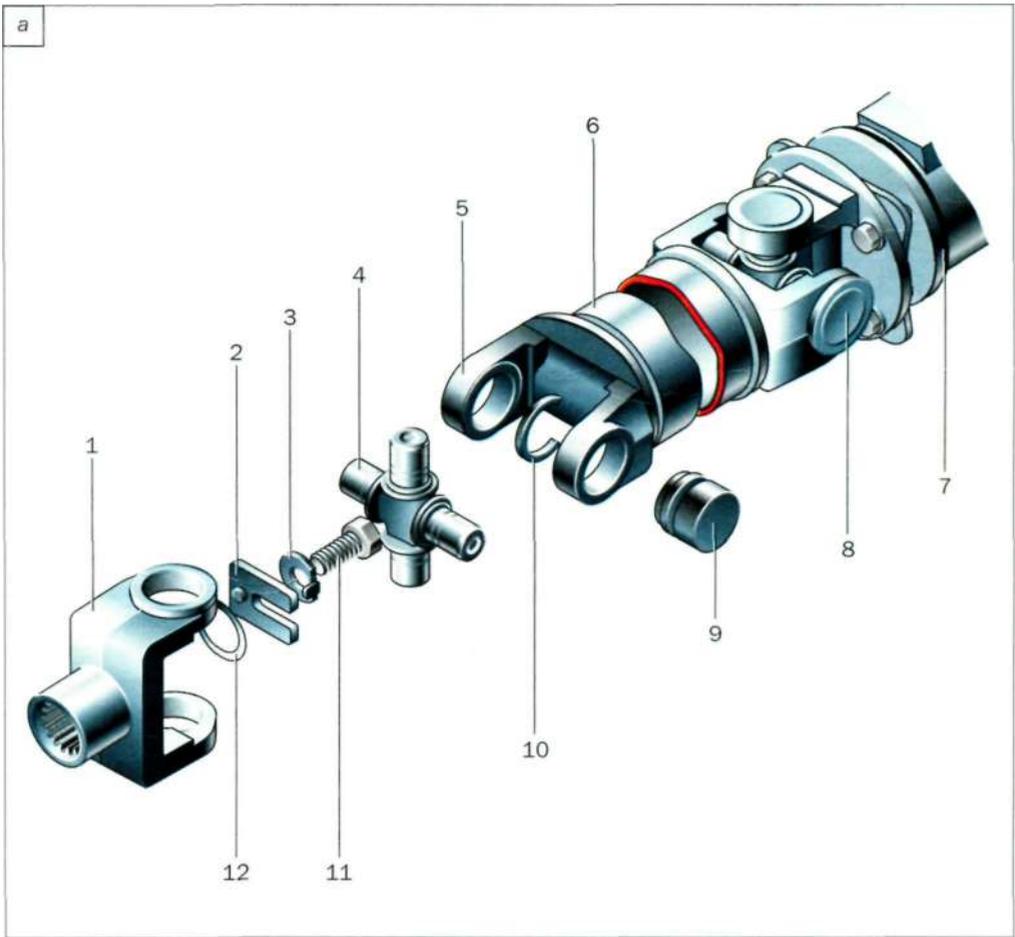
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. 3.19.

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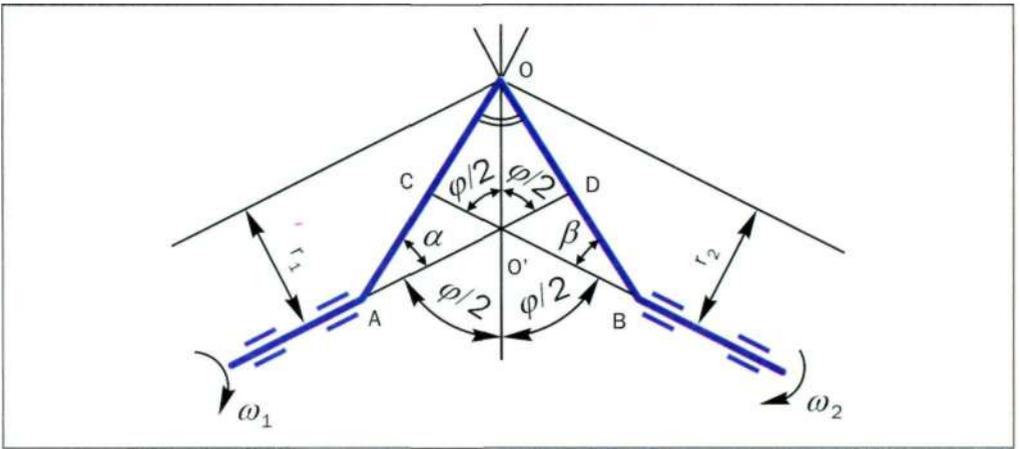
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(. 3.19)

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3.21. : 1 2 — 1 2 ; , —
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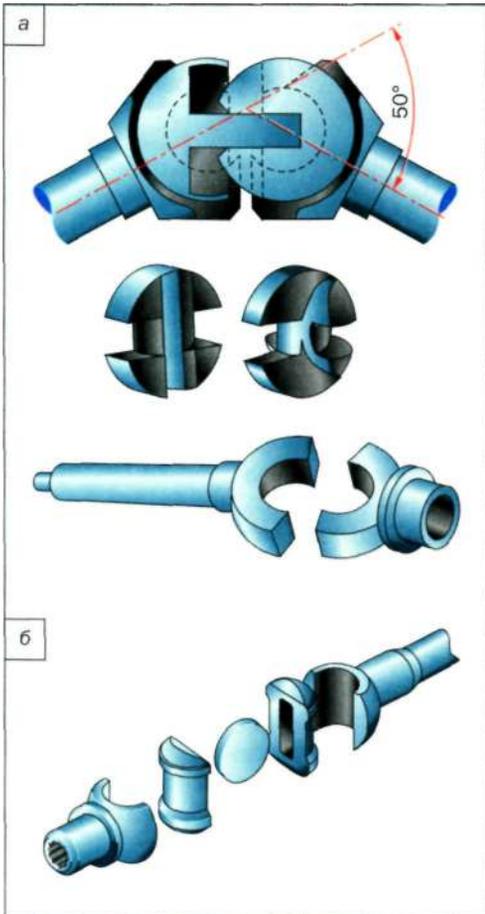
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(. 3.226)

45°.

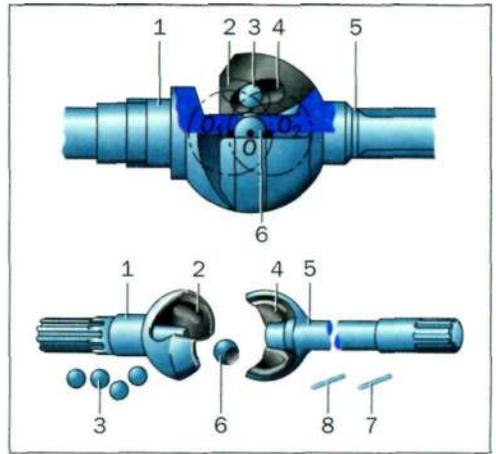
1923 .

(« ») (. 3.23).



. 3.22.

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. 3.23.

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. 3.24.

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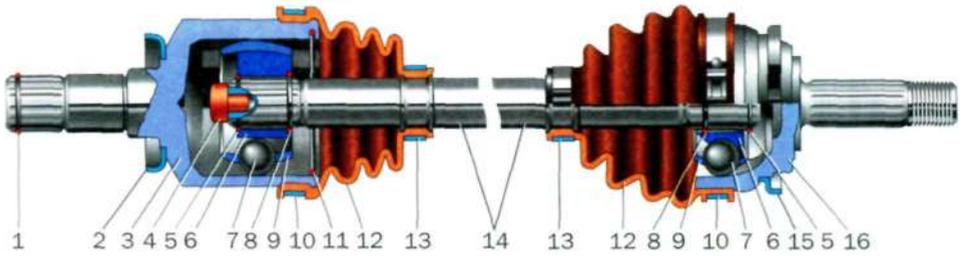
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. 3.25.

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45°.

40°.

(GKN) (. 3.25).

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90°

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(0,9-0,92),

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1913 „

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. 3.26.

(. 3.28)
1925



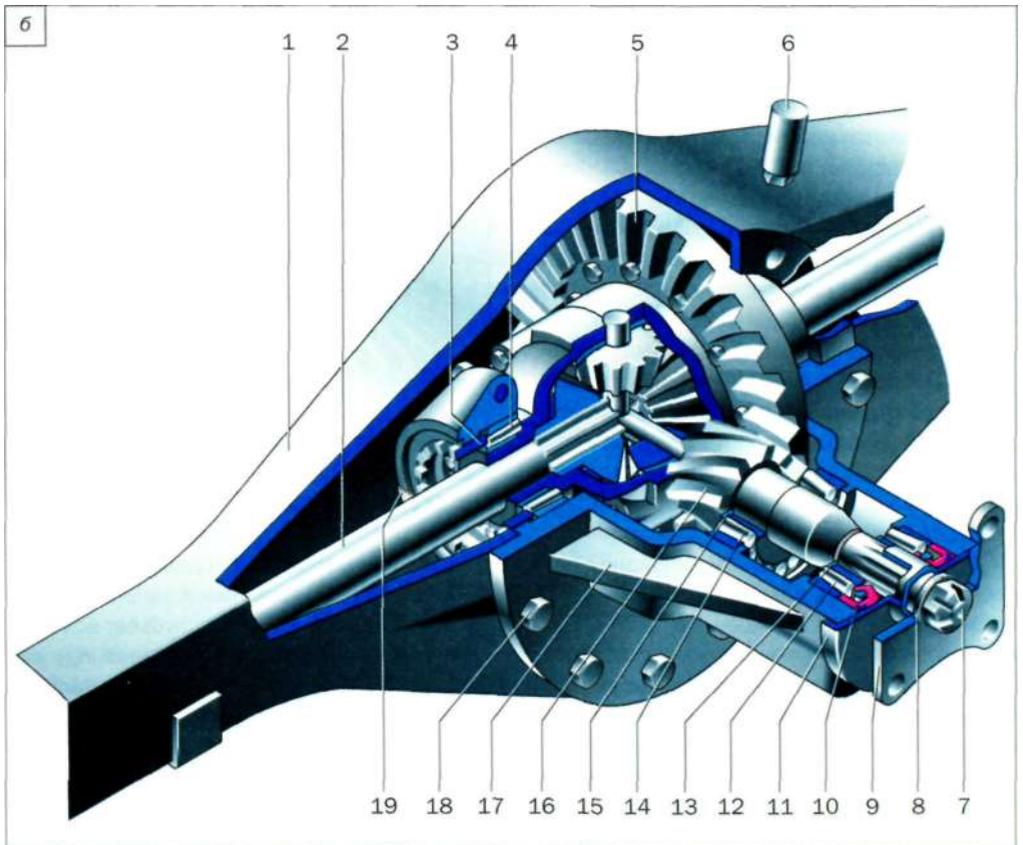
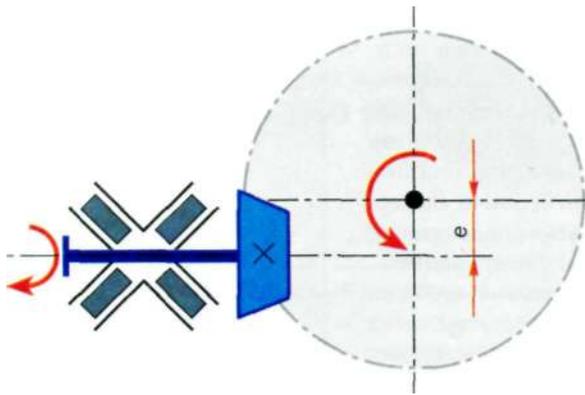
. 3.27.

0,96.

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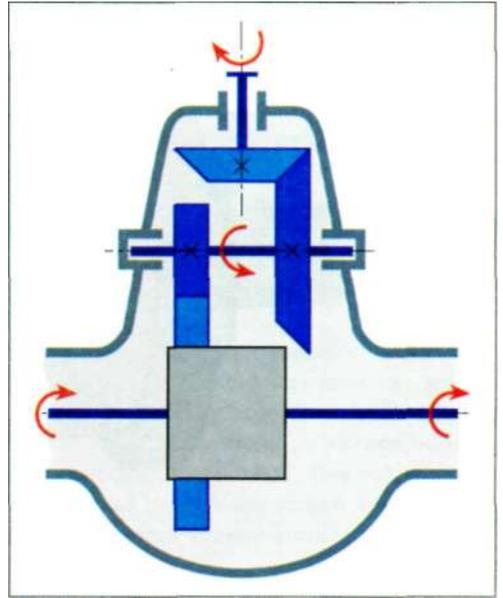
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(. 3.30)



.3.28. : — ; — : 1 —
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 ; 17 — ; 18 — ; 19 —

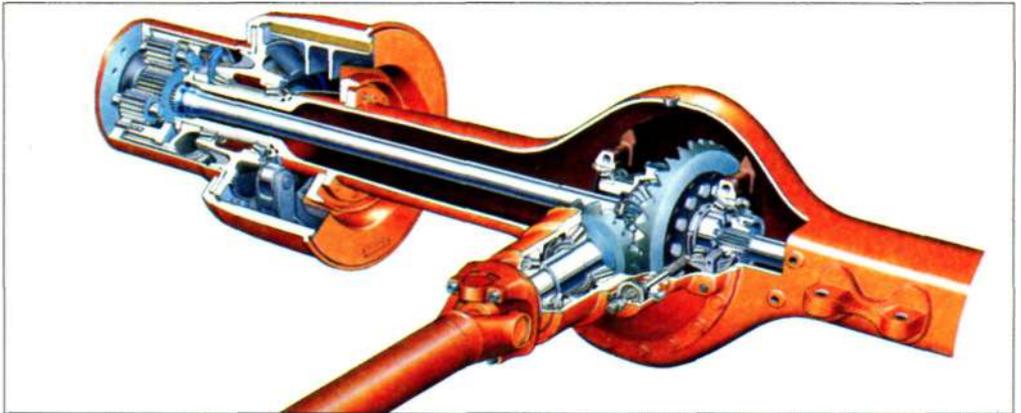


. 3.29.



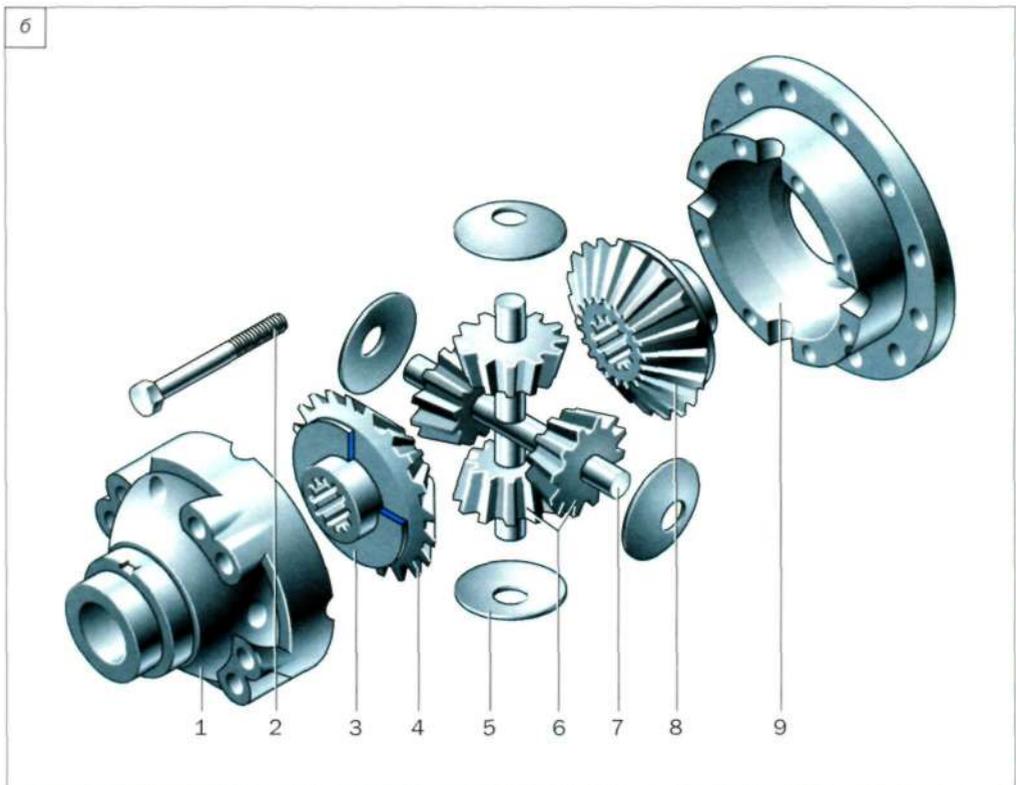
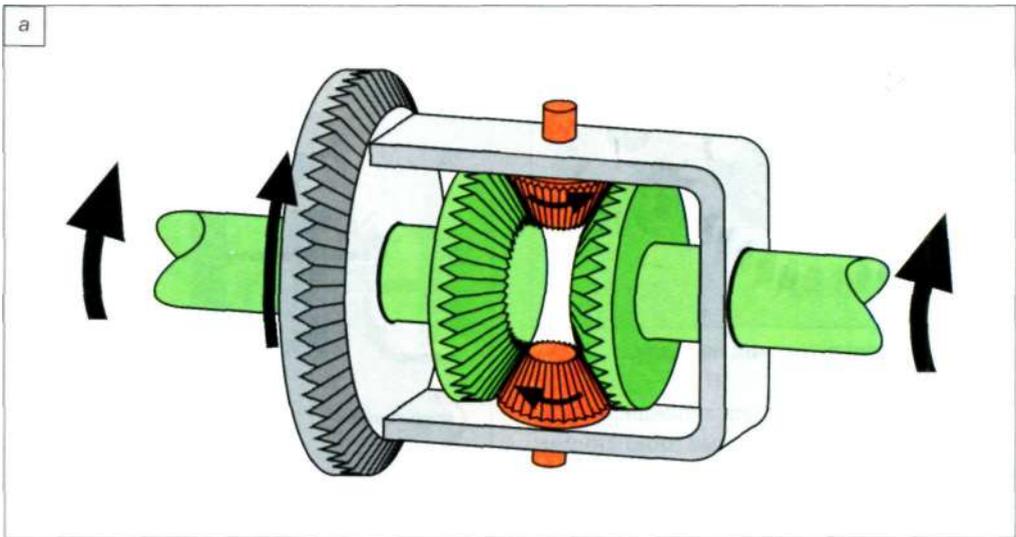
. 3.30.

(. 3.31)



. 3.31.

).



. 3.32. () () :
 1 — ; 2 — ; 3 — -
 ; 4, 8 — ; 5 — ; 6 — -
 ; 7 — ; 9 —

(. 3.32),

()

(. §22

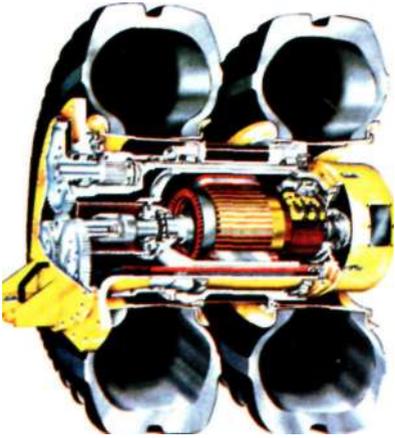
«

»).

§21

() ,

: « »



. 3.33.

(. 3.33).

(. . 8).

() , ()
() ()

()

- 1.
- 2.
- 3.

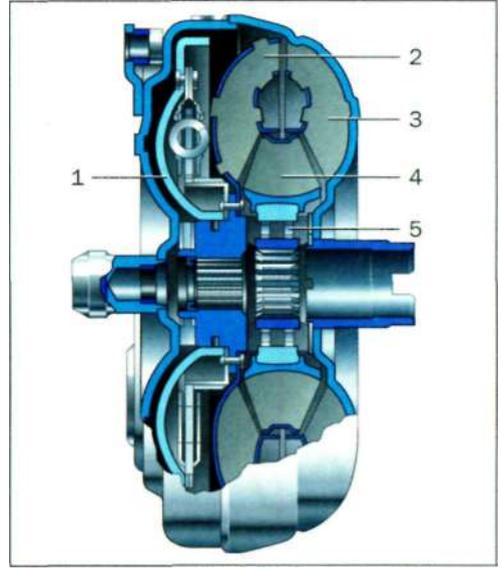
—
—
—

1930- Wilson, Oldsmobile. : 1940 . Hydramatic
90 %
Mercedes-Benz, Opel, BMW.
(.) , Ford — () , GM — Borg-Warner
Aisin-Warner. — Jatco

(. 3.34; 3.35)

1905 .

(. 3.36).



. 3.34.

1 — ; 2 —
; 3 — ; 4 —
; 5 —



. 3.35.

()



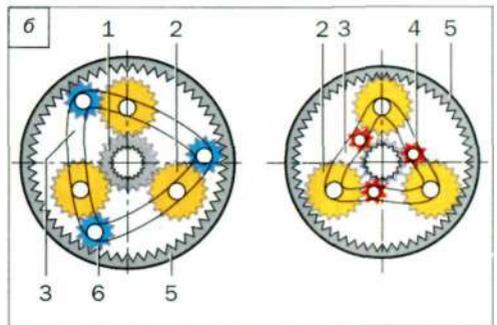
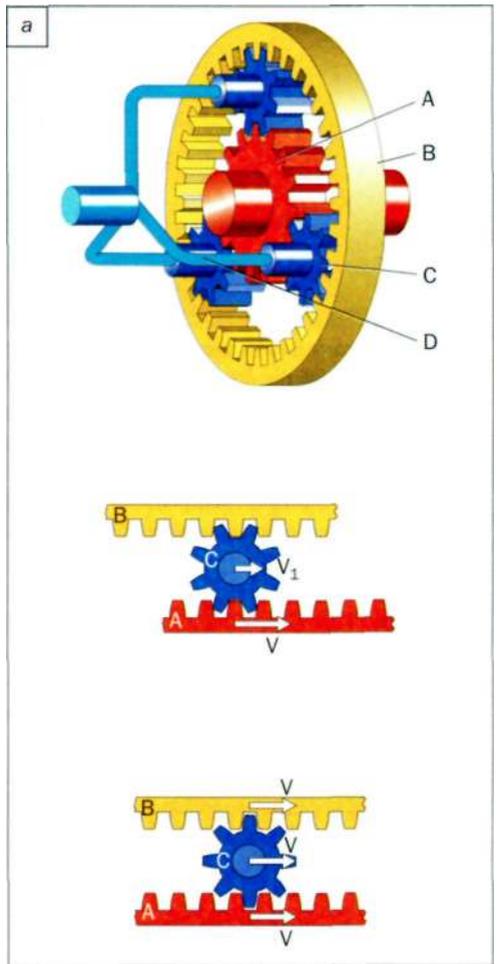
. 3.36. ; 1 — ; 2 — ;
 3 — ; 4 — ; 5 — ;
 ; 6 — ; 7 —
 ; 8 — ; 9 —
 ; 10 —

2,4 ().

0,7 0,8.

0,85 0,97,

— 0,97.



. 3.37.

(): — ; — ;
 — ; D — ; V — ;
 ;
 1 — ; 2, 4, 6 — ():
 ; 3 — ; 5 —



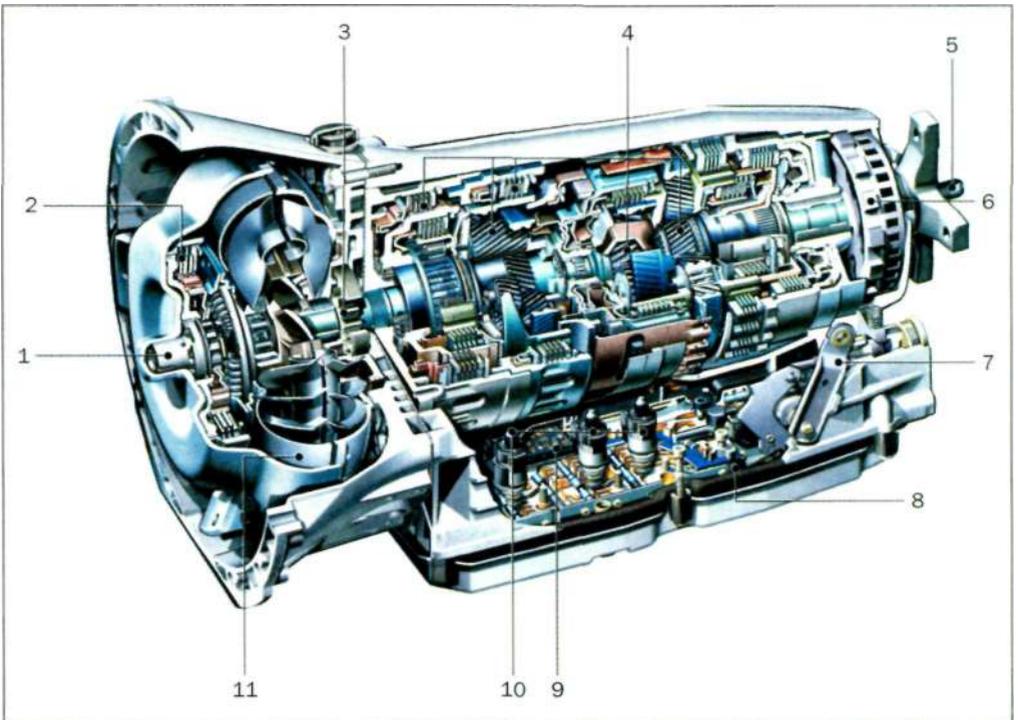
. 3.40.

7G-Tronic —

(Mercedes-Benz)

BMW, Audi, Jaguar

Zanradfabrik (ZF),



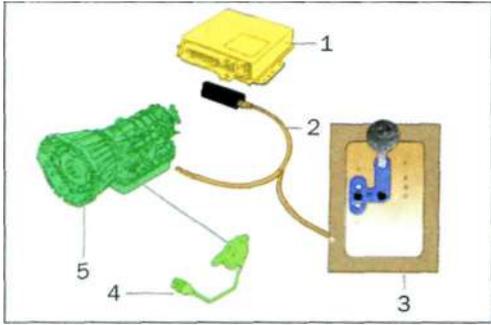
. 3.41.

7G-Tronic: 1 — ; 2 —

; 3 — ; 4 — ; 5 — ; 6 —

; 7 — ; 8 — ; 9 — ; 10 —

; 11 —



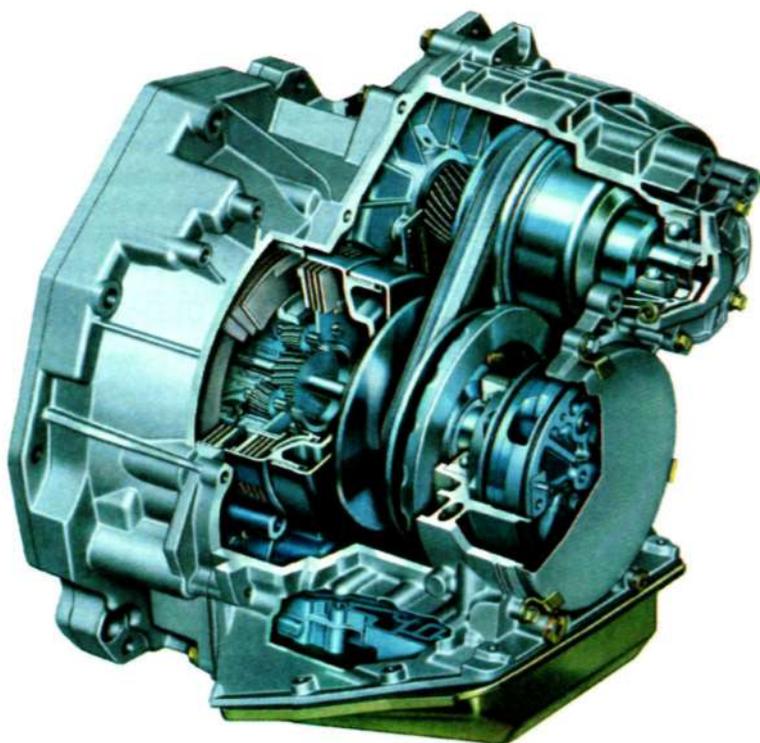
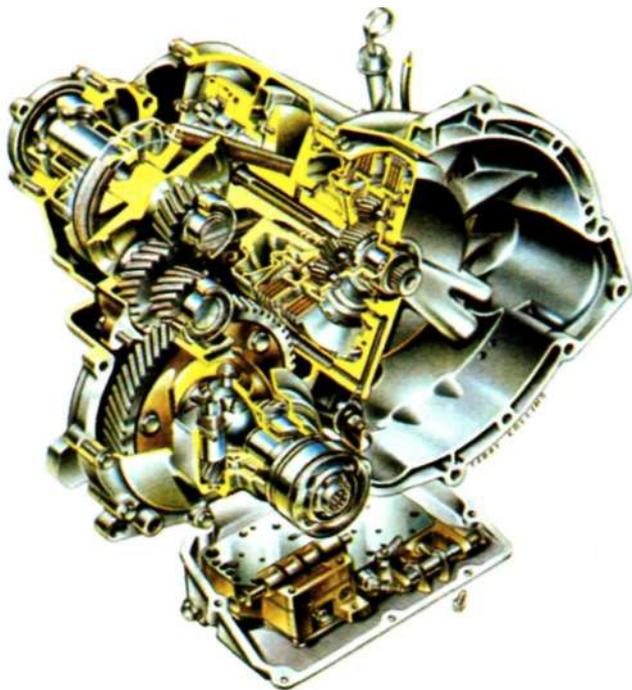
2003
 Mercedes-Benz , S, SL CL
 7G-Tronik (. 3.40).

5 %

. 3.42.
 : 1 —
 ; 2 — ; 3 —
 ; 4 —
 5 —

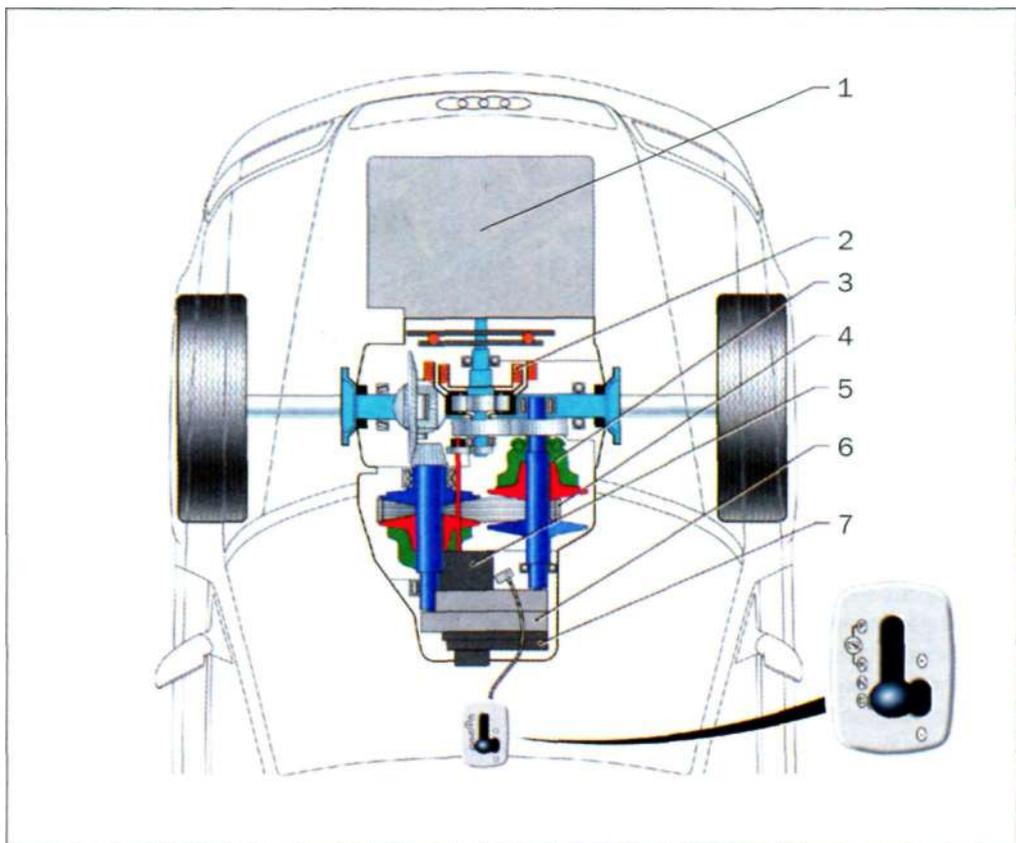
—
 R —
 N —
 D —
 D
 « »,
 —
 —
 —
 —
 —

CVT (Continuously Variable Transmission) —

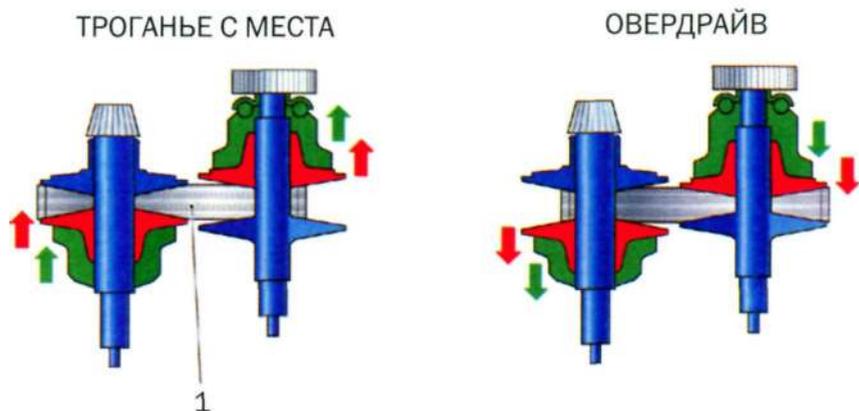


. 3.44.

