FOREWORD

This latest edition of our Workshop Manual is designed to assist in ensuring that all necessary maintenance and repair work is carried out in a skilled and competent manner. It is for the use of master mechanics and fitters whose practical and theoretical training at our Service School will be complemented by the detailed information provided in this reference work.

Each main section is preceded by the relevant Technical Data.
The same classification system has been adopted as that used in our Flat Rate Catalogue.

The page references are broken down as follows, for example 33–10/2:

33 Main Section
–10 Sub Section
/ 2 Running page number in the Sub Section

The special tools necessary for carrying out some aspects of repair work are summarized in our Special Tool Catalogue, Order Number 01 99 9 099 421. In each case their use is illustrated for relevant jobs.

For each operation a description of the removal procedure is always given. If refitting is not possible in reverse sequence appropriate fitting instructions will be provided.

In addition to the improvements and modifications which are notified regularly by circulars we can recommend our clearly and generously illustrated Spare Parts Catalogue as an additional source of information.

BAYERISCHE MOTOREN WERKE AG
Customer Service Department

Published by Bayerische Motoren Werke AG, Customer Service Department, 8 Munich 40, Western Germany.
All rights reserved. Reproduction in whole or in part only with our express written permission.
Printed in Germany

Repair manual

BMW R60/6 75/6
90/6 90S

Bayerische Motoren Werke AG München

Tightening torques and preload forces

Applicable only to bolts in accordance with DIN 912, 931, 933, 960, 961, 6912 and nuts with a nut height of 0.8 x d in accordance with DIN 934 and exclusively for μ ges = 0.14 (Bolts phosphate treated, nuts without aftertreatment or galvanized. Lubricated condition: either non-lubricated or oiled.)

For cadmium plated bolts or nuts (μ ges $\approx$ 0.08 to 0.09) the tightening torque must be $\approx$ 30% less than in the table with the same utilization factor of the bolt material.

Not applicable when another surface or lubricated condition of the thread is used or if there is a variation in the nut height. In such cases it is necessary to determine the values separately.

Not applicable to bolts with expansion shanks, self-locking screw connections as well as screw connections of parts made of different materials. The utilization factor of the bolt in the case of a standard metric thread is:

$$\sigma_{red} = 0.09 \cdot \sigma_{0.2}$$

Thread	Tightening torque M_A mkp / ft. lb — Strength rating as per DIN 267						Preload force P v kp / lb — Strength rating as per DIN 267					
	5.6	6.8	6.9	8.8	10.9	12.9	5.6	6.8	6.9	8.8	10.9	12.9
M 6	0.4+0.1 2.9+0.7	0.6+0.1 4.3+0.7	0.7+0.1 5+0.7	0.9+0.1 6.5+0.7	1.2+0.2 8.7+1.4	1.5+0.2 10.8+1.4	425 937	600 1323	685 1510	855 1885	1210 2668	1440 3175
M 8	1.0+0.1 7.25+0.7	1.6+0.2 11.6+1.4	1.8+0.2 13+1.4	2.2+0.2 16+1.4	3.0+0.3 21.7+2.2	3.6+0.4 26+2.9	740 1631	1190 2624	1330 2932	1570 3462	2170 4785	2630 5799
M 10	2.0+0.2 14.5+1.4	3.2+0.4 23.1+2.9	3.6+0.4 26+2.9	4.3+0.5 29+3.6	6.0+0.7 43.4+5	7.3+0.8 52.8+5.8	1160 2558	1880 4145	2090 4608	2500 5512	3480 7673	4200 9261
M 20 x 1.5	1.0+0.1 7.2+0.7	1.0+0.2 7.2+1.4	1.8+0.2 13+1.4	2.2+0.2 16+1.4	3.0+0.3 21.7+2.2	3.6+0.4 26+2.9	740 1631	1190 2624	1330 2932	1610 3550	2200 4851	2670 5887
M 8 x 1	2.0+0.2 14.5+1.4	3.2+0.4 23.1+2.9	3.6+0.4 26+2.9	4.3+0.5 29+3.6	6.0+0.7 43.4+5	7.3+0.8 52.8+5.8	1160 2558	1900 4189	2120 4674	2520 5556	3530 7784	4250 9371
M 10 x 1.25	3.4+0.4 24.6+2.9	5.4+0.6 39+4.3	6.1+0.7 44.1+5	7.2+0.8 52+5.8	10.3+1 74.5+7.2	12.0+1.5 86.7+10.8	1720 3792	2710 5975	3070 6769	3610 7960	5100 11245	6090 13428
M 12 x 1.25	3.4+0.4 24.6+2.9	5.4+0.6 39+4.3	6.1+0.7 44.1+5	7.2+0.8 52+5.8	10.3+1 74.5+7.2	12.0+1.5 86.7+10.8	1690 3726	2670 5887	3030 6681	3570 7872	5040 11113	6000 13230
M 12 x 1.5	5.4+0.6 39+4.3	8.6+1 62.2+7.2	9.8+1 71+7.2	11.5+1.5 83+10.8	16.0+2 115.7+14.5	20+2 144.6+14.5	2330 5137	3720 8202	4180 9217	5030 11091	6970 15369	8510 18764
M 14 x 1.5	8.3+1 60.0+7.2	13.5+1.5 97.6+10.8	15.5+1.5 112+10.8	18.0+2 130+14.5	25+3 180.7+22	30.0+4 217+29	3240 7144	5190 11444	5840 12877	6920 15258	9710 21410	11770 25953
M 16 x 1.5	11.0+1.5 19.5+10.8	18.0+2 130+14.5	20.0+2.5 144.6+18	24.0+3 173.5+22	34.0+4 246+29	40.0+5 289+36	3890 8577	6240 13759	7020 15479	8380 18478	11800 26019	13960 30782
M 18 x 1.5	16.0+2 115.7+14.5	26.0+3 188+22	29.0+3.5 210+25	34.0+4 246+29	49.0+5 354+36	59.0+6 426.6+43.4	5070 11179	8170 18015	9180 20242	10680 23549	15200 33516	18250 40159

The values stipulated in the table apply to a screw connection which corresponds to the above conditions. The tightening torque including tolerance is only given on the layout or assembly drawing if

a) a value different from the Standard sheet is necessary for operational reasons,
b) the strength rating of the bolt and nut is not evident.

Note: All deviations from this table have been taken into account in the technical data

A BMW Standard regarding tightening and test torques for screw connections with self-locking nuts as per DIN 985 and BMW N 113 48.0 is being prepared.

Tightening torques

for self-locking nuts

BMW N
113 49.0

Applicable only to nuts in accordance with BMW N 113 48.0 and DIN 985.

Surface condition: Bolt phosphate treated or galvanized, nut galvanized and not waxed. Lubricated condition of bolt: either non-lubricated or lightly oiled.

For cadmium plated bolts or nuts the tightening torque, with the same utilization factor of the bolt material, must be $\approx$ 30% less than the value in the table.

Not applicable in the case of another surface or lubricated condition of the thread, a strength rating of the bolt of less than 8.8 (e. g. 6.9) in conjunction with expansion bolts.

In such cases it is necessary to determine the values separately.

Thread	Tightening torque M_A mkp / ft. lb — Nuts as per BMW N 113 48.0 Strength rating			Nuts as per DIN 985 Strength rating		
	8	10	12	8	10	12
M 6	1.1+0.1 7.9+0.7	1.5+0.2 10.8+1.4	1.8+0.2 13.0+1.4	1.0+0.1 7.2+0.7	1.3+0.2 9.4+1.4	1.6+0.2 11.6+1.4
M 8 M 8 x 1	2.5+0.3 18.0+2.2	3.4+0.4 24.6+2.9	4.0+0.5 29.0+3.6	2.5+0.2 18.0+1.4	3.3+0.3 24.0+2.2	3.9+0.4 28.2+2.5
M 10 M 10 x 1.25	35.4+0.5 4.9+3.6	6.8+0.8 49.0+5.8	8.0+0.9 57.8+6.5	4.7+0.5 34.0+3.6	6.4+0.7 46.3+5	7.7+0.8 55.7+5.8
M 12 M 12 x 1.5	8.1+0.9 58.5+6.5	11.4+1.3 82.4+9.4	13.5+1.5 97.6+10.8	7.8+0.8 56.4+5.8	10.9+1 78.8+7.2	12.6+1.5 91.0+10.8
M 14 M 14 x 1.5	13.0+1.5 94.0+10.8	18.0+2 130.0+14.5	22.0+2 159.0+14.5	12.7+1.5 92.0+10.8	17.0+2 123.0+14.5	21.0+2 152.0+14.5
M 16 M 16 x 1.5	22.5+2 162.7+14.5	28.0+3 202.0+22	33.0+4 238.6+29	19.5+2 141.0+14.5	26.0+3 188.0+22	31.0+4 224.0+29
M 18 M 18 x 1.5	27.0+3 195.0+22	38.0+4 274.7+29	44.0+5 318.6+36	26.0+3 188.0+22	36.0+4 260.0+29	42.0+5 303.6+36

The respective preload forces Pv (kp/lb), according to the individual strength ratings, can be taken from the table "Tightening torques and preload forces" in BMW N 600 02.0.

The values stipulated in the table apply to a screw connection which corresponds to the above mentioned conditions. The tightening torque including tolerance is only given on the layout or assembly drawing if a value different from the Standard sheet is necessary for operational reasons.

In the case of a screw connection which is highly stressed dynamically an exact examination by means of calculations and tests is essential.

BMW N 600 02.0

Bolts and Screws

Description	Head shape	DIN No.	Strength rating
Hexagon bolts		931 933 960 961 70614	8.8 10.9 12.9
		561	8.8
Cheese-head screws		84	4.8 8.8
		912 6912	8.8 10.9
Button-headed screws		7986	4.8
Carriage bolts		603	4.6 8.8
Countersunk screws		63	4.8 8.8
		7987	4.8 8.8
Oval-head screws		920 921	5.6[4]
		7985	4.8
Oval-head countersunk screws		91	4.8 8.8
		7988	4.8
Cheese-head self-tapping screws		7971	[1]
Hexagon self-tapping screws		7976	[1]

Description	Head shape	DIN No.	Strength rating
Countersunk self-tapping screws		7982	[1]
Oval-head self-tapping screws		7981	[1]
Oval-head countersunk self-tapping screws		7983	[1]
Stud bolts	–	833 835 836 838 939 940	8.8
Threaded pins		417 551 553	[2] [4]
		438	4.8[4]
Shoulder studs		427	5.8
Winged screws		316	4.6
Screw plugs		906 908	4.6
		910 7604	5.6[4]
Hollow screws		7623 71436	6.8
Cap screws		3871	5.6[4]
Slotted plugs		71022	5.6[4]

Nuts

Description	shape	DIN No.	Strength rating
Hexagon nuts		439	[5]
		985	8 10[4]
		934	[3]
		936	6G 8G
		70615 70616	8/10[4] 6G/8G[4]
Castellated nuts		935 937	8/10 6S/8G
Wing nuts		315	GTS

Description	shape	DIN No.	Strength rating
Square nuts		557	5–2
		562	4D–2
Cap nuts		986	8[4]
		1587	6–2
Slotted nuts		70851 70852	6G[4]
Screw caps		3870 7606	5D–2[4]
Knurled nuts		466 467	5–2
Ball collar nuts Flat collar nuts		74361	8/10

[1] Case hardened steel, tempered file-hard, depth of case 0.1 . . . 0.2 mm (0.004 . . . 0.008")
[2] up to M 10: 4.8, from M 12: 4.6
[3] up to M 4: 5–2, from M 5: 8 and 10
[4] The stipulated strength characteristics deviate from the DIN specification
[5] up to M 8: 4D-2, for M 10: 5S-2

11 Engine

Technical Data . . . . . page 11– 0/3

11 00 039 Compression-testing 11–00/1
11 00 050 Engine-removing and refitting 11–00/2
11 11 527 Cylinders-boring and honing 11–11/1
11 12 080 Cylinder head – removing and refitting 11–12/1
11 12 513 Cylinder head – dismantling, assembling and valve grinding 11–12/3
11 12 561 Valve guides – renewing 11–12/5
11 12 621 One valve seat ring – renewing 11–12/5
11 14 060 Timing cover – removing and refitting 11–14/1
11 14 651 Crankshaft radial seal – renewing 11–14/2
11 14 691 Revolution counter drive radial seal – renewing 11–14/2
11 14 671 Camshaft radial seal – renewing 11–14/2
11 15 101 Engine breather hose – renewing 11–15/1
11 15 111 Check valve for breather – renewing 11–15/1
11 21 001 Crankshaft – renewing 11–21/1
11 21 531 Main bearing bushes – renewing 11–21/3
11 22 000 Flywheel – removing and refitting 11–22/1
11 24 000 Connecting rod – removing and refitting 11–24/1
11 25 000 Piston – removing and refitting 11–25/1
11 31 061 Timing chain gear train – renewing 11–31/1
11 34 504 Valve clearance – adjusting 11–34/1
11 41 000 Oil pump – removing and refitting 11–41/1

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Engine Lubrication:				
Lubrication system	Force feed circulation			
Oil filter	in main circuit			
Differential pressure for opening the bypass valve – atmg (psi)	1.5 (172)			
Oil pressure warning lamp lights at below	0.2÷0.5 atmg (2.9÷7.3 psi)			
Safety valve opening pressure – atmg (psi)	5.0 (73.4)			
Oil filling quantity without filter change – litres (Imp/US pints) with filter change – litres (Imp/US pints)	2.0 (3.5/4.2) 2.25 (4.0/4.7)			
Oil consumption litres/100 km max.	0.1			
Type of oil:	HD branded oil for internal combustion engines			
Viscosity at external temperature, primarily over +30° C over 0° C below 0° C	 SAE 40 SAE 20 W 40 SAE 10 W 30	 SAE 10 W 40	 SAE 20 W 50 SAE 20 W 50 SAE 10 W 50	
Oil Pump				
Oil pump design	Eaton type (Hyp. Trochoidal gearing)			
Delivery litres/hour at rpm	1400 6000			
Outer rotor diameter, mm(in)	$57.1\,^{0}_{-0.025}$		$(2.22\,^{0}_{-0.0009})$	
Housing inner diameter, mm(in)	$57.2\,^{+0.046}_{0}$		$(2.23\,^{+0.0017}_{0})$	
Outer rotor/pump housing clearance, mm(in)	0.10÷0.17 (0.0039—0.0066)			

11-0/5

11-0/6

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Rotor height, mm(in)	$14\,^{-0.016}_{-0.034}$		$(0.54\,^{-0.00066}_{-0.0013})$	
Housing depth, mm(in)	$14\,^{+0.025}_{+0.010}$		$(0.54\,^{+0.00097}_{+0.00039})$	
Clearance between pump housing base and rotor seal base, mm(in)	0.026÷0.059 (0.001÷0.0023)			
Gap between inner and outer rotor, mm(in)	0.12÷0.30 (0.0046÷0.0117)			
Entry depth in cover, maximum, mm(in)	0.05 (0.0019)			
Length of excess pressure spring, unbiased, mm(in)	68 (2.65)			
Valve Clearance:				
Set with engine cold, max. 35° C Inlet valve, mm(in) Exhaust valve, mm(in)	 0.15 (0.0058) 0.20 (0.0078)			
Valve timing settings	Camshaft setting with 2 mm (0.08") valve clearance			
Inlet opens Inlet closes Exhaust opens Exhaust closes	BTDC 40° ABDC 40° BBDC TDC ± 2.5°		10° BTDC 50° ABDC 50° BBDC 10° BTDC ± 2.5°	
Valves:				
Overall valve length Inlet, mm(in) Exhaust, mm(in)	 98.5—0.3 (3.84—0.12) 97.5—0.3 (3.80—0.12)		 98.8—0.4 (3.85—0.15) 98.8—0.4 (3.85—0.15)	
Valve head diameter Inlet, mm(in)	38 (1.48)	42 (1.63)	42 (1.63)	42 (1.63)
Valve head diameter Exhaust, mm(in)	34 (1.32)	38 (1.48)	40 (1.56)	40 (1.56)
Stem diameter Inlet, mm(in)	$8\,^{-0.050}_{-0.065}$		$(0.312\,^{-0.0019}_{-0.0025})$	

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Stem diameter Exhaust, mm	$8^{-0.065}_{-0.080}$	$8^{-0.050}_{-0.065}$	$8^{-0.050}_{-0.065}$	$8^{-0.050}_{-0.065}$
Minimum rim thickness of valve head Inlet, mm(in) Exhaust, mm(in)	1 (0.039) 1 (0.039)			
Valve head deflection, mm(in)	0.025 (0.0009)			
Valve seat ring: Outer diameter, mm Inlet	$39.2^{0}_{0.025}$	$43.2^{0}_{-0.025}$	$43.2^{0}_{-0.025}$	$43.2^{0}_{-0.025}$
Outer diameter, mm Exhaust	$39.2^{0}_{-0.025}$	$43.2^{0}_{-0.025}$	$43.2^{0}_{-0.025}$	$43.2^{0}_{-0.025}$
Valve seat ring bore in cylinder head: Inlet, mm	$39^{+0.025}_{0}$	$43^{+0.025}_{0}$	$43^{+0.025}_{0}$	$43^{+0.025}_{0}$
Exhaust, mm	$39^{+0.025}_{0}$	$43^{+0.025}_{0}$	$43^{+0.025}_{0}$	$43^{+0.025}_{0}$
Interference fit in head Inlet, mm Exhaust, mm	0.15÷0.20 0.15÷0.20	0.15÷0.20 0.11÷0.15	0.15 0.11	0.15 0.11
Valve seat angle, °	45			
Correction angle, outer °	15			
Correction angle, inner °	75			
Valve seat width: Inlet, mm(in)	1.5 (0.058)			
Exhaust, mm(in)	2.0 (0.078)			

Note: multiply by 0.039 to convert mm to inches

11-07

11

11-08

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Valve seat ring oversize, mm(in)	0.2 (0.0078)			
Valve guides: Overall length, mm(in)	54 (2.106)			48 (1.87)
Outer diameter, mm(in)	$14^{+0.061}_{+0.050}$ $\left(0.546^{+0.0023}_{+0.0019}\right)$			
Inside diameter, mm(in)	8 H 7 (0.31 H 0.27)			
Bore in cylinder head, mm(in)	14 H 7 (0.54 H 0.27)			
Interference fit in cylinder head, mm(in)	0.032÷0.061 (0.0012÷0.0023)			
Oversize, first stage diameter, mm(in)	$14.1^{+0.061}_{+0.050}$ $\left(0.549^{+0.0023}_{+0.0019}\right)$			
Second stage diameter, mm(in)	$14.2^{+0.061}_{+0.050}$ $\left(0.553^{+0.0023}_{+0.0019}\right)$			
Valve stem clearance: Inlet, mm(in)	0.050÷0.080 (0.0019÷0.0031)	0.050÷0.080 (0.0019÷0.0031)		
Exhaust, mm(in)	0.065÷0.095 (0.0025÷0.0037)	0.050÷0.080 (0.0019÷0.0031)		
Maximum permissible wear tolerance, mm(in)	0.15 (0.0058)			
Valve gear: Valve operation	by the camshaft via hard cast tappets, push rods and rocker arms			
Camshaft drive	Duplex chain 3/8 × 7/32 (double roller chain) with chain tensioner under spring pressure (leaf spring)			
Number of links	50			

12

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Valve Springs: Wire thickness, mm(in)	4.25 (0.165)			
Outer coil diameter, mm(in)	31.9 (1.244)			
Spring length, relaxed, mm(in)	approx 43.5 (1.696)			
Spring force in kp at test length, mm(lb/in)	29 at 37.6 70 at 28.5 (63.8 at 1.46, 154 at 1.11)			
Coil direction	right hand			
Number of windings, resilient	4			
Number of windings, total	6			
Fitting direction	With the windings painted green facing the cylinder head side			
Rocker arms:	Needle-roller-mounted			
Axial float of rocker arm	Clearance-free but easily movable			
Rocker arm ratio	1 : 1.39			

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Camshaft: Flange bearing bore in crank case, diameter, mm(in)	$40^{+0.039}_{0}$		$(1.560^{+0.0015}_{0})$	
Flange bearing outer diameter, mm(in)	$40^{0}_{-0.016}$		$(1.560^{0}_{-0.0006})$	
Flange bearing bore diameter, mm(in)	$25^{+0.013}_{0}$		$(0.975^{+0.0005}_{0})$	
Camshaft bearing journals – alternator end, diameter, mm(in)	$25^{-0.020}_{-0.033}$		$(0.975^{-0.0007}_{-0.0012})$	
Bearing bore, flywheel end, for camshaft in crank: case, diameter, mm(in)	$24^{+0.021}_{0}$		$(0.936^{+0.0008}_{0})$	
Camshaft bearing journal – flywheel end, diameter, mm(in)	$24^{-0.020}_{-0.033}$		$(0.936^{-0.0007}_{-0.0012})$	
Alternator and flywheel end radial clearance, mm(in)	0.02÷0.046 (0.0007÷0.0017)			
Maximum permissible deflection of contact breaker shaft, mm(in)	0.02 (0.00078)			
Axial float (clearance between camshaft starter collar and flange mounted bearing) mm(in)	0.1 ± 0.02 (0.0039 ± 0.00078)			
Cam base circle diameter, mm(in)	28 (1.092)			
Cam lift, mm(in)	6.198 (0.2417)	6.756 (0.2634)	6.756 (0.2634)	6.756 (0.2634)
Tappet outer diameter, mm(in)	$22^{-0.025}_{-0.015}$		$(0.858^{-0.0009}_{-0.0005})$	
Tappet bore in crankcase, diameter, mm(in)	$22^{+0.006}_{-0.015}$		$(0.858^{+0.0002}_{-0.0005})$	
Tappet radial clearance, mm(in)	0.01÷0.051 (0.0004÷0.0019)			
Maximum permissible wear tolerance for tappets, mm(in)	0.075 (0.0029)			

Engine

Technical Data

Type			R 60/6	R 75/6	R 90/6	R 90 S
Crankshaft and Bearings: Main bearing journals			Diameter mm(in) Main bearing journal			Order no. Bearing shell
Standard	0	red	$60.00^{-0.010}_{-0.020}$	$(2.34^{-0.00039}_{-0.00078})$		11 11 1 250 155
		blue	$60.00^{-0.020}_{-0.029}$	$(2.34^{-0.00078}_{-0.00113})$		11 11 1 255 285
First stage	0,25	red	$59.75^{-0.010}_{-0.020}$	$(2.33^{-0.00039}_{-0.00078})$		11 11 1 254 788
		blue	$59.75^{-0.020}_{-0.029}$	$(2.33^{-0.00078}_{-0.00113})$		11 11 1 255 286
Second stage	0,50	red	$59.50^{-0.010}_{-0.020}$	$(2.32^{-0.00039}_{-0.00078})$		11 11 1 254 789
		blue	$59.50^{-0.020}_{-0.029}$	$(2.32^{-0.00078}_{-0.00113})$		11 11 1 255 287
Third stage	0,75	red	$59.25^{-0.010}_{-0.020}$	$(2.31^{-0.00039}_{-0.00078})$		11 11 1 255 288
		blue	$59.25^{-0.020}_{-0.029}$	$(2.31^{-0.00078}_{-0.00113})$		11 11 1 255 289
Bore for 3-component bearing in crankcase, diameter, mm(in)			$65^{+0.019}_{0}$	$(2.535^{+0.0007}_{0})$		
Bore for 3-component bearing in bearing cap, diameter, mm(in)			$65^{+0.019}_{+0}$	$(2.535^{+0.0007}_{0})$		
Main bearing journal, radial clearance, mm(in)			0.035÷0.065 (0.0013÷0.0025)			
Bearing seat for grooved bearings of front crankshaft mounting, diameter, mm(in)			$35^{+0.025}_{+0.009}$	$(1.365^{+0.0009}_{+0.0003})$		
Bearing seat bore for grooved bearing in timing cover, diameter, mm(in)			$62^{-0.009}_{-0.039}$	$(2.418^{-0.0003}_{-0.0015})$		

11-0/11

13

11-0/12

Engine

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Crankshaft seating, sprocket wheel, diameter, mm(in)		$35.003^{+0.020}_{+0.009}$	$(1.365^{+0.00078}_{+0.0003})$	
Mounting bore, sprocket wheel, mm(in)		$35.003^{+0.003}_{-0.013}$	$(1.365^{+0.0001}_{-0.0005})$	
Axial float, crankshaft, mm(in)		0.08÷0.15 (0.0031÷0.0058)		
Thrust washer, red – thickness "S" mm(in)		2.483÷2.530 (0.0968÷0.0986)		
blue – thickness "S" mm(in)		2.530÷2.578 (0.0986÷0.1005)		
green – thickness "S" mm(in)		2.578÷2.626 (0.1005÷0.1024)		
yellow – thickness "S" mm(in)		2.626÷2.673 (0.1024÷0.1042)		
Maximum permissible wear tolerance, mm(in)		÷0.20 (0.0078)		
Maximum permissible deflection at shaft journal (alternator end) externally when supported at main bearing points, mm(in)		0.02 (0.00078)		
Maximum permissible dynamic imbalance in crankshaft (without flywheel), cmp		20		
Maximum lateral deflection at flywheel, mm(in)		0.1 (0.0039)		
Connecting rod and bearings	Diameter mm Crank pin			Order No. Bearing shell
Standard 0	$48.00^{-0.009}_{-0.025}$	$(1.872^{-0.0003}_{-0.0009})$		11 24 1 258 460
Stage 1 0.25	$47.75^{-0.009}_{-0.025}$	$(1.862^{-0.0003}_{-0.0009})$		11 24 1 258 419
Stage 2 0.50	$47.50^{-0.009}_{-0.025}$	$(1.852^{-0.0003}_{-0.0009})$		11 24 1 258 420
Stage 3 0.75	$47.25^{-0.009}_{-0.025}$	$(1.842^{-0.0003}_{-0.0009})$		11 24 1 258 421
Basic bore diameter for big end bearing eye, mm(in)		$52^{+0.010}_{0}$	$(2.028^{+0.00039}_{0})$	
Connecting rod radial clearance mm(in)		0.023÷0.069 (0.00089÷0.00269)		
Width of connecting rod at big end bearing eye, mm (in)		$22^{-0.065}_{-0.117}$	$(0.858^{-0.0025}_{-0.0045})$	
Crank pin bearing width, mm(in)		$22^{+0.149}_{+0.065}$	$(0.858^{+0.0058}_{+0.0025})$	
Axial connecting rod clearance, mm(in)		0.130÷0.266 (0.00507÷0.01037)		
Maximum permissible axial wear tolerance in connecting rod clearance, mm(in)		0.32 (0.0124)		

16

Technical Data

Type			R 60/6	R 75/6	R 90/6	R 90 S
Centre to centre bore spacing, mm(in)			135 (5.265)			
Connecting rod bore at small end eye (basic bore), diameter, mm(in)			$24\,^{+0.021}_{0}$		$(0.936\,^{+0.00081}_{0})$	
Small end bush outer diameter, mm(in)			24.060÷24.100 (0.938÷0.939)			
Piston pin bore diameter in small end bush, mm(in)			$22\,^{+0.020}_{+0.015}$		$(0.858\,^{+0.00078}_{+0.00058})$	
Piston pin bore diameter in small end bush (wear tolerance), mm(in)			22+0.040 (0.858+0.00156)			
Maximum permissible deviation from parallelism in connecting rod bores with bearing shells over 150 mm spacing, mm(in)			0.04 (0.00156)			
Maximum permissible basic bore twist relative to piston pin bore over 150 mm spacing, mm			1.3 (0.0507)			
Permissible weight discrepancy of both connecting rods, gr (oz)			6			
Cylinders:						
Bore diameter original	A	mm(in)	73.50 (2.8665)	82.00 (3.1980)	90.00 (3.5100)	90.00 (3.5100)
	B	mm(in)	73.51 (2.8668)	82.01 (3.1983)	90.01 (3.5103)	90.01 (3.5103)
	C	mm(in)	73.52 (2.8672)	82.02 (3.1987)	90.02 (3.5107)	90.02 (3.5107)
1. Oversize + 0.50 mm	A	mm(in)	74.00 (2.8860)	82.50 (3.2175)	90.50 (3.5295)	90.50 (3.5295)
	B	mm(in)	74.01 (2.8863)	82.51 (3.2178)	90.51 (3.5298)	90.51 (3.5298)
	C	mm(in)	74.02 (2.8867)	82.52 (3.2182)	90.52 (3.5302)	90.52 (3.5302)
2. Oversize + 1.00 mm	A	mm(in)	74.50 (2.9055)	83.00 (3.2370)	91.00 (3.5490)	91.00 (3.5490)
	B	mm(in)	74.51 (2.9058)	83.01 (3.2372)	91.01 (3.5493)	91.01 (3.5493)
	C	mm(in)	74.52 (2.9062)	83.02 (3.2376)	91.02 (3.5497)	91.02 (3.5497)
Peck to valley height, µm			2.5÷4			

17

11-0/13

11-0/14

Technical Data

Type			R 60/6	R 75/6	R 90/6	R 90 S
Permissible ovality of cylinder bore, mm(in)			0.01 (0.00039)			
Permissible taper in cylinder bore, (head end tighter), mm(in)			0.01 (0.00039)			
Pistons: Piston form			Convex-rising-oval			
Weight category, piston complete			+ or — punched-in			
Piston diameter, mm(in) (original)	A		73.460 (2.8649)	81.960 (3.1964)	89.960 (3.5084)	89.960 (3.5084)
	B		73.470 (2.8653)	81.970 (3.1967)	89.970 (3.5088)	89.970 (3.5088)
	C		73.480 (2.8657)	81.980 (3.1972)	89.980 (3.5092)	89.980 (3.5092)
1. Oversize + 0.50 mm (0.019 in)	A		73.960 (2.8844)	82.460 (3.2159)	90.460 (3.5279)	90.460 (3.5279)
	B		73.970 (2.8848)	82.470 (3.2163)	90.470 (3.5283)	90.470 (3.5283)
	C		73.980 (2.8852)	82.480 (3.2167)	90.480 (3.5287)	90.480 (3.5287)
2. Oversize + 1.0 mm (0.039 in)	A		74.460 (2.9039)	82.960 (3.2354)	90.960 (3.5474)	90.960 (3.5474)
	B		74.470 (2.9043)	82.970 (3.2358)	90.970 (3.5478)	90.970 (3.5478)
	C		74.480 (2.9047)	82.980 (3.2362)	90.980 (3.5482)	90.980 (3.5482)
Piston fitting clearance mm(in)			0.035÷0.045 (0.0013÷0.0017)			
Total permissible wear clearance of piston and cylinder, mm(in)			0.12 (0.0046)			
Piston fitting direction			Arrow with "vorn" in direction of travel			

18

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Piston rings: Rectangular ring first groove [1] Height, mm(in)		$1.75^{+0.060}_{+0.040}$	$(0.068^{+0.0023}_{+0.0015})$	
Ring gap, mm(in)	0.25÷0.40 (0.0097÷0.015)	0.30÷0.45 (0.0117÷0.0175)	0.30÷0.45 (0.0117÷0.0175)	0.30÷0.45 (0.0117÷0.0175)
Side clearance, mm(in)	0.06÷0.07 (0.0023÷0.0027)			
Lower compression ring, second groove [1] Height, mm(in)		$2.00^{+0.050}_{+0.030}$	$(0.078^{+0.0019}_{+0.0011})$	
Ring gap, mm(in)	0.25÷0.40 (0.0097÷0.015)	0.30÷0.45 (0.0117÷0.0175)	0.30÷0.45 (0.0117÷0.0175)	0.30÷0.45 (0.0117÷0.0175)
Side clearance, mm(in)	0.05÷0.06 (0.0019÷0.0023)			
Ventilated oil ring with bevelled corresponding edge, third groove [1] Height, mm(in)		$4.00^{+0.030}_{+0.010}$	$(0.156^{+0.0011}_{+0.0003})$	
Ring gap, mm(in)	0.25÷0.35 (0.0097÷0.013)	0.25÷0.40 (0.097÷0.015)	0.25÷0.40 (0.097÷0.015)	0.25÷0.40 (0.097÷0.015)
Side clearance, mm(in)	0.03÷0.04 (0.0011÷0.0015)			
Fitting direction of piston rings	With marking "top" upward			

[1] Not in accordance with DIN specifications
Special BMW version

19

11-0/15

11-0/16

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Piston pins: Piston pin offset from piston centre, mm(in)	1.5 (0.058)			
Piston pin diameter, code colouring white, mm(in)		$22^{0}_{-0.003}$	$(0.858^{0}_{-0.00011})$	
Piston pin diameter, code colouring black, mm(in)		$22^{-0.003}_{-0.006}$	$(0.858^{-0.00011}_{-0.00022})$	
Bore diameter of piston boss, colour coding (white) W punched-in piston crown, mm(in)		$22^{+0.003}_{0}$	$(0.858^{+0.00011}_{0})$	
Bore diameter of piston boss, colour code (black) S punched-in piston crown, mm(in)		$22^{+0.003}_{0}$	$(0.858^{-0.00011}_{0})$	
Piston pin clearance [1] in piston, mm(in)	0.000÷0.006 (0.0÷0.00022)			
Running clearance of piston pin in connecting rod bush mm(in)	0.015÷0.026 (0.00058÷0.00101)			

[1] Piston and piston pin must always be replaced together.

20

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Road performance:	The actual maximum speed reached by the motorcycle after running in depends to a high degree on the air resistance offered by the driver and is governed by such variable factors as size, attitude and clothing, the condition of the road and weather conditions.			
Speed, seated kph(mph)	155 (97)	165 (103)	178 (111)	195 (121)
Speed, prone kph(mph)	167 (104)	177 (110)	188 (117)	over 200 (124)
Acceleration 0 to 50 kph in secs (31 mph)	2.2	2.0	1.6	1.6
0 to 80 kph in secs (50 mph)	5.0	4.4	3.7	3.5
0 to 100 kph in secs (62 mph)	7.7	6.7	5.2	4.8
0 to 120 kph in secs (75 mph)	10.8	9.1	7.4	6.9
0 to 140 kph in secs (87 mph)	16.0	12.7	10.3	9.0
0 to 160 kph in secs (100 mph)	27.5	19.8	14.0	12.6
Standing kilometer in secs	29.7	28.1	26.1	25.3
Average speed reached in kph(mph)	121 (75)	128 (80)	138 (86)	142 (88)

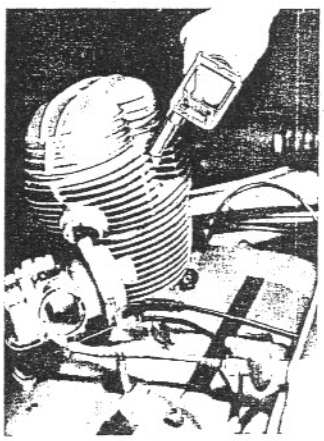
Tightening torques in mkp (ft/lb)

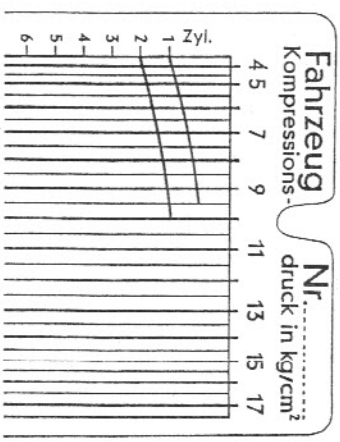
Cyl. head studs (in 3 stages 1.5—3.5—3.9)	3.5÷3.9 (25.3÷28.2)	Nuts for valve adjustment screw	1.8÷2.2 (13.0÷15.9)
Connecting rod bolts	4.8÷5.2 (34.7÷37.6)	Oil sump on crankase	1.2 (8.7)
Flywheel on crankshaft R 60/6, R 75/6	6.0÷6.5 (43.4÷47.0)		
Flywheel on crankshaft R 90/6, R 90 S	7.0÷7.5 (50.6÷54.2)		

All other nuts, screws and bolts are to be tightened with the values recommended in the manufacturer's tables or the latest BMW Standard Specification 60 002.0.

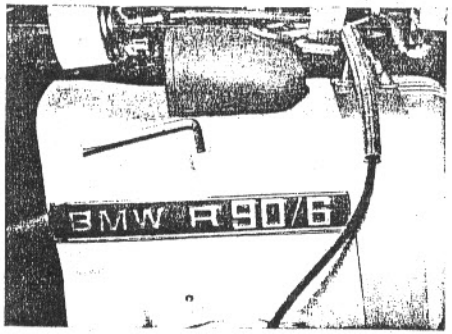
11 00 039 Check Compression of all Cylinders

1. Unscrew spark plugs.
2. Carry out measurements at starting speed with a calibrated compression gauge, battery fully charged, engine at normal running temperature and the throttle twist grip set to full acceleration.
Remove constant pressure carburettor before measurement.





Graph for visual compression indicator.



11 00 050 Engine, Removing and Refitting

Remove ignition coil, left. 12 13 100.

Take off exhaust system 18 00 020.

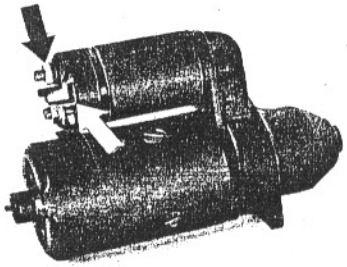
Remove gearbox 23 00 020.

Remove right-hand carburettor.

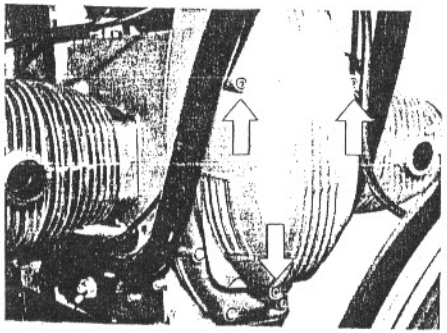
Disconnect Bowden cables on left and right carburettors and lay both carburettors aside.

Refitting and adjustment of carburettors – 13 00 004.

After removing the two hexagonal socket head screws take off the starter cover to the right.



Detach leads (arrows) on starter.