Hyper CVT-M6



. 3.45. **Multitronic:** 1 — ; 2 — ; 3 —
; 4 — ; 5 — ; 6 — ; 7 —



. 3.46. **Multitronic:** 1 —

(. 3.47)

() -

() , (

(

1877 .
Perbury-Hayes
1930- ..



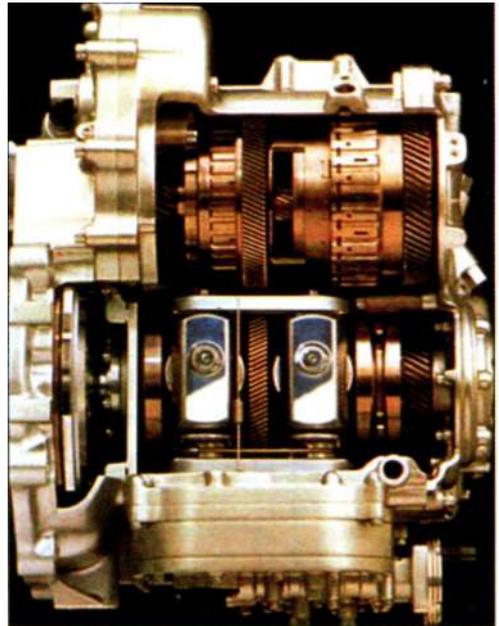
. 3.47.

1999 . Nissan

Extroid.

300 « ,

10 .



. 3.48.

Mazda -

Nissan

Extroid

1999

Mazda

(. 3.48).

— SMG (Sequential M Gearbox) —

BMW

(. 3.49).

BMW M3,

Tiptronic.

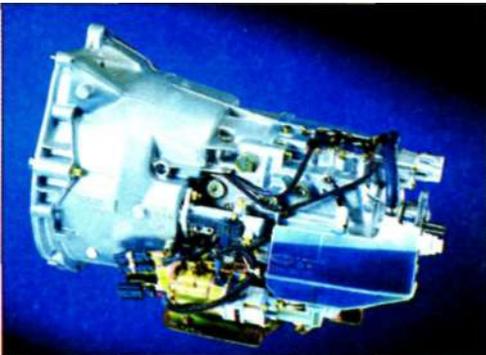
BMW

0,08

15 /

Easytronic (. 3.50),

Valeo Luk

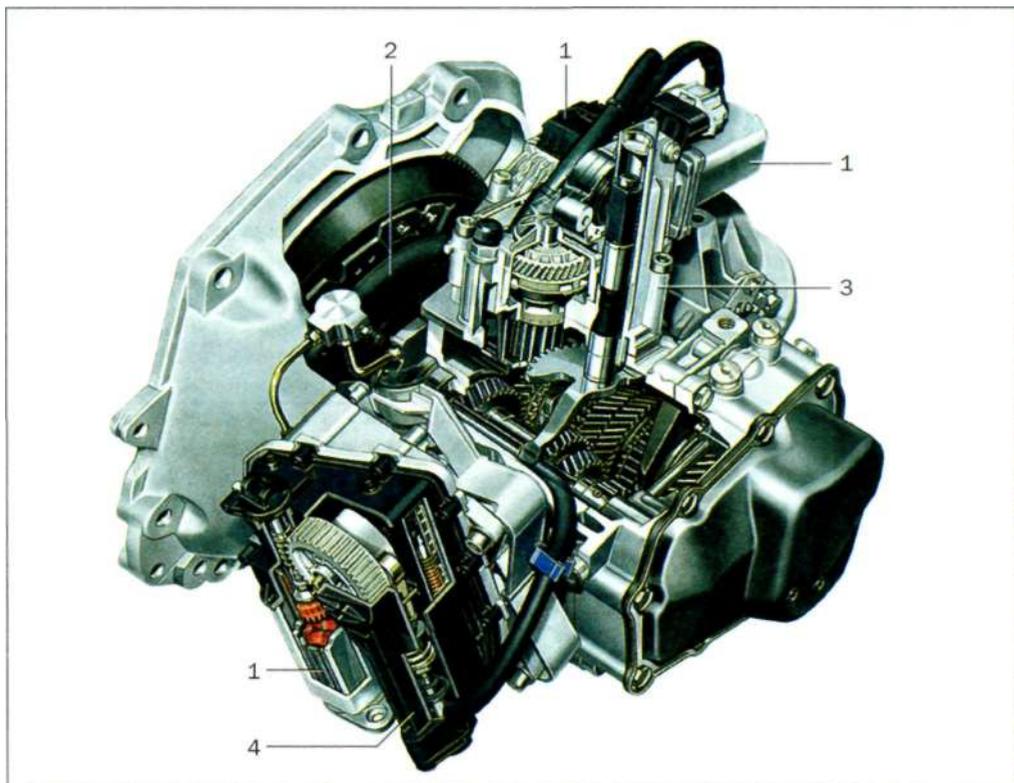


. 3.49.

SMG

(Sequential M Gearbox)

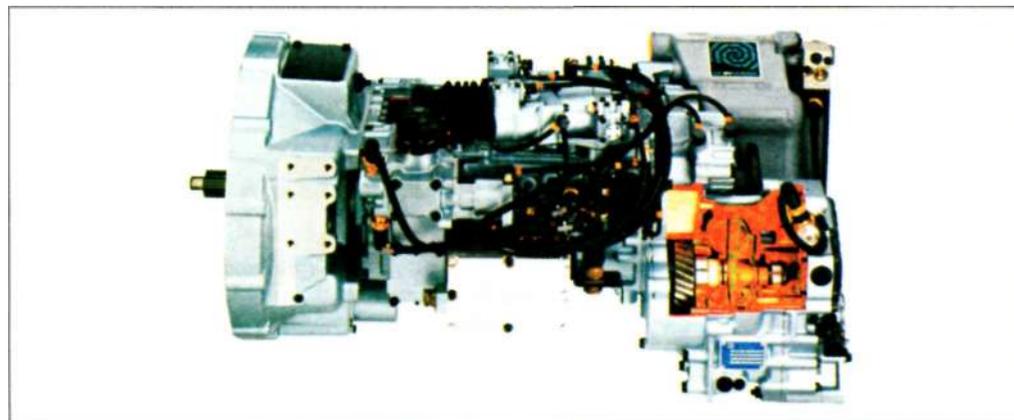
(. 3.51).



. 3.50.

Easytronic

: 1 — ; 2 —
; 3 — ; 4 —



. 3.51.

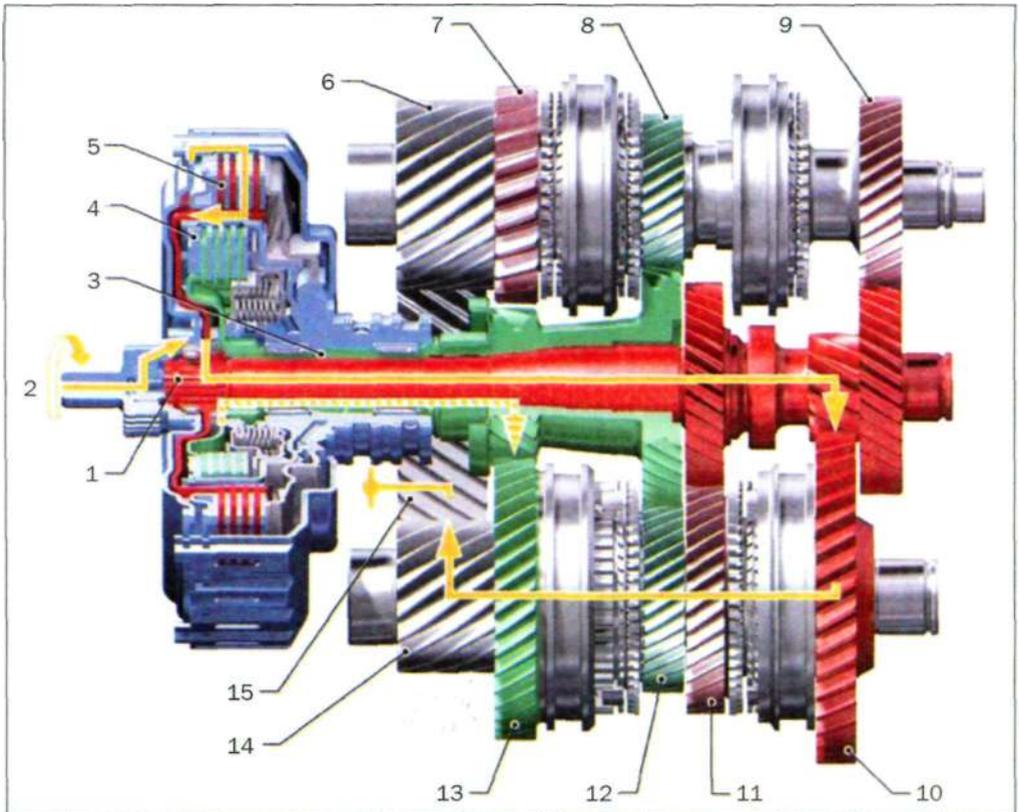
Eurotronic

(. 3.52).

(. 3.53).

(1, 3, 5),

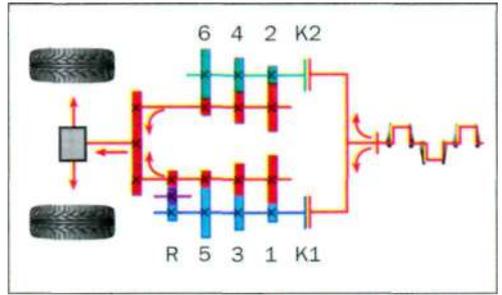
(2, 4, 6 . .).



. 3.52.

Audi TT 3.2 Quattro:

- 1 — I; 2 — ; 3 — II; 4 — II; 5 — I;
- 6 — (); 7 — ; 8 — VI; 9 — V; 10 — I -
- (); 11 — III; 12 — IV; 13 — II (); 14 — -
- ; 15 —



. 3.53.

: 1, 2 —
; 3, 4, 5, 6 —

Audi.

Ferrari

-1.

Audi Quattro

1978 .

§22

-2121 « », -

SUV (Sport Utility Vehicle —

) RV (Recreational Vehicle —

AWD (All Wheel Drive —)

4WD (4 Wheel Drive —

4x4.

3.54.

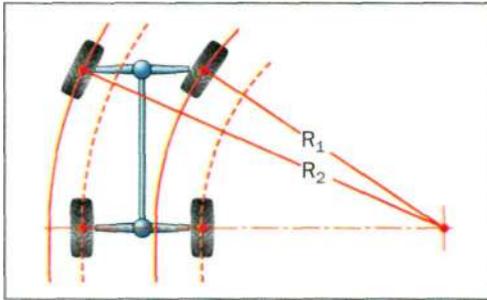
Willis,

Land Rover

-69. -

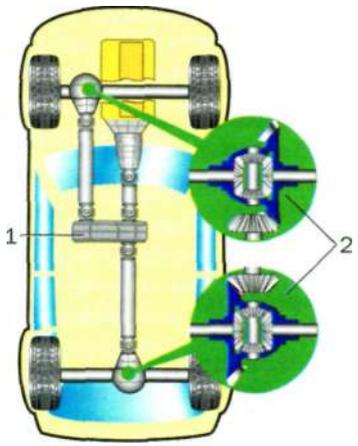
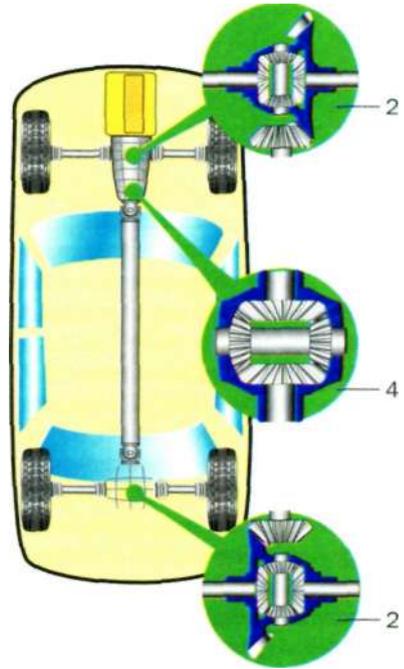
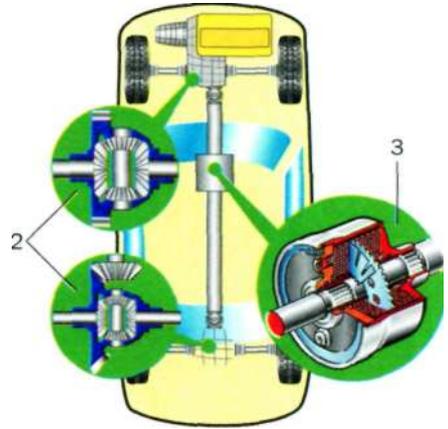
(. 3.55).

().



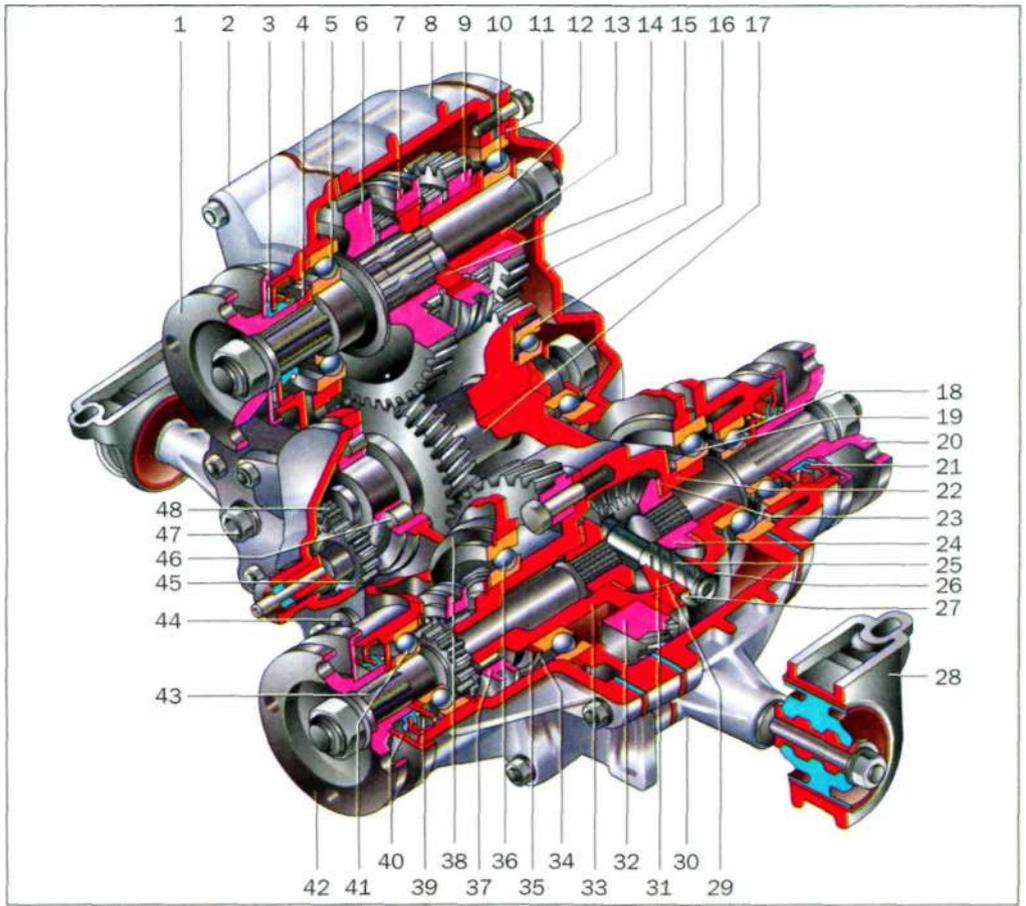
. 3.55.

: R_1 R_2 —



. 3.56.

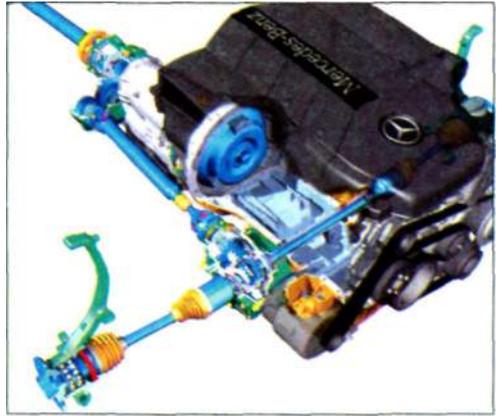
2 — ; — ; 3 — ; 4 — ; 1 — ;



. 3.57.

-21213 « »: 1 —

- 5 — ; 2 — ; 3 — ; 4 — ;
- 6 — ; 7 — ;
- 8 — ; 9 — ; 10 — ;
- 11 — ;
- 12 — ; 13 — ; 14 — ; 15 — ; 16 — ;
- 17 — ; 18 — ;
- 19 — ; 20 — ; 21 — ;
- 22 — ; 23 — ;
- 24 — ; 25 — ; 26 — ;
- 27 — ; 28 — ; 29 — ; 30 — ;
- 31 — ; 32 — ;
- 33 — ; 34 — ; 35 — ;
- 36 — ; 37 — ;
- 38 — ; 39 — ;
- 40 — ; 41 — ;
- 42 — ; 43 — ;
- 44 — ; 45 — ; 46 — ;
- 47 — ; 48 — ;



. 3.58.

Mercedes-Benz 4-matic S-

. 3.56

(. 3.57).

(. 3.58).

Subaru

Jaguar

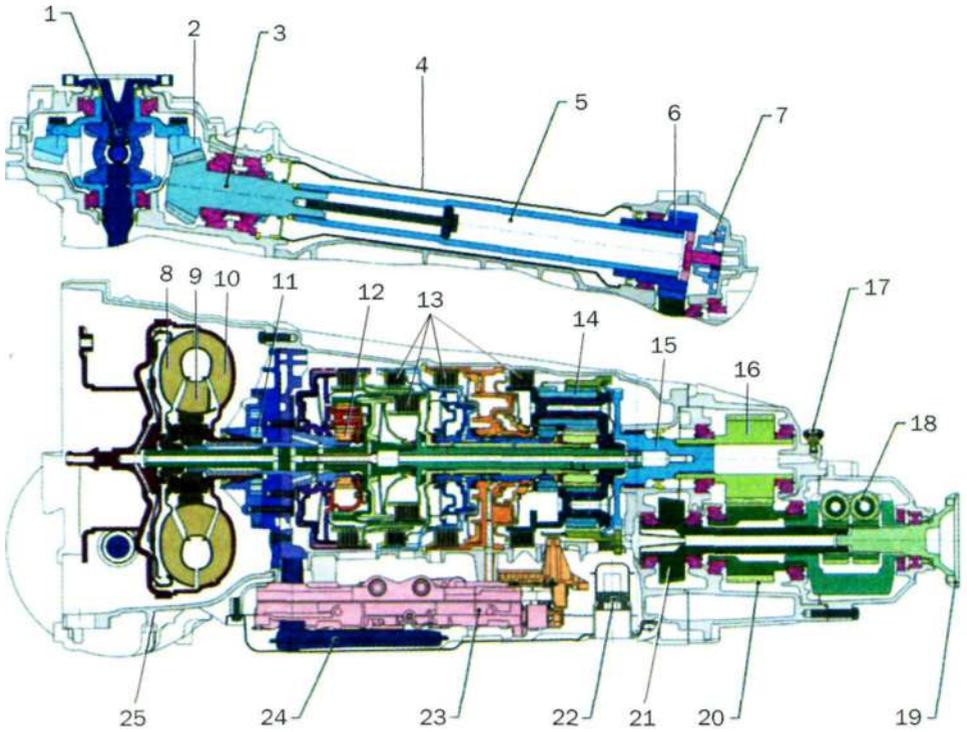
X.

(

Audi).

(. 3.59).

Carrera)



. 3.59.

Audi Quattro: I —

- 2 — ; 3 —
- 4 — ; 5 — ; 6 —
- 7 — ; 8 —
- 9 — ; 10 — ; 11 — ; 12,14 —
- 13 — (; 15 — ; 16 —
- 17 — ; 18 —
- (Torsen); 19 — ; 20 —
- 21 — ; 22 —
- 23 — ; 24 — ; 25 —

Torsen.

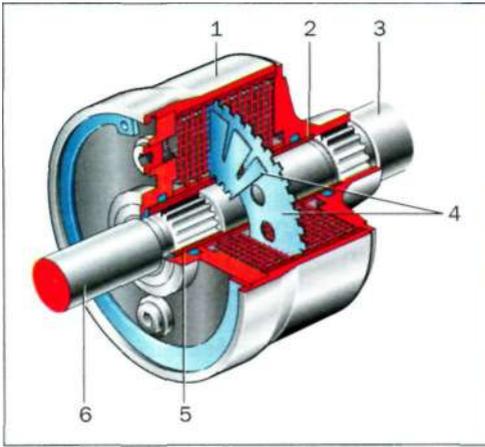
, a Torsen

:

(-66,)

« »

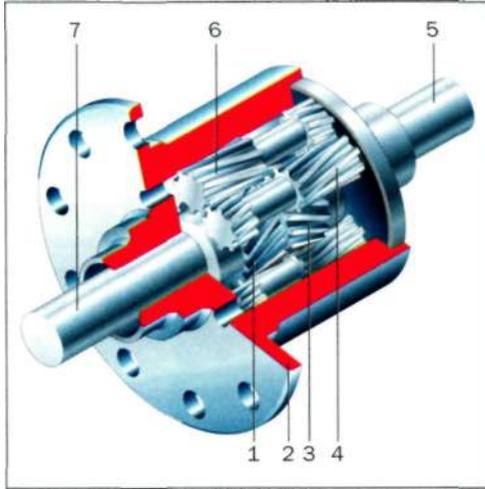
()



. 3.61.

() : 1 — ; 2 —
 ; 3, 6 — ; 4 —
 ; 5 —

()

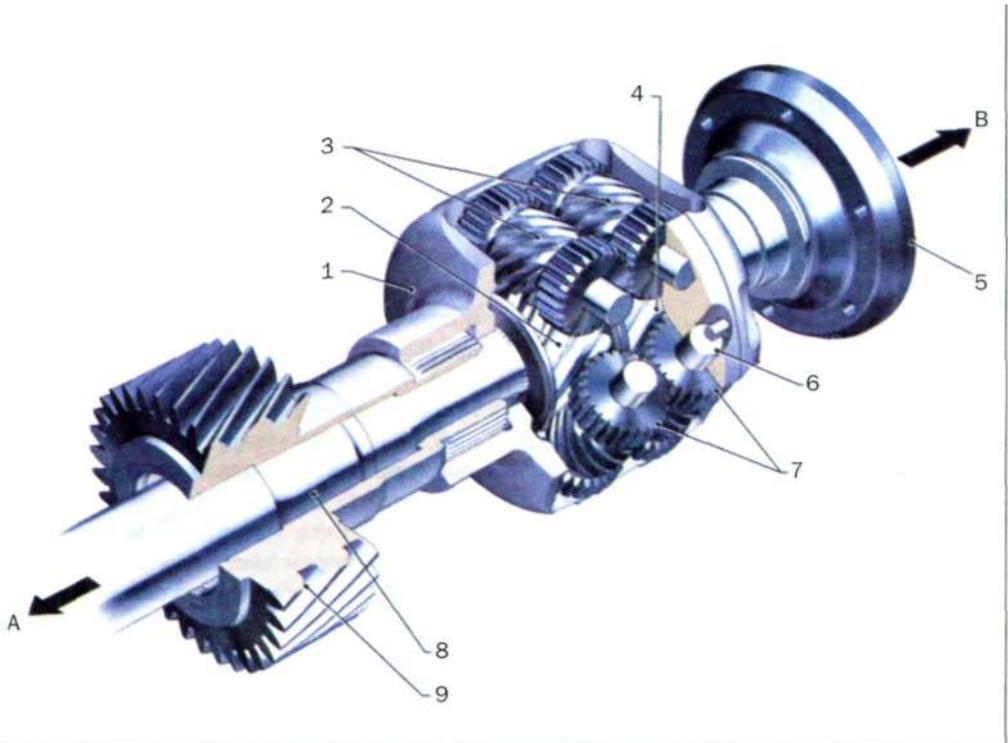


. 3.62.

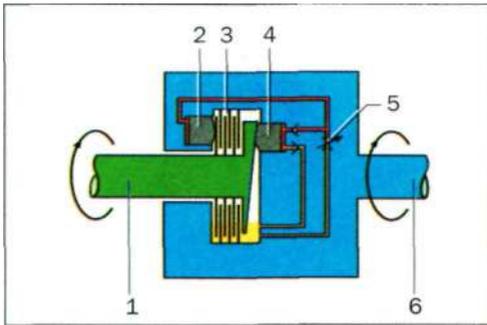
Torsen: 1, 3 —
 ; 2 — ; 4 —
 ; 5, 7 —
 6 —

(. 3.61).

()



. 3.63.	Torsen	Audi Quattro: I
; 2,4 —	; 3 —	; 5 —
; 6 —	; 7 —	; 8 —
9 —	; —	; —
Torsen (TORque SENsing —)		
(. 3.62).		
()		
2,5:1 (60 % : 40 %)	6:1 (84 % : 16 %)	7:1 (86 % : 14 %),
Torsen		
(. 3.63).		



Torsen

(. 3.64).

. 3.64.

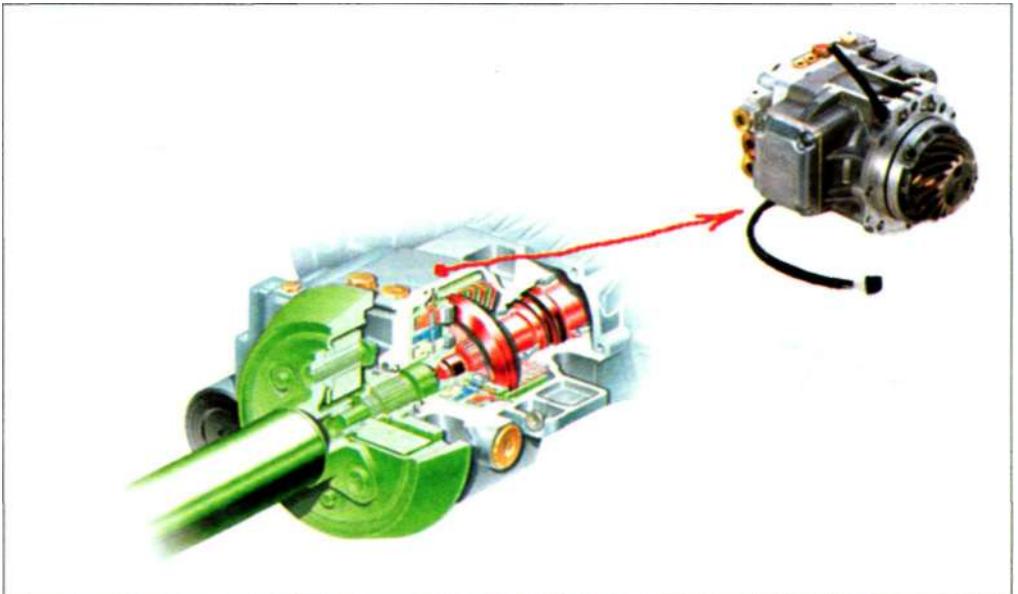
2— ; 1— ;
 ; 3— ; 4— ;
 ; 5— ; 6—

Haldex

(. 3.65).

Haldex

()



. 3.65.

Haldex,

Haldex
Volkswagen Volvo.

Isuzu
12

TOD (TORQUE-ON-

DEMAND),

§23

1990-

« ».

(),

(

),

) (

(

« »

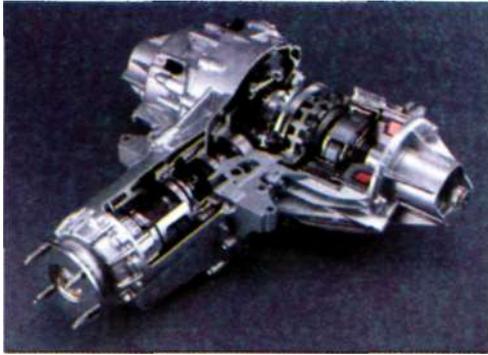
).

« »

« »

(

),



3.66.
Honda

1996 .
Honda
(Automatic Torque Transfer System —

ATTS
ATTS

ATTS

(« »).

Mitsubishi Subaru

Prodrive ()
Active Torque Dinamic (ATD) —

2000 .

ATD

ATD

Prodrive

ATD

Honda

(3.66),

4

§24

§25

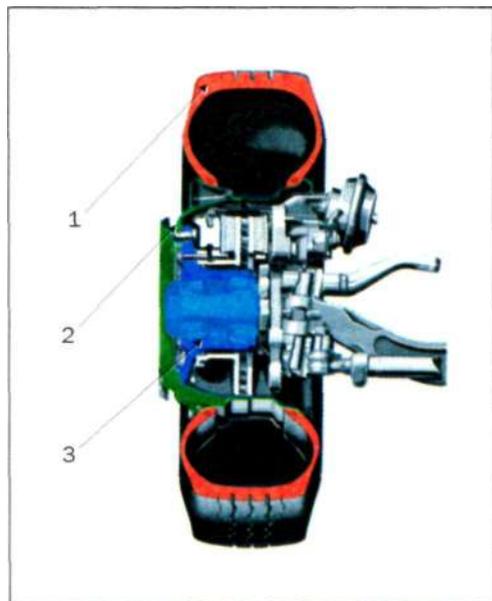
() (. 4.1).

(. § 26).

(. 4.2).

(5 ± 1)°.

()



. 4.1.

: 1 — ; 2 — ; 3 —



. 4.2.