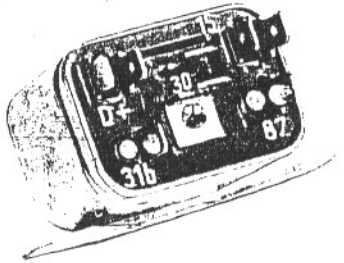


Slacken off horn at the top fastening screw.

Remove engine guard cover forward after releasing the three hexagonal socket head screws. Draw rev. counter drive shaft from the pinion after releasing the locking screw.

Note when fitting:

When fitting ensure that the breather tube for the interrupter chamber is first inserted in the engine cover.

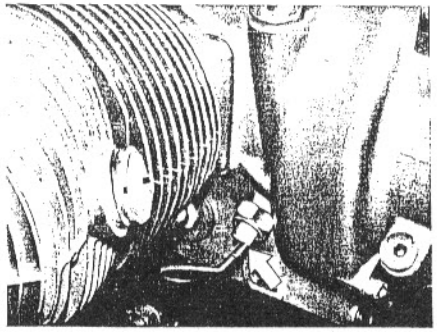


Pull off engine wiring harness D + (blue) 30 (red), 87 (black) from the starter relay and the triple plug from the electronic voltage regulator.

Pull off both spark plug terminals, ignition leads and, after opening the front clamp, take the engine lead harness from the rubber grommet in the tank.

Flat terminal connection „87" – black lead
Flat terminal connection „15" – green lead
Flat terminal connection „30" – red lead
Flat terminal connection „31 b" – brown/black lead
Flat terminal connection „D+" = lead 2 blue

Remove lead from oil pressure warning switch (arrow).

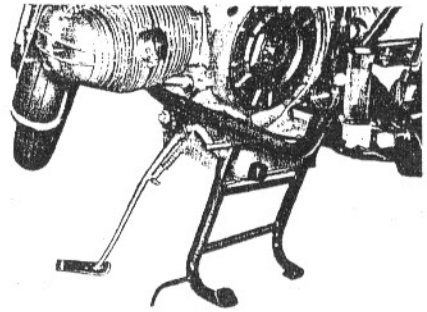


Before extracting the engine bolts disengage the three tilt and side stand springs.

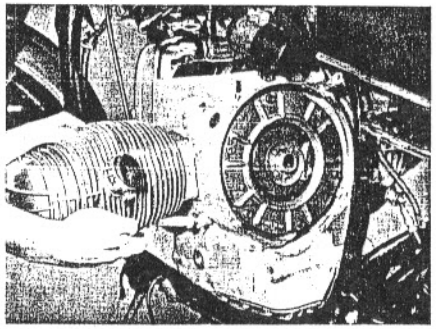
When removing the bolts care must be taken to ensure that the engine with pushrod protective tubes does not tilt out of the frame.

Note when fitting:
The rear engine mounting bolt is long to accommodate the left and right foot rests and the exhaust system clamps. Care must be taken to ensure that one spacer collar each is fitted at the rear right and left between crankcase and frame (wider spacer collar to the right).

On the front engine mounting the side rest and parking stand clip is to be fitted on the left and the parking stand clip on the right.

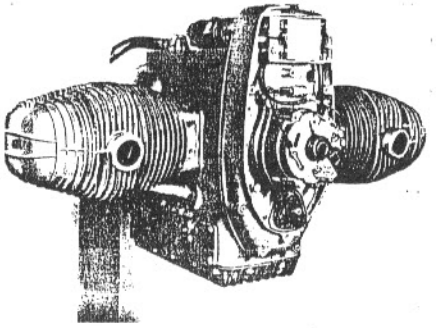


Tilt the engine slightly to the left from vertical position and lift out of the frame.



Fit engine on assembly stand BMW No. 6000 in jig BMW No. 6005/1 and screw down firmly.

Before dismantling the engine it is advisable to check the ignition timing 12 11 004, contact gap 12 11 141 and valve clearances 11 34 504 in order to ascertain any faults in advance and take due account of them during subsequent tests and measurements.

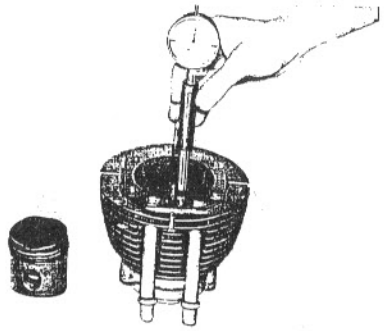


11 11 527 Cylinder, Boring and Honing

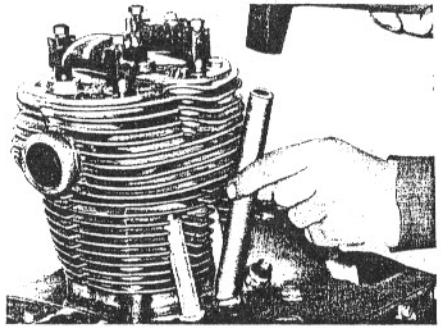
Cylinder head, remove and refit, 11 12 08. Piston, remove and refit 11 25 000.

All the testing and repair jobs outlined in the preliminary work are to be carried out only where necessary. The cylinders can be reground in two stages. See Technical Data section for oversizes.

As a result of thermal stresses to which the cylinders are subjected regrinding to a third oversize is not possible. Gauge reground cylinder; measuring point cylinder base. Determine oversize piston according to cylinder dimensions, see Technical Data section for piston fitting tolerances.



If there are any leaks in the rubber collar on the push rod protective tubes the contact rings can be tapped down with the special BMW No. 221 tubular punch to improve the rubber sleeve contact pressure.



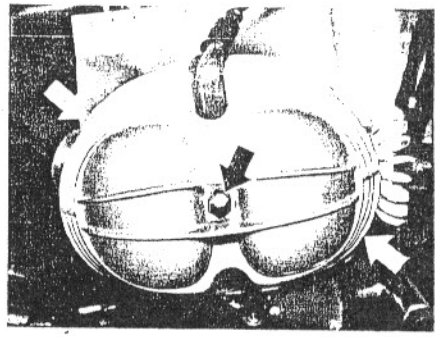
11 12 080 Cylinder Head, Removing and Refitting

Engine removed 11 00 050 or fitted.

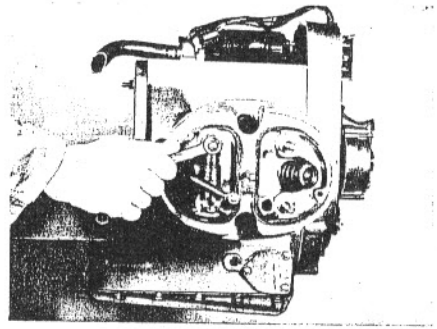
Remove exhaust system where engine is still in situ.

Note when fitting:
Insert both exhaust manifolds with cross tube in the exhaust ducts before tightening the cylinder heads.

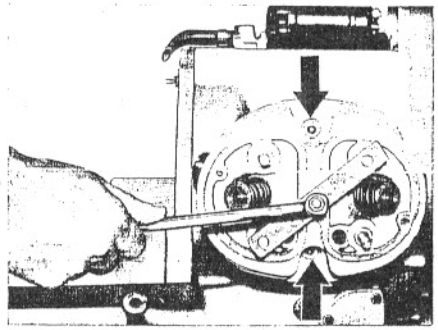
Unscrew cap nut and the two nuts (arrows), remove cylinder head cover and gasket.



After releasing the four collar nuts on the tie rod bolts take off rocker arms and withdraw push rods.

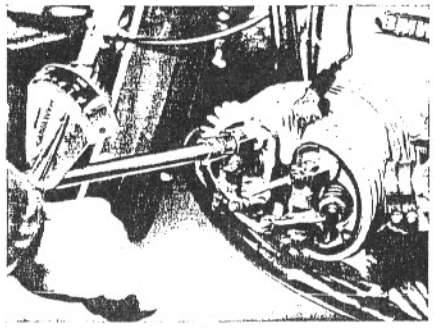


Screw down two collar nuts on a cross-over pattern approx. 15 mm to finger tightness on tie rod bolts.
Fit special BMW No. 209 thrust bridge into position and use cap nuts to pull the cylinder head and cylinders away from the crankcase. Unscrew two hexagonal nuts (arrows). Use rubber mallet to tap cylinder head away from cylinder and draw off from tie rod bolts.

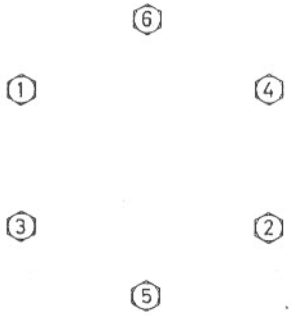


Note when fitting cylinder head

With the engine cold tighten the cylinder head fastening nuts in three stages – see drawing for sequence. See Technical Data section for tightening torques.



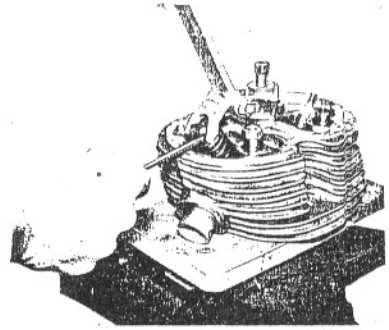
Tightening Sequence



11 12 513 Cylinder Head – Dismantling, Assembling and Valve Grinding

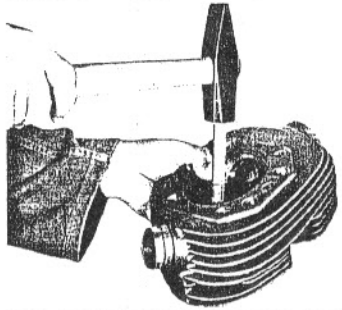
Cylinder head 11 12 080 – remove and refit.

Fasten cylinder head on the BMW No. 5034 assembly jig clamped in the bench vice. Use the valve lifter on the jig to compress the valve springs and then lift the pair of tapered cones out of the spring retainer with a magnet or scriber, after which the spring retainers and valve springs are laid to one side. Remove the cylinder head from the assembly jig and withdraw the valves.



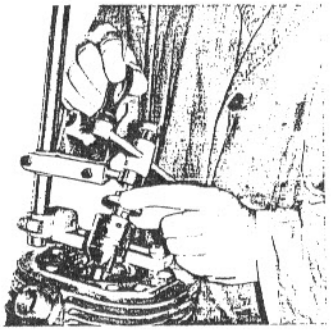
Cylinder head checks

a) For cracks and perfect sealing surfaces.
b) Secure valve guides (illustration) and valve seats.
c) Valve guide wear.
d) Surface condition of contact surface and spherical recess.
e) Radial play in rocker arm.
f) Check valve spring resiliency and force (see Technical Data section)
g) Check security of screw unions for carburettor mounting. If necessary set threads cleanly with Locktite No. 59.

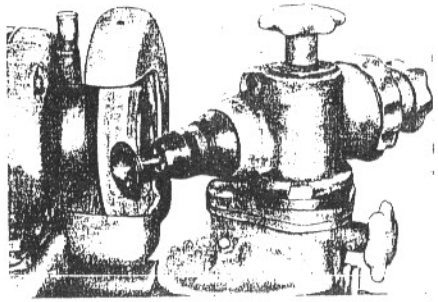


Regrinding Valve Seats

Regrind the valve seat rings in the cylinder head with Hunger valve seat grinder. Valve face angle 45° + 20', seat contact width for inlet valve 1.5 mm, for exhaust valve 2.0 mm measured at 45° angle. Chamfer sloping toward combustion chamber 15°, toward induction or exhaust duct 75°. The sealing seat should be close to the maximum valve seat diameter.



Regrind seat on valve in grinding machine to 45° 20'. Maximum permissible regrinding up to 1 mm valve disc rim width.
No grinding in of the valves is necessary with ground valve tapers and valve seat rings turned on the Hunger machine. Nevertheless after the valves have been fitted it is necessary to carry out a sealing test (tipping petrol into the valve chamber).

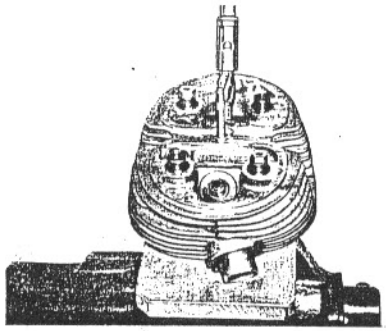


11 12 561 Valve Guides, Renewing

Cylinder head, remove and refit 11 12 080.
Dismantle cylinder head, grind in valves 11 12 513.

All the testing and repair jobs described in the preliminary work are to be carried out only where necessary.

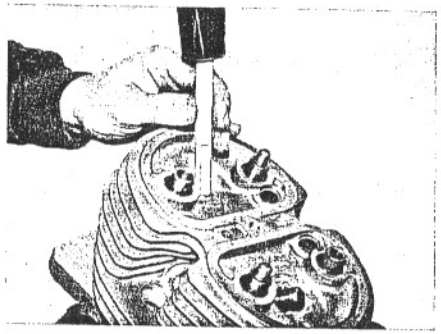
Lower top of old valve guide to the circlip.



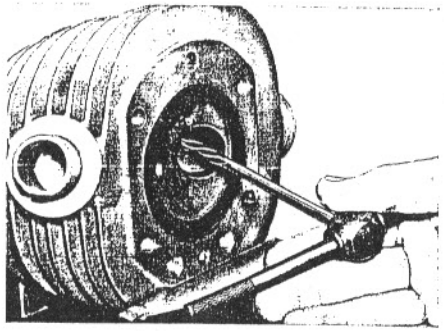
Remove circlip, heat cylinder head to 240 ÷ 260° C and knock out valve guide toward combustion chamber with BMW No. 5128 drift.

Before knocking out the guide the valve support of BMW No. 5034 assembly jig is to be removed.

Oversizes of seat rings and basic bores in the cylinder head will be found in the Technical Data section.



Tap in new valve guides (see Technical Data section) complete with circlip into the heated cylinder head. After the valve guide has cooled it must be reamed out with fixed valve guide reamer 8H7.

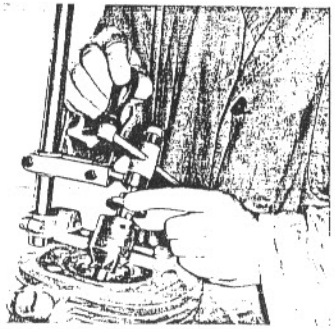


11 12 621 One Valve Seat Ring, Renewing

Cylinder head removed, 11 12 080.

Dismantle cylinder head, grind in valves 11 12 513.

If it is necessary to change the valve seat ring after the valve seats have been remachined several times, use the Hunger valve seat turning cutter to turn out the valve seat ring taking care to avoid damaging the basic bore in the cylinder head. Heat cylinder head to 240÷260° C and fit new valve seat ring (see Technical Data section).



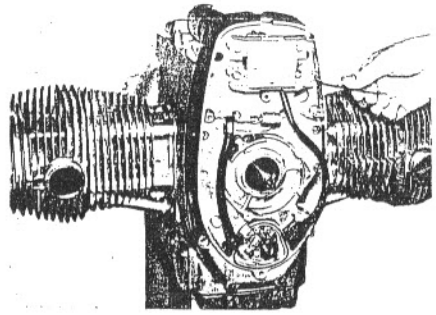
11 14 060 Timing Cover, Removing and Refitting

Engine removed (11 00 050) or fitted. Illustration and text were completed with engine removed.

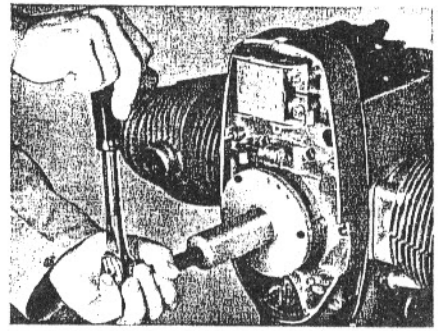
Overhaul alternator 12 31 212.

Replace contact breaker points 12 11 141.

Unscrew nine hexagonal socket head bolts and three hexagonal socket nuts with angled Allen key.

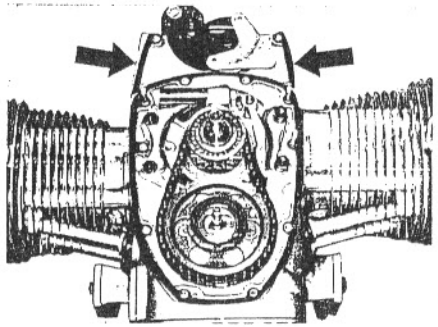


Bolt the BMW No. 214 extractor tool to the tapped fastening bores for the alternator housing with the aid of three hexagonal socket head bolts (M 5), not forgetting the extractor thrust cup. Draw off the timing cover.

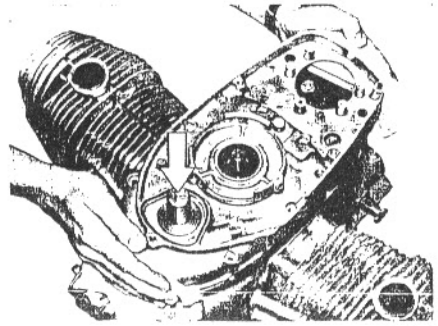


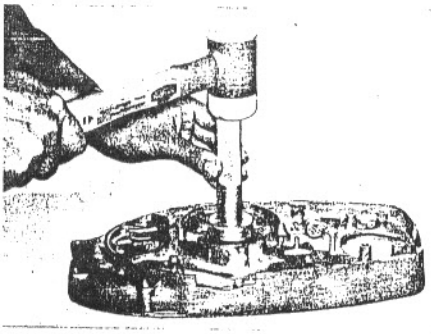
Timing Cover, Fitting

Position the crankcase vertically in the assembly jig and lay the gasket and two strip seals (arrows) in position on the housing. For refitting the timing cover remove the diode carrier. Heat timing cover to 80÷100° C.



Fit the slip sleeve BMW No. 225 over the centrifugal timing advance shaft. With the aid of the BMW No. 225 locating bush fit and centre the timing cover. Tighten the hexagonal socket head bolts and nuts starting from the centre. Relax grooved ball bearings in their seating with a few taps with a rubber hammer.

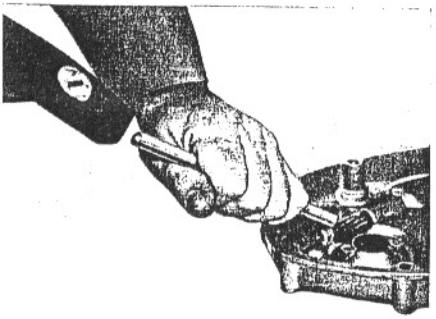




11 14 651 Crankshaft Radial Seal, Renewing

Timing cover, remove and refit 11 14 060.

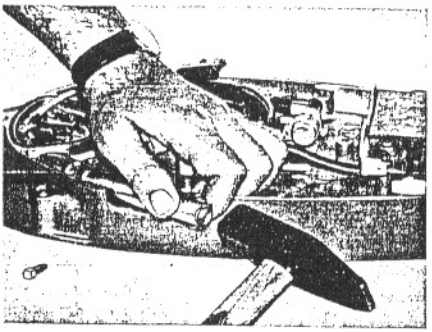
With the aid of BMW No. 224 drift, fit radial seal for front crankshaft journal.



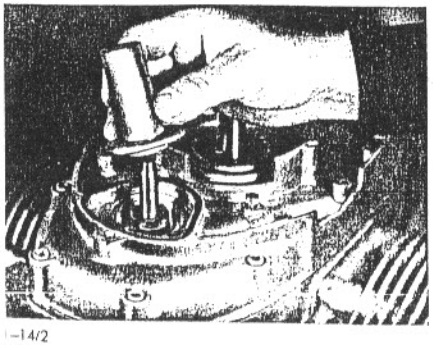
11 14 691 Revolution Counter Drive Radial Seal, Renewing

Timing cover, remove and refit 11 14 060.

When replacing the radial seal for the revolution counter helical gear drive, unscrew the retaining screw and extract the bush with the aid of a suitable hook.
Position an aluminium drift against the helical drive gear and knock out with radial seal.



Fit helical drive gear thrust washer, radial seal and bush and knock firmly into position with the aid of a suitable drift.



11 14 671 Camshaft Radial Seal, Renewing

Timing cover, remove and refit 11 14 060.

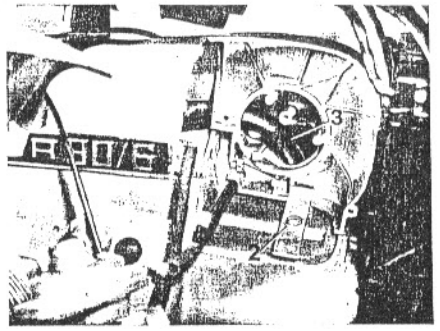
Fit radial seal over slip collar and knock in as far as it will go with the aid of BMW No. 225 tool.

11 15 101 Engine Breather Hose, Renewing

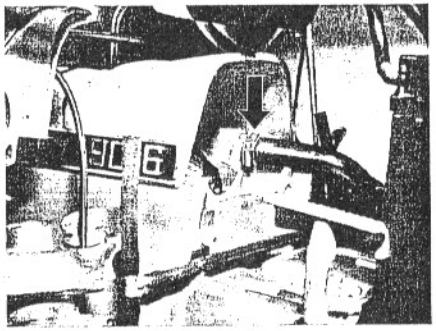
Air filter element, remove and refit 13 72 000.

On the R 75/6 model disconnect both choke cables at the carburettor and lay to one side with left hand half on the air filter housing shell.

With a straight ring spanner unscrew nut (1), slacken hexagonal bolt (2) and take off the right hand half of the air filter housing shell, at the same time pushing breather hose (3) to the rear.



Release hose clamp (arrow) and take off breather hose.

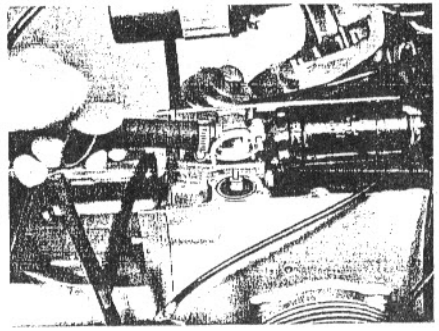


11 15 111 Check Valve for Breather, Renewing

Engine breather hose, renew 11 15 101.

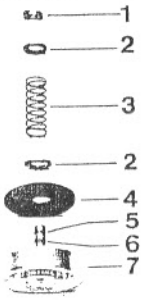
Disconnect battery, remove tank and starter cover.
Take off breather dome with breather hose.

Replace plastic valve disc.



Check valve (engine breather)

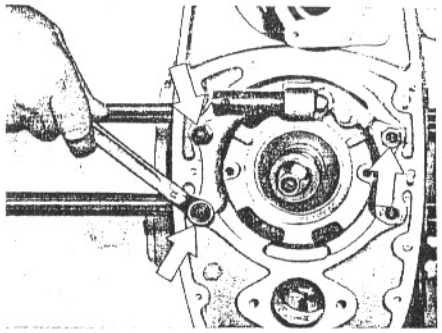
1. Lock ring
2. Washer
3. Spring
4. Valve disc
5. Spring groove, R 60/6, R 75/6
6. Spring groove, R 90/6, R 90 S
7. Valve body



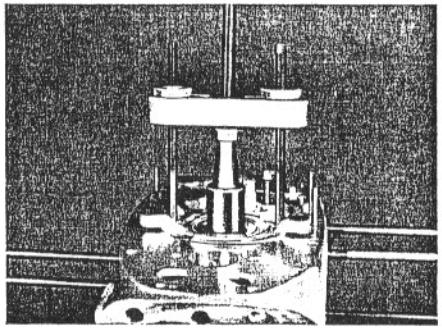
11 21 001 Crankshaft, Renewing

Timing chain gear train, renew 11 31 061.

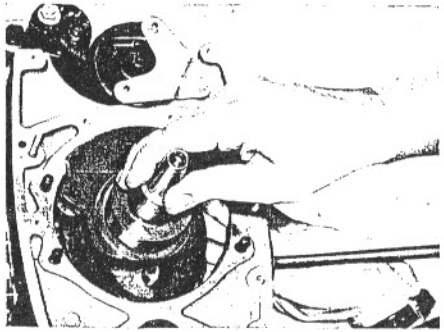
All the testing and repair jobs detailed in the preliminary work are to be carried out only where necessary. Remove remaining three hexagonal nuts, one collar nut and two nuts from the main bearing cap.



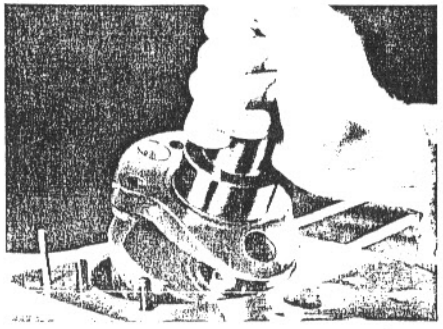
Position engine vertically. Screw two bolts on the BMW No. 216 extractor tool into the appropriate tapped bores in the main bearing cap. Position extractor bridge Kukko no. 17/K parallel to the main bearing cap, remembering to fit the extractor thrust cup. Draw off main bearing cap.



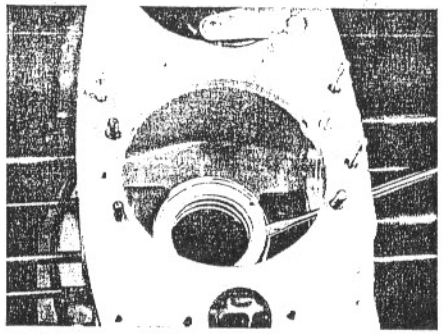
Turn crankshaft so that the front counterweight is positioned under the top housing aperture. Withdraw crankshaft (only on R 60/6).



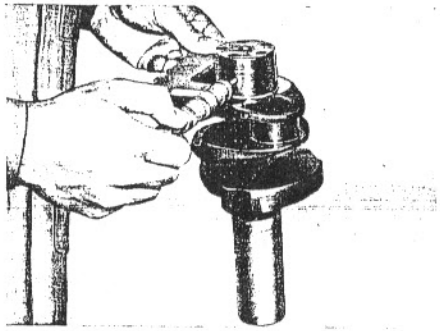
Turn crankshaft until the metal plugs face in the direction of the starter, tilt downwards and then withdraw completely (R 75/6 – 90 S).



11–21/1

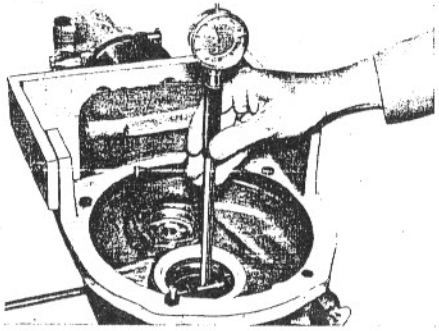


Knock both thrust washers off the locating pins using a screwdriver.

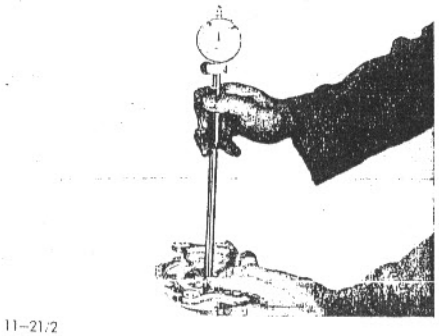


Crankshaft and Bearing Bush, Measurement

Remove housing from assembly mount. Measure the main and big end bearing journals with micrometer caliper on a criss-cross pattern.



Big end bush in crankcase,



Bearing cap and,

11–21/2

Big end bore measuring with inside gauge in criss-cross pattern with connecting rod bolted together. See Technical Data section for nominal dimensions and tolerances.

■

11 21 531 Main Bearing Bushes, Renewing

Crankshaft, renew 11 21 001.

All the testing and repair jobs detailed in the preliminary work are to be carried out only where necessary.

Main Bearing Bush in Crankcase, Replace

Heat crankcase to 100÷120° C and then invert over the cylinder of the BMW No. 205 extractor tool in such a way that the locating pins for the inside thrust washer engage in the corresponding bores of the cylinder. Press out the bearing bush with the aid of the BMW No. 205 Arbor press and a hand press.

■

Pressing in oversize bearing bush reground to 1st or 2nd stage

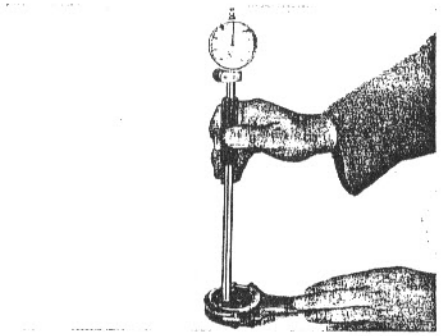
Heat crankcase to 100÷120° C. Fit the aluminium cap of BMW tool no. 205 on the Arbor cylinder and invert the crankcase over the Arbor press so that the two locating pins engage in the appropriate bores in the aluminium cap.

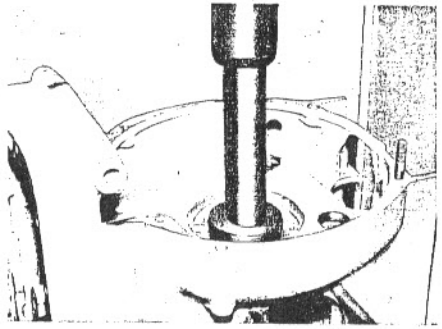
Fit new bearing bushes so that the bush join is at the top right as viewed toward the flywheel end and the oil bores of the bush are vertical (arrows); bearing bush join offset approx. 26° from vertical.

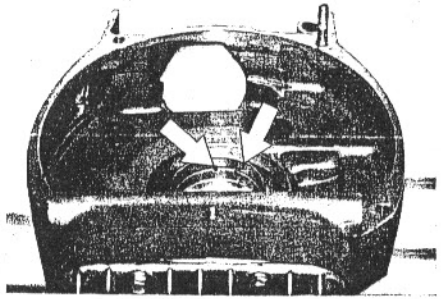
■

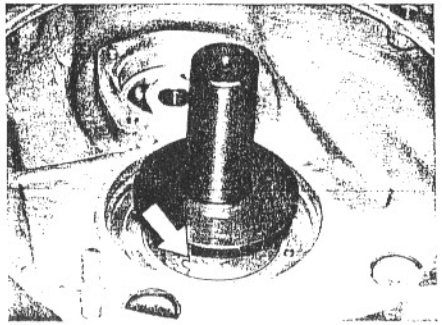
Insert the press Arbor with plastic bush on the BMW No. 205 tool in the bearing bush, taking care to ensure that the locating pins projecting in the housing protrude into the recesses around the arbor after the bearing bush has been pressed into position. The bearing bush is proportioned so that both sides stand back slightly when it is fitted in the crankcase bearing bore.

■

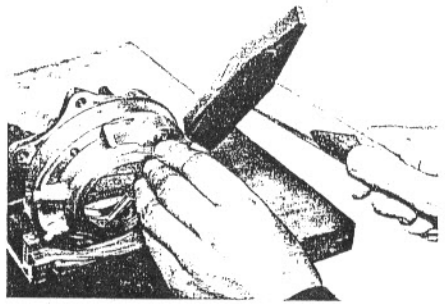








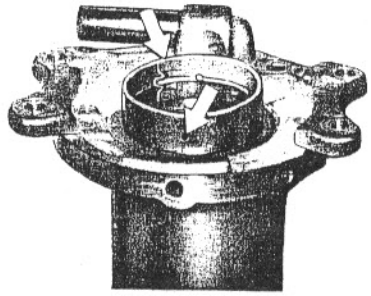
11–21/3



Main Bearing Bush in Main Bearing Cap, Replace

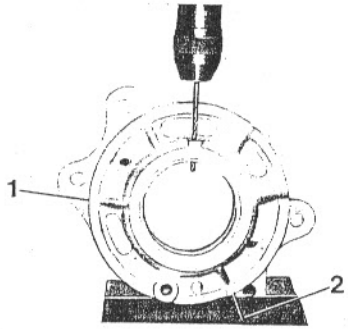
Knock out the bearing bush locating pin from the inside. Heat bearing cap to 100÷120° C and lay on the cylinder of the BMW No. 205 arbor press. With the aid of the arbor on the BMW No. 205 tool press out the bearing bush by hand.

■



Press the new bearing bush into the bearing cap heated to 100÷120° C so that the bearing bush join viewed vertically onto the fitted bearing cap is at the upper left and the oil bores are vertical. Bearing bush joint offset by approx. 25° from vertical (arrows).

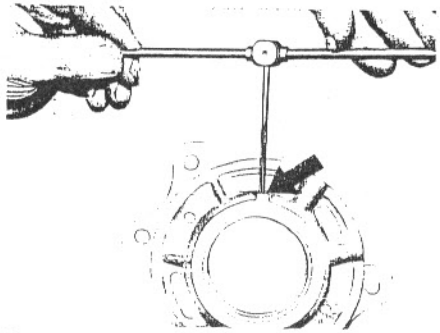
■



Clamp bearing cap between soft-jaws in bench vice. Drill two extra oil bores 1 and 2 in the bearing bushes through the two 3.2 mm diameter bores already existing in the bearing cap. Carefully deburr the bore apertures in the bearing bush.

Secure bearing bush! Fit on bearing bush locator with 3.9 mm spiral bit through the locating pin mounting bore (4H8) in the bearing cap and then bore through the bearing bush to 3.8 mm (basic reaming bore).

■



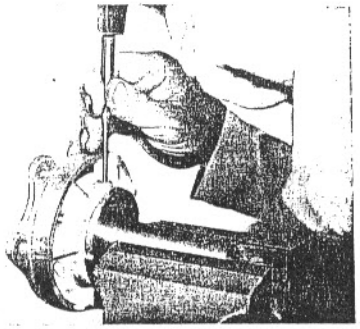
Do not ream completely through the bearing bush with the hand reamer (4H8) so that the retaining pin cannot escape inward.

Carefully deburr the bore apertures.

■

11–21/4

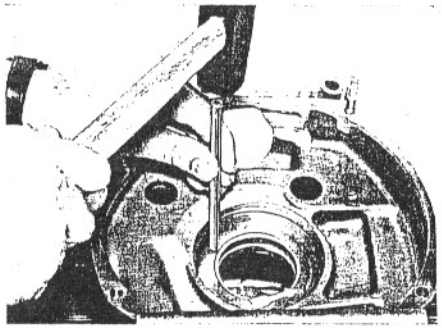
Clamp the BMW No. 205 arbor press in the bench vice, fit bearing cap, knock in retaining pin only until it stands 0.5 to 1.0 mm back from the bearing bush bore. Lock pin in position with three notches.



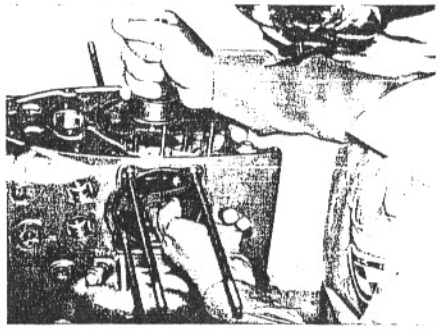
Crankshaft Endplay, Resetting

See Technical Data section for thrust washer selection chart.

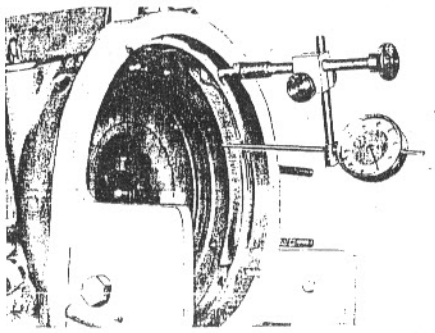
To facilitate adjustment of crankshaft endplay it is advisable to fit a green thrust washer on the inside and a red thrust washer on the outside of the locating pins. Both locating pins must project an equal distance into the clutch and crankshaft end of the crankcase. Heat the crankcase to align or insert the locating pins.

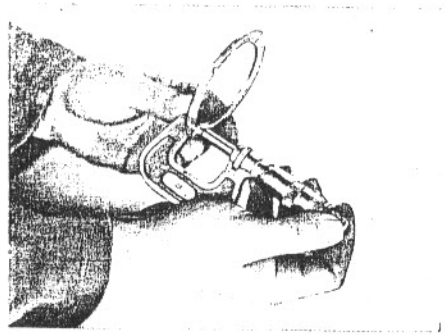


Heat the crankcase to 100÷120° C, fit in assembly mount and position vertically. Insert crankshaft carefully into the crankcase. Fit and tighten down bearing cap. Rotate crankcase by 180°. Fit flywheel (flywheel, remove and refit 11 22 000).



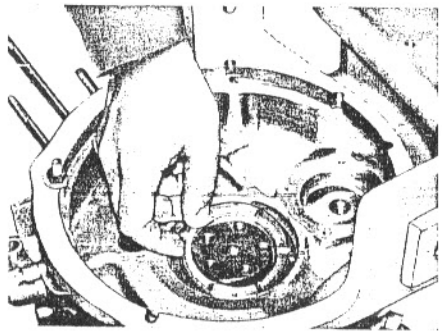
Return crankcase to horizontal position. Bolt BMW No. 5104 gauge holder to the gear box flange of the crankcase. Establish end play. Remove flywheel and use micrometer gauge to measure the fitted red-marked thrust washer.



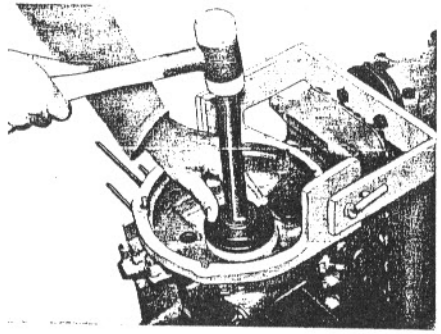


Example:

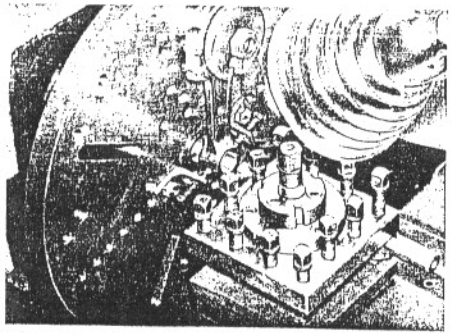
Established endplay	=	0.18 mm
Required endplay	=	0.12 mm
Discrepancy	=	0.06 mm
Established thickness of removed thrust washer	=	2.48 mm
Plus discrepancy	=	+0.06 mm
Thrust washer (blue) to be used	=	2.54 mm



From the blue-marked thrust washers select one with a thickness as close as possible to the value measured and which does not deviate from it by more than + 0.03 mm or − 0.04 mm. Fit the thrust washer on the locating pins.