Michelin,

: 5J X 13 2 30, :

5 —

13 —

J 2 —

30 — ()
()

Einpresstiefe —) 30

«

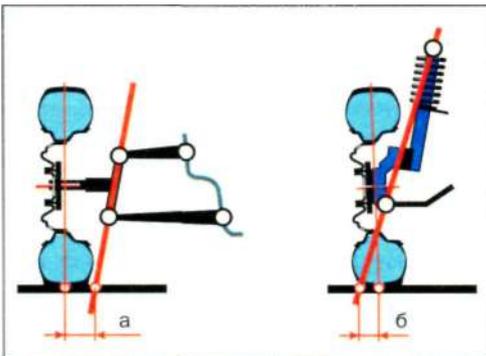
(. 4.3),

()

()

70- Citroen

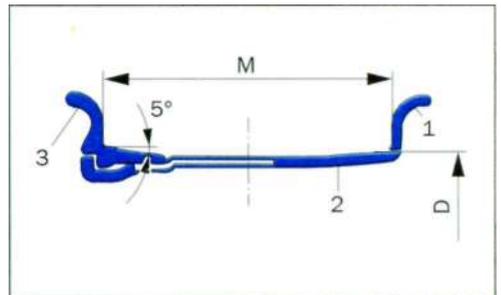
(. 4.4)



. 4.3.

()

()



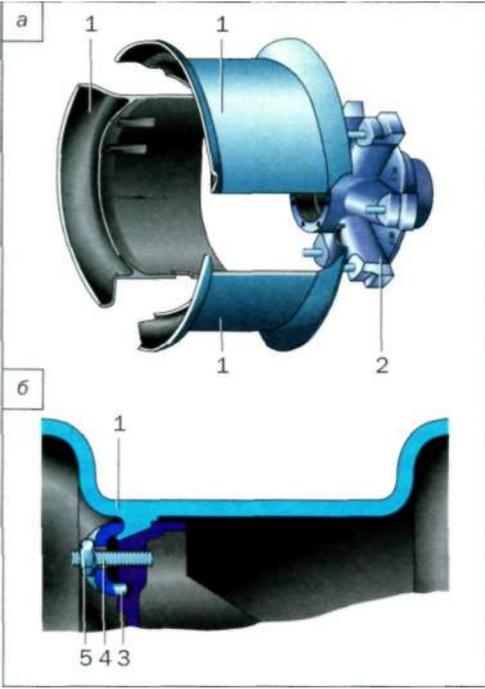
. 4.4.

: 1 —

; 2 —

3 —

; D —



(. 4.5)

. 4.5.
 () ; 2 — ; 3 — ; 4 — ; 5 — ; 1 —

§26

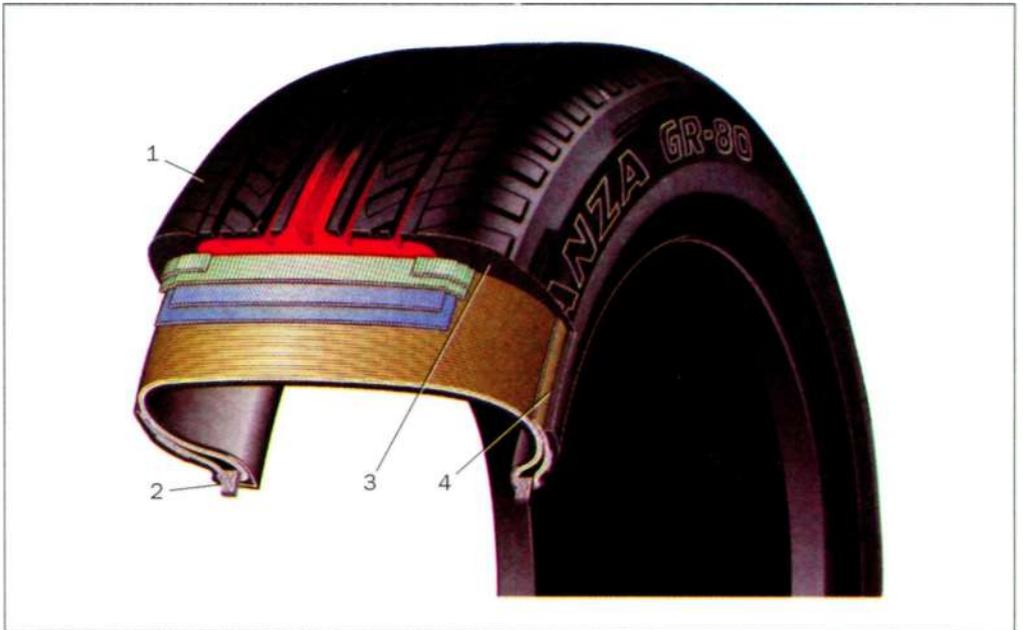
(. 4.6).

(,),

1931-1932 .

).

().

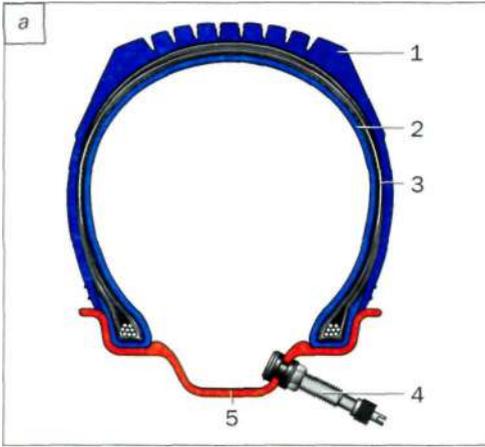


.4.6.

: 1—

); 2—
; 4—

; 3—

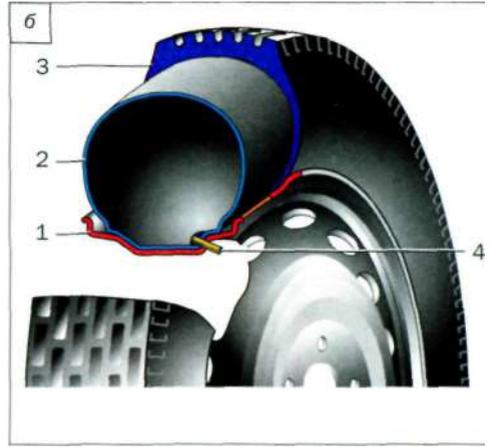


. 4.8.

()

()
4 —

: 1 —

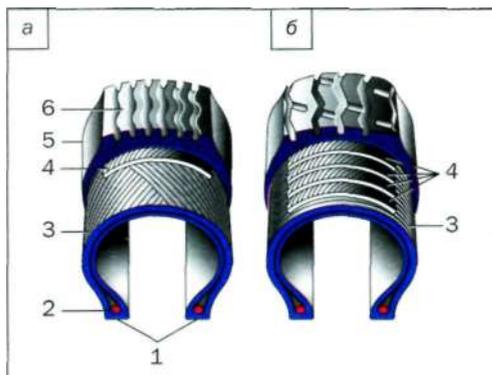


: 1 — ; 2 —
; 3 — ; 4 — ; 5 —
; 2 — ; 3 — () ;

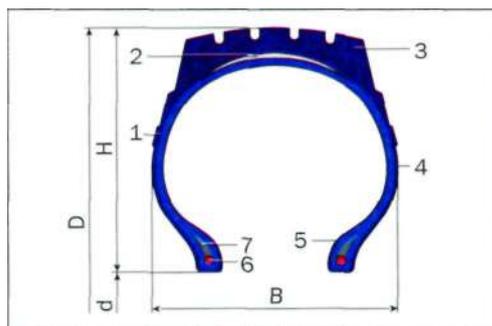
(. 4.9).

1947

Michelin



4.9. ()
 () : 1 — ; 2 —
 ; 3 — ; 4 — ;
 5 — ; 6 —



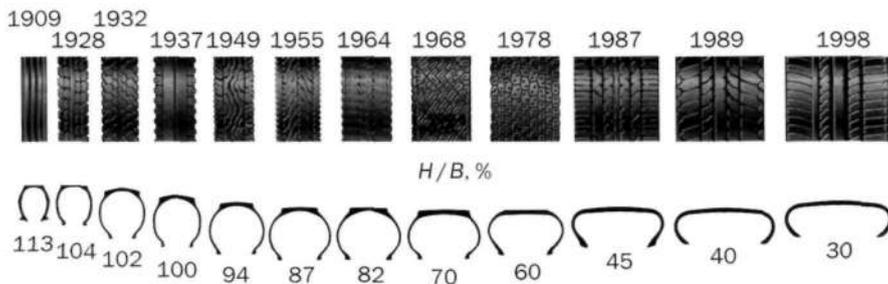
4.10.
 : D —
 ; — ;
 — ; d —
 () ; 1 —
 ; 2 — ; 3 — ; 4 —
 ; 5 — ; 6 — ;
 7 —

(. 4.10).

90 %.

(. 4.11).

70 % 60 %



4.11.

30 %

60, 65, 70 %.

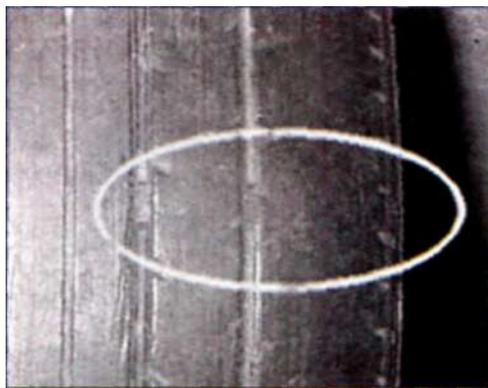
25-40 %.

(, ,)

(0,01-0,05).

1,6

(. 4.12) —



. 4.12.

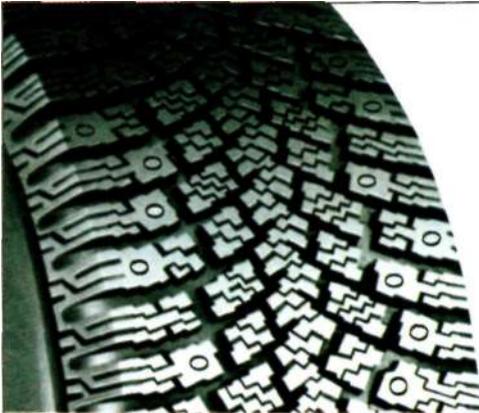
1,6

. 4.13.

Nokian

(. 4.13).

(. 4.14)



(HIGHWAY)

(SNOW MUD+SNOW-M+S)

. 4.14.

(ALL SEASON)

(PERFORMANCE)

(ALL SEASON PERFORMANCE)

(. 4.15).

185/70 R14 83 S

).

185 —

70).

80-82%.

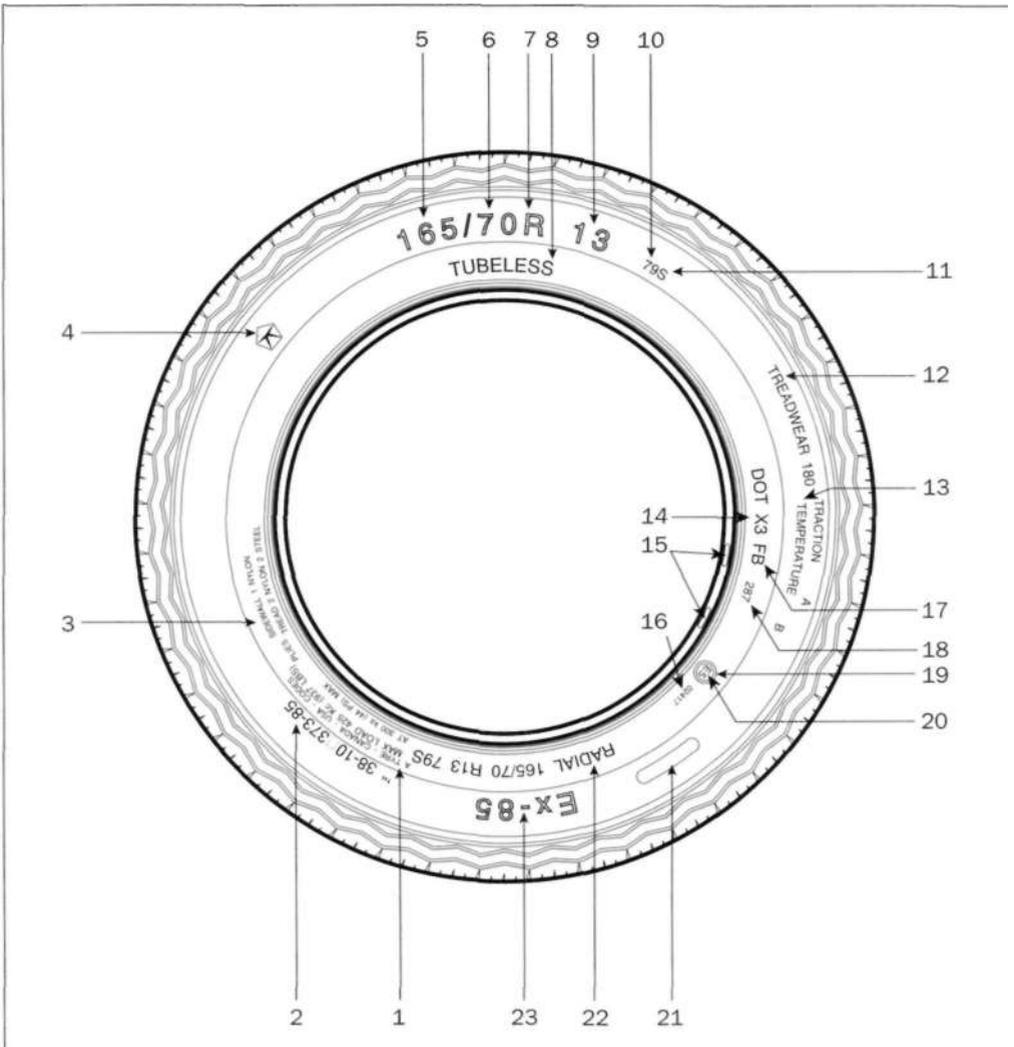
R

R —

(14),

25,4

14x25,4=355,6



4.15.

() ; 2 — ; 3 — : 1 — -
 ; 4 — ; 6 — «70» (/) ; 7 — -
 (1992) ; 5 — ; 8 — ; 9 — (13"); 10 — -
 ; 11 — («S» — 180 /) ; 12 — -
 () ; 13 — -
) ; 14 — (-
) ; 15 — (15); 16 — -
 30 (1247); 17 — -
 () ; 18 — (28 1987) ; -
 19 — -
 30 () ; 20 — -
 (5 —) ; 21 — ; 22 — ; 23 — -

83

483

MAX LOAD ()

4.1

4.1

J	L	N	Q	R	S	V	VR	W	Y	ZR						
100	110	120	130	140	150	160	170	180	190	200	210	240	>210	270	300	>240

180 /

(Passenger)

LT (Light Truck)

DOT

22,

(22 —)

; TREAD WEAR INDEX (TWI);

(TRACTION

INDEX);

(TEMPERATURE INDEX).

MAX PRESSURE.

«M+S» (Mud+Snow — +)

WINTER () —

AQUATRED AQUA CONTACT —

AS (All Seasons —)

AW (Any Weather —) —

tubeless

) —

. TWI (tread wear indicator —

(TWI),

TWI

ROTATION — ();
 LEFT — ;
 RIGHT — ;
 OUTSIDE Side Facing Out — ;
 INSIDE Side Facing Inwards — .

« »

(. 4.16),

(Goodyear, Michelin)

(Dunlop, Continental)

Michelin

«PAX» (. 4.17),

160

88 / ,

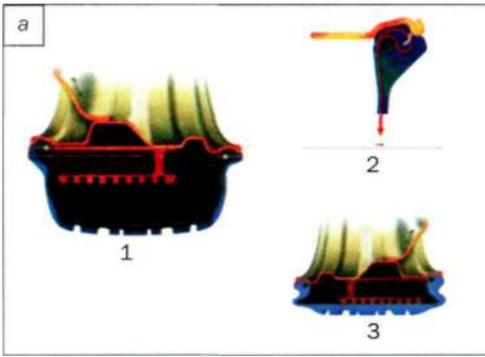


«PAX»

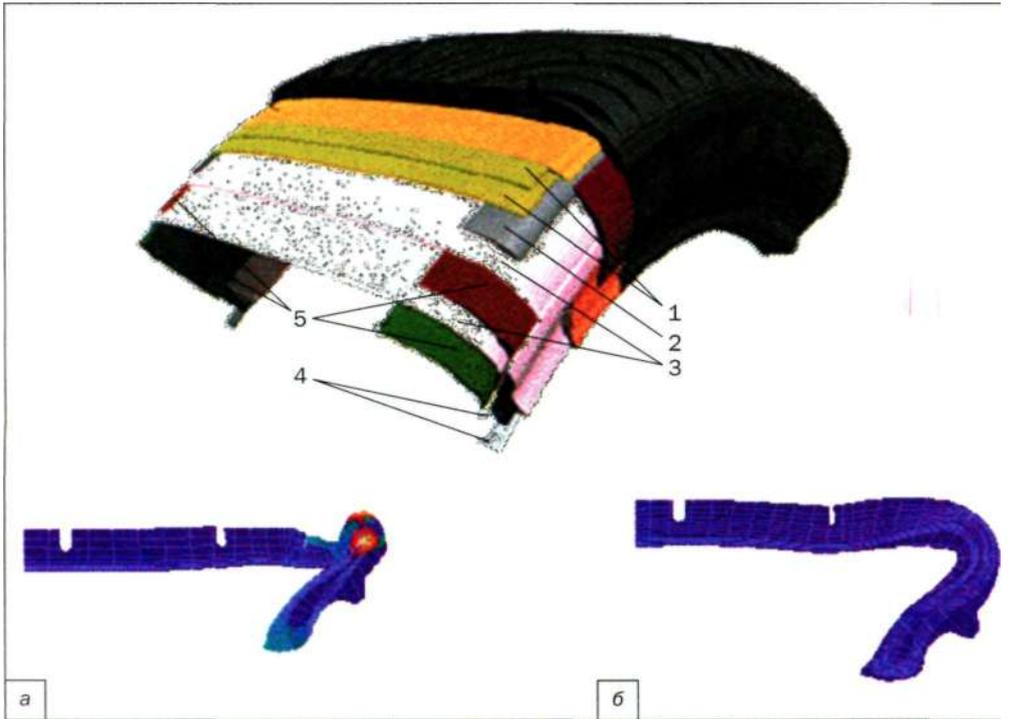
«PAX»,

. 4.16.

« »



.4.17. «PAX» Michelin a: 1 — ; 2 — ; 3 — ; : «PAX» Audi. «PAX» Goodyear (Extended Mobility Tire — .4.18).



.4.18. : 1 — ; 2 — ; 3 — ; 4 — ; 5 — ; — ; —



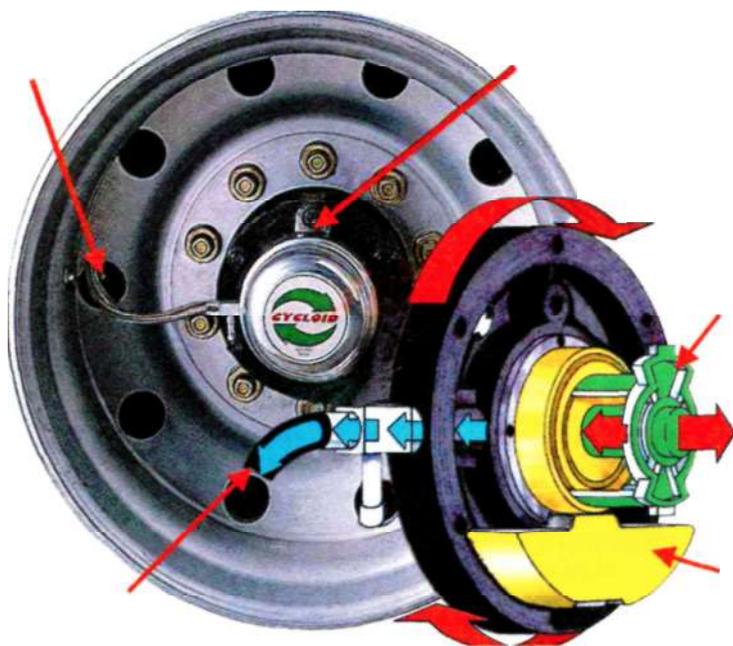
4.19.
Siemens

(4.19).

2006 .

(4.20),

Cycloid



4.20.

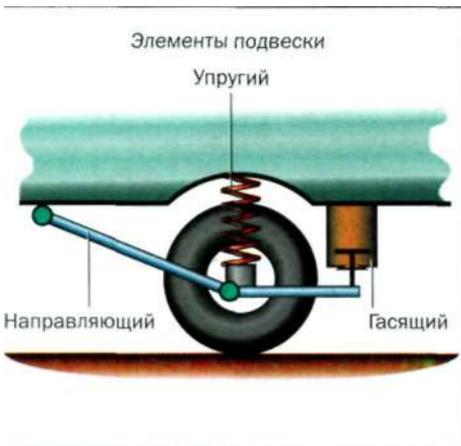
Cycloid

§27

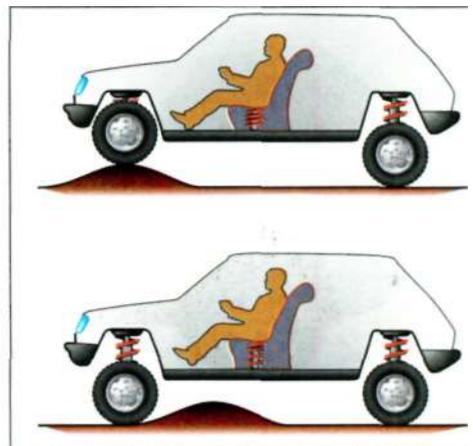
() .

(. 4.21).

(. 4.22)



. 4.21.



. 4.22.

(. 4.23).



. 4.23.

()

(. . 4.24).

).

(



. 4.24. () ()

6-10°.

1-3,5°

()

(. 4.25).

(),

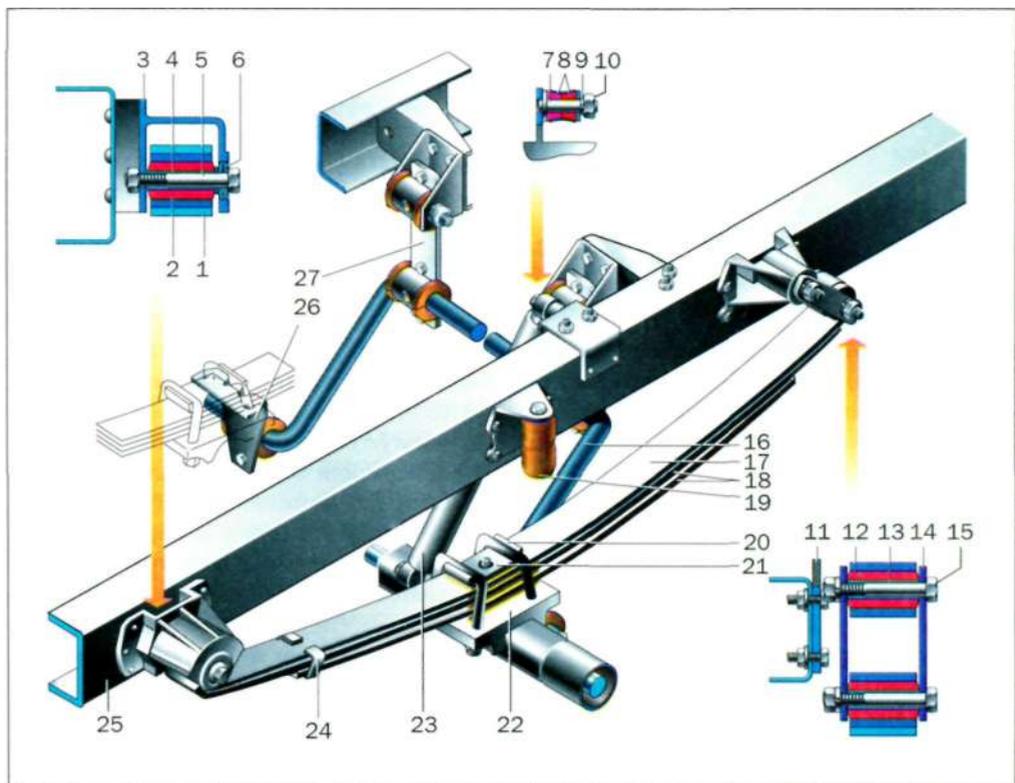


. 4.25.

Jaguar

()

(. 4.27).

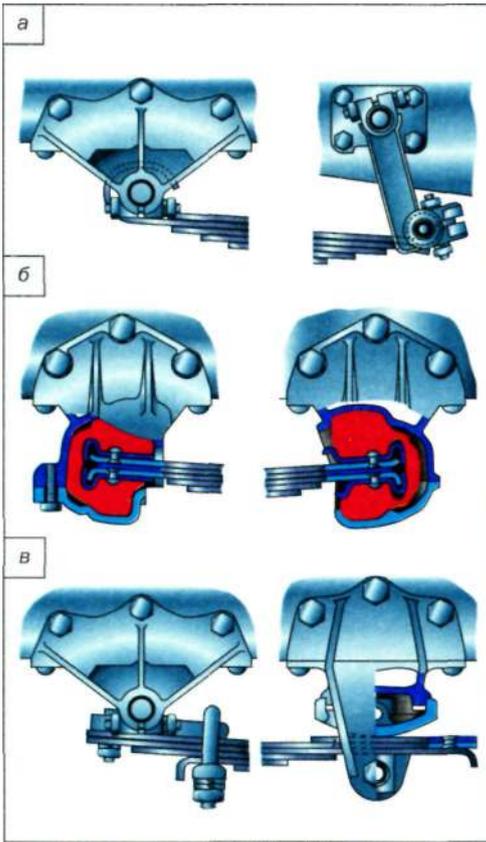


. 4.26.

: 1 —

; 2 —

- 3 — ; 4 — ; 5 — ; 6 — ; 7 — ; 8 — ; 9 — ;
- ; 10 — ; 11 — ; 12 — ; 13 — ; 14 — ;
- ; 15 — ; 16 — ; 17 — ; 18 — ;
- ; 19 — ; 20 — ; 21 — ; 22 — ;
- ; 23 — ; 24 — ; 25 — ; 26 — ;
- ; 27 — ;



Volvo 940

.4.27.

; — ; —

),

)

().

() (.4.296).

(),

(.4.28)

(.4.29)



4.28.

Peugeot 206

(Range Rover, Mercedes, Audi).

(4.30),

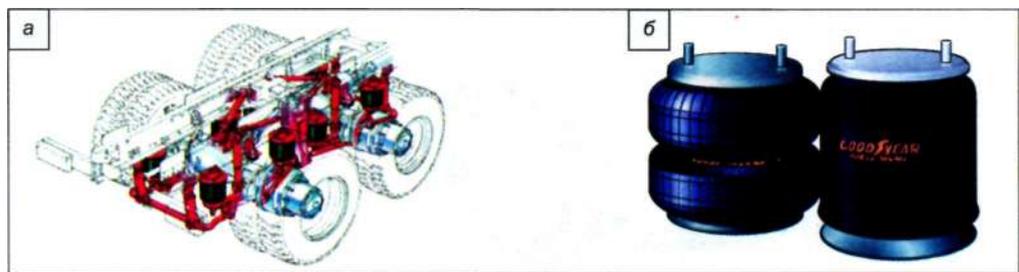


Рис. 4.29. Упругие элементы пневматических подвесок: а — рукавного типа; б — двойные баллоны

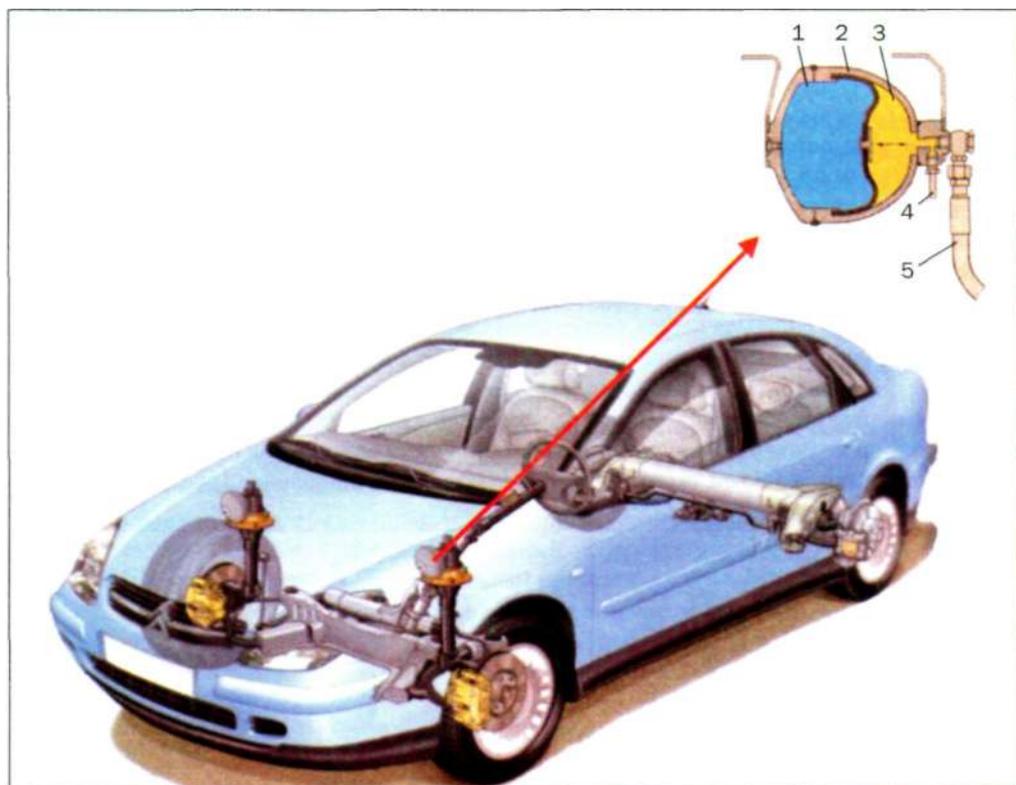


(. 4.31).

((),
().

. 4.30.

Mercedes



. 4.31.

: 1 —

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; 3 —

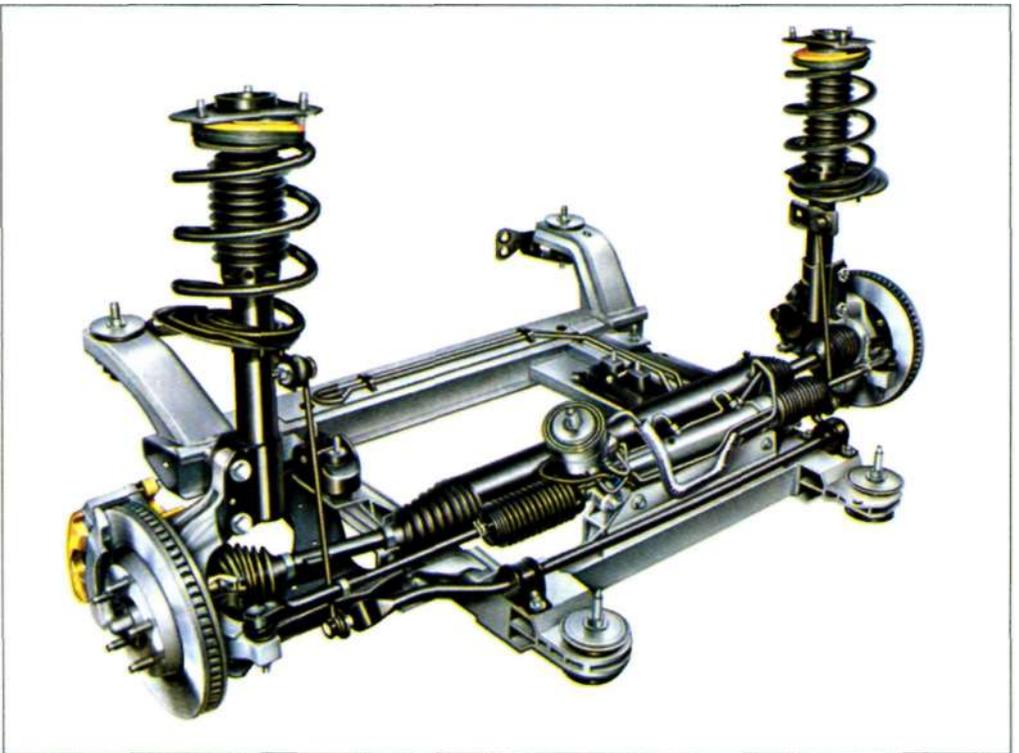
; 4 —

; 5 —

(Citroen, Mercedes, Rolls-Royce .)