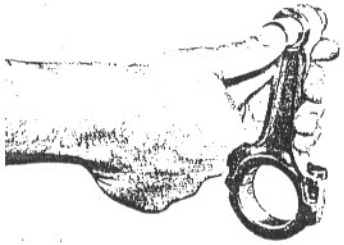


With the aid of BMW No. 201 arbor knock the radial seal into the crankcase down to the contact collar. Lightly oil the radial seal.



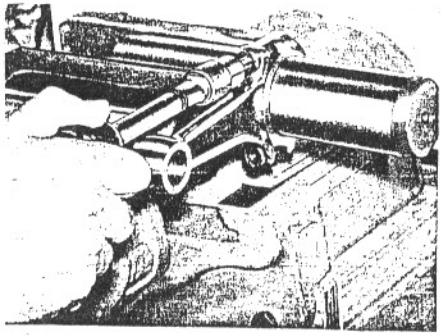
Press in new bush with inside oversize. Mount the connecting rod on the face plate of a lathe, align and precision turn down to finished dimension. See Technical Data section.

■



With a new bush it must be possible to push the wrist pin into position under light thumb pressure.

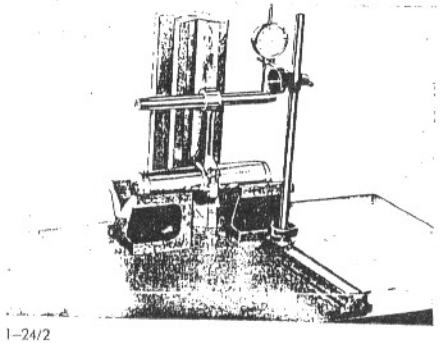
■



Connecting Rod, Measuring and Aligning

Press the bearing shells to be checked into the connecting rod. Mount the connecting rod on a hardened and ground test arbor and tighten bolts. The test arbor should not have any radial play in the big end bearing bore. Insert a ground and hardened test arbor approximately 150 mm long into the small end bush so that the arbor projects an equal distance to either side.

■



Position two prisms of equal dimensions on a surface plate. Lay the test arbor with connecting rod on the prisms. Bring the vertical connecting rod to rest against the back prism. Use the column gauge at the ends of the test arbor to check whether the wrist pin axis runs parallel to the crank pin axis. See Technical Data section for connecting rod parallelism check.

■

Clamp the connecting rod in a bench vice with aluminium jaw pads for straightening and correct any angle. See Technical Data section for permissible tolerances when using a 150 mm long test arbor.

■

Check connecting rod for twisting. For this purpose replace the connecting rod in the prisms and support it at the wrist pin end so that the space between the surface plate and the centre of the crank pin and wrist pin bores is approximately equal. Bring a columm gauge up against the test arbor ends to check the connecting rod for twisting, straightening where necessary. See Technical Data section for permissible tolerances.

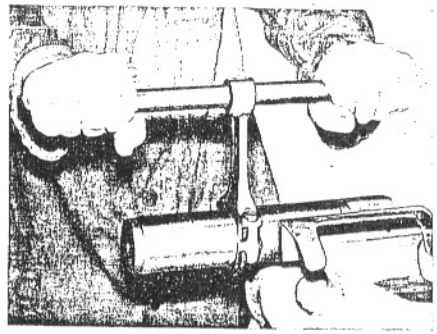
■

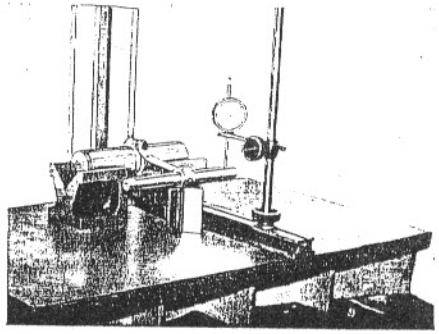
Ensure that the basic bore in the big end bearing is clean and round before pressing in the bearing shells.

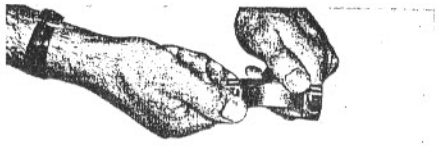
■

Before refitting the crankshaft smear the main and connecting rod bearing shells lightly with Molykote Paste G.

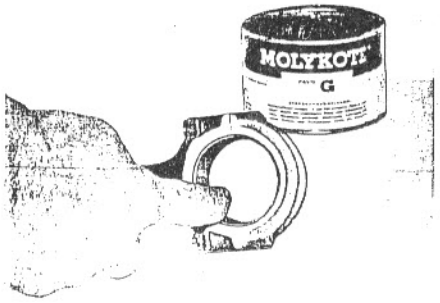
■





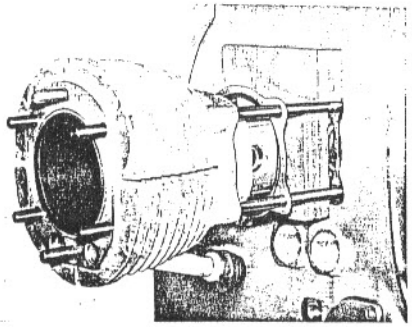




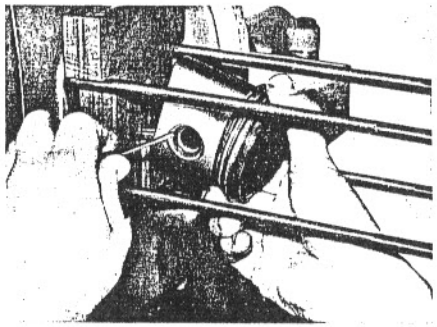


11 25 000 Piston, Removing and Refitting

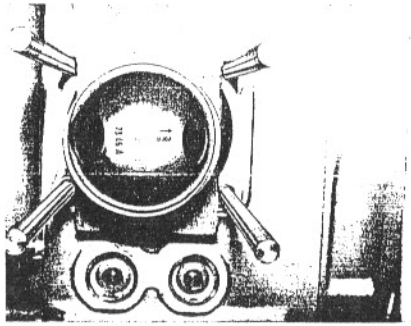
Cylinder head, remove and refit 11 12 080.
Draw the cylinder and cylinder base seal off the four tie bolts, taking care to ensure that the piston is not damaged on emerging from the cylinder. Insert a protective block of wood behind the piston and between the tie bolts.



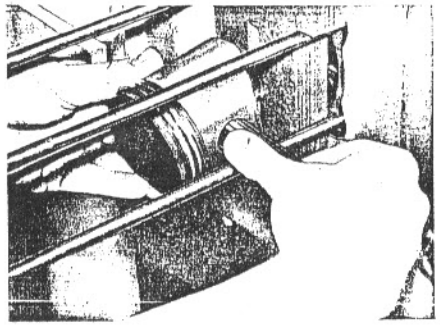
Lift out the wrist pin retainer by pressing in a scriber or small screwdriver into the transverse slot. Press out the wrist pin with a conventional extractor device or a BMW No. 210 arbor press.



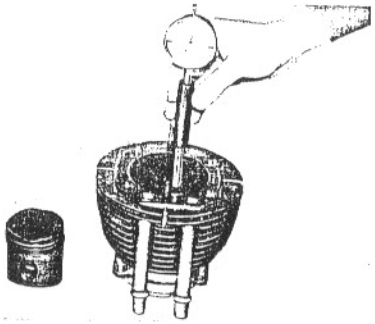
Note when fitting:
Fit the piston so that the marking "vorn→" on the piston crown points in the direction of travel. This is the correct fitting position for the offset piston. The piston does not have to be heated for fitting the wrist pin. It is essential to use only pistons of the same weight category within each engine.



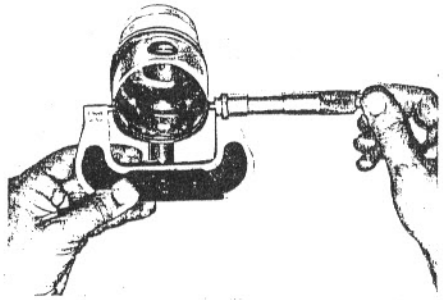
Insert the wrist pin circlip in the groove so that one end completely covers the transverse slot. Press the centre of the circlip into the wrist pin bore so that both ring ends come as close together as possible. Use the BMW No. 210 arbor press to push the ring fully into the groove.



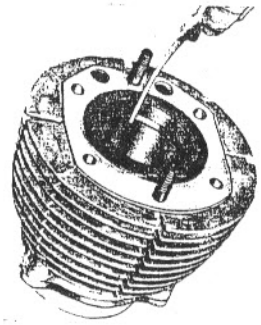
11–25/1



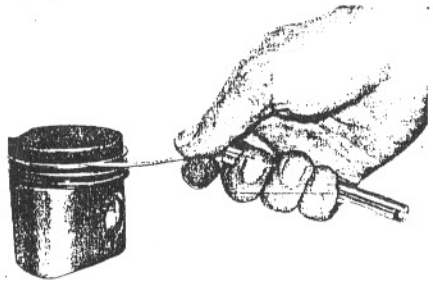
Testing and Repair: Measure the cylinder bore in the wrist pin direction and at 90° thereto 10 mm from the top, in the centre and at the bottom with an inside gauge. This should be carried out at a room temperature of 20° C.



Use a micrometer gauge to measure the piston diameter at the piston skirt transverse to the wrist pin bore.



Check the ring gap

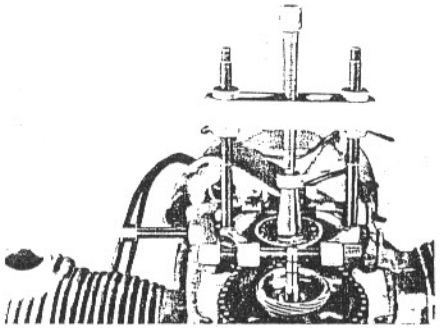


and side clearances of the piston rings with the aid of a feeler gauge. See the Technical Data for the nominal dimensions and oversizes of cylinder bore and piston, diameter and the ring gap and side clearances of the piston rings.

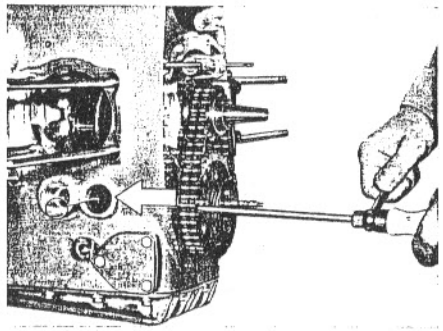
11–25/2

11 31 061 Timing Chain Gear Train, Renewing

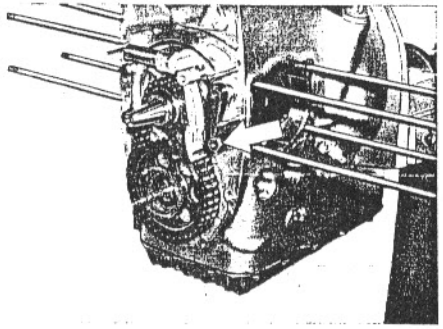
Engine, remove and refit 11 00 050.
Cylinder head, remove and refit 11 12 080.
Timing cover, remove and refit 11 14 060.
Flywheel, remove and refit 11 22 000.
Connecting rod, remove and refit 11 24 000.
Piston, remove and refit 11 25 000.
Oil pump, remove and refit 11 41 000.
Alternator, remove and refit, 12 31 020.
Clutch, remove and refit 21 21 000.
Bring the crankcase into horizontal position, fit the BMW No. 217 grooved bearing extractor into position (not forgetting the extractor pad cap) and draw off bearing.



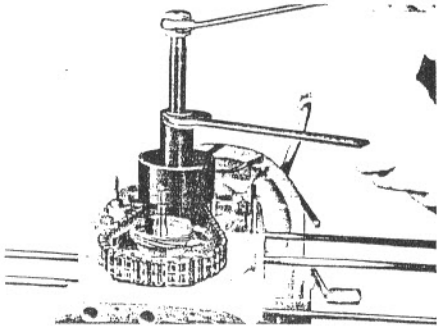
Unscrew the two Phillips screws fastening the camshaft flanged bearing with the aid of a spanner and Phillips screwdriver. Withdraw four push rods with the aid of a wire hook.



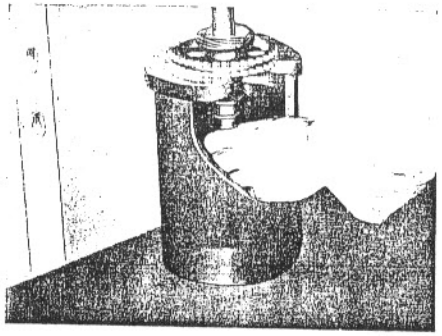
After removing the circlip, take off the chain tensioner. Remove the chain tensioner spring after releasing the nut (arrow).



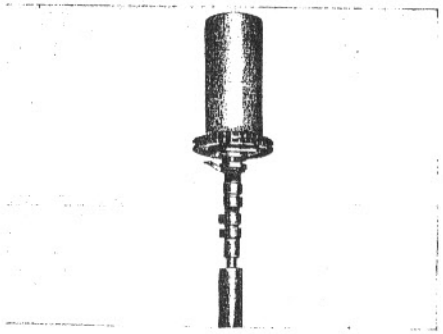
Fit the BMW No. 213 timing chain sprocket extractor on the crankshaft sprocket (not forgetting the extractor pad cap). Draw off the sprocket while tightening the camshaft.
Warning: as the sprocket is pulled off the rivet studs can be damaged by the chain links, in which case the timing chain must be replaced.



11-31/1



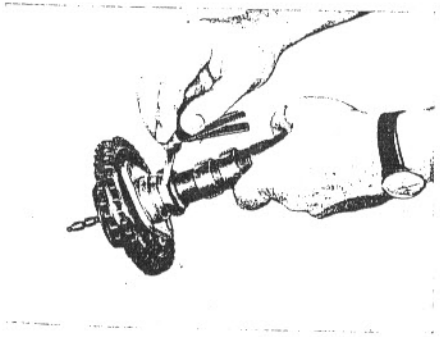
Insert the camshaft into a suitable pipe (outer diameter approx. 106 mm, inner diameter approx. 90 mm and length approx. 225 mm) so that the sprocket lies flat on the pipe. Fit BMW No. 212 sleeve on the camshaft end face and press out the sprocket together with the rev. counter drive gear.



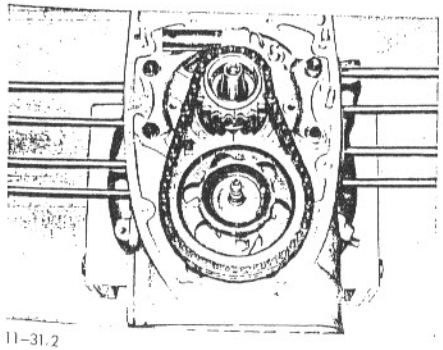
Before refitting the timing gears grease the gear bores lightly with tallow.

The rev. counter drive is pressed on in reverse sequence to removal. Push the flanged bearing on to the camshaft, then push the sprocket followed by the rev. counter drive gear into place.

When pressing the camshaft into the sprocket hold a feeler gauge (see Technical Data for thickness) between the camshaft thrust collar and the flanged bearing.



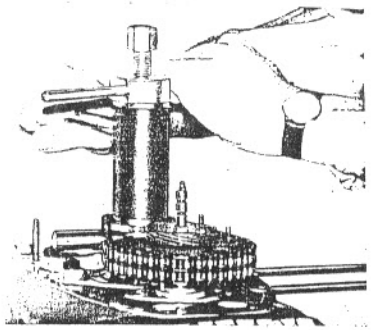
Check the end play on the camshaft flanged bearing once again with a feeler gauge.



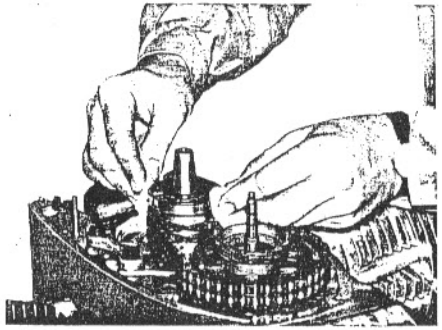
Position the crankcase vertically for fitting the camshaft. Lay the camshaft and crankshaft sprocket into the chain so that the tooth marking lines are exactly opposed.
Insert the camshaft in the crankcase and push the drive gear with slip collar on to the crankshaft stump so that the sprocket groove coincides with the fitting key.

11-31.2

Screw the BMW No. 223 and 535 screw press with spindle into the crankshaft stump. Press the sprocket firmly into position ensuring that the camshaft is guided accurately into its bearing feet at the flywheel end.

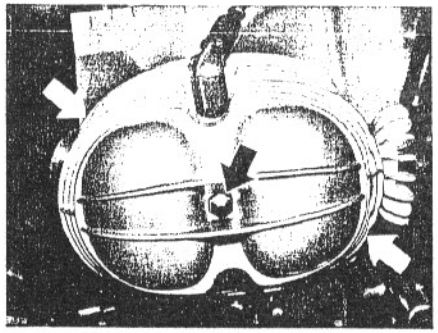


Tighten the camshaft flanged bearing with its two Phillips screws. Heat the grooved bearing to approx. 80÷100° C and mount on crankshaft stump. Fit chain tensioner, ensuring that the rubber running surface is in good condition. Do not change the form or spring pressure of the timing chain tensioning spring.

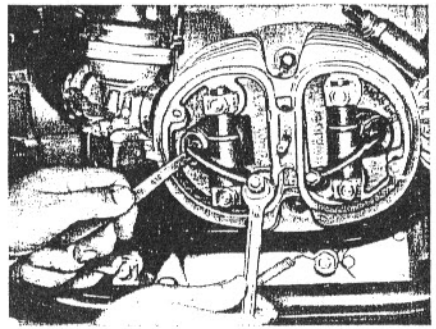


11 34 504 Valve Clearance, Adjusting

Slacken off the cap nut and the two nuts (arrows), remove the cylinder head cover and gasket.



Adjust the valve clearance with the engine cold and stationary by inserting the appropriate feeler gauge between the valve stem and rocker arm. For this purpose take out the spark plugs and turn the engine with the kick starter till the cylinder to be adjusted is at top dead centre. Both valves are closed. If necessary adjust the adjusting screw after releasing the lock nut and then secure with the lock nut. Recheck the valve clearance. See Technical Data section for valve clearances.



11 41 000 Oil Pump, Removing and Refitting

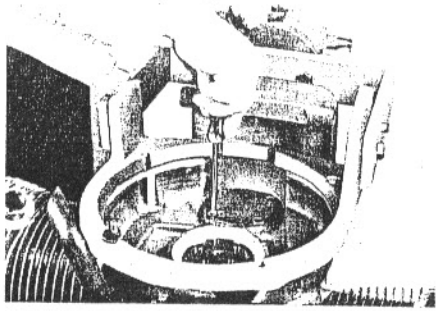
First possibility: engine, remove and refit 11 00 050.
The illustrations and text were prepared after this preliminary work

Second possibility: gearbox, remove and refit 23 00 020. (Engine remains in frame).

Clutch, remove and refit 21 21 000.
Flywheel, remove and refit 11 22 000.

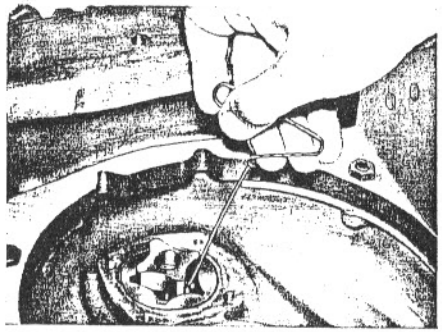
After unscrewing the four Phillips screws take off the oil pump housing cover.

■



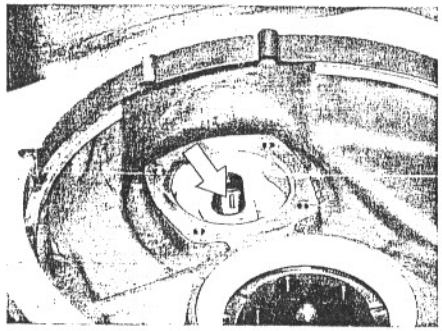
Take the inner and outer rotor out of the housing with the aid of a wire hook.

■



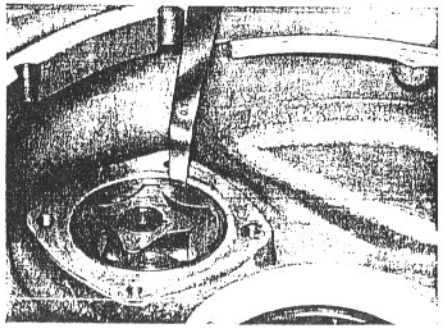
Before extracting the driver key (fitting key) for the inner rotor it is advisable to press a small rag into the oil pump housing bores.

■



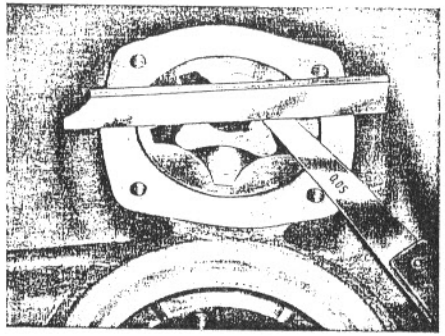
Tests: See Technical Data section for clearance between outer rotor and pump housing.

■



See Technical Data section for clearance between pump housing contact surface and rotor sealing surface.

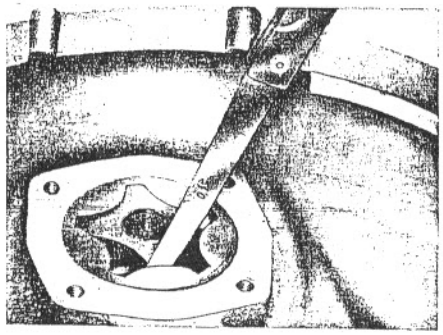
■



Determine the gap between the inner and outer rotors with the aid of a feeler gauge. See Technical Data section for clearances.

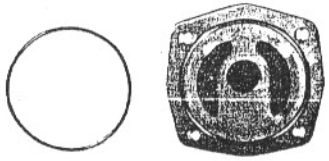
When reassembling do not forget to replace the fitting key and ensure that the O-ring in the cover is in perfect condition.

■



When assembled the O-ring must be compressed so that the cover lies flat on the housing contact surface.

■



12 Engine electrical systems

Technical Data	. . . . . page	12– 0/3
12 11 004	Ignition timing – adjusting	12–11/1
12 11 141	Contact breaker points – renewing	12–11/4
12 13 100	One ignition coil – removing and refitting	12–13/1
12 31 009	Alternator, diode carrier and regulator – testing	12–31/1
12 31 019	Alternator with regulator – quick test	12–31/2
12 31 020	Alternator – removing and refitting	12–31/2
12 31 212	Alternator – overhauling	12–31/3
12 31 689	Stator winding, rotor and diode carrier – testing	12–31/3
	Fault finding on alternator	12–31/6
12 32 000	Regulator switch for generator – removing and refitting	12–32/1
12 41 009	Starter – testing in situ	12–41/1
12 41 020	Starter – removing and refitting	12–41/1
12 41 513	Starter – dismantling and reassembling	12–41/3
12 41 541	Carbon brushes – renewing	12–41/5
12 41 602	Starter – overhauling	12–41/5
12 41 701	Energizer coil – renewing	12–41/6
	Fault finding on the starter	12–41/7

Technical Data

Engine electrical system					
	R 60/6	R 75/6	R 90/6	R 90 S
Type	Bosch DF 12 V 0.5 HP			
Starter:				
Type	Bosch G 1 14 V 20 A 21/280 W			Bosch G 1 14 V 17 A 22/238 W
Starting short circuit current strength A	290			
Output HP	0.5			
Torque mkp(ft/lb)	0.885 (6.39)			
Repeat start cutout relay	Stribel SR 9572			
Axial float, armature, mm(in)	0.10–0.15 (0.0039–0.0058)			
Alternator:				
Type	Bosch G 1 14 V 20 A 21/280 W			Bosch G 1 14 V 17 A 22/238 W
Alternator drive	direct from crankshaft			
Maximum output W/V	280/14			
Maximum current strength A	20			
Resistance between phase outputs, Ohms	0.62			
Charging commences, rpm	980			
Maximum rpm	10 000			
Maximum deflection at slip rings, mm(in)	0.06 (0.0023)			
Minimum slip ring diameter, mm(in)	26.8 (1.045)			
Voltage Regulator:				
Type (Bosch)	0 190 601 013 AD 1/14 V			0 190 601 009 AD 1/14 V
Regulating voltage, without load, volt	13.5—14.2			
under load, volt	13.9—14.8			

Engine electrical system

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Diode carrier: Type (Bosch)	0 197 002 003			
Ignition coil: Type (Bosch)	E 6 V			
Length of starting spark at 300 sparks/minute and 3 V, mm(in)	8 (0.312)			
Length of operating spark at 3600 sparks per minute, mm(in)	13.5 (0.526)			
Spark plugs: Thread	M 14 × 1.25			
Bosch	W 230 T 30	W 200 T 30	W 200 T 30	W 200 T 30
Beru	230/14/3A	200/14/3A	200/14/3A	200/14/3A
Champion	N 7 Y	N 7 Y	N 7 Y	N 6 Y
Electrode gap, mm(in)	0.7 (0.028)			
Contact breaker: Type (Bosch)	Automatic centrifugal advance on camshaft			
Advance commences, rpm	1550	1550	1550	1550
Advance ends rpm	3000	3000	3000	3000
Breaker lubricating felt and centrifugal advance lubrication	Bosch grease Ft 1 v 4			
Bearing journal for centrifugal advance	Bosch grease Ft 1 V 22 or Ft 1 v 26			
Contact breaker points gap mm(in)	0.35÷0.40 (0.014÷0.016)			
Contact spring pressure p	450			

55

Engine electrical system

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Dwell angle °	78° ± 1°			
Capacitor	0.2 µ F — 25 %			
Ignition timing, static for engine assembly	9° ± 3° BTDC			
Adjustment range, °crankshaft	25° ± 2°			

54

Tightening torques mkp (ft/lb)

Armature fastening screw	2.3÷2.7 (16.6÷19.5)	Spark plugs	2.3÷3 (16.6÷21.7)
Starter fastening bolts	4.75 (34.3)	Centrifugal advance unit	0.6÷0.7 (4.3÷ 5.1)

All other bolts and nuts are to be tightened in accordance with the usual figures shown in the manufacturer's tables or in accordance with the latest BMW Standard Specification 60 002.0.

12 11 004 Ignition Timing, Adjusting

Engine is removed (11 00 050) or fitted. Illustrations and text (apart from the two pictures with the timing gun) were prepared with engine removed.

Take off engine cover after unscrewing the three hexagonal socket head bolts.

Note when fitting:

When assembling ensure that the breather hose is first inserted in the engine cover.

■

Where no dwell angle tester is available turn the engine, with spark plugs removed, clockwise as viewed facing against direction of travel, with the aid of the rotor fastening hexagonal socket head bolt.

■

The interrupter arm (hammer) must lift fully clear. Check points gap with feeler gauge. If necessary replace points 12 11 141.

■

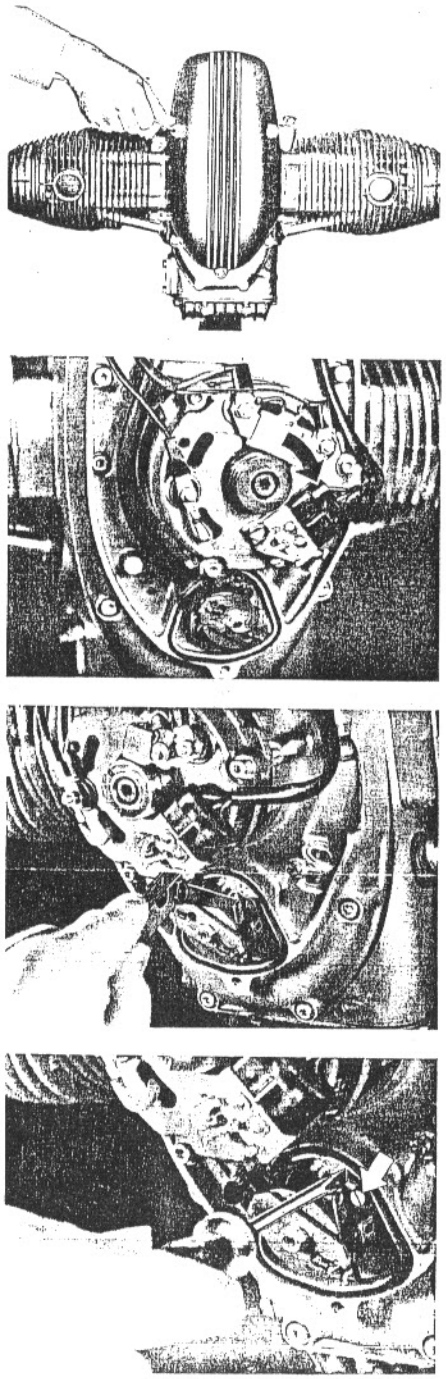
Adjusting the Points Gap

Slacken off the locking screw (arrow), insert screwdriver between the two pegs and in the slot of the anvil point and adjust the points gap by turning the screwdriver. Tighten lockscrew.

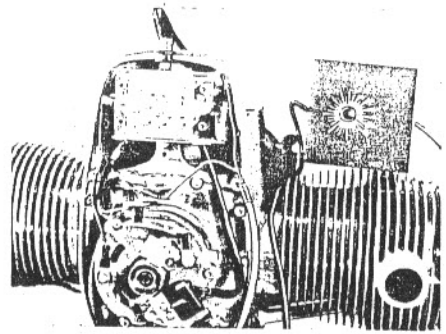
Recheck the dwell angle and points gap.

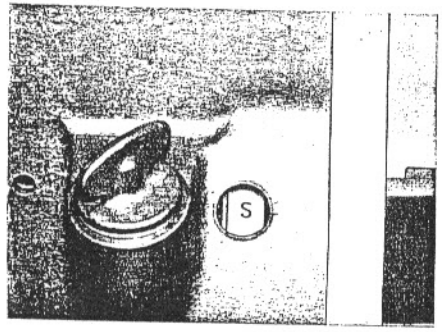
See Technical Data section for dwell angles and points gap.

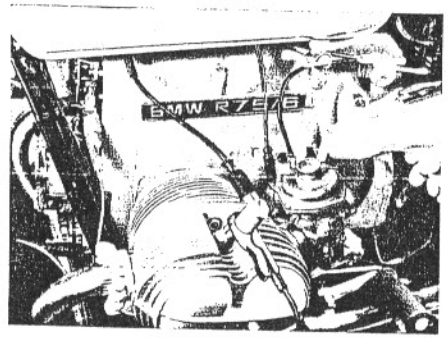
■

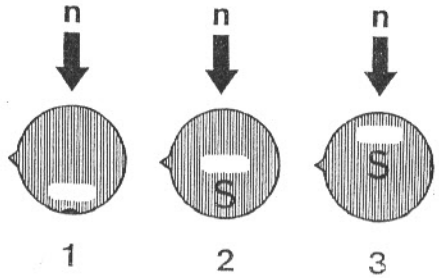


12–11/1









12–11/2

Timing Check

a) With test lamp

b) Timing light gun (stroboscope)

c) Connect the test lamp with one terminal to the capacitor and the other to earth. Switch on ignition.

■

The test lamp must light up when the "S" marking on the flywheel coincides with the sight aperture marking when the engine is turned clockwise (centrifugal weights in rest position).
Between the left and right cylinders the ignition timing may deviate by a maximum of 6° (corresponding to 12 mm on the flywheel circumference).

■

Timing light gun (stroboscope)
Connect up and aim at the flywheel marking in the sight aperture while the engine is running.

■

At engine idling speed (600–800 rpm) the white spot on the "S" flywheel marking must appear in the sight aperture. If the spot appears below the centre (1) the timing is retarded and above the centre the timing is advanced.

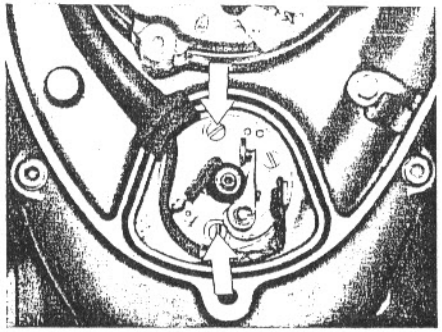
With the timing set correctly (2) the white spot coincides with the marking on the housing.

As engine speed increases the flywheel marking "S" disappears upwards (adjustment commences at about 800 rpm) until as the revolution speed increases still further the flywheel marking "F" (full advance) appears from the bottom in the sight aperture and at 2800 ± 200 rpm it moves up to the housing mark.

■

Ignition Timing Adjustment:

Slacken off two slotted screws (arrow) in the base plate of the points. Turning the base plate in the same rotary sense as the engine retards the timing and turning contrary to the rotary sense of the engine advances the timing (rotary sense of engine and camshaft are identical). Tighten the slotted screws.

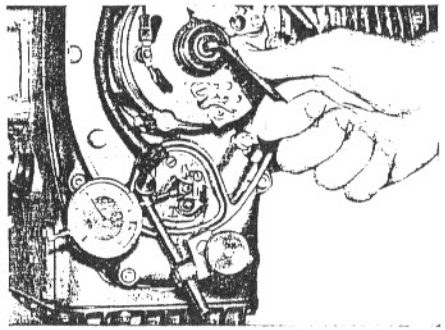


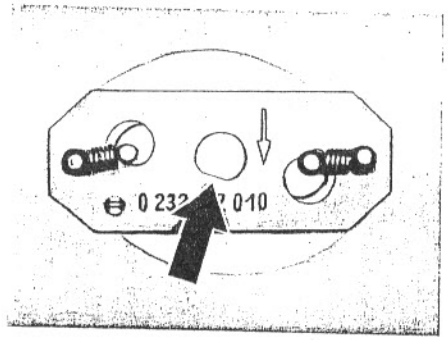
When checking the timing with a test lamp turn the engine back 45° contrary to the direction of rotation of the engine (test lamp extinguishes) in order to eliminate all play between the moving elements for the subsequent rotation in the same direction of rotation as the engine. Recheck the timing.

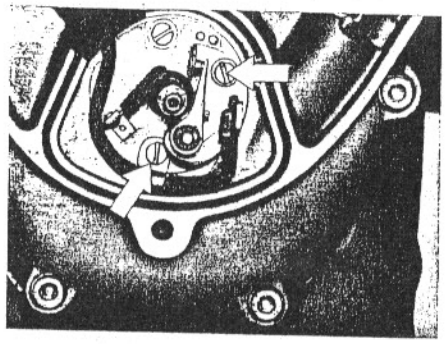
Timing check with **timing light gun** (stroboscope).

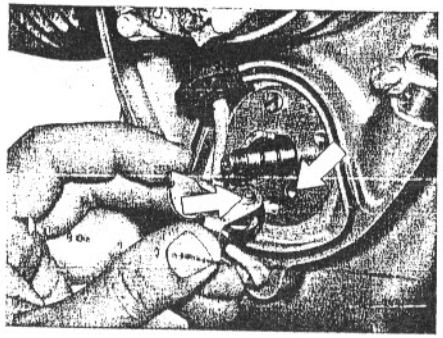
If full advance cannot be reached check the ease of operation of the adjusting cam on the bearing journal.

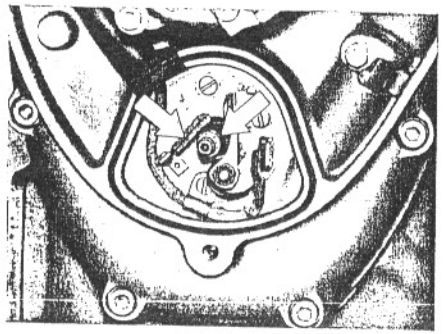
If the timing sequence from one cylinder to the other is outside the stipulated tolerance check the bearing journal for wobble.











12 11 141 Contact Breaker Points, Renewing

Take off the engine cover after unscrewing the three hexagonal socket head bolts. When refitting ensure that the breather hose is first inserted in the engine cover.

After unscrewing the hexagonal nuts remove the centrifugal timing advance.

When refitting the centrifugal timing advance note the locating surface (arrow).

Check the points for wear, smoothing with a point file in emergencies but preferably if worn they should be renewed. To replace the points unscrew the two cheese head screws (arrows) from the plate, pull off the lead plug from the capacitor and remove with contact breaker.

When fitting ensure that the protruding brass axis of the contact breaker arm (hammer) is inserted accurately in the relevant bore of the contact breaker plate (arrows).

Before fitting the centrifugal advance mechanism check the breaker cam lubricating felt and, if necessary, rub in a little Bosch Ft 1 v 4 lubricating grease. Grease the centrifugal advance drive shaft with Bosch grease F 1 v 22. Ensure that the breaker cam on the drive shaft operates smoothly and easily.

12 13 100 One Ignition Coil, Removing and Refitting

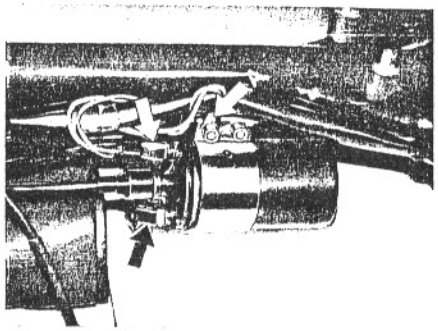
Fuel tank, remove and refit 16 11 030.

Disconnect the battery earth lead fastened with the gearbox breather screw.

Remove leads "1" and "15" (arrows) and the high tension lead from the coil.

Unscrew the hexagonal socket head fastening bolts and remove coil.

Note when fitting:
An earth lead (arrow A) is fitted on the front fastening screw of the left hand coil.