().

(. 4.32).



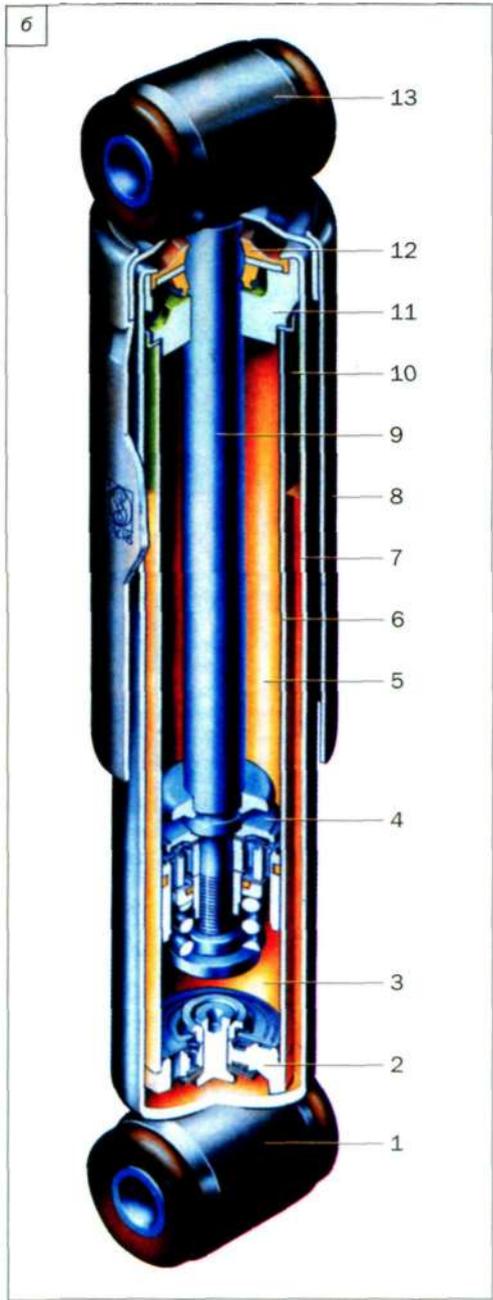
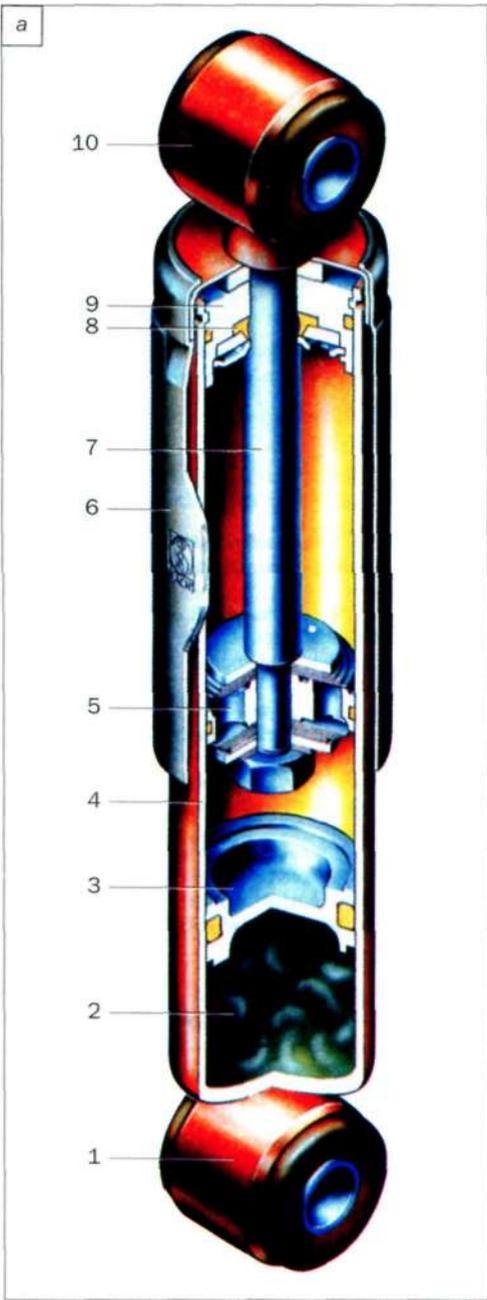
. 4.32.

Pontiac Grand Prix

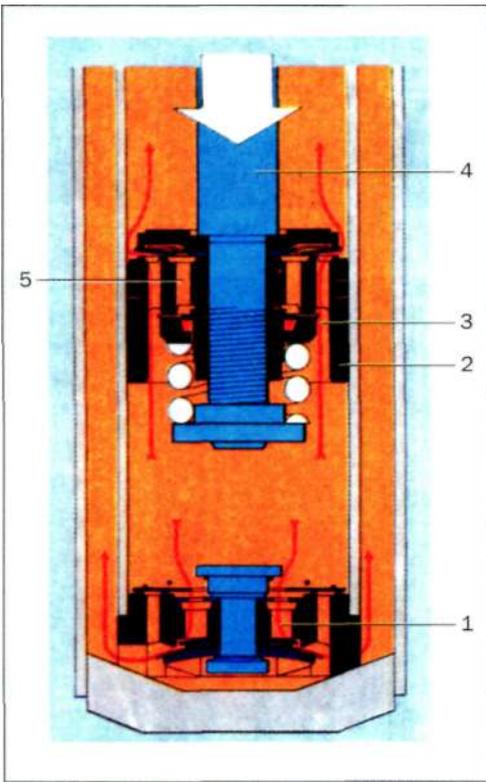
(. 4.33).

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(. 4.33)



. 4.33. () : 1 —
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 ; 7 — ; 8 — ; 9 — ; 10 —
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 8 — ; 9 — ; 10 — ; 11 — ; 12 —
 ; 13 —



(. 4.34).

. 4.34.

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- ; 3 — ; 4 — ; 5 — -

KONI,

(. 4.35),



. 4.35.

« Delphi », « Magneride » .

Delphi

Magneride.



Delphi

. 4.36.
Delphi

Magneride

Magneride

(. 4.36)

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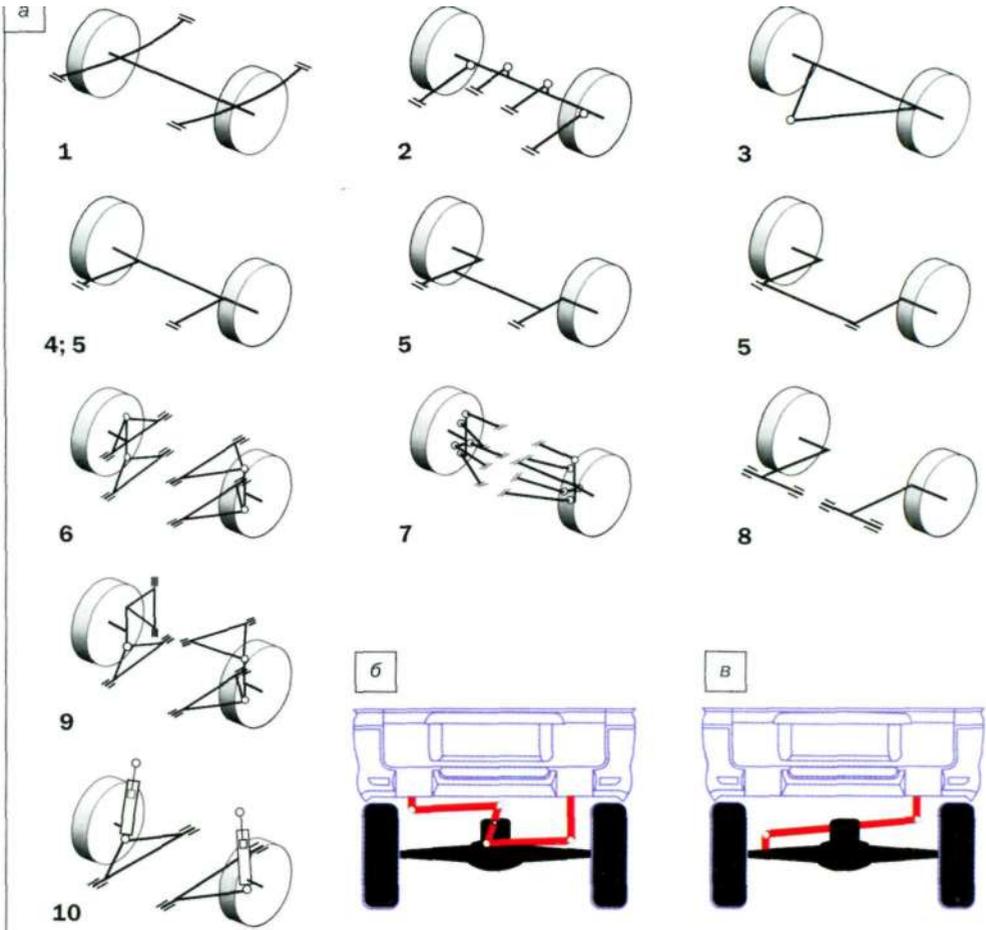
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. 4.37.

(McPherson),
(Multilink).

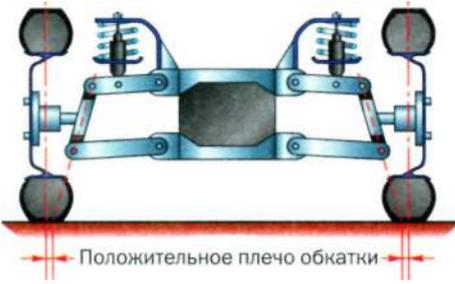
(. 4.38).

(. 4.39).

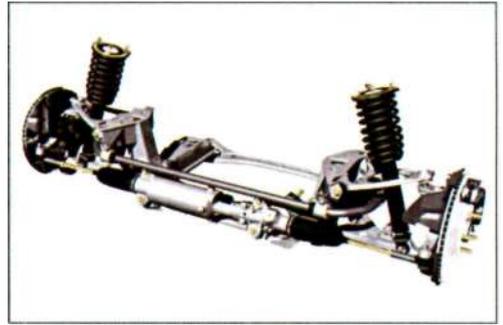


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5. ()	*	+	—	+	+	—	+	—	—	
6.		+	—	+	+	+	+	+	+	
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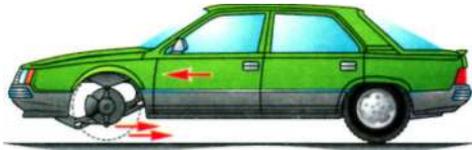
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. 4.38.

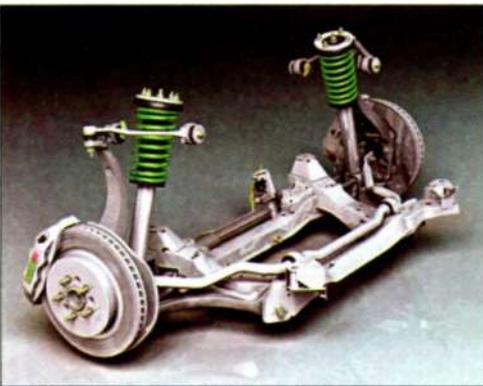


. 4.39.



. 4.40.

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. 4.41.

Jaguar S-type

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(. 4.41).

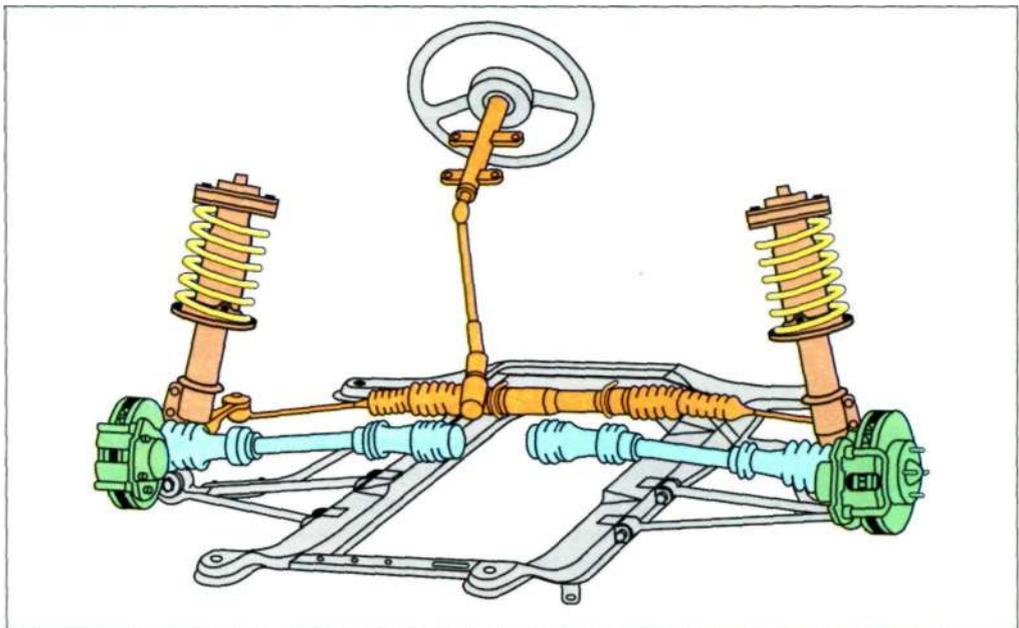
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(McPherson),

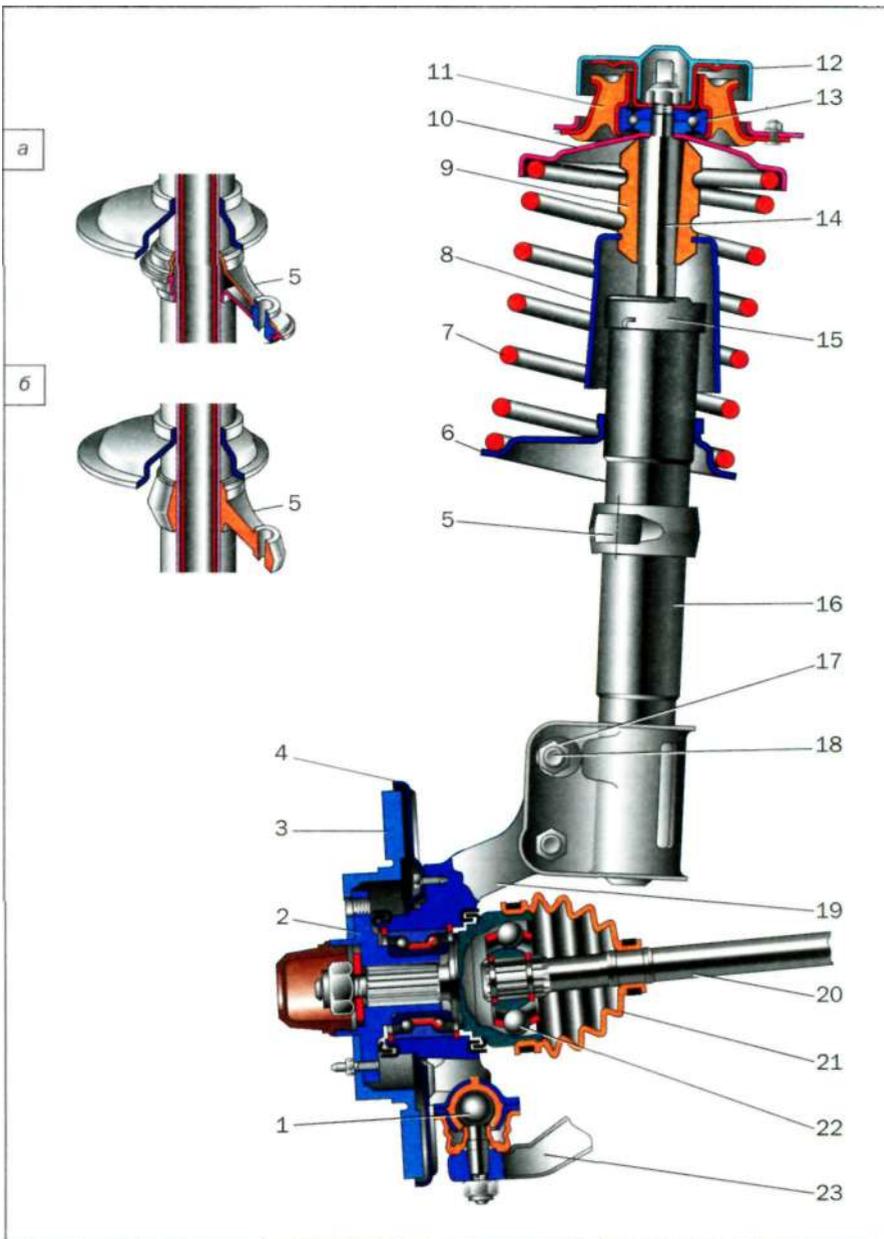
(. 4.42).

(. 4.43),

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. 4.42.



. 4.43. -2109:1 - ; 2 — ;
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. 4.44.

Audi 1995

Audi A4.

(. 4.25).

(. 4.44)

(. 4.45).



. 4.45.

Peugeot 206

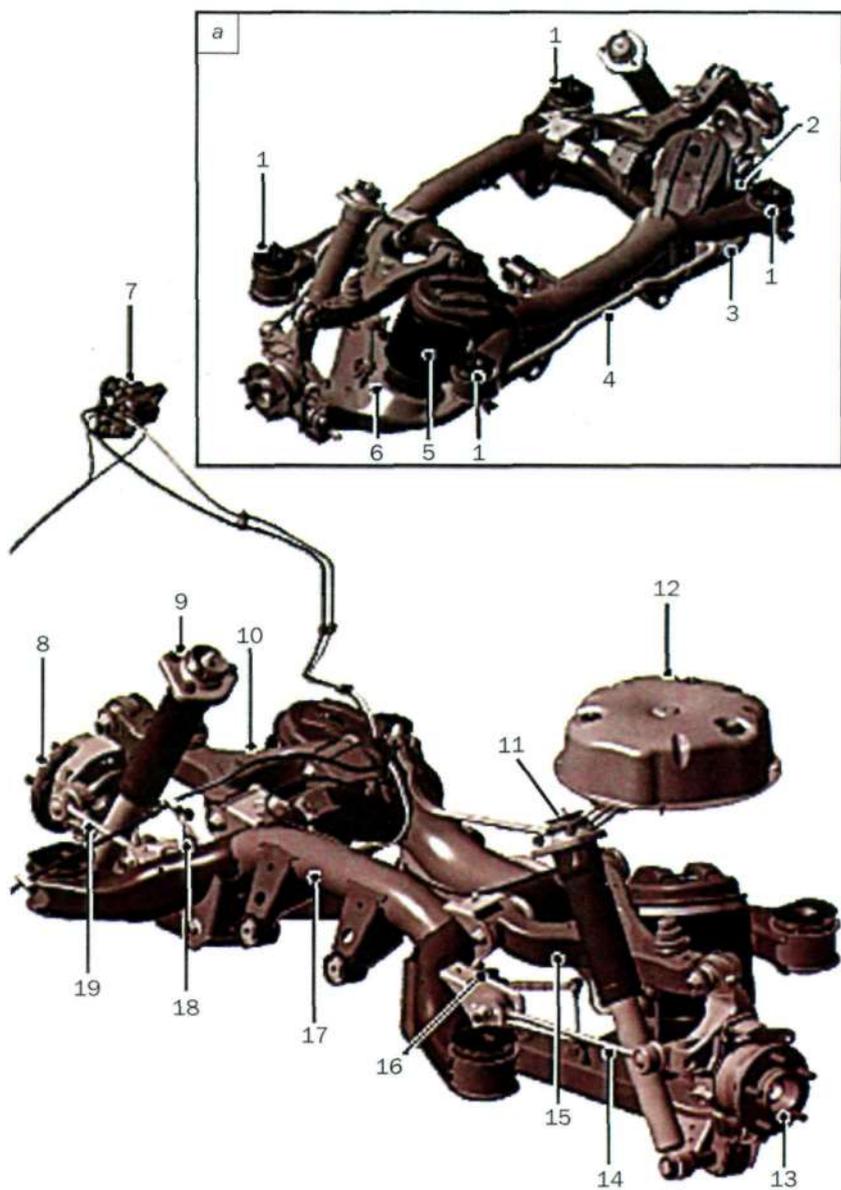


. 4.46.

Audi A2

(. 4.46)

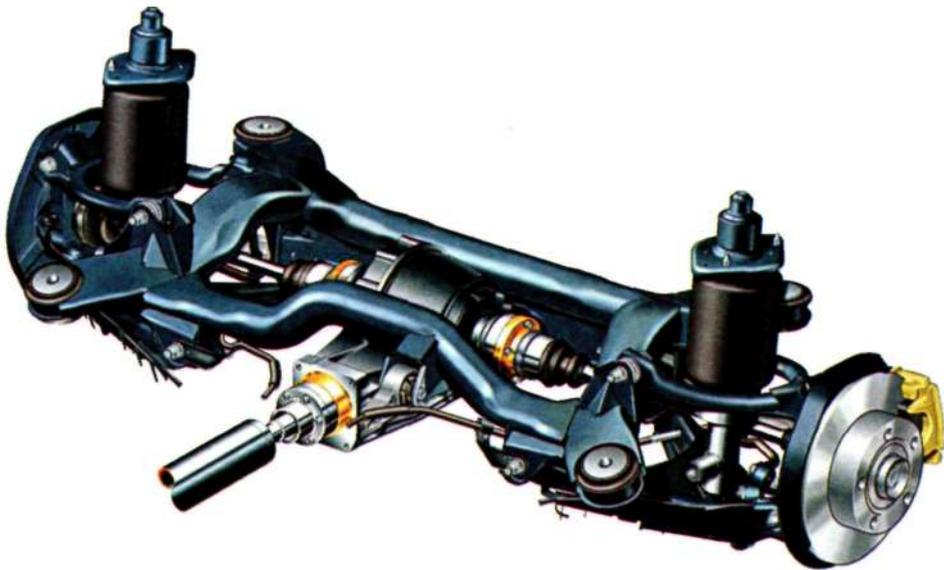
1970-



. 4.47.

New Range Rover: a —

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| ; 19 — | | | |



. 4.48.

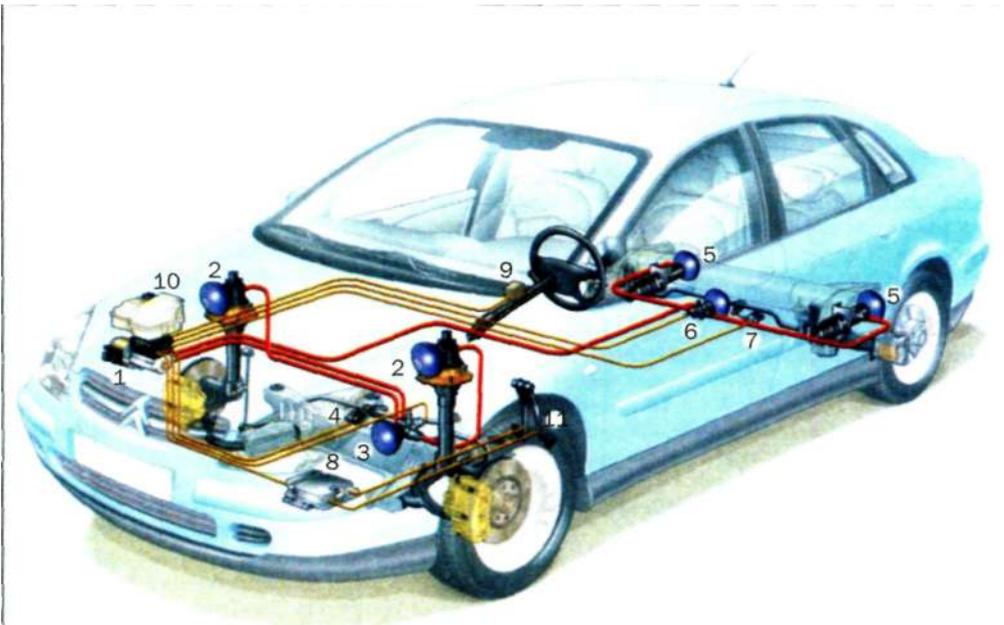
Audi Allroad.

New Range Rover

(. 4.47),

Mercedes, Audi (. 4.48)

Citroen



. 4.49.

Hydroactive

Citroen C5

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Citroen

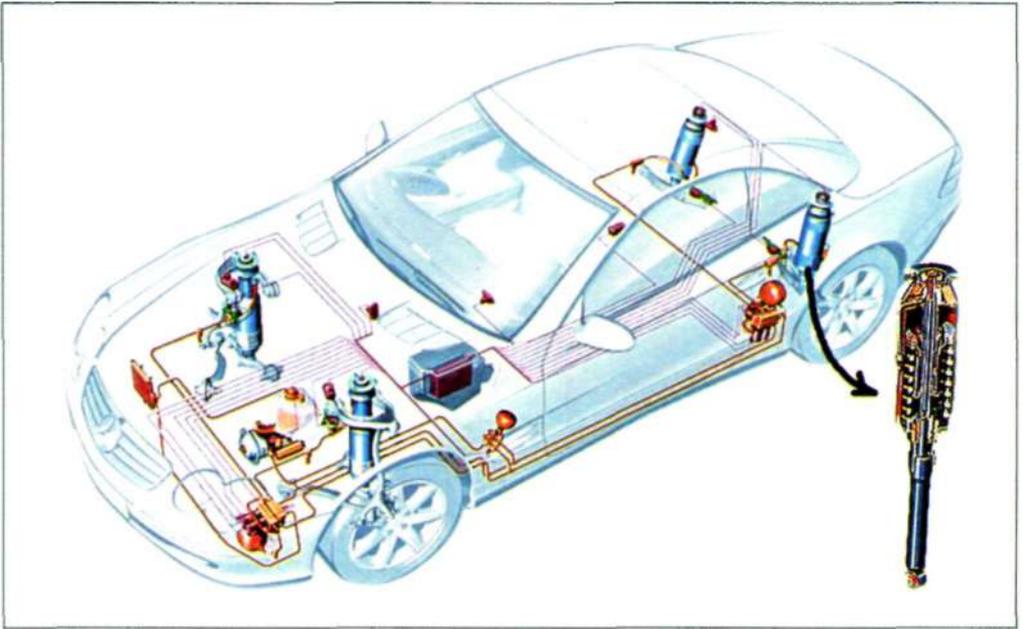
Hydractive
(. 4.49).

Citroen

Activa,

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0,5°,



. 4.50.

Mercedes

0,5°

1999

Mercedes

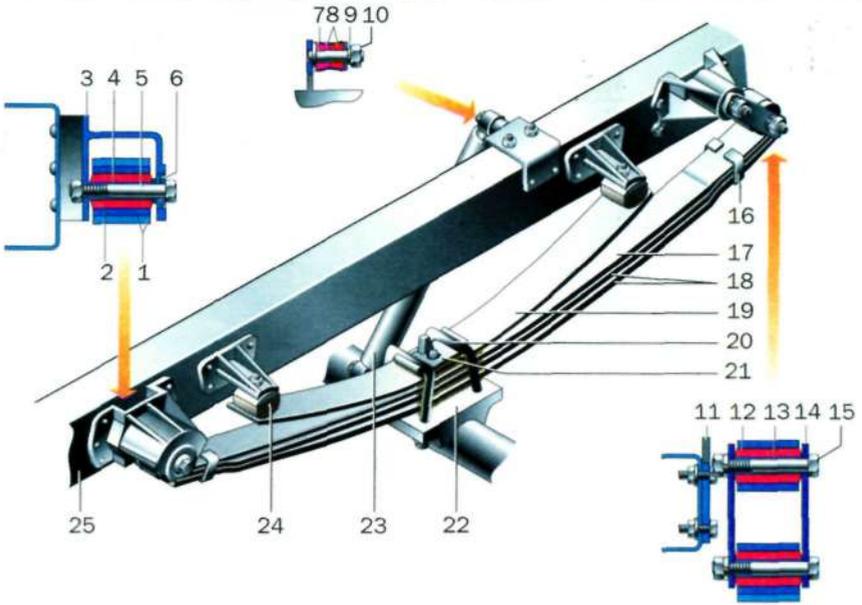
ABC (Active Body Control —
(. 4.50)

ABC

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13

(. 4.51).



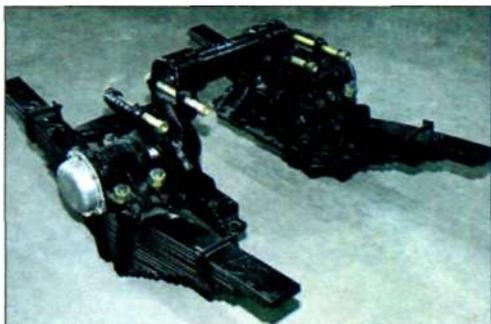
. 4.51.

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| 8 — | | ; 9 — | | ; 10 — | | ; 11 — | | ; 12 — | | | |
| | ; 13 — | | ; 14 — | | ; 15 — | | ; 16 — | | ; 17 — | | |
| 18 — | | ; 19 — | | | | ; 20 — | | | | ; 21 — | |
| 22 — | | ; 23 — | | ; 24 — | | | | ; 25 — | | | |

(. 4.52)



. 4.52.



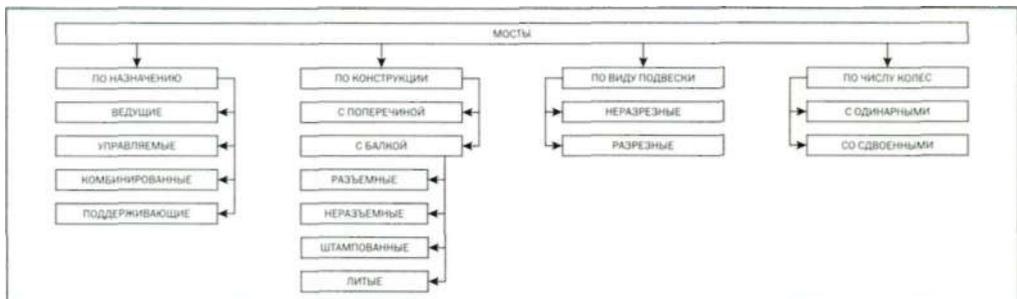
. 4.53.

(. 4.53).

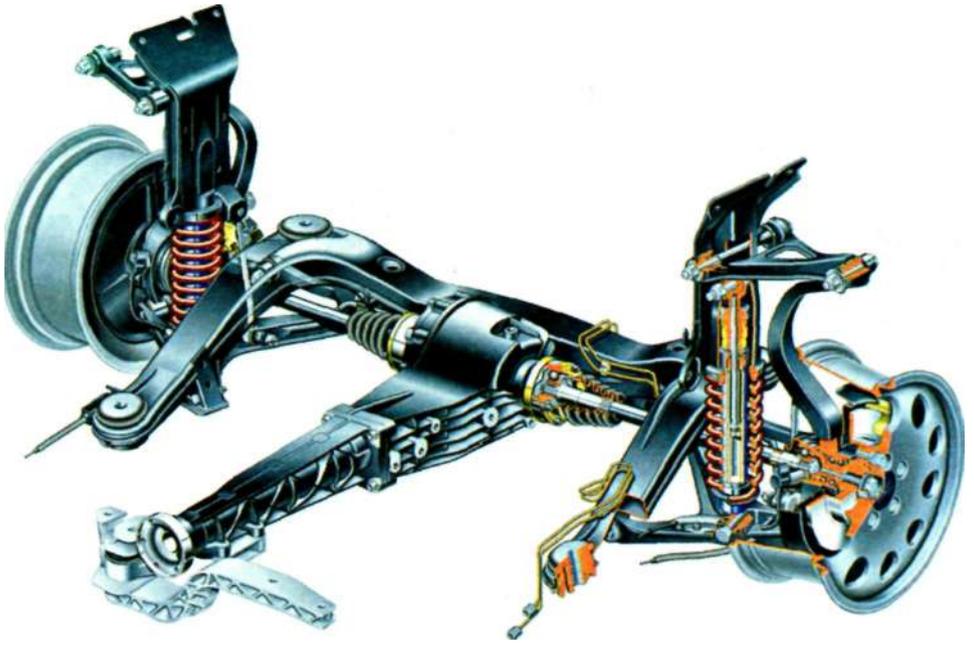
§28

. 4.54

(. 4.55)



. 4.54.

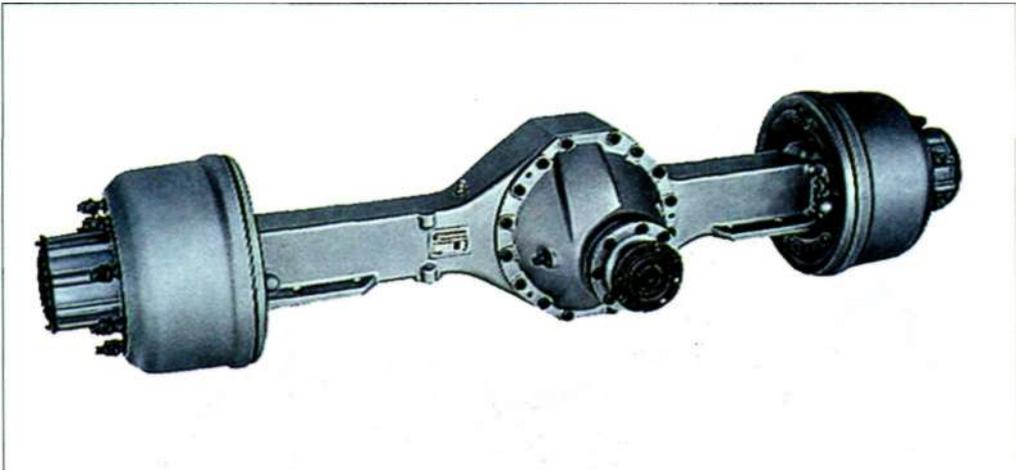


. 4.55.

4x4

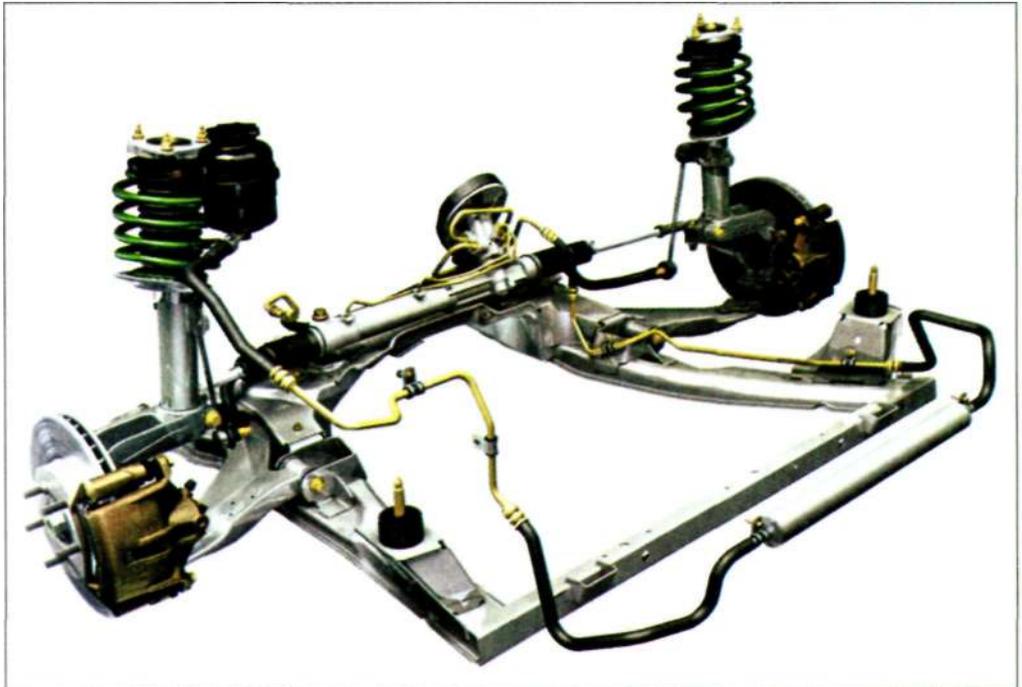
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. 4.56.

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. 4.57.

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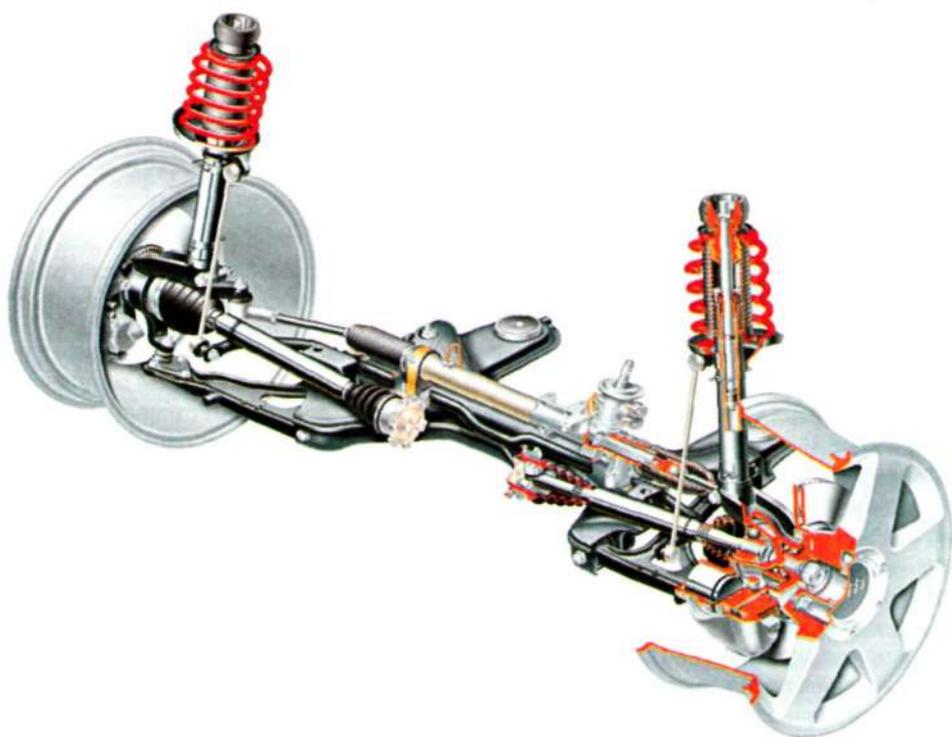
(. 4.58)

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(. . 4.46).



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(. 5.1);
(. 5.16);
() (. 5.1).



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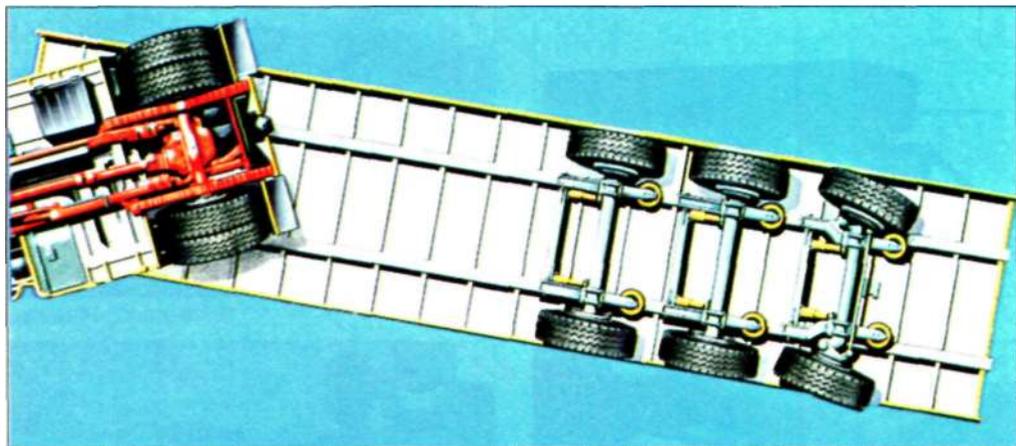
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(. . 1.16).

(. 5.2).

ESP (. §31).

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(. 5.3)

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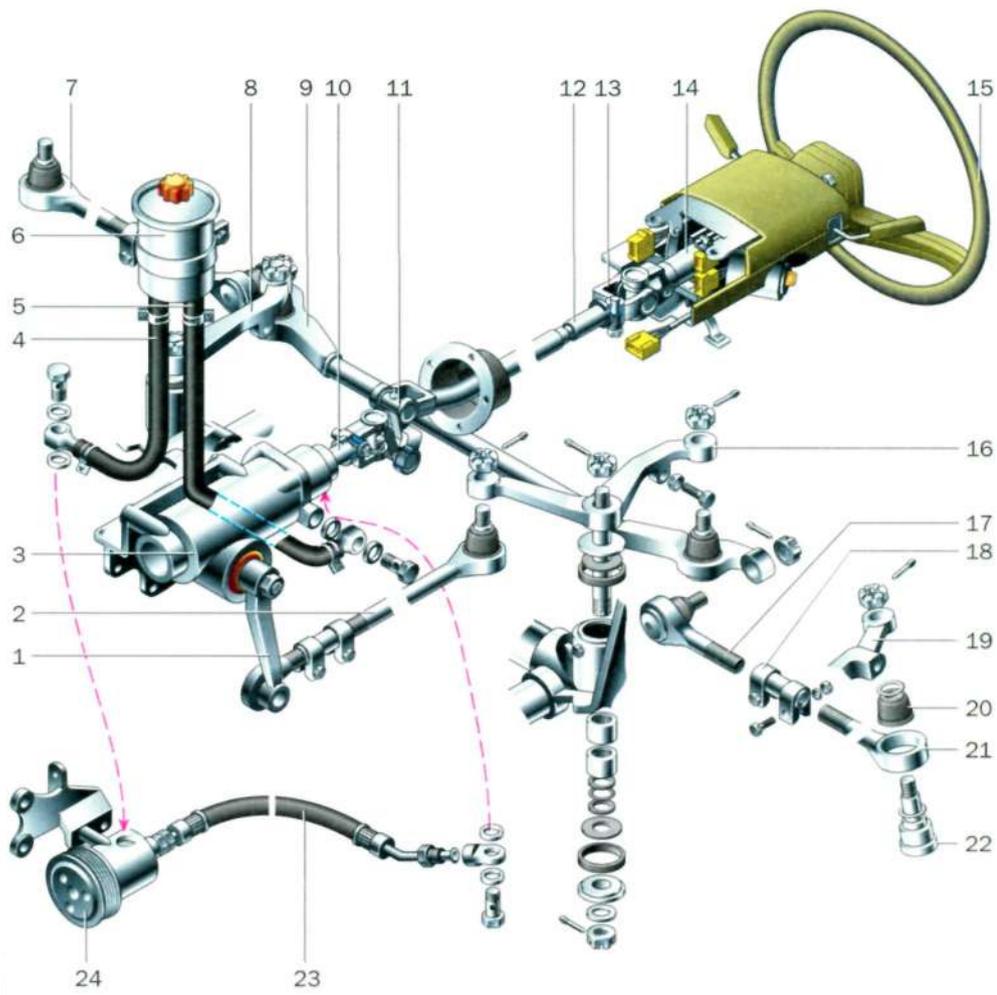
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30-45°

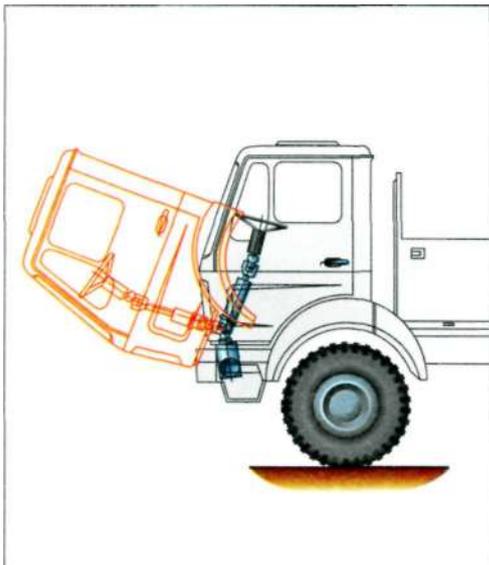
(. 5.4).

(. 5.5),



5.3

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5.4.



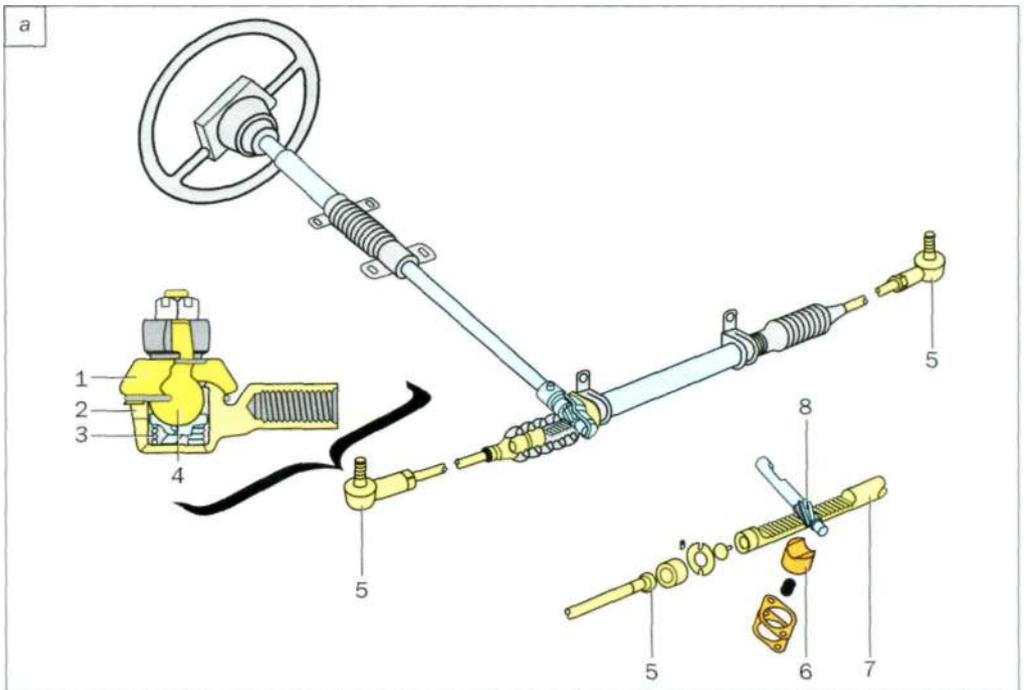
5.5.

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(5.6).

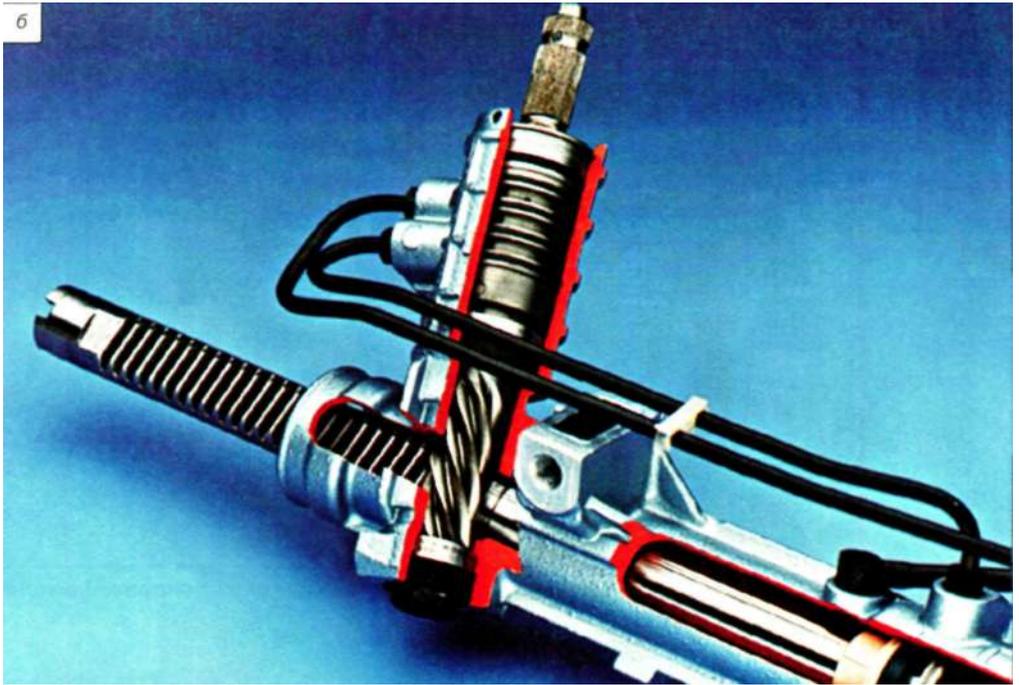
(24)

« — » (. 5.7).
 (-2105, -2107),

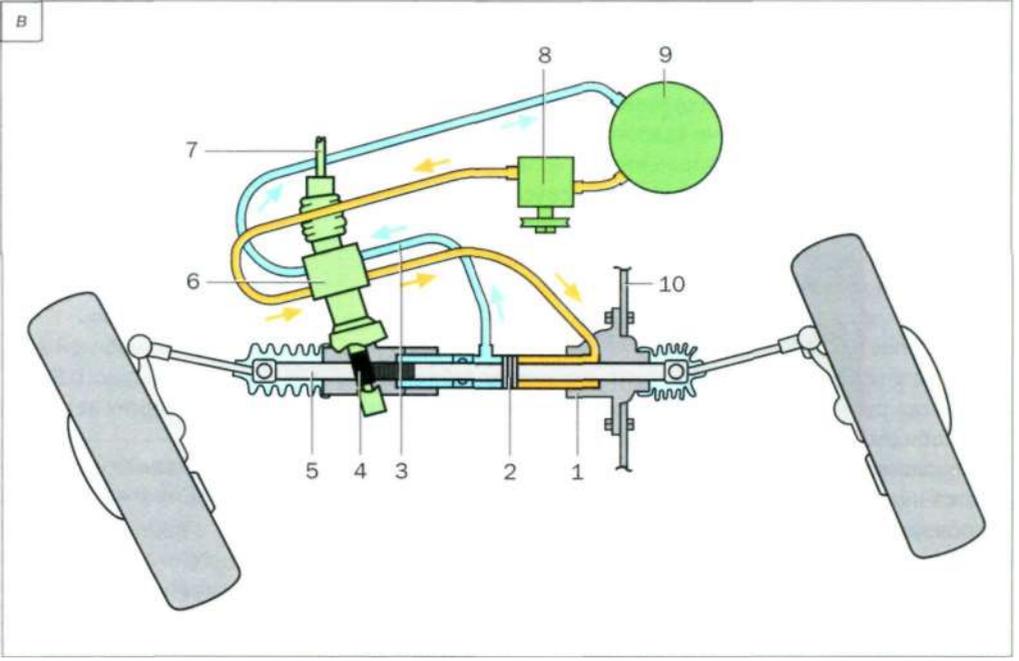


. 5.6 . : 1 — ; 2 — ;
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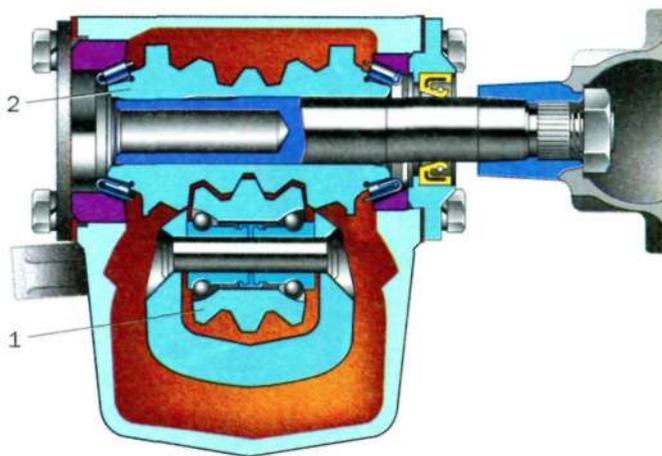
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- 5.6 ; 1—
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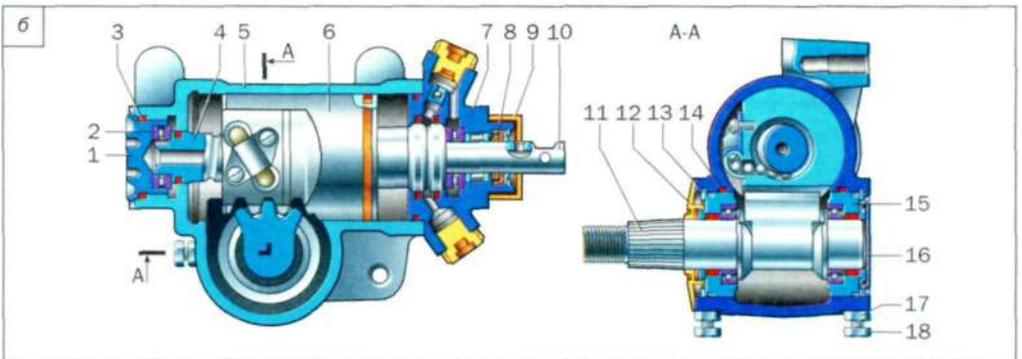
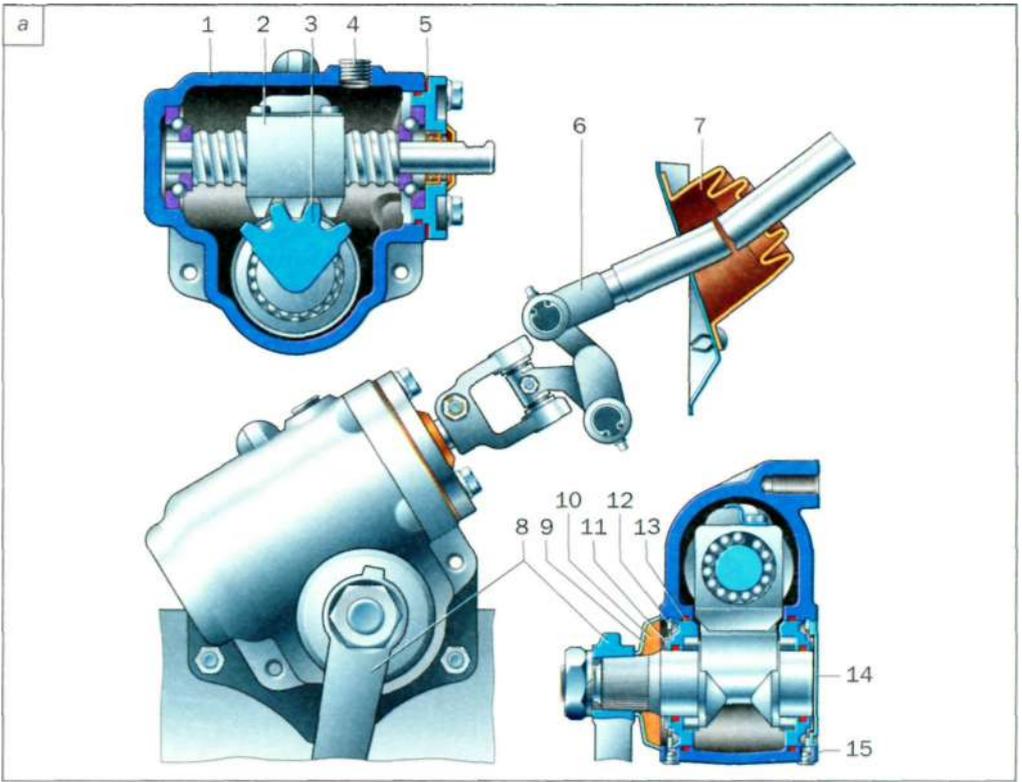


5.7. « - » :
 1 — ; 2 —

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(Mercedes, Range Rover).

« - », « - », « - - - ».



. 5.8.

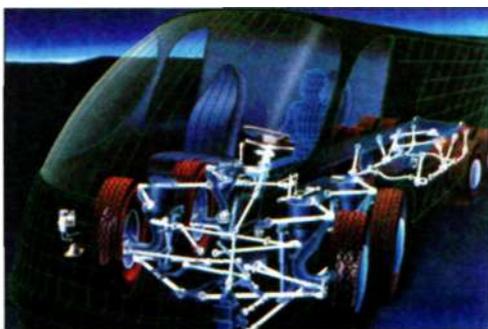
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 ; 2 — ; 3 — ; 4 — ; 5 — ; 6 — ;
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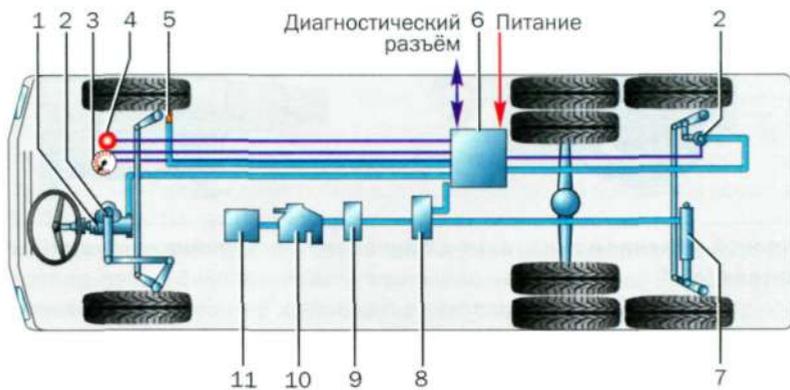
(. 5.10).



. 5.9.



. 5.10.



. 5.11.

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. 5.12.

20-30 / . (. 5.11).

(. 5.12)
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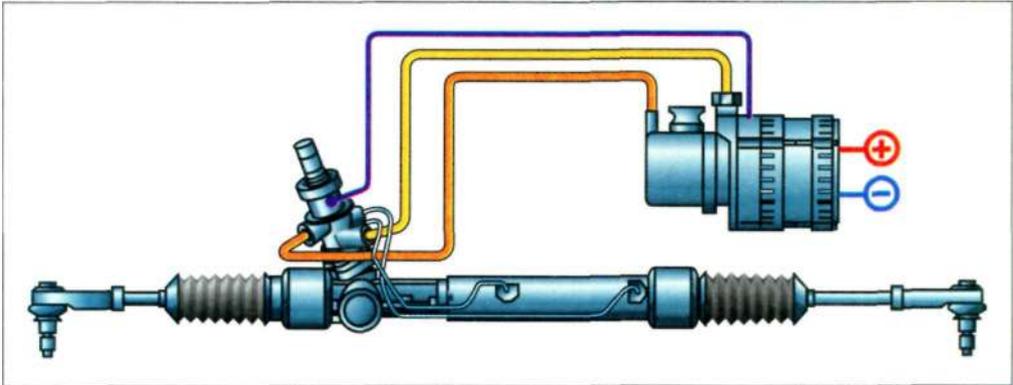
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. 5.13.

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.5.14.

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§31

ESP

ESP (Electronic Stability

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ESP (. 5.15)

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(. 5.16).



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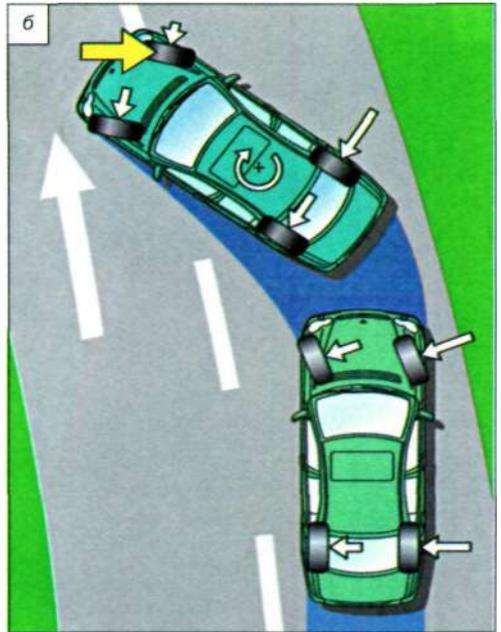
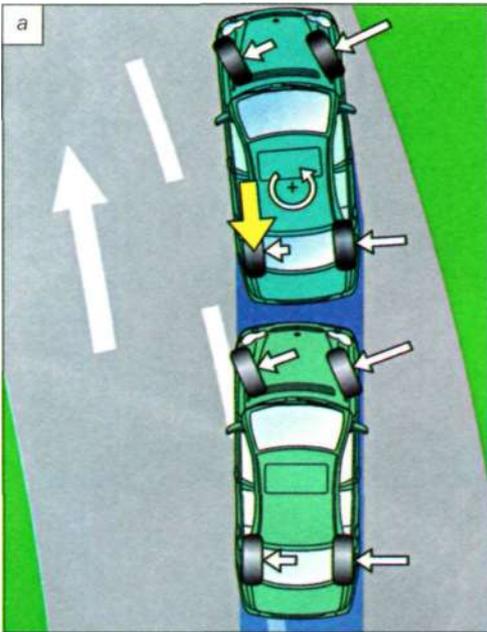
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. 5.16.

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§32

Front Steering (

— ESP
BMW,

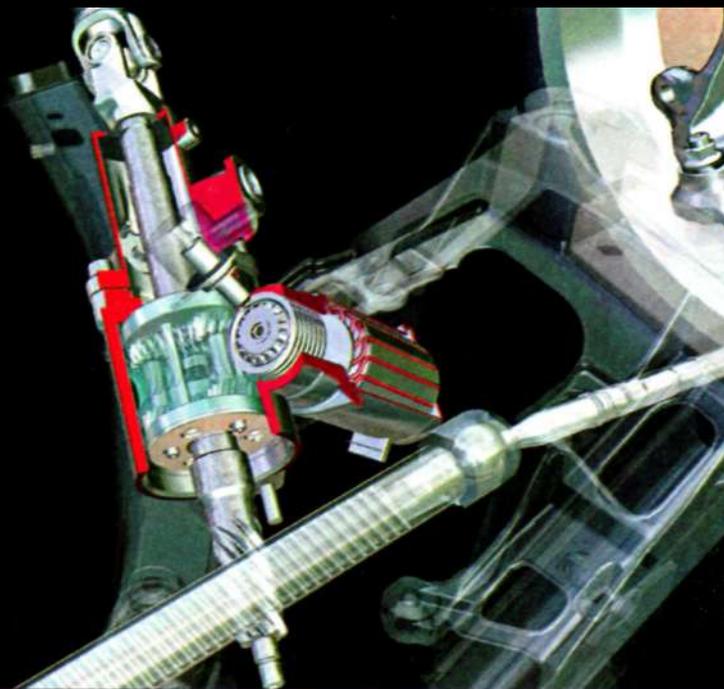
AFS — Active
AFS (. 5.17)

(. § 31).