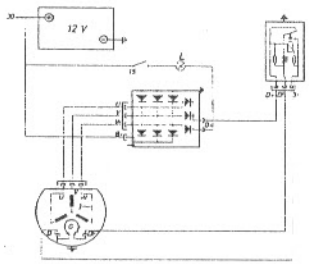


12 31 009 Alternator, Diode Carrier and Regulator, Testing

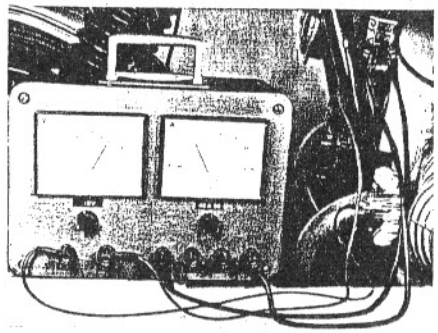
The picture shows the arrangement of the alternator, diode carrier and regulator.

Warning: The leads between battery, alternator and regulator should be parted only when the engine is stationary. If the battery is charged with a charger while still in the motor cycle the positive and negative leads must be disconnected from the battery.

The battery warning lamp (L) is used to pre-energize the alternator.

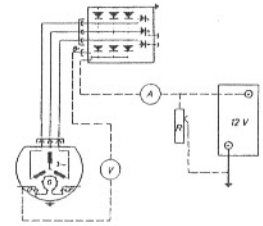


To check the regulator remove the B+ (black lead) from the diode carrier while the engine is stationary. Connect the volt meter to B+ and D–. Start engine. The voltage should read 13.5 to 14.2 volts shortly after the regulator commences operation.

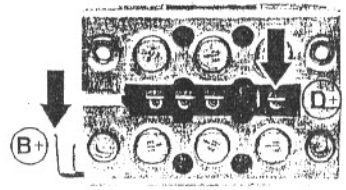


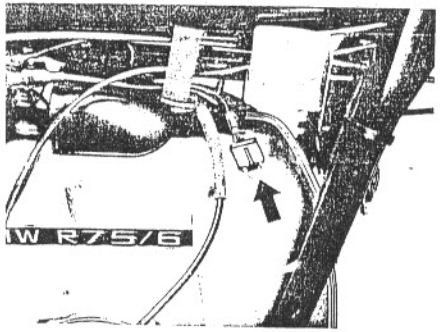
To check the charge current interpose an ammeter (measuring range 15–20 A) in the B+ lead. Switch on a consumer unit or slide resistor (potentiometer) allowing a loading of up to 13 amps, connect parallel with battery.

Allow engine to run at about 4000 rpm. Set maximum current strength on sliding resistor (potentiometer). Read off regulator voltage at load on volt meter, see Technical Data section for values.



With the aid of a volt meter (measuring range approx. 3 V) the voltage difference can also be measured direct between D+ and B+.
A voltage difference of up to 0.5 V indicates a fault in the regulator.
With a voltage difference of 1.5 V to 4 V the fault is in the diode carrier.





12 31 019 Alternator with Regulator, Quick Test

Fuel tank removed 16 11 030.

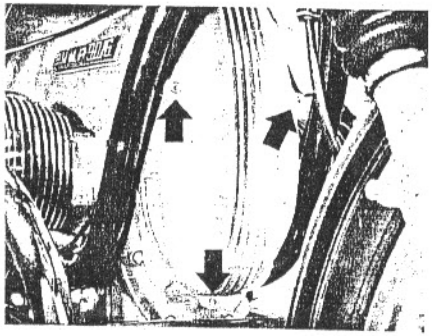
The check should be carried out only when the battery charge telltale remains permanently on while the engine is running.

Unplug the multiple plug from the regulator while the engine is stationary. Use a wire bridge (arrow) to connect lead D+ (blue) with lead DF (black).

Start engine and allow to run at approx. 1000–2000 rpm. If the battery charge telltale extinguishes immediately then this indicates a faulty regulator.

If the battery charge telltale glows or continues to display a bright light this indicates that the alternator is defective.

■

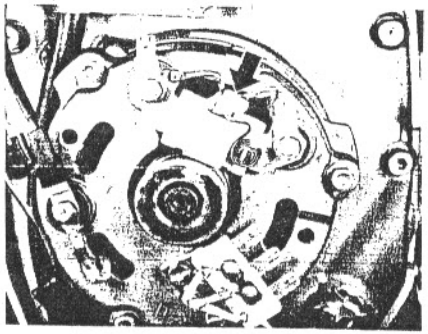


12 31 020 Alternator, Removing and Refitting

Engine removed 11 00 050 or fitted.
Take off engine cover after unscrewing the three hexagonal socket head bolts.

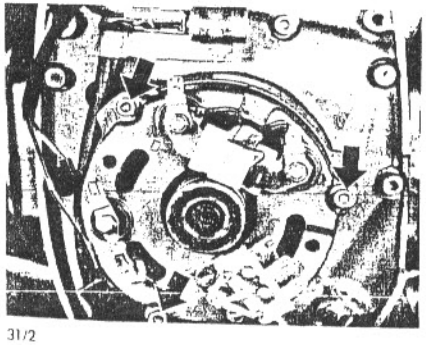
Note when fitting:
During installation ensure that the breather hose is first inserted in the engine cover.

■



Pull the three-pin flat plug from the housing. Lift the brushes slightly and block in this position with thrust springs.

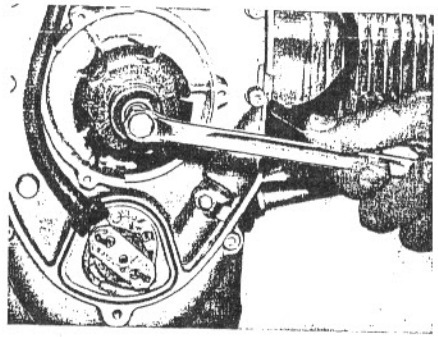
■



Unscrew the three hexagonal socket head bolts from the housing and remove housing.

■

Unscrew the rotor fastening screw and press the rotor off the crankshaft stump with the aid of screw press BMW No. 5030.



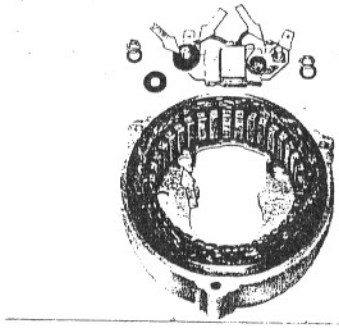
■

12 31 212 Alternator, Overhauling

Alternator, remove and refit 12 31 020.

Unscrew two nuts from the inside of the housing and draw out brush holder with brushes. If the brushes have to be renewed care must be taken when soldering (arrow) to ensure that no solder escapes into the copper wires.

Fit insulating brushes on the brush holder stud bolts. Retighten brush holder in housing, not forgetting insulating washers.

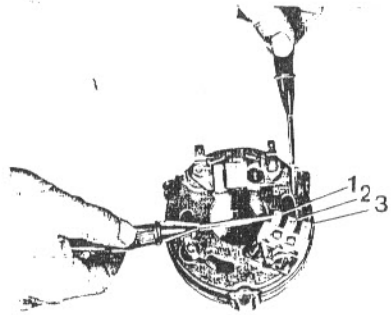


■

12 31 689 Stator Winding, Rotor and Diode Carrier, Testing

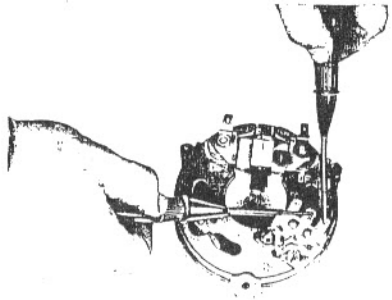
Alternator, overhaul 12 31 212.

Check stator winding for shorting with 40 V ac, make three measurements in each case.

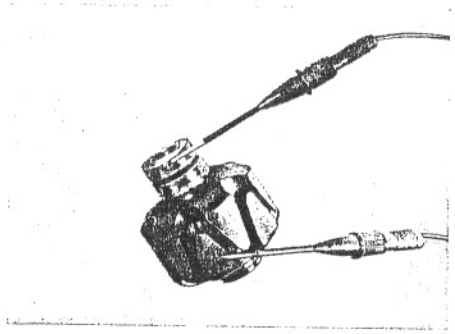


■

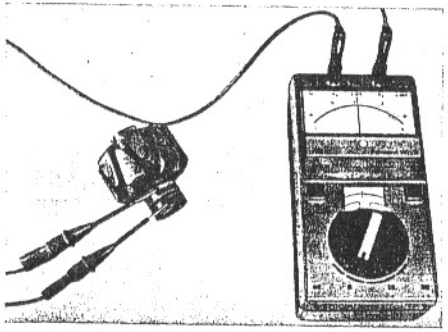
Check the resistance alternatively between the phase outputs, see Technical Data section for values.



■

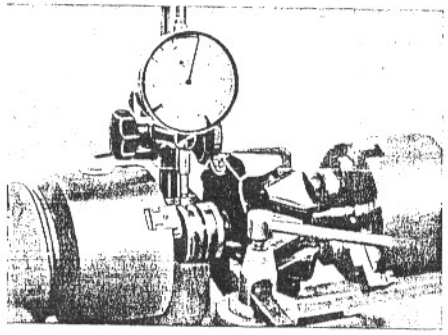


After removal, check the claw pole rotor with 40 V ac for shorting.

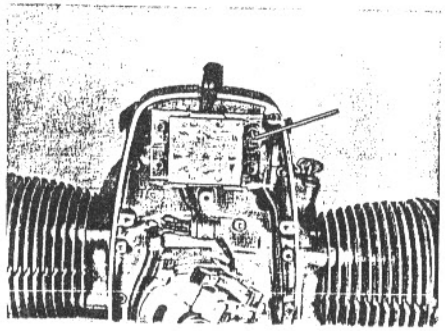


Check energizer winding (ohmmeter).

Resistance value 6.9 ohms + 10 %



Scored rotor slip rings must be precision finished. The mounting cone must run true. See Technical Data section for maximum deflection at the slip rings and minimum slip ring diameters.

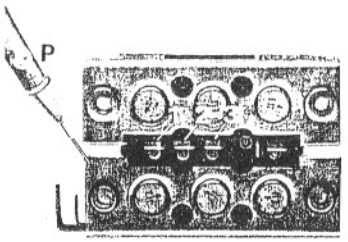


Check the diode carrier after removing the flat plug.

a) Positive Diodes

Check diodes with a maximum of 24 volts. The test lamp (P) must **not light up** when the test probe (+) is touched against the housing. Use the other test probe to check each of the three plug contacts.

Diode carriers must be replaced only as complete units.

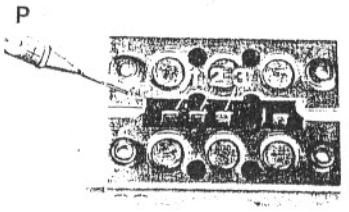


b) Negative Diodes

Check diodes with a maximum of 24 volts.

The test lamp (P) **must light up** when the test probe (+) is touched against the housing.

Use the other test probe to check each of the three plug contacts.

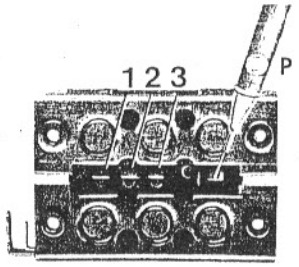


c) Energizer Diodes

Check the diodes with a maximum of 24 volts.

The test lamp (P) must **not light up** when the test probe (+) is touched against the plug connection.

Use the other test probe to check each of the three plug contacts.



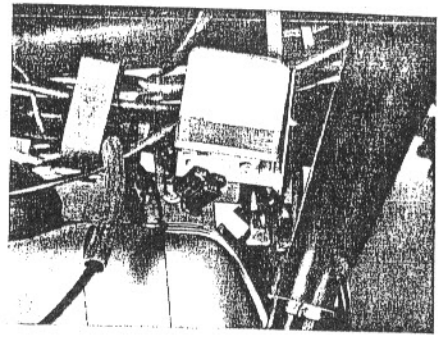
Fault finding on the alternator

Fault	Cause	Remedy
Alternator emitting noises	Brushes squeaking	Remove slip rings or brushes and replace
Telltale burns at half power while engine is running	Poor contact in lead connection	Check wiring connection and lead
	Faulty regulator	Replace regulator
	Faulty brushes	Replace brushes
	Rectifier diode defective or shorting	Replace rectifier diode
	Stator shorting	Replace stator
	Rotor shorting periodically.	Replace rotor.
Battery generating gas	Poor contact between regulator and alternator	Check wiring connections to regulator and alternator
	Faulty regulator	Replace regulator
Telltale burns at half or full brightness while engine running	Faulty regulator	Replace regulator
	Interruption or short circuit in feed lines	Check wiring connections and leads
	Faulty brushes	Replace brushes
	Faulty rotor winding	Replace rotor
	Energizer current circuit interrupted	Check lead connections
	Faulty diodes or diode carrier	Check diodes or diode carrier and replace where necessary

12 32 000 Regulator Switch for Alternator, Removing and Refitting

Remove fuel tank 16 11 030.

Detach battery earth lead. Remove plug (arrow) and take off regulator after unscrewing the two Phillips screws.

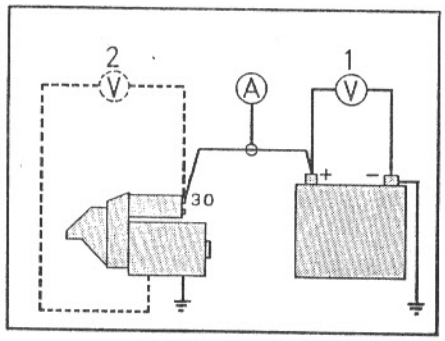


12 41 009 Starter, Testing in situ

Check the state of the battery charge, see Technical Data section for values.

For the purpose of checking the starter engage fourth gear and depress the footbrake.

Actuate starter for two to three seconds. The starter voltage should not drop below 8 volts under load and must be uniform with the volt meter at 1 and 2, otherwise the earth connection to engine or battery is poor; at the same time read off the current input from the ammeter, see Technical Data section.



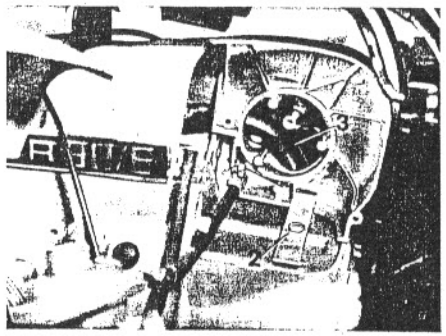
12 41 020 Starter, Removing and Refitting

Air filter element, remove and refit 13 72 000.

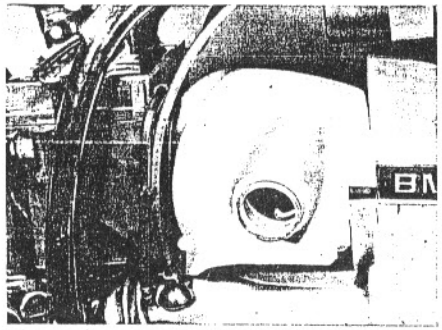
Fuel tank, remove and refit 16 11 030.

Detach both choke cables at the carburettors and lay aside the left-hand half shell of the air filter housing with choke cable.

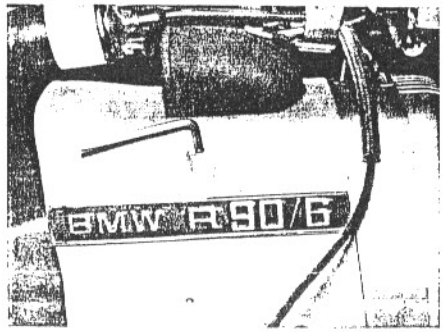
Unscrew nut (1) with straight ring spanner, slacken hexagonal bolt (2) and



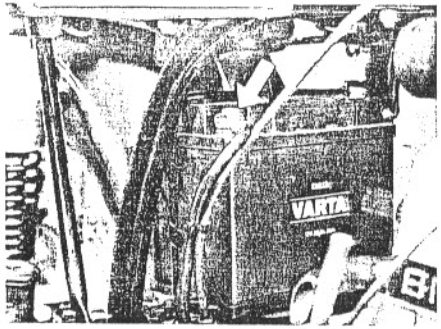
remove the right-hand half shell of the air filter housing, at the same time pushing the breather hose (3) to the rear.



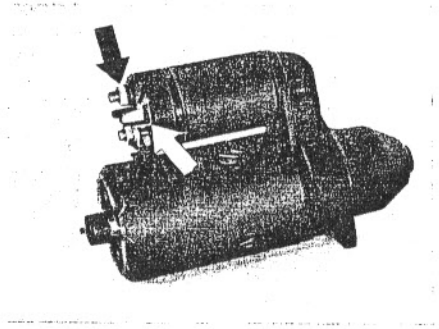
After unscrewing the two hexagonal socket head bolts tilt out the starter cover to the right.



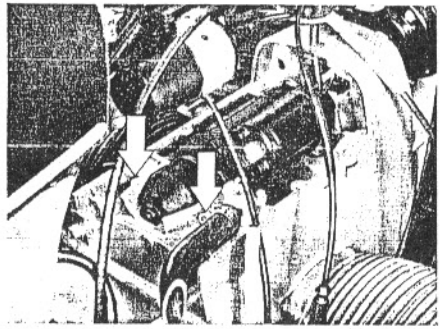
12-41/1



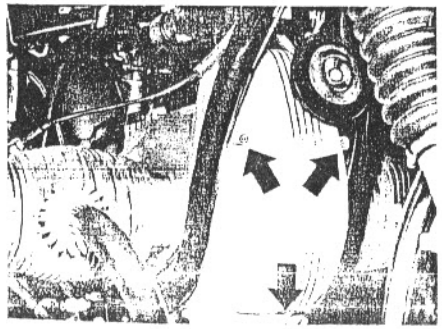
Disengage the battery clamping straps, lift cover upwards and



detach lead from the starter.



Remove rear fastening screws (arrows).

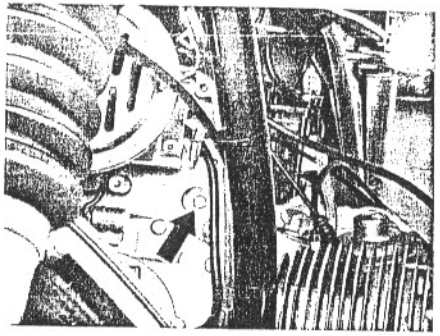


Slacken the top fastening screw on the horn.

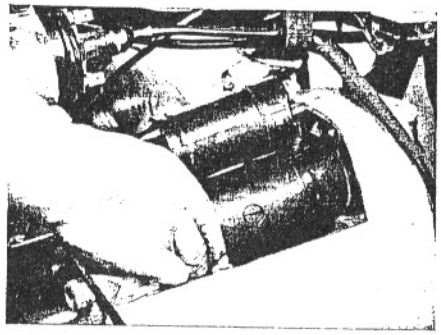
After unscrewing the three hexagonal socket head bolts remove the engine cover.

12-41.2

Unscrew the hexagonal bolt (arrow) with a box spanner.