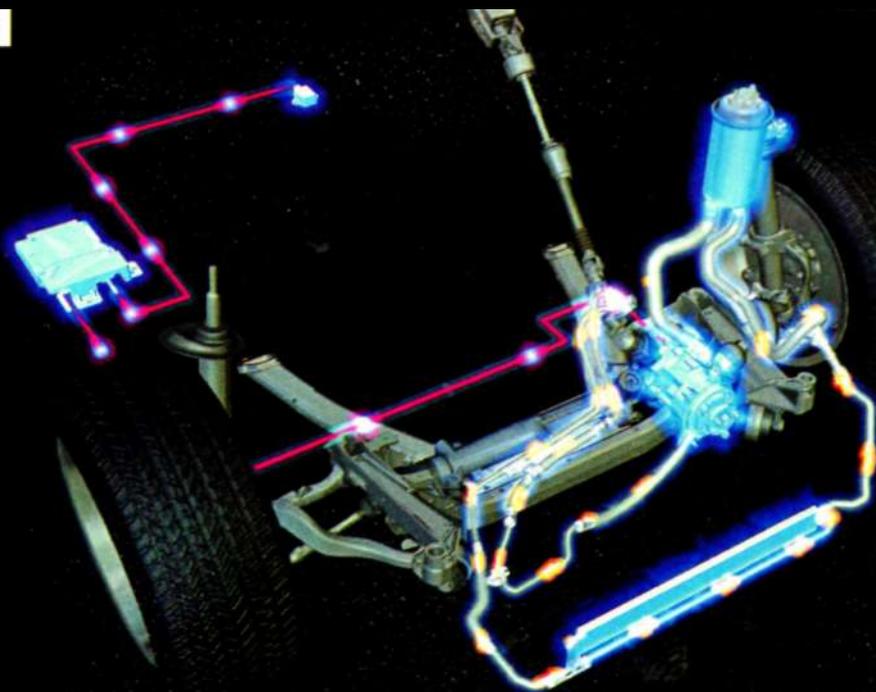
AFS,

(Steer by wire).

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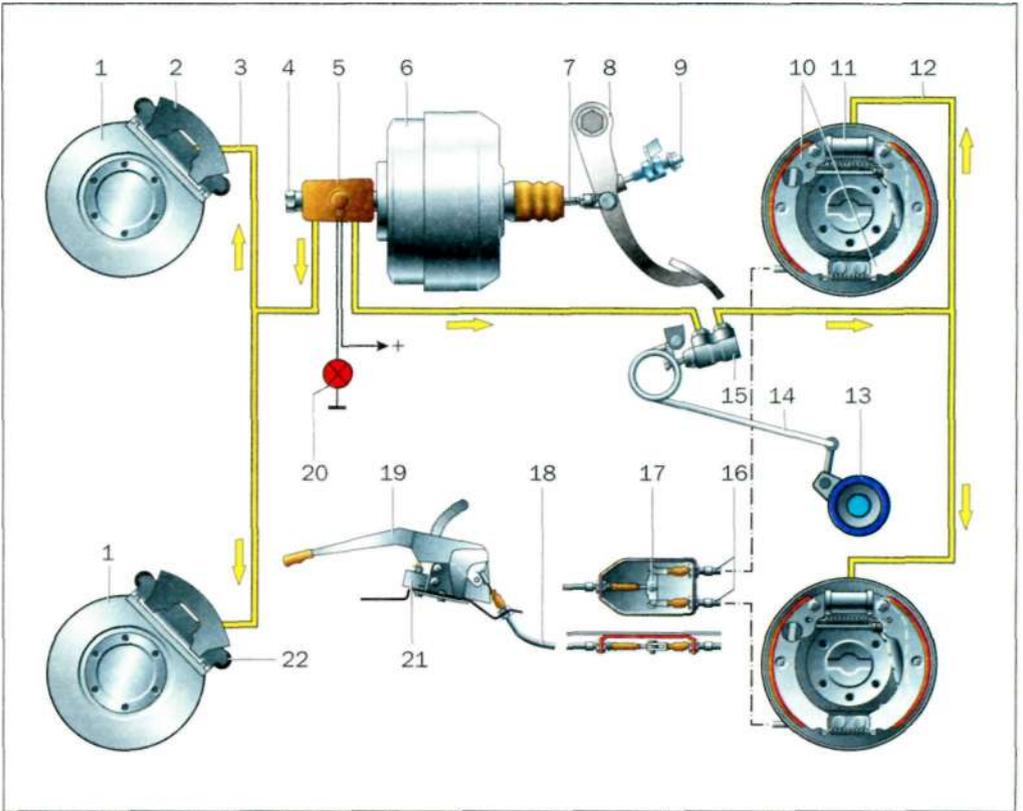
750 . 6.1

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41.13-99 ()
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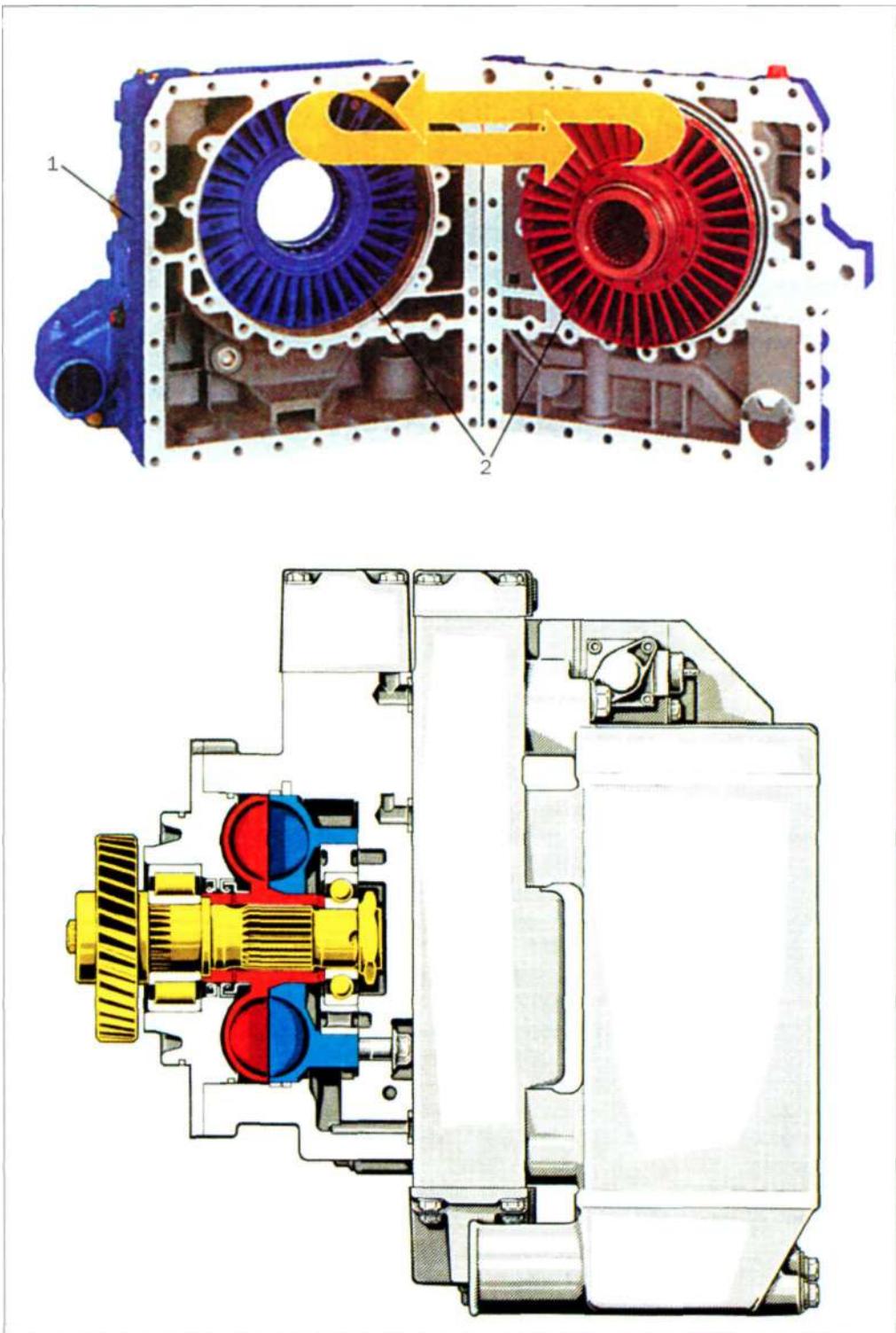
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.6.3

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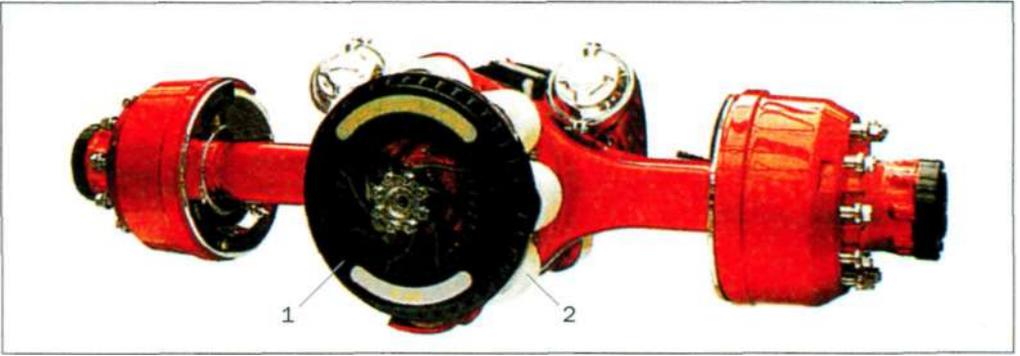


. 6.3.

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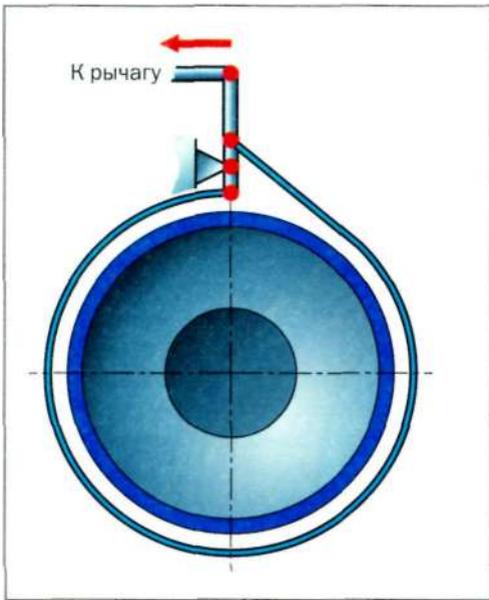
. 6.4.

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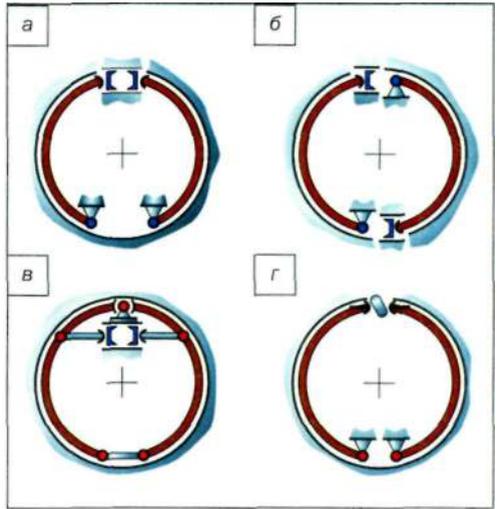
§35

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(. 6.5).



6.5.

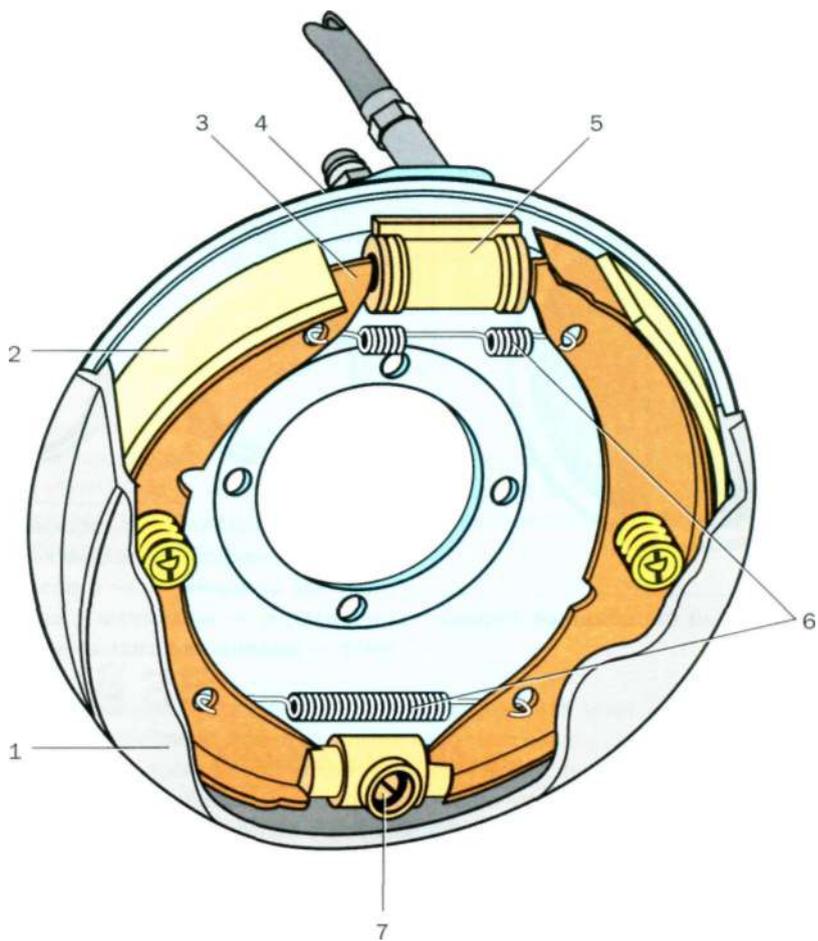


6.6.

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6.7

6.6



. 6.7.

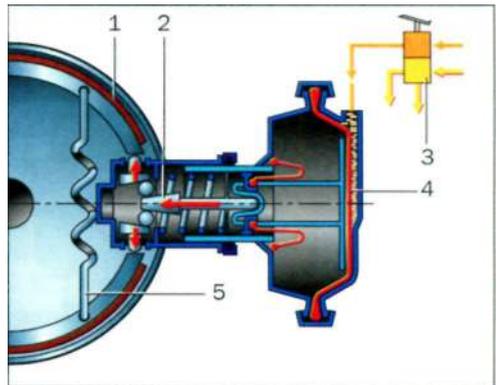
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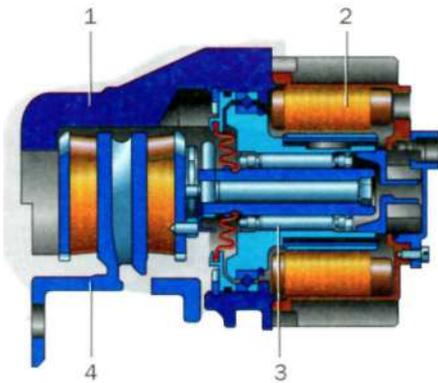
. 6.8.

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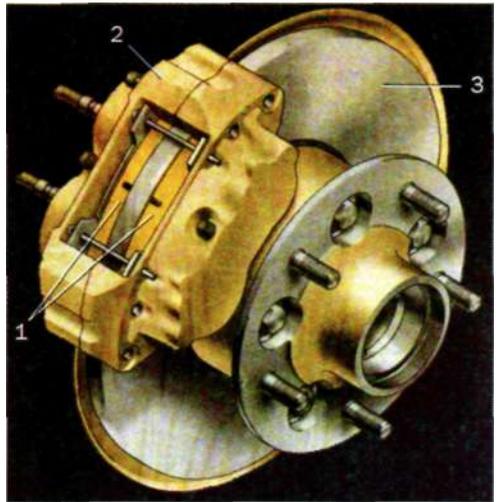


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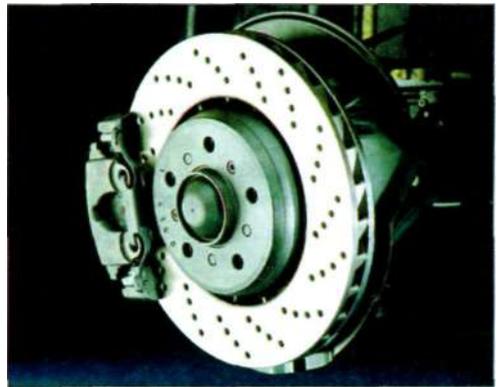
. 6.9.

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. 6.10.

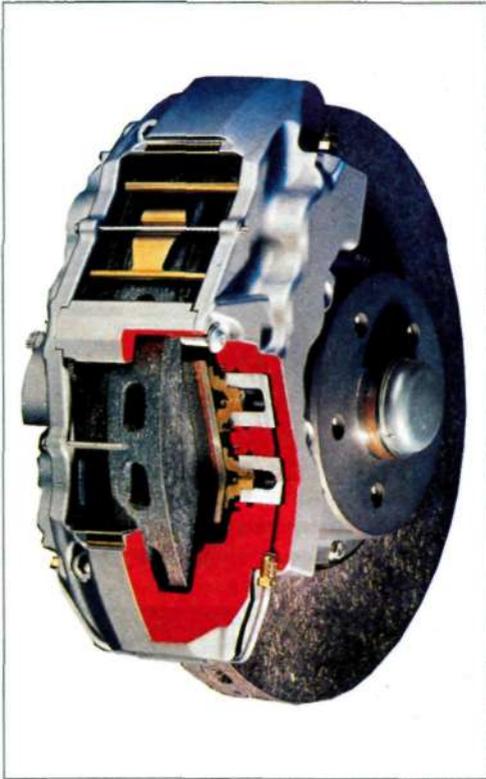
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. 6.11.

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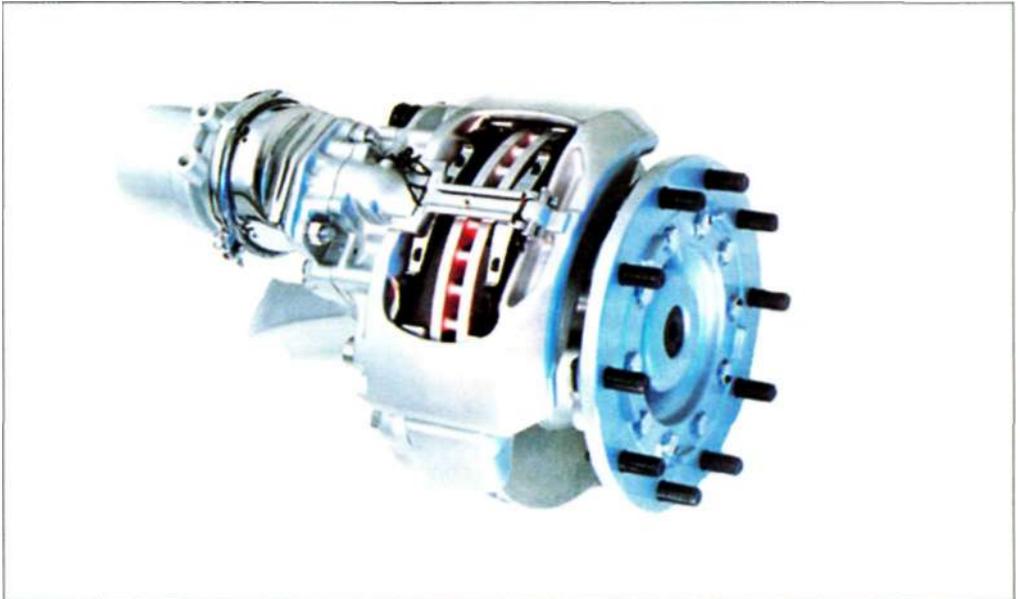
(. 6.12)



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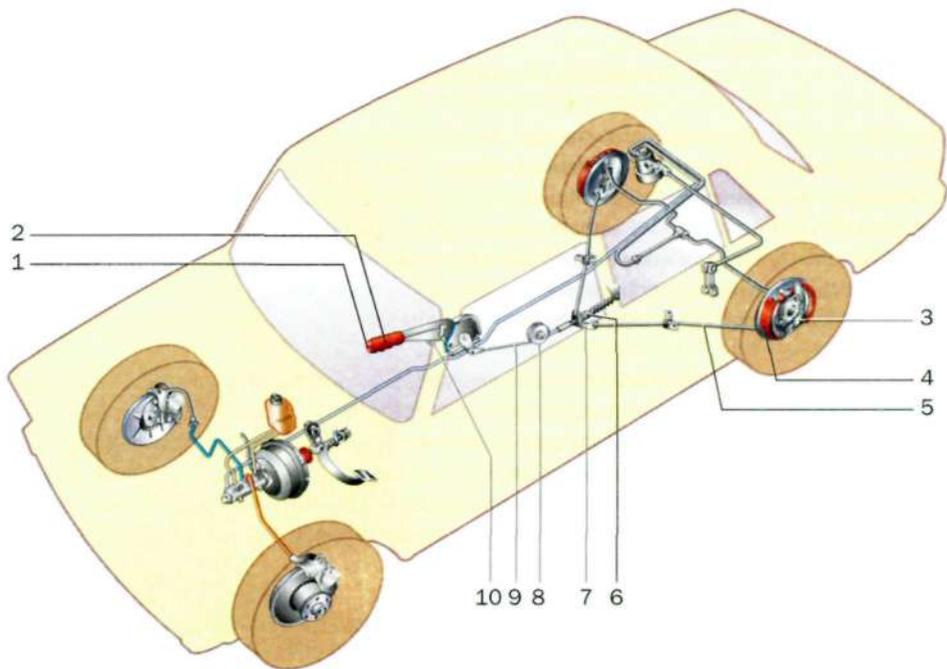
. 6.13.

§36

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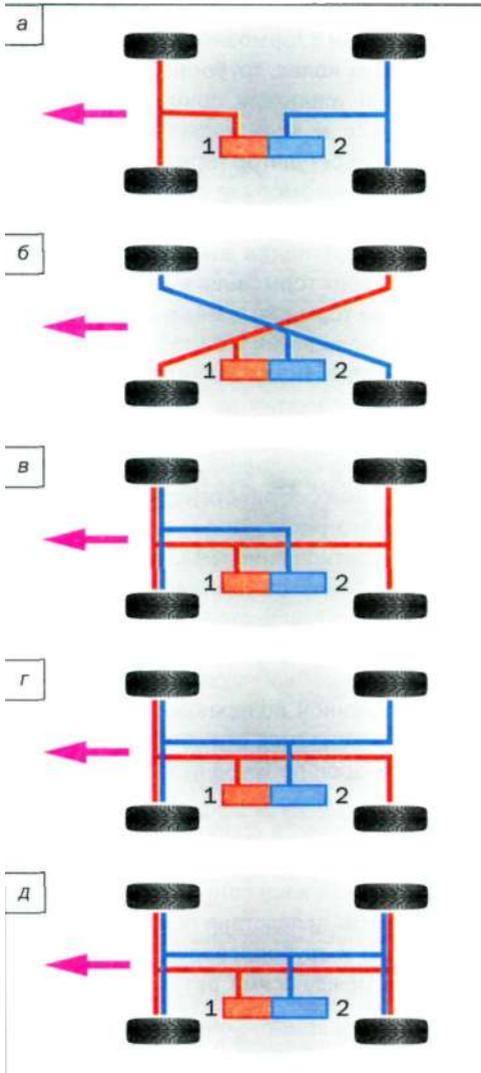
(. . 6.5)

(. 6.14).



. 6.14.

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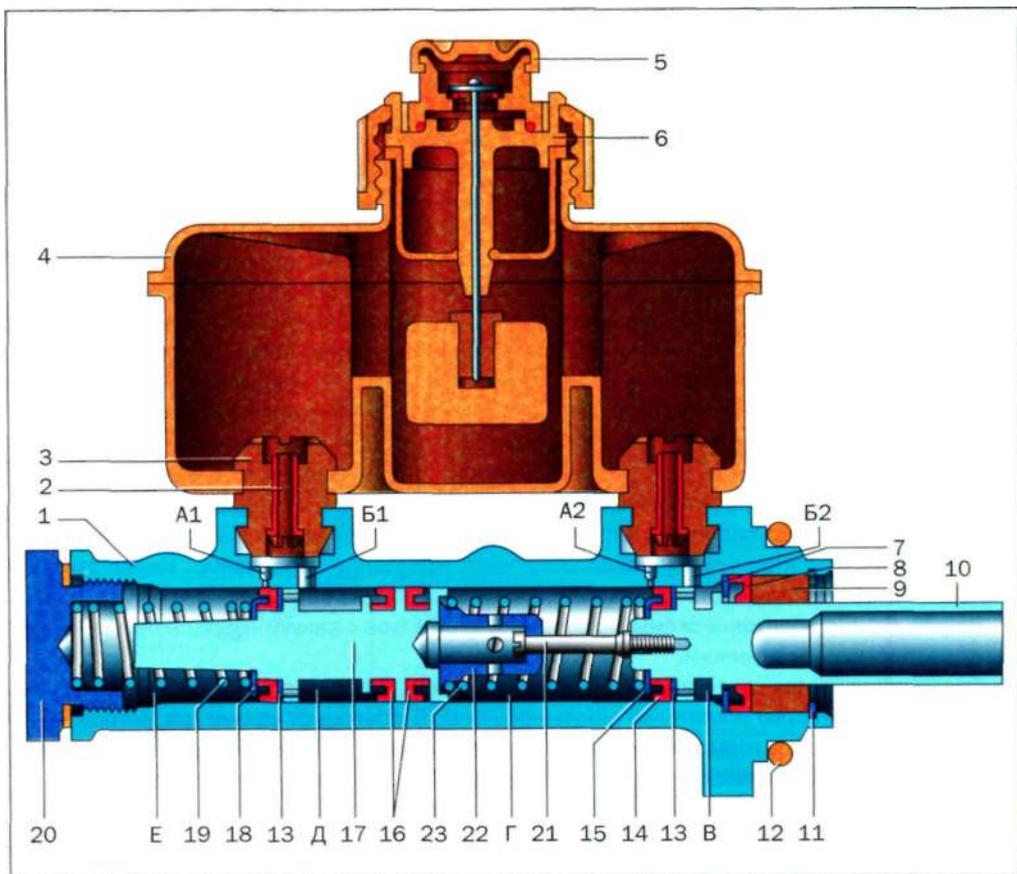
-21412 (. 6.15)

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(-41045), Volvo). . 6.15



. 6.16.

: A1, A2 —

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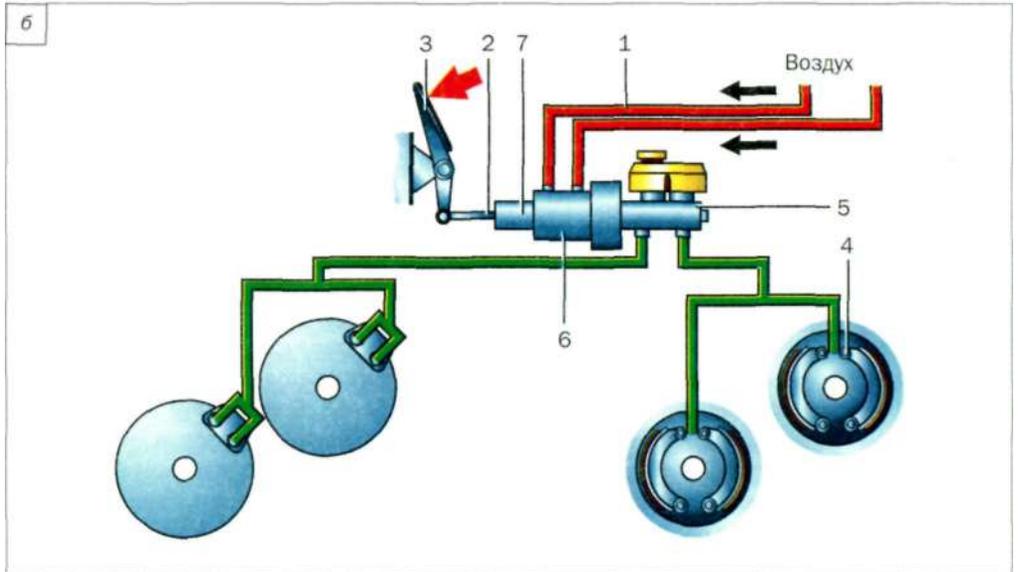
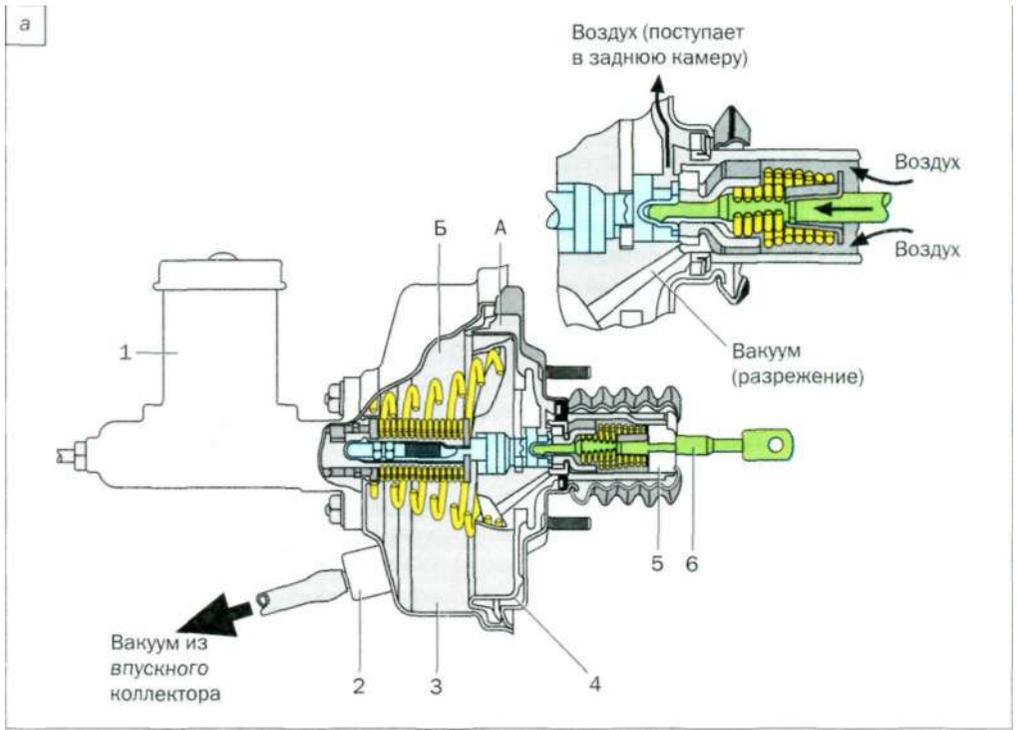
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; 6 —

; 7 —

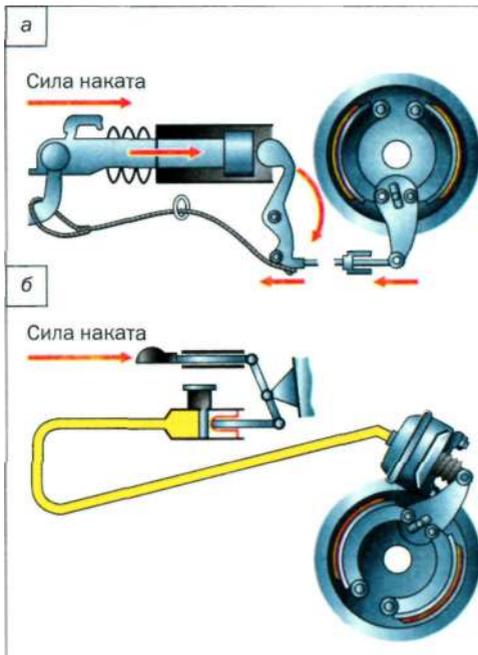
()

3-4

(. 6.176)

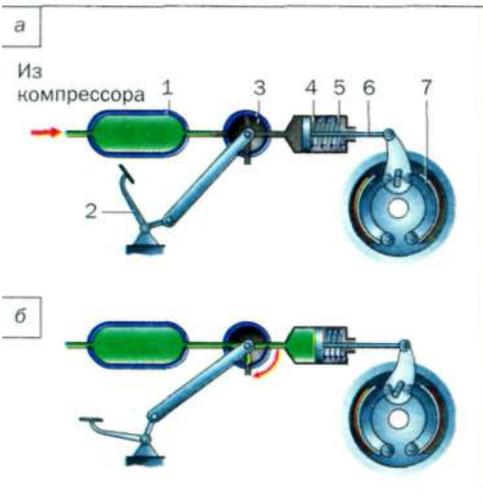
3,5). (. 6.18),

(



.6.18.

() ,



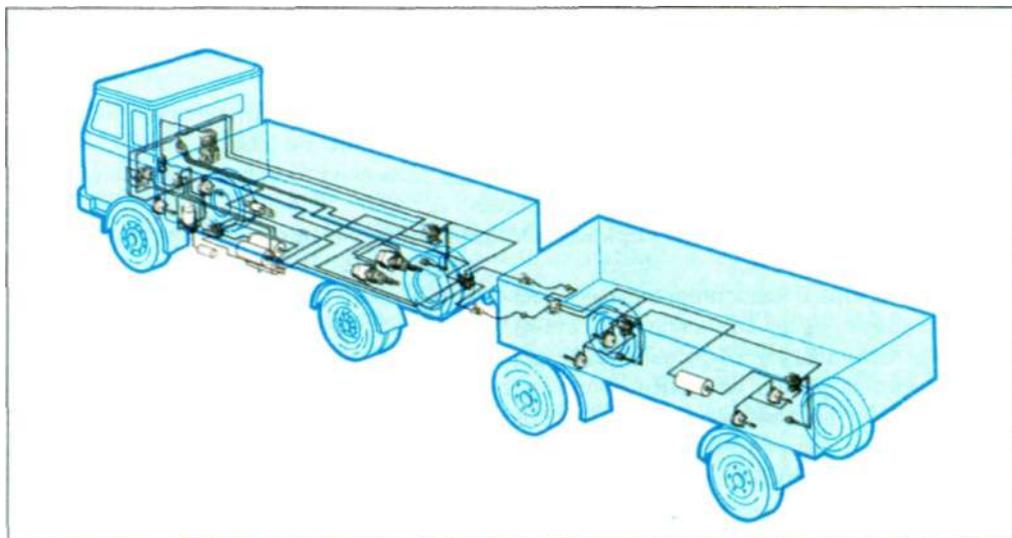
(. 6.19)

(. 6.196).

. 6.19.

: 1 —
 ; 2 — ; 3 — ; 4 — (. 6.19)
 ; 5 — ; 6 —
 ; 7 —

. 6.20.



. 6.20.

() .

()

2-4

, 1-2 3-4 1-3

1,5
0,65-0,8

()

()

0,48

0,48

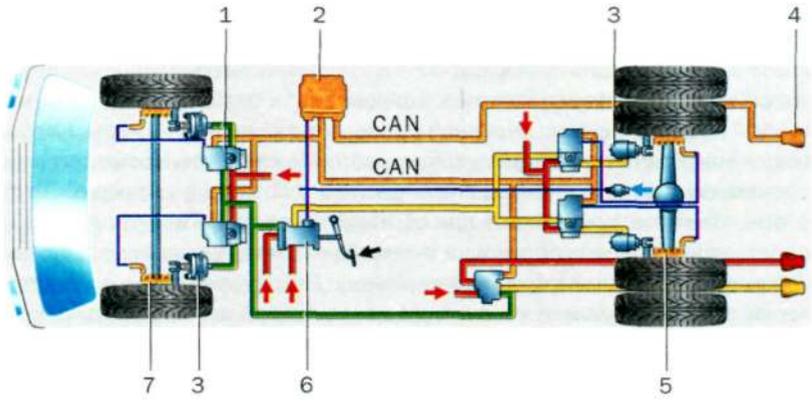
(-).

(.6.21).

);

()

(



. 6.21.

; 2 — ; 3 — ; 4 — ; 5 — / ; 6 — ; 7 —

90-

()

§37

()

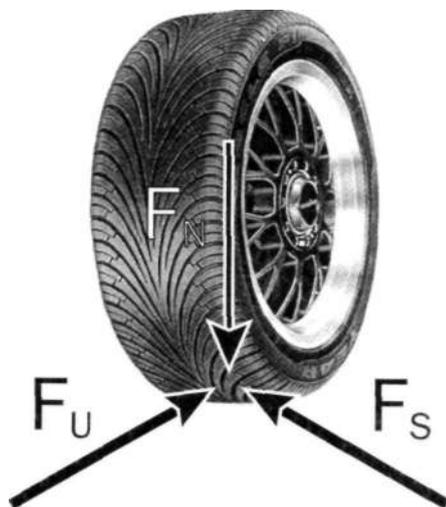
(. 6.22).

F_u

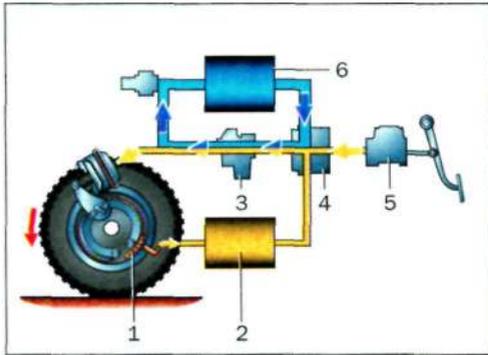
(), F_s (

() 20-
()

1969 .



. 6.22.



(1, 2, 3) (,)—

. 6.23. : 1 — —
 ; 2 — ; 3 — —
 4 — ; 5 — —
 ; 6 — 75 % () ;

— ;
 — () ;

— ;
 — ;
 — ;

— ;
 — (, , .). (. 6.23):

— (, .);
 — ;
 — () .

— () ;
 — ;

— ;
 — () ;

— ;
 — ;

— () ;
 — ;

— ;
 — ;

()

(- -)

(Individual

Regelung) — IR;

« »

(Select Low) — SL;

« »

« »

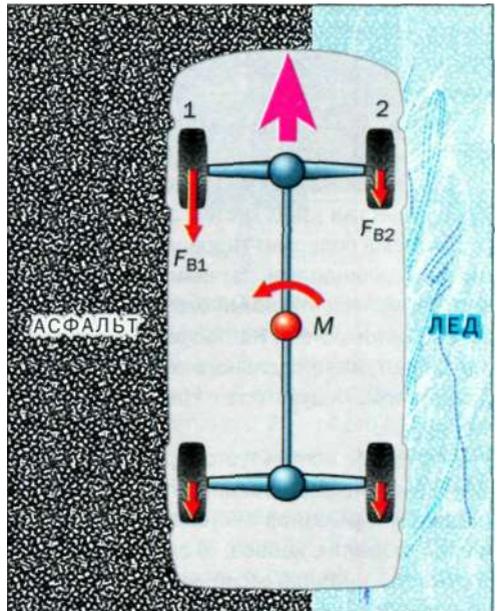
(Select High) — SH;

— Modifizierte Individual Regelung

SL IR. MIR

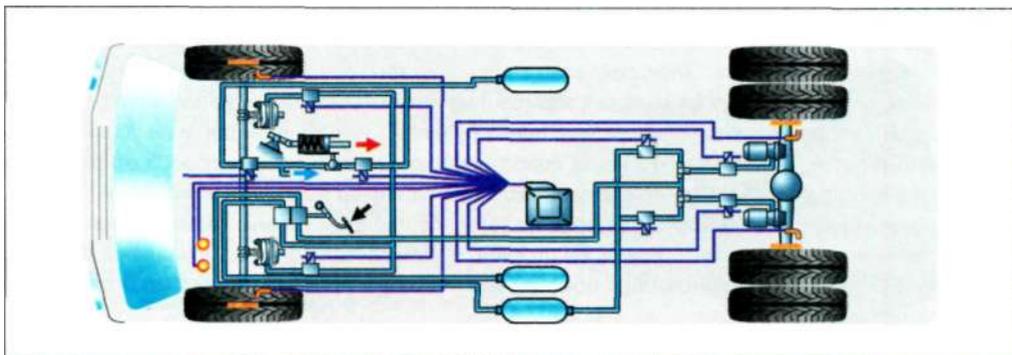
« »,

. MIR



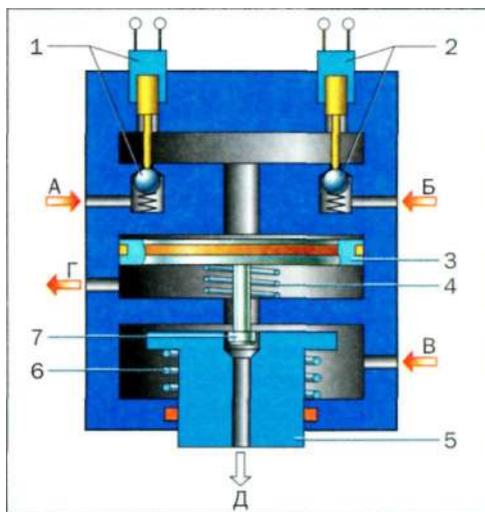
6.24.

(. 6.24).



. 6.26.

. 6.26.



. 6.27.

(. 6.27)
1 2

: 1, 2 —

; 3 —
4. 6 — ; 5 —
; 7 —

()

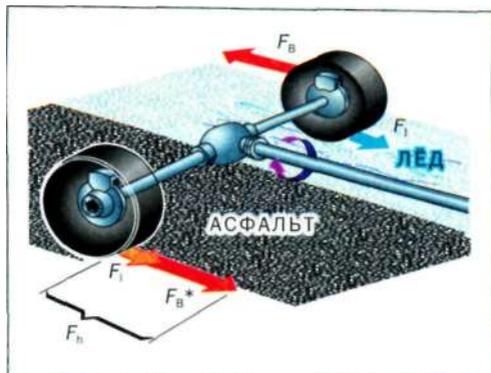
0,2 %.

()

§38

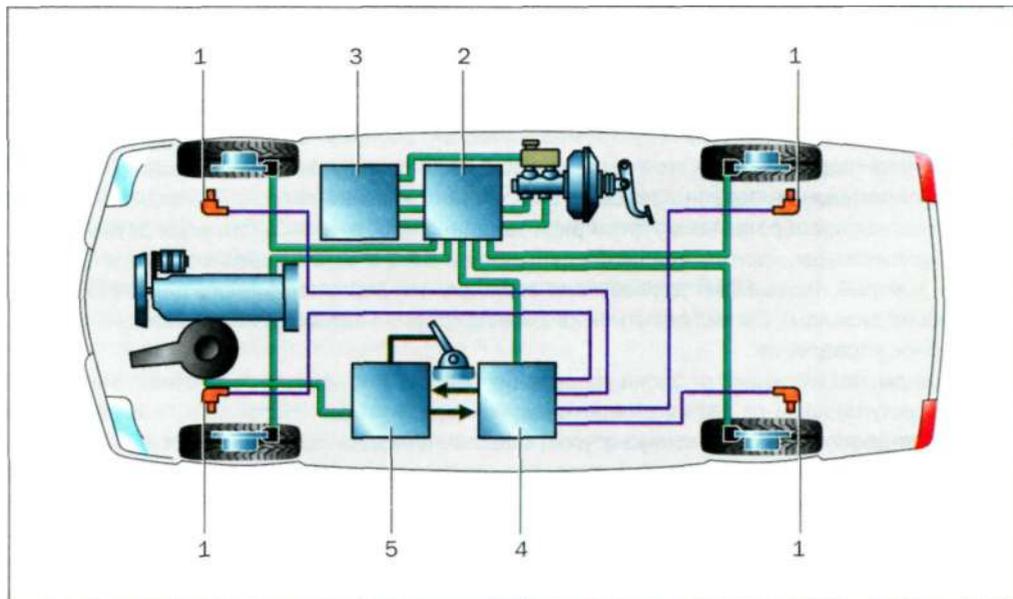
(),

(. 6.28).



. 6.28.

(); F_B — ; $F_B \gg$ — ; F_h —



. 6.29.

; 2 — ; 3 — ; 4 — ; 5 — ; 1 —

—
—
—

/

. 6.29.

«

».

« »

(

),

(

).

« ».

80-

10°

100

6x2

(90)

30 %

§39

(Electronic Brake Management) —
DBC (Dynamic Brake Control) —

(Electronic Brake Assist) —

Mercedes,

BMW

3 ;
600 / ;

5 / ;

() .

5 / .



. 6.30.

Range Rover

(. 6.30).

ABS —

, DSC —

ETS —

— HDC (Hill Descent Control) —

— EBD (Electronic Brake Distribution) —

— (Cornering Brake Control) —

— (Electronic Brake Assist) —

ABC DSC,

(BBW — Brake By Wire).

BBW

36

BMW

BBW.

BBW

—
—
();

—
— ;
— ;
— ;
— ;
— ;
— ;

— ESR TCS, , EBD . . . ;

(Electronic Parking Brake —

) .

Brake).

(Automatic Parking

« ».
Jaguar.

BBW

« »

7

§40

§41

§42

(. 7.1).



. 7.1.

XX .

XX ..

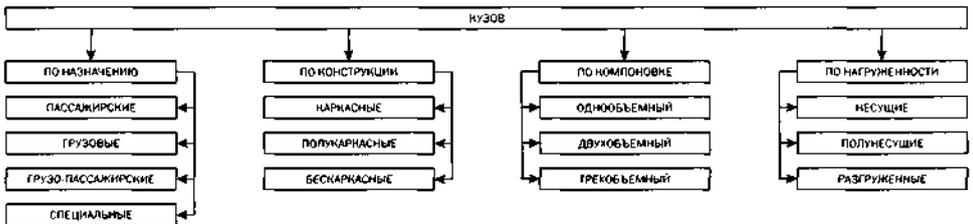
(. . 1.14),

30-

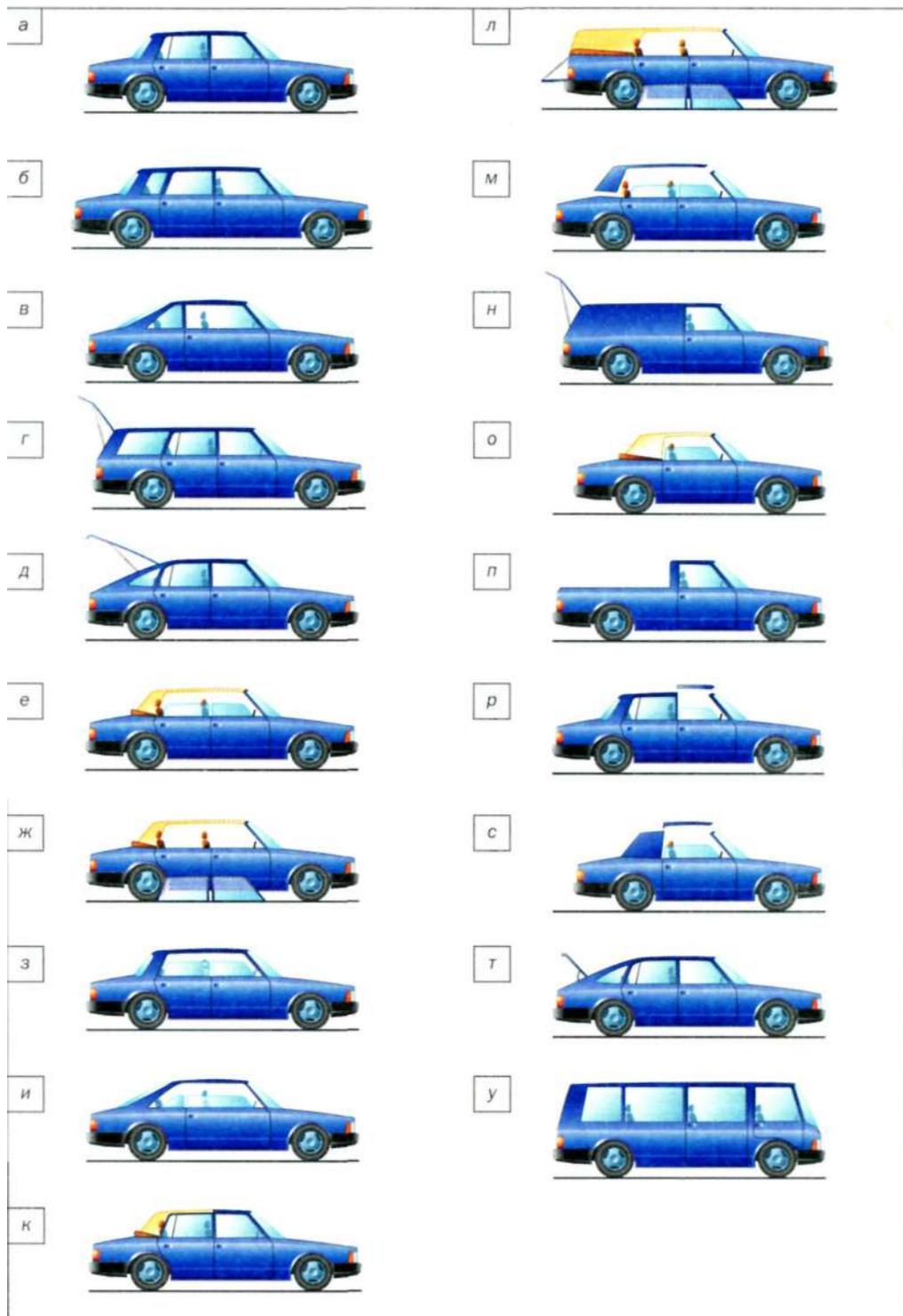
XX

§43

(. 7.2),



. 7.2.



. 7.3.

§44

...).

(... .114)

... :

()

()

—

(, ...).

« »

(. 7.4), (. 7.46,)

(. 7.4).

—

()

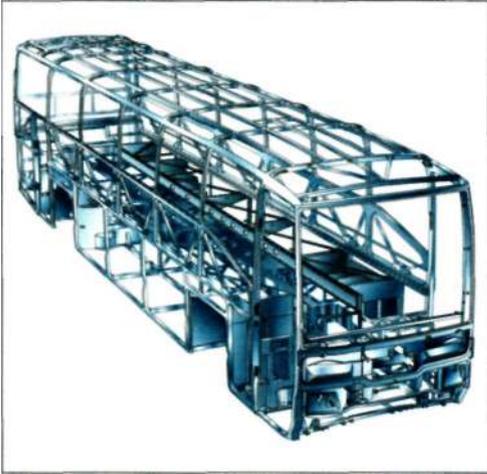
()).

).

(CAD — Computer Aided Design),

(FEM — Finite Element Modelling)

(. 7.5),



. 7.5.



. 7.6.



. 7.7.



. 7.8.

(. 7.6).

(. 7.7).

(. 7.8),

(, ,)

(. 7.9).



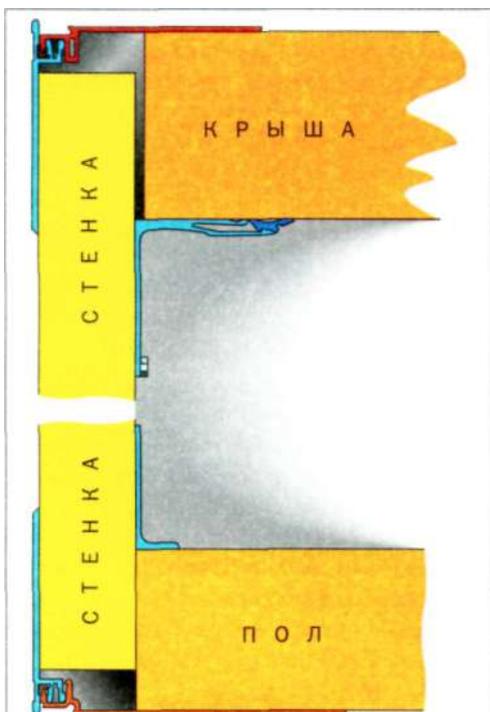
. 7.9. : — ; —

),

(

(

).



. 7.11.

: —

; 6 —

;

—

. 7.10.

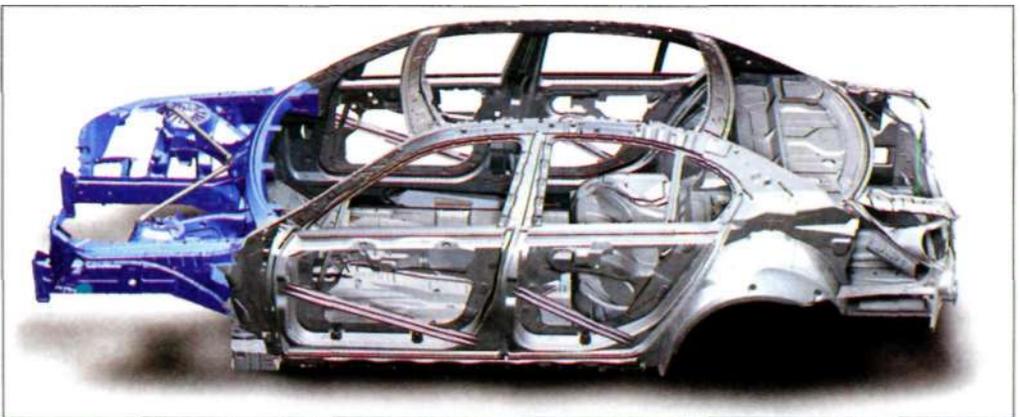
50 %

(. 7.12),

().

(,),

(. 7.13)
ASF Audi,



. 7.13.

()

), (PTFE) (PVC — Polyvinyl Chloride)

(GRP — Glass Reinforced Plastic),

Compound),

(DMC — Dough Moulding Compound).

(SMC — Sheet Moulding

« »

« »

(Sandwich) —

§46



7.14.

20

100 % -

10-18

(7.14).

(20-30);

(35);

(35-45);

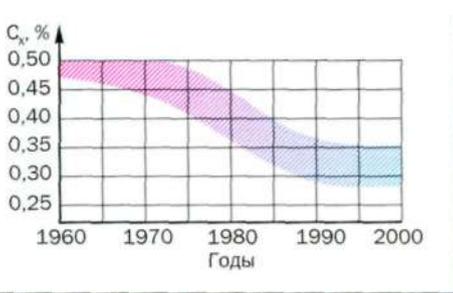
(40-45).

§47

« : »

—
—
—
—
—

(40 ,)



. 7.15.

XX

(. 7.15). 1,5 100

(. .), (. 7.16).



. 7.16.



(. 7.17).



. 7.17.

() (. 7.18).

(. 7.19).



. 7.18.

1 —

; 2 —

; 3 —

; 1 2, —



. 7.19.

Volvo FH



. 7.20.

(. 7.20),

§48

10 . 50 / , 100 g,

100 .

(. .),

50 / ,

80 .

20 g.

35

() (. 7.21).

30°

1



. 7.21.

40 %-

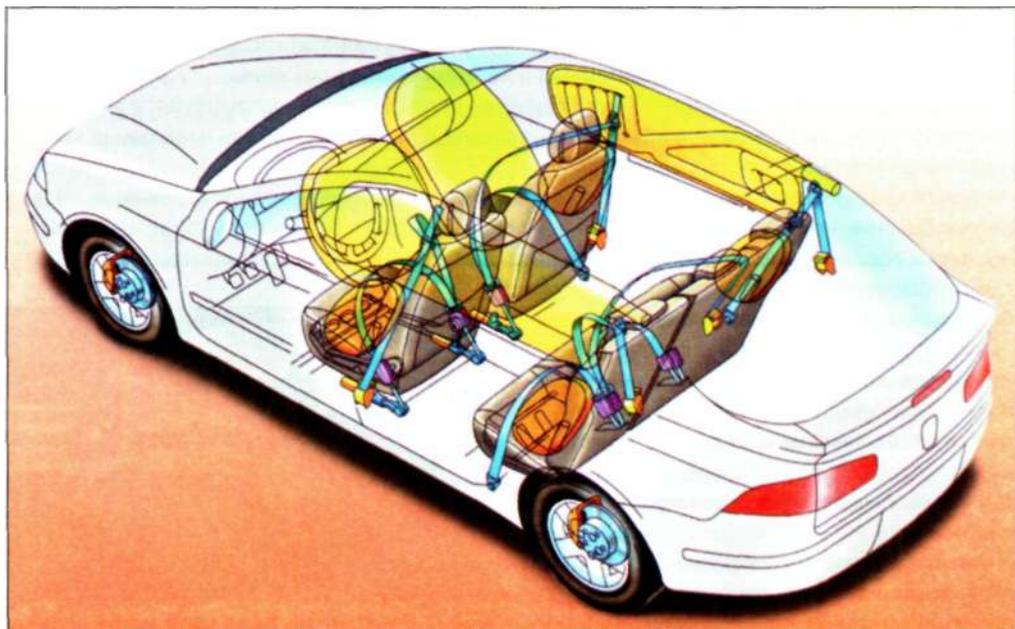
Euro-NCAP
64 / . Euro-NCAP

80 /

56 %

1990-

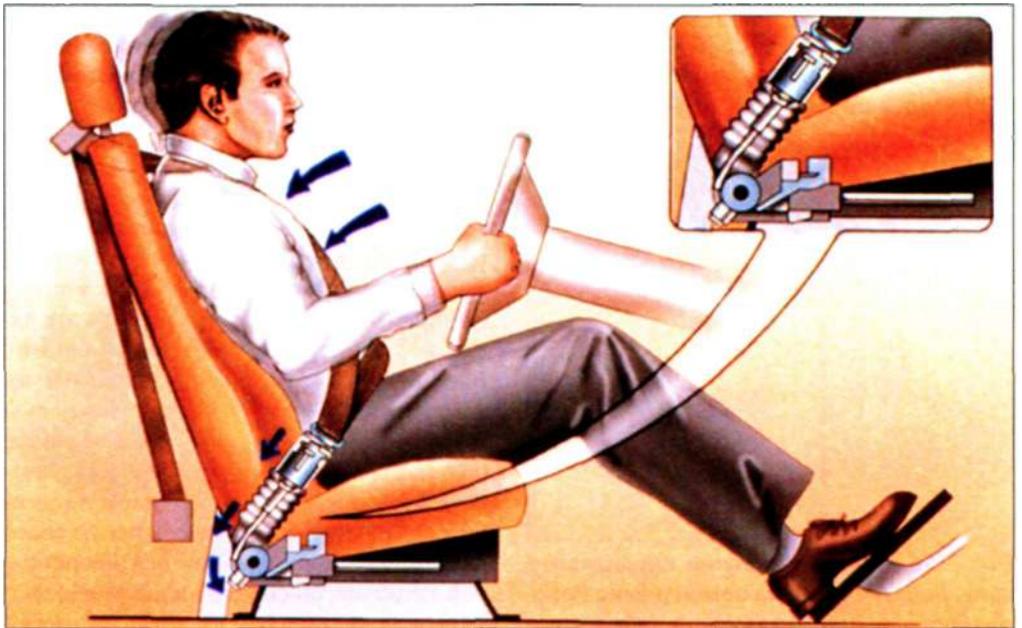
64 / .



. 7.22.

Renault Laguna II

. 7.22.

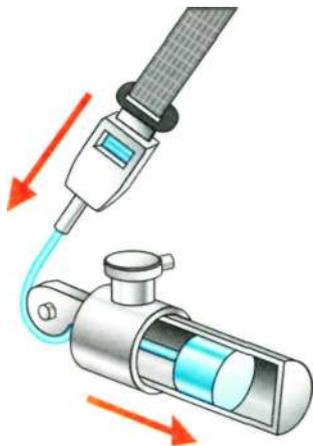


. 7.23.

()

(. 7.24);

25



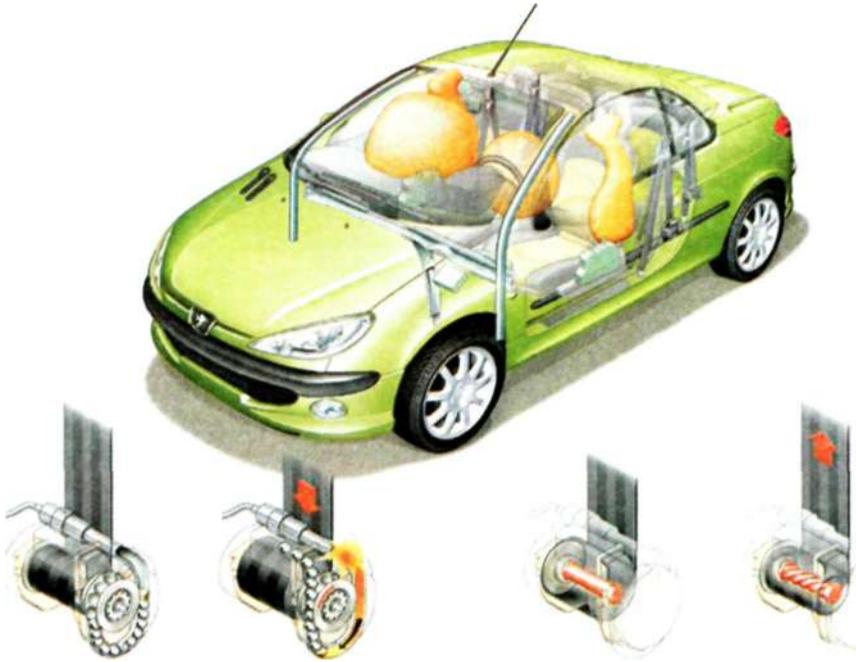
Renault

(. 7.25).

. 7.24.

()

30-50 %.



. 7.25.

(. 7.26).

ISOFIX,

ISOFIX,



. 7.26.



ISOFIX

30

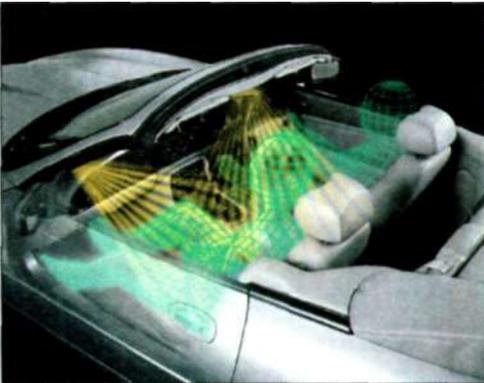
60

(4),

— 150

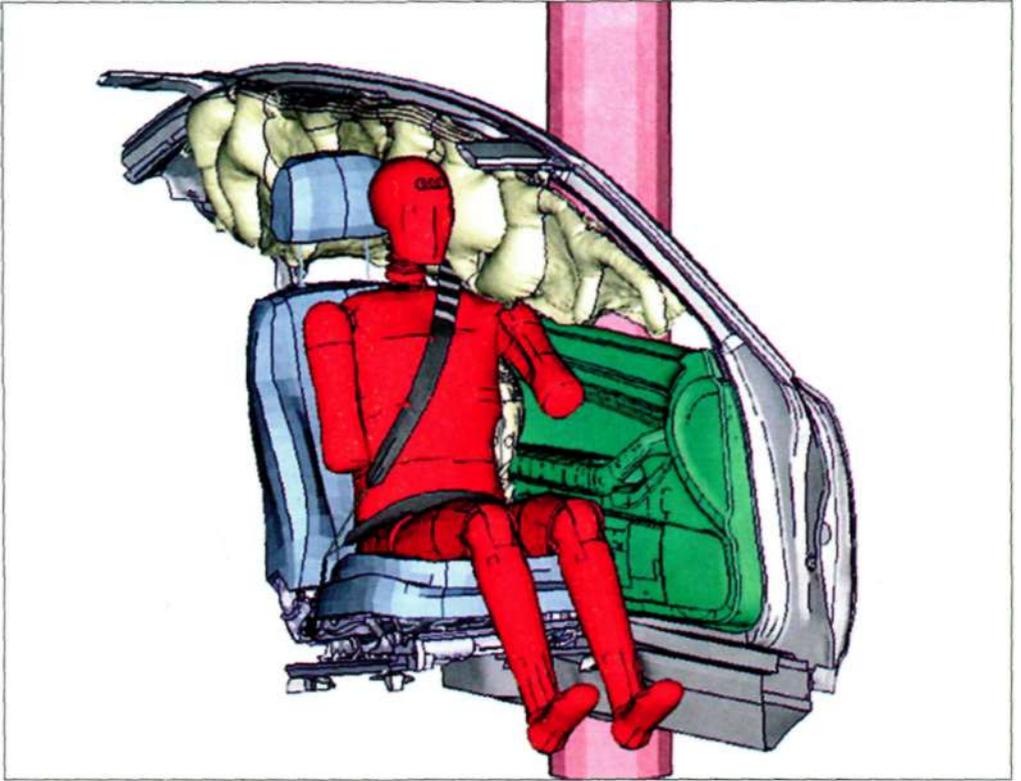
(

(. 7.27).