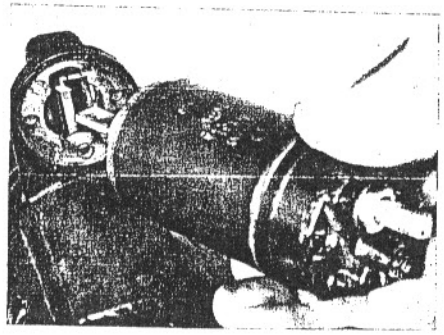
Lift the starter forward out of its guide.



12 41 513 Starter, Dismantling and Re-assembling

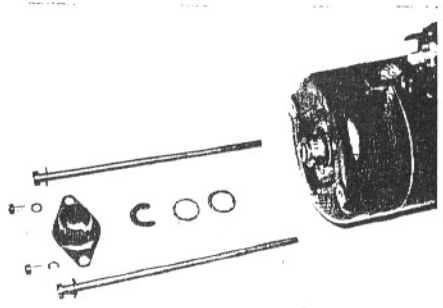
Starter, remove and refit 12 41 020.

Unscrew the energizer coil lead.
Detach solenoid switch.
Disengage engaging arm.

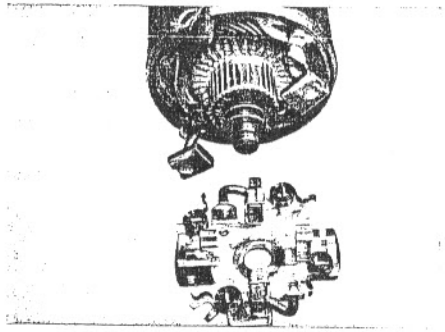


Remove dustcap.
Take off lockwasher, shim and gasket.
Unscrew the pole housing screws.
Pull off the cap.

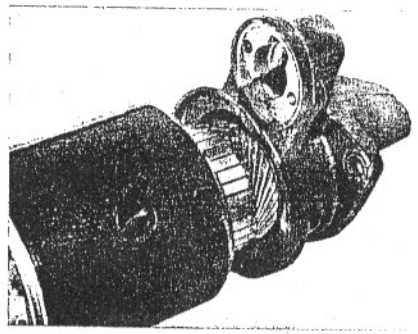
Note when fitting: Compensate axial armature float, see Technical Data section.
Check commutator bearings.



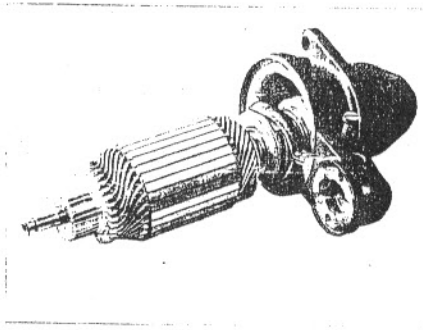
12–41/3



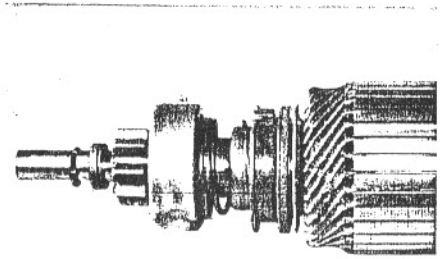
Lift out the positive brush and remove the brush holder plate.



Separate the pole housing from the drive bearing.



Unscrew the bearing screw for the engaging lever. Draw out armature with engaging lever.



Press the thrust ring to the rear.
Lift out circlip.
Pull off starter gear.

Note when fitting: Coat the steep thread and engaging ring with Bosch Silicon grease Ft 2 v 3.

Draw the starter ring over the circlip.

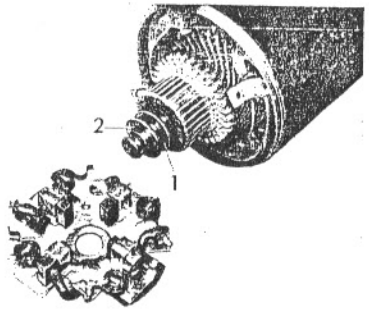
12–41/4

12 41 541 Carbon Brushes, Renewing

Starter, dismantle and re-assemble 12 41 513.

Unsolder and resolder the brushes on the energizer coil and the brush holder plate.

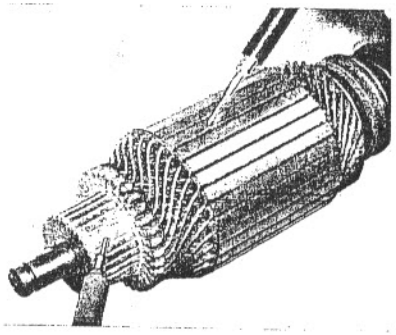
Note when fitting: Washer (1) on armature, insulating washer (2) before it.



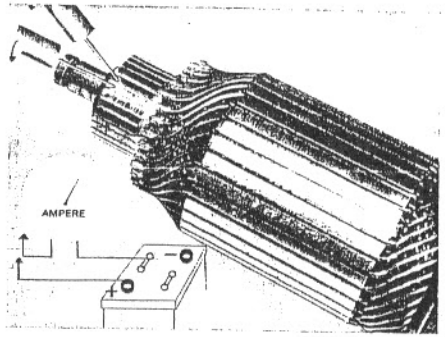
12 41 602 Starter, Overhauling

Starter, dismantle and re-assemble 12 41 513.

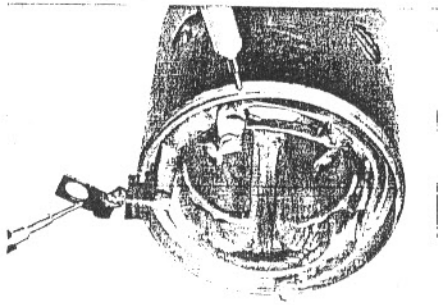
Check armature and field winding – test lamp 220 volts.
Probe commutator and plate stack with test probe.
In the event of earthing the lamp will light up and the armature must be replaced.



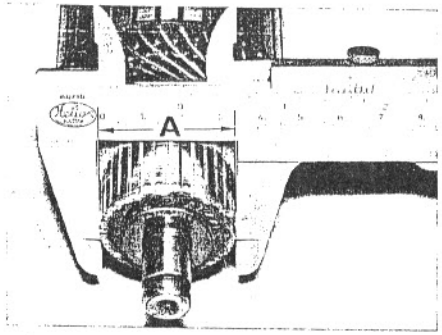
Interpose an ammeter (measuring range 60 amps) in the current circuit and probe the commutator briefly from segment to segment. Test voltage 2–4 volt.
The deflection on the instrument should be uniform between the individual segments.
Sharp deviations indicate a short circuit and the defective armature must be replaced.

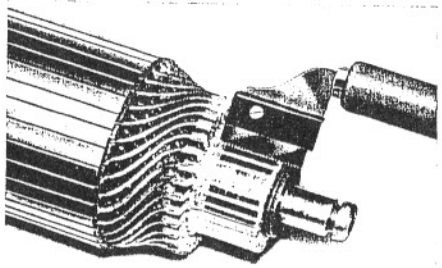


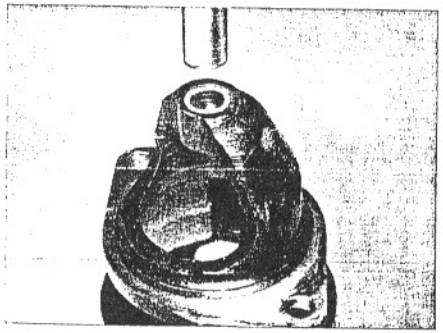
Check energizer coil for earthing. Replace scorched or charred windings.

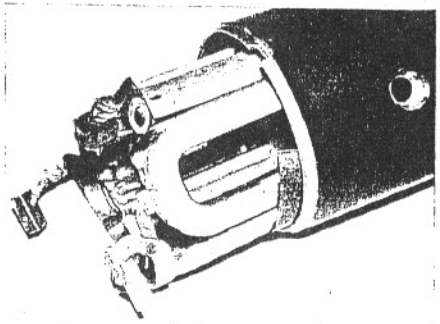


12–41/5









12–41/6

Superfinish the commutator. The commutator diameter (A) may not be less than 33 mm.

Undercut the commutator segments, removing any swarf or metal dust with polishing cloth. The insulation should be 0.5 mm deeper than the segments.

Press out worn bush.

Note when fitting:
Before fitting the new bush it should be soaked for at least 30 minutes in engine oil and pressed into a flush fit.

12 41 701 Energizer Coil, Renewing

Starter, dismantle and re-assemble 12 41 513.

Mark the pole terminals to ensure the same position on re-assembly. Unscrew the four pole terminal screws. Remove the pole terminals and energizer coil from the pole housing.

Note when fitting:
Before finally tightening down the pole screws ensure that the pole terminals are aligned parallel to the longitudinal axis.
Lay paper insulating strip between the energizer coil and pole housing.

Fault finding on starter

Fault	Test method/Causa	Remedy
Starter fails to turn when starter button is operated	Switch on light.	
	Light does not burn. Battery dead. Battery feed interrupted.	Measure battery voltage. Recharge battery. Check battery leads and terminals.
	Light burns, becoming gradually dimmer as starter is actuated. Battery dead.	Recharge battery.
	Light burns but extinguishes immediately starter is actuated. Oxydized battery terminals or earth connection.	Clean battery terminals or earth connection.
	Light burns normally. Bridge terminals 50 and 30 on the starter. The starter turns. Ingnition/starter switch defective or input leads interrupted.	Replace ignition/starter switch, remedy interruption.
	Light burns normally. Solenoid switch actuates, starter fails to turn. Bridge with an appropriate lead from the battery positive pole to terminal 30 on the starter. Starter turns. Solenoid switch contact fouled or scorched.	Replace solenoid switch.
Starter fails to turn when lead is routed direct from the battery positive pole to terminal 30.	Brushes too short. Brushes jamming. Inadequate brush pressure.	Replace brushes. Release jamming. Replace thrust springs.
Starter turns too slowly, fails to turn engine over.	Commutator fouled. Faulty armature or energizer coil.	Clean commutator. Repair starter.
Starter turns at high speed, engine remains stationary or turns over jerkily.	Drive pinion faulty. Spur gear faulty. Drive pinion failing to disengage. Steep thread fouled or damaged.	Replace drive pinion. Replace flywheel. Repair starter.

13 Fuel preparation and control system

Technical Data . . . . . page 13– 0/3
13 00 004 Engine idling and fuel/air mixture – adjusting 13–00/1
13 10 004 Fuel level – checking and adjusting 13–10/1
13 10 009 Carburettor cleaning 13–10/1
13 10 100 Left and right-hand carburettors – removing and refitting 13–10/1
13 10 370 Choke chamber – removing and refitting 13–10/2
13 72 000 Air filter element – removing and refitting 13–72/1

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Carburettor: Construction	2 inclined Bing slide-type carburetors with needle jet and central lever float	2 inclined Bing constant depression carburetors with needle jet, vacuum plunger, throttle butterfly and central lever float		2 inclined Dellorto slide-type carburetors with needle jet, central lever float and accelerator pump
Carburettor type: Left-hand carburettor Right-hand carburettor	1/26/111 1/26/112	64/32/9 64/32/10	64/32/11 64/32/12	PHM 38 BS PHM 38 BD
Carburettor throat diameter, mm(in)	26 (1.02)	32 (1.26)		38 (1.5)
Main jets	140	135	150	155
Needle jets	2.68 with accelerator pump	2.70	2.68	2.60
Jet needle number	4	46÷241		K 4
Needle position	2	3	1	3
Choke jet diameter, mm(in)	—	60 (0.624)		77 46/70
Air jet diameter, mm(in)	—	2.0 (0.078)		—
Diameter of mixture bores in rotary slider, mm(in)	—	2.0 / 1.2 / 0.7 (0.078 / 0.046 / 0.027)		—
Idling jets	40	45 44÷950		60
Idling air jet diameter, mm(in)	—	1 (0.03)		1.2 (0.046)
Idling air regulating screw opened (turns)	$1/4 \div 1\,1/4$	—		$1 \div 1\,1/2$
Idling mixture regulating screw opened (turns)	—	$1/2 \div 1$		—
Bypass bore diameter, mm(in)	0.8 (0.031)	1.0 (0.039)	0.7 (0.028) 0.65 (0.026)	1.4 (0.055)
Float valve diameter mm(in)	2.2 (0.087)	2.5		3.0 (0.118)

13-0/3

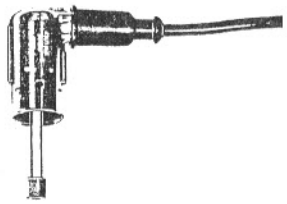
13-0/4

Technical Data

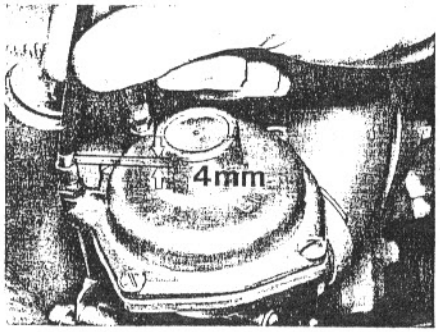
Type	R 60/6	R 75/6	R 90/6	R 90 S
Float chamber vent bore diameter, mm(in)	—	—	—	2.5 (0.09)
Throttle valve	20÷570	—	—	—
Float weight, gr(oz)	10 (0.35)	13 (0.46)	13 (0.46)	10 (0.35)
Control slider weight, gr(oz)	—	102 (3.6)	106 (3.6)	
Idling outlet bore diameter, mm(in)	0.8 (0.031)	—	—	
Rotary slider diaphragm		65—810		
Induction air filter	A common "Micro Star" dry air filter for both carburettors			
Fuel System: Fuel grade	Super (premium)			
Minimum octane rating (ROZ)	98			
Fuel tank, filling capacity (litres/Imp gall/US gall)	18 including approx. (3.5 / 4.3) 2.0 litres reserve (0.44 / 0.53)			24 (5.3 / 6.3) 2 (0.44 / 0.53)

13 00 004 Engine Idling and Fuel/Air Mixture, Adjusting

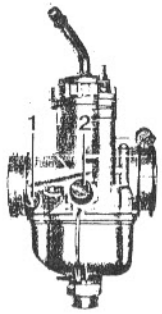
Adjust idling with engine running at normal operating temperature and with throttle twist grip closed. Fit supressor (Beru EPI or other suitable metal insert) to sparkplug cap to prevent scorching of parts of the waterproof gasket by arcing when the plug lead is laid on the cylinder.
If the engine already idles at the correct idling speed (see Technical Data section) it is then merely necessary to make an acoustic or rev. counter check by alternately detaching the sparkplug caps to see whether both cylinders are operating at a uniform speed.
If this is not the case, i. e. if the idling speed is above or below the specified rate, the carburettors must be adjusted as follows:



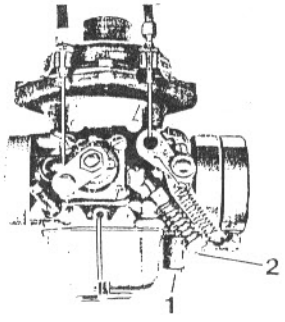
Select a provisional cable play of four millimeters to prevent the throttle valve or butterfly valve fouling the cables.



On the R 60/6 and R 90 S models adapt the revolutions of the cylinder deviating by the greatest amount from the prescribed idling speed to the other cylinder. For this purpose turn throttle valve stop screw 2 to the right (speed up engine) or to the left (slow down engine).
To adjust to the most favourable mixture turn the idling-air regulating screw 1 carefully to both sides and check whether the engine reacts by a marginal increase in revs; if this happens the ideal mixture composition has been found. The same procedure is followed with the opposite carburettor.
If the engine speed is still outside the prescribed 600–800 rpm, the engine speed is reduced by turning to the left the throttle valve stop screw 2 or increased by turning them to the right. Reset the idling regulating screw 1.



On the model R 75/6 and R 90/6 adjust the choke cables so that when the choke is off the choke arm is pressed into its end position. Adjust the idling mixture regulating screw 1 and the butterfly valve stop screw 2 of both carburettors to their basic settings; to do this tighten the idling mixture regulating screw fully and then slacken by one turn, tighten the butterfly valve stop screw till it just touches the butterfly valve lever, at this point tighten the valve stop screw by one turn. Allow the engine to warm up; use choke to start. Turn the idling mixture regulating screw of both carburettors to the left and to the right until the most favourable mixture is obtained (can be seen by the maximum engine revs. obtained).
Now adjust the carburettors by constantly alternating from one to the other. Gradually screw in the butterfly valve stop screw and find the ideal mixture composition with the idling mixture regulating screw after each ajustment. This procedure must be repeated until the cylinder being adjusted dies out after a few cycles if it is working alone. (The sparkplug lead of the opposite cylinder is disconnected.)

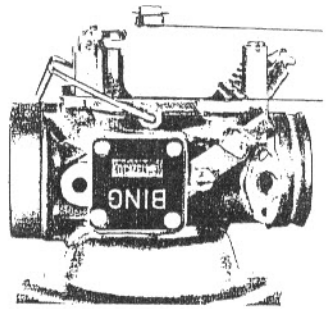


Warning: the engine must not be allowed to idle for longer than ten minutes at a time.

To regulate the transmission from idling to partial load turn the throttle twist grip slightly to cause a nominal increase in idling speed. Take off the sparkplug cap alternately to check whether both cylinders are operating uniformly. If necessary turn to the left the throttle cable adjusting screw on the carburettor which cuts in later and lock into position with the hexagonal lock nut.

13 10 004 Fuel Level, Checking and Adjusting

Carburettors, left and right, remove and refit 13 10 100.

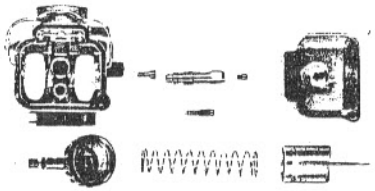


Take off the float chamber and hold the carburettor so that the float needle valve closes off the fuel inlet bore by its own weight. Hold the float parallel to the chamber contact surface and check whether the brass tabs of the float just touch the ball of the float needle valve in this position. If necessary bend the brass tabs as required.

Ensure that the brass tabs always run parallel to the float axis.

13 10 009 Carburettor, Cleaning

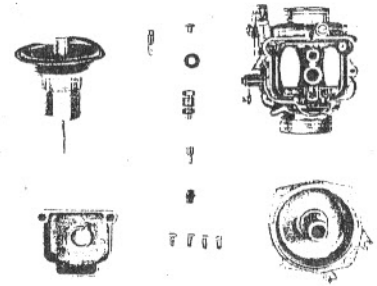
Carburettors, left and right, remove and refit 13 10 100.



Fuel level, check and adjust. 13 10 004.

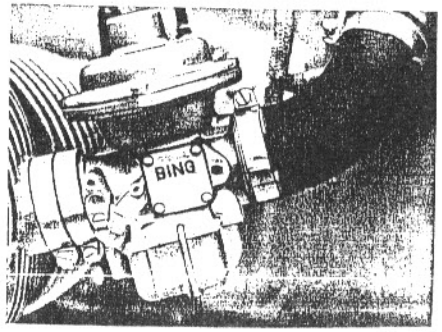
On the R 60/6 and R 90 S models take off the carburettor cover and remove the throttle slider, idling jet, main jet, main jet holder, accelerator pump, needle jet and atomizer and clean in clean fuel