. 7.27.

(. 7.28).



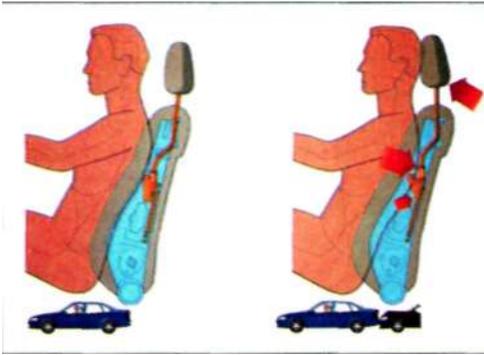
. 7.28.

(. 7.29).



(. 7.30),

. 7.29.



. 7.30.

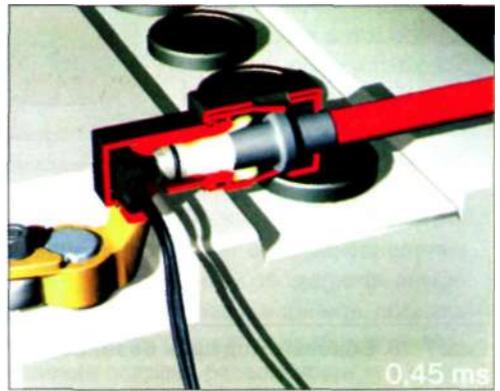
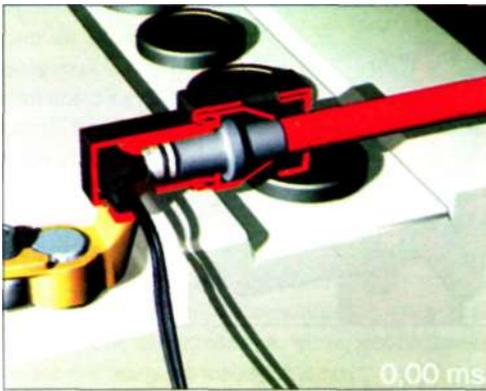


Рис. 7.31. Аккумулятор с отключаемыми клеммами (BMW)

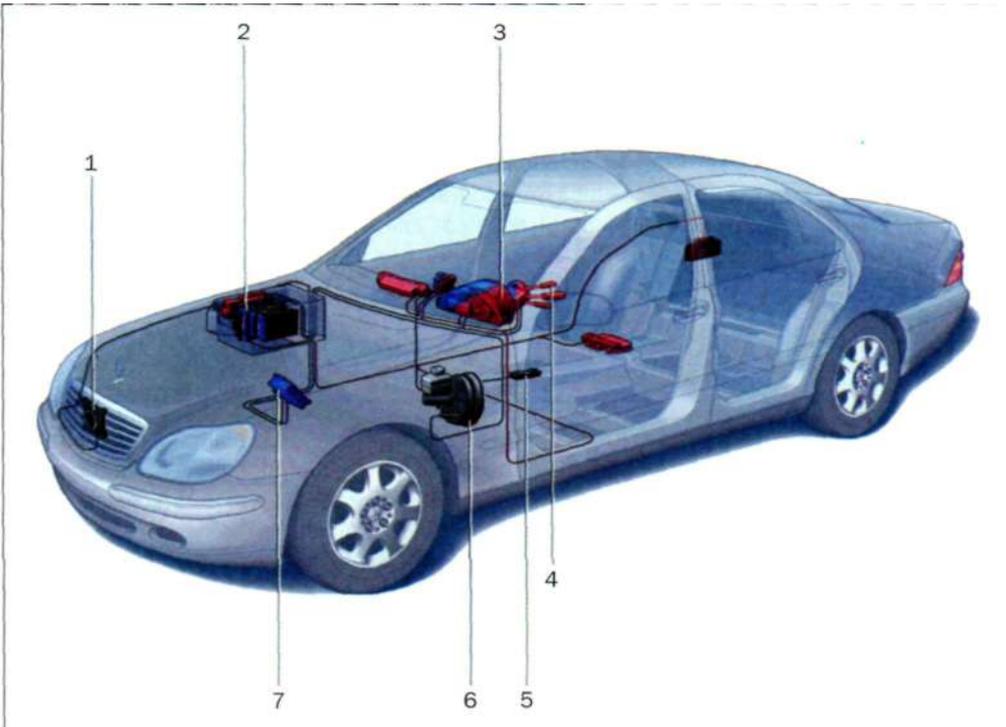
Volvo

WHIPS,

(. 7.31).

(,),

« »



.7.32.

1 —
3 —
; 6 —

; 2 —
DISTRONIC; 4 —
; 7 —

DISTRONIC

DISTRONIC:
ESP;

; 5 —

tronic (. 7.32)

Mercedes-Benz S-

ESP.

dis-

«

§49

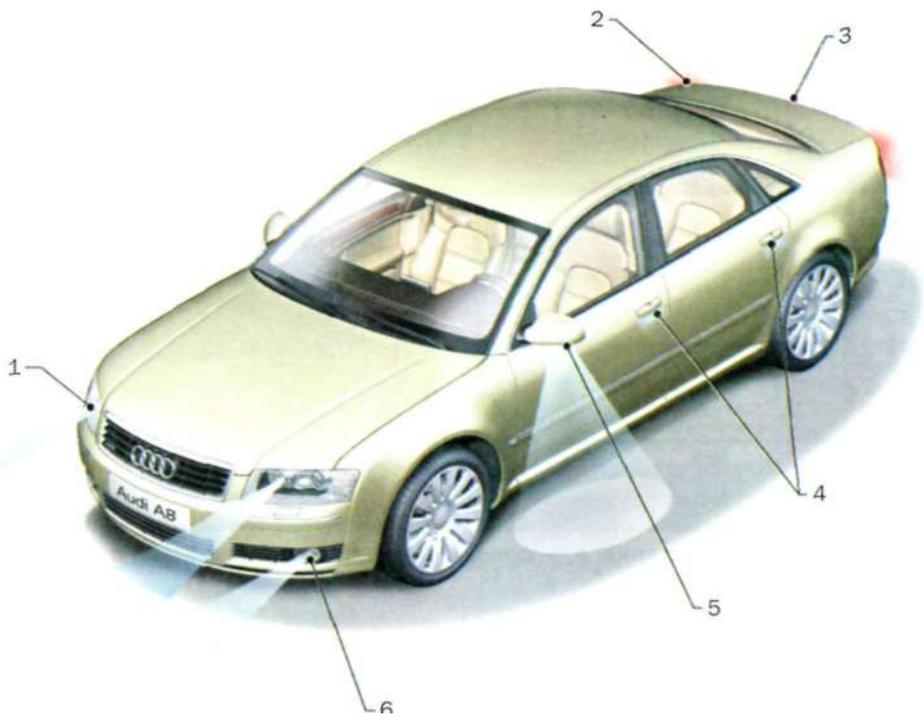
(HID — High Intensity Discharge)

3 000 ,
HID,

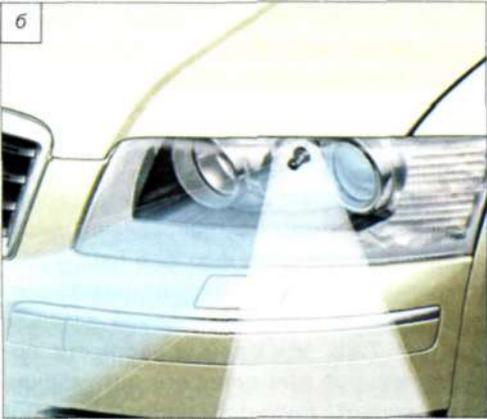
HID-

35
60

a

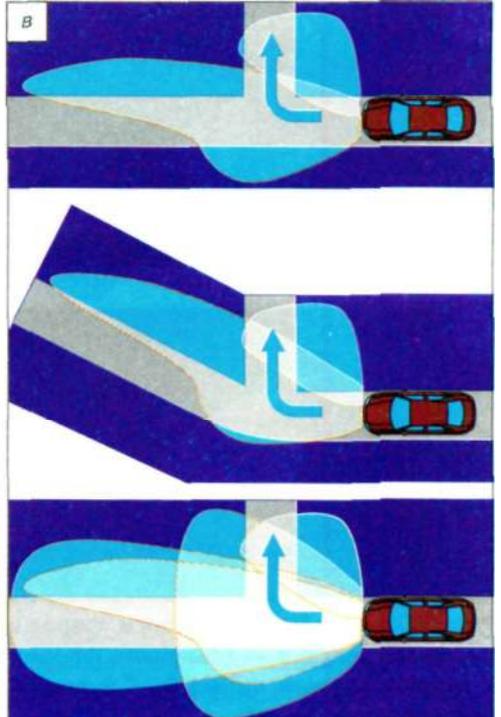


6



. 7.33.

1 — ; 2 — () ;
 3 — ; 4 — ;
 ; 5 — ;
 ; 6 — () ;
 () ;
 ()





7.34.

: —

; —

BMW; —



7.35.

: —

; —

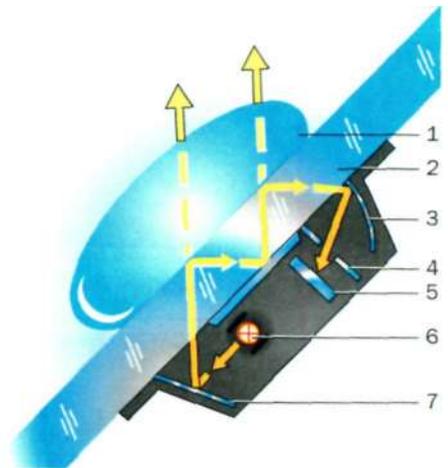
« » (7.33),

(7.35):

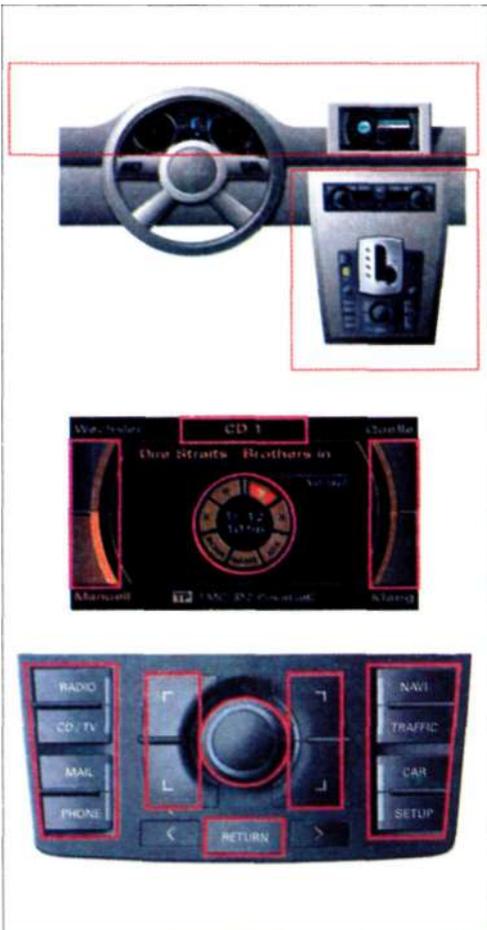
(7.34).

Bosch Valeo

Mercedes



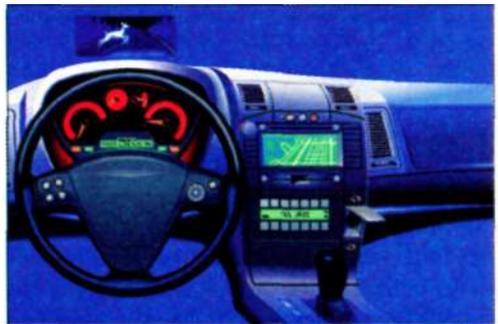
- 7.36. : 1 —
; 2 — ; 3 — ;
4 — ; 5 — ; 6 —
; 7 —



(. 7.37).

(. 7.38).

. 7.37.



. 7.38.

CD DVD,

(GPS — Global Positioning System).

GPS

» (« »).

(. 7.39).



Jaguar,

»

«

. 7.39.



. 7.40.

(. 7.40).

Mercedes-Benz

20-

1950 . 70-

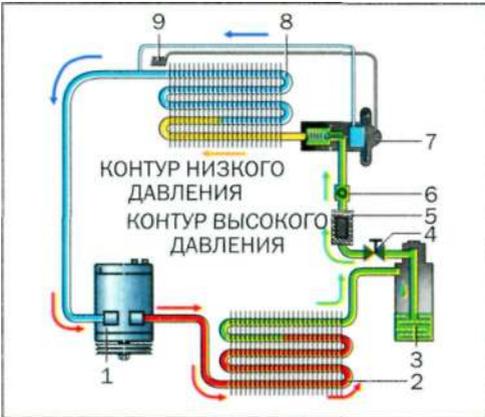
(,),

(.7.41)

(),

(CFC)

(, 12).



R134a.

(HFC),

R134a,

().

. 7.41.

: 1 —

; 2 —

; 3 —

4 —

; 5 —

; 6 —

; 8 —

9 —

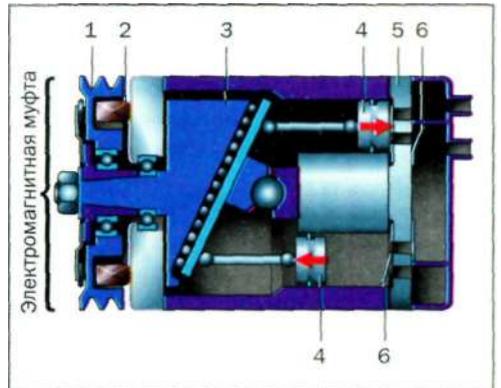
(R134a).

(. 7.42).

(5-7)

().

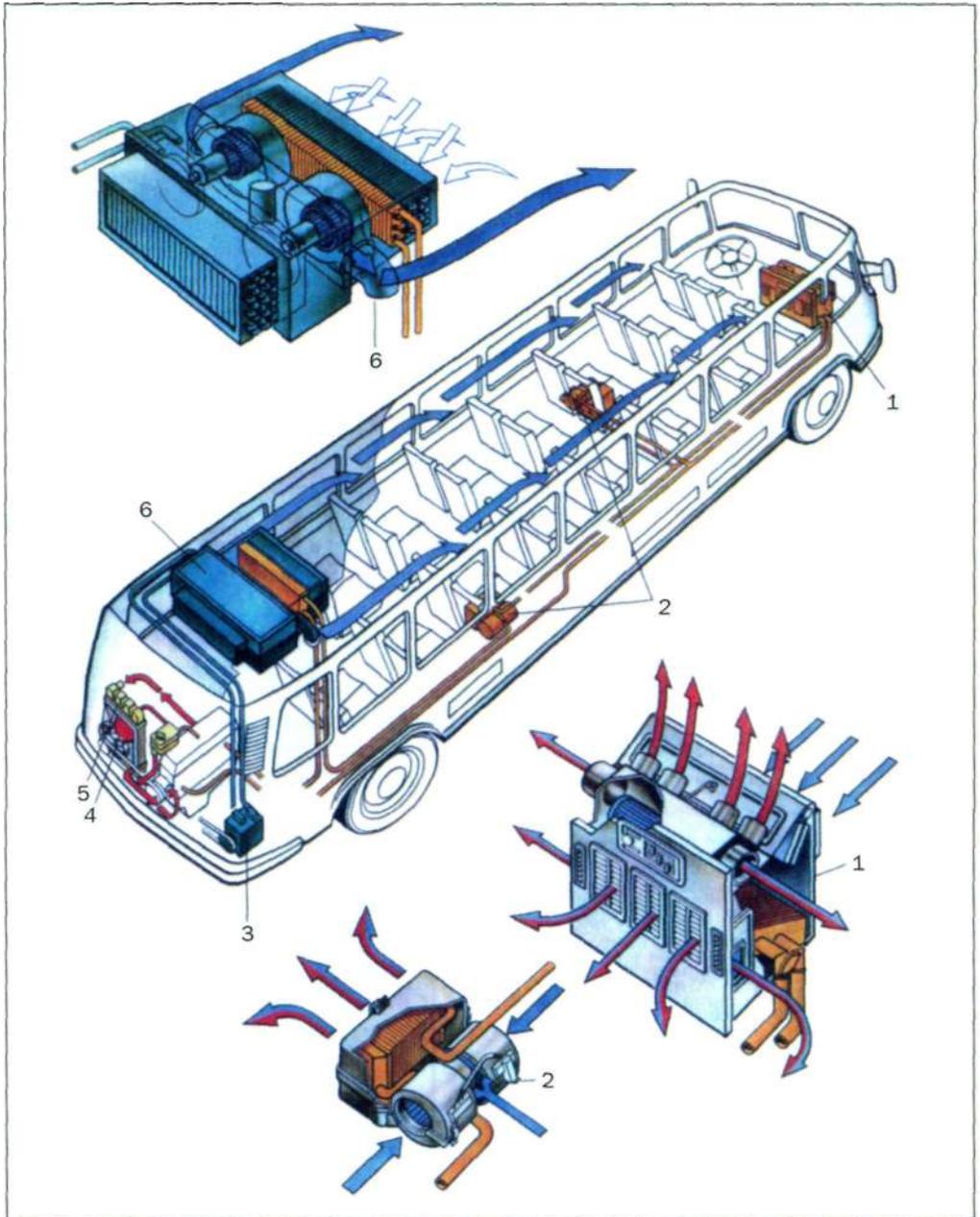
(HVAC —
Heating, Ventilation and Air Conditioning).



. 7.42.

- 1 — ; 2 —
- 3 — ; 4 — ;
- 5 — ; 6 —

(. 7.43).



. 7.43. : 1 — ;
2 — ; 3 — ; 4 — ;
5 — ; 6 — ;

8

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-
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-
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§50

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1. ，
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()
，
2010 . -

2.

O₂,

2010 .

2000 .

25 %.

3.

1,5

(

.)

(

),

(

).

§51

100

()

O₂

(LPG — Liquefied Petroleum Gas)

10 %

O₂,

Natural Gas) — (CNG — Compressed



8.1. BMW 740 hL

(Methanol) —

5 %

(Ethanol) —



8.2. Mini Cooper,

4 %

(2) —

(Volvo, Vauxhall, Mercedes).

BMW, BMW 750hL Mini Cooper Hydrogen (. 8.1; 8.2)

§52

60-80

40

«

».

(. 8.3).

1990-

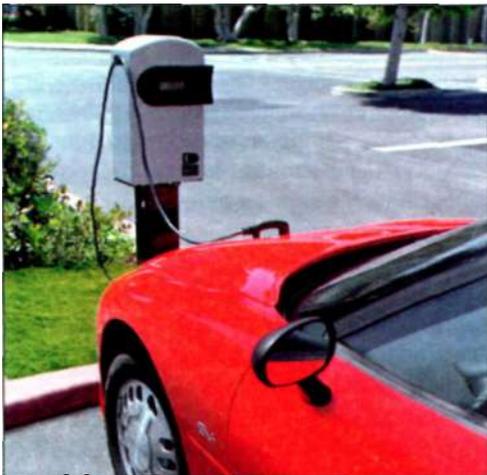
()

()

? !

Electric Vehicle);

HEV (Hybrid



. 8.3.

Electric Vehicle —

FCEV (Fuel Cell

).

()

4,5 / 1 12 / ,
 50 - , 0,6 / - 12 , -
 1 20 . ,
 160 .

70- XX

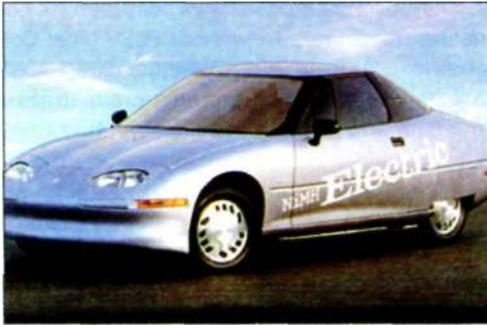
(- , -).

(. 8.4).

). 1997 . Honda

10

12 , . .



8.4.

GM

XIX

Zero Pollution Motors 2000

e.Volution,

30 000

300 96,5 / 200 3

4

40 000

e.Volution

1990-

2000 . (),
Honda

Insight,

70-120 ,

Zytec ()

60 -

13

Mitsubishi

perator —

).

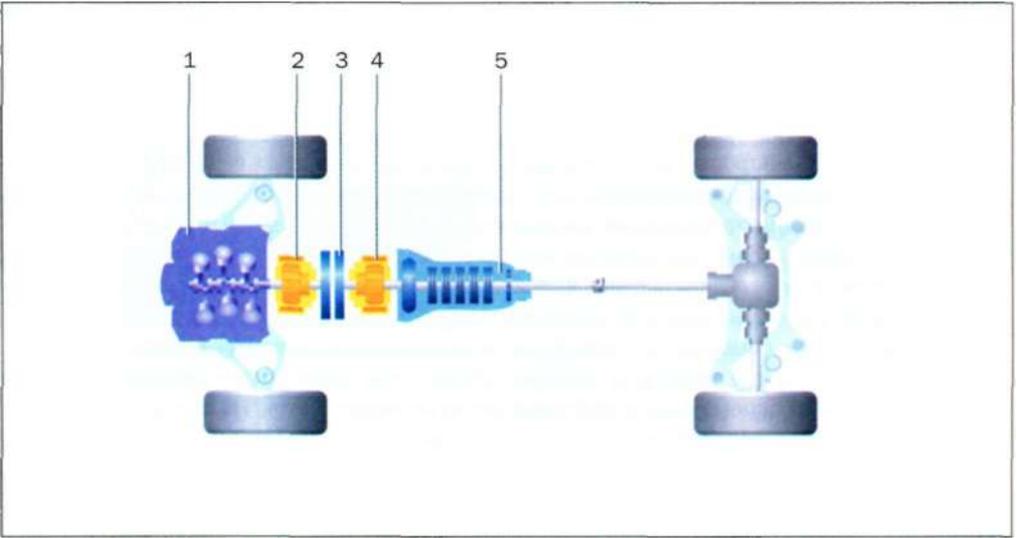
(. recu-

()

(. 8.5),

)—

(



8.5.

DaimlerChrysler

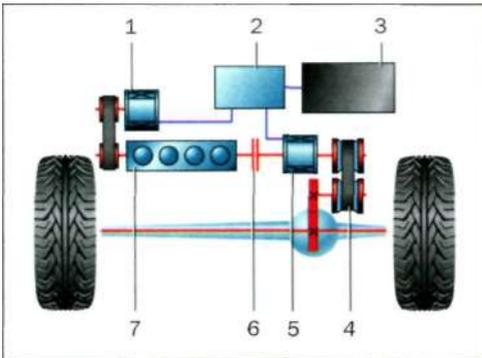
«

»: 1 — (); 2 — 1; 3 — ; 4 —
2; 5 —

30 %

Nissan

1999 . (. 8.6).



8.6.

: 1 —

; 2 — ; 3 —

; 4 — CVT;
5 — ; 6 — ;

7 —

OG 18DE

Insight.
HV-M4

(. 8.7).

Toyota Honda
Toyota Prius
Toyota

2,4

Toyota, 2003 .

Toyota Prius

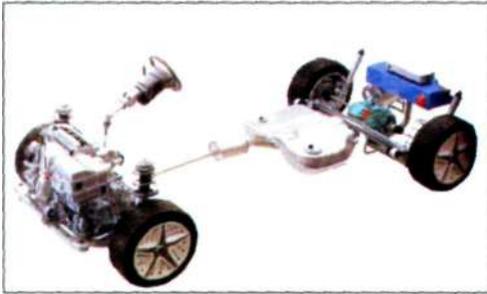


Рис. 8.7. Шасси гибридного автомобиля Toyota HV-M4



8.8.

Ford

Model	Year	Price (USD)	Price (EUR)
Honda Insight	2000	113	91
Toyota Prius	2000	1500	1130
Insight	2000	1130	910
Toyota Prius — Insight	2000	1500	1130
Citroen FIAT	2000	1500	1130
(Volvo, Ford, FIAT, GMC)	2000	1500	1130

1824

50 %.

),
50 %,

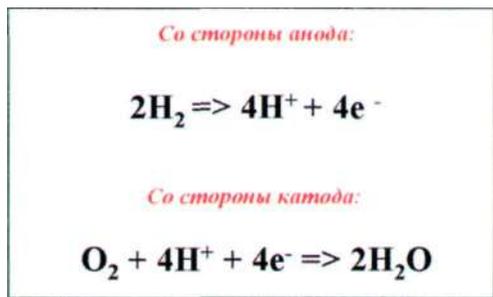
1960-

(1000 °).

(PEMFC — Protone Exchange Membrane Fuel Cell).

(. 8.9).

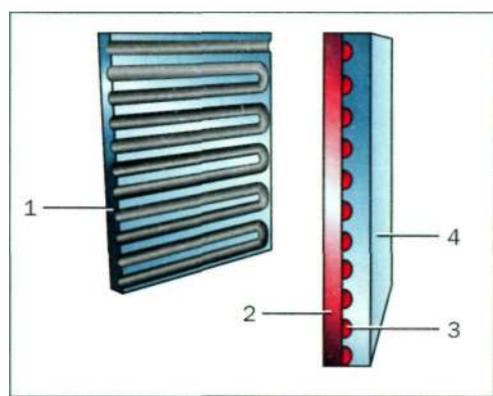
()



. 8.9.

(PEMFC)

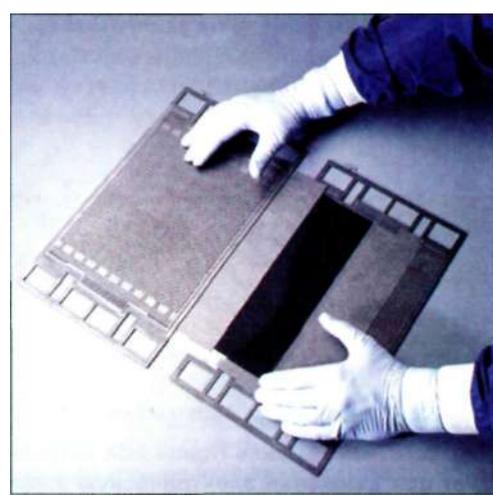
(. 8.10).



. 8.10.

: 1 — ; 2 —
 (); 3 — ()
); 4 —

()



. 8.11.

(. 8.11),

().

()

().

(2)

(+)² (~).
(),
)

(O₂)

() (20).

0,7

(80 °),



(DaimlerChrysler, GM, Ford, Honda, Toyota)

1999

. 8.12.

DaimlerChrysler
Mercedes

DaimlerChrysler 1994 .
NECAR I



Benz

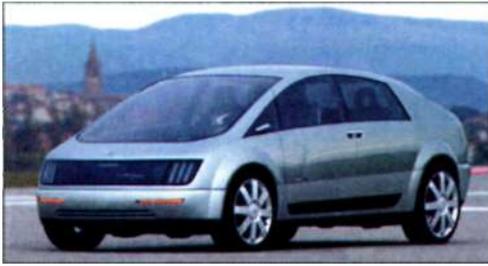
NECAR V
Mercedes-

(. 8.12).

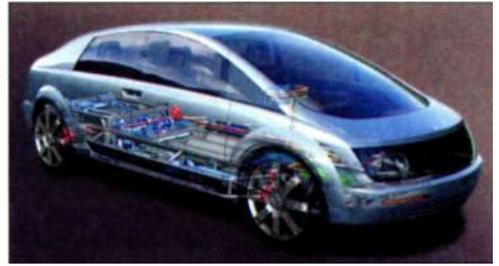
. 8.13.

Honda FCX

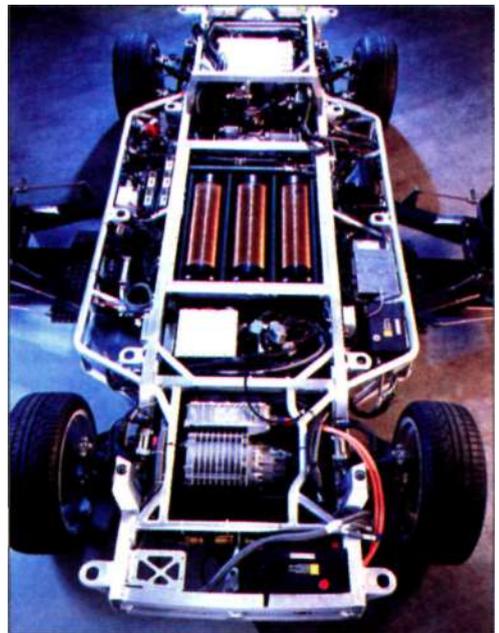
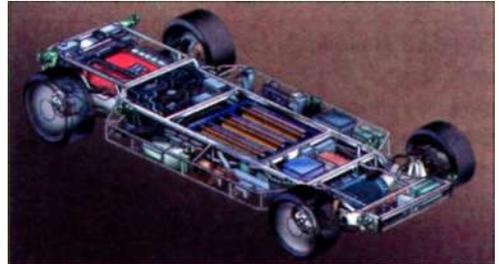
(



. 8.14.



Wire General Motors



. 8.15. Wire

Honda,
2003
Honda FCX-V4

1989

Ballard.

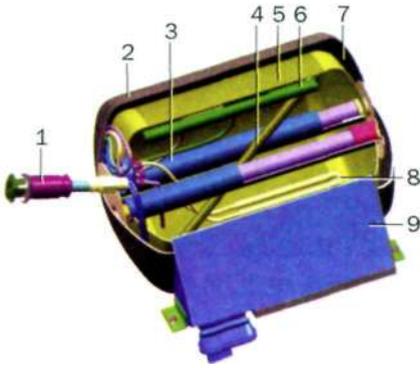
78

60

272

40 %

355



. 8.16. **BMW** -
Magna Steyer -
 " » -
 : 1 — -
 ; 2 — ; 3 — ; -
 4 — ; 5 — ; -
 6 — ; 7 — -
 ; 8 — ; 9 — -



. 8.17. **BMW 750 hL** -



. 8.18. **BMW 750 hL** — -

Honda FCX — -

ZEV — Zero Emission Vehicle (-
). -

Honda -
 , 30 -

General Motors (. 8.14). -

GM Wire 26 -

150 (. 8.15) -

Wire -

Opel -

BMW. -

Magna Steyer, -

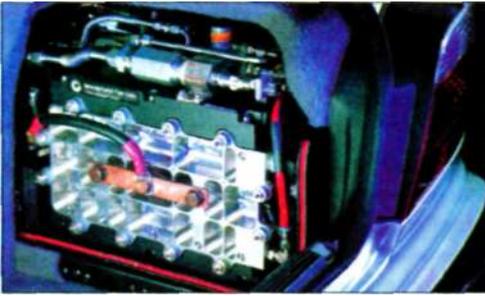
, BMW -

(. 8.16). -

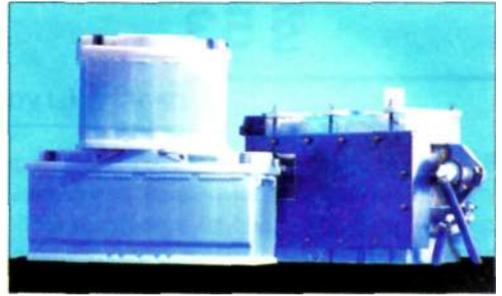
(. 8.17). -

2002 . -

() -



. 8.19.



BMW 750 hL

Mini Cooper Hydrogen,

2003 . BMW

BMW 750 hL (. 8.18).

12-

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« — » (The Total Life Cycle — TLC).

(Recycling),

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75 % 1987

25 %

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2000 .

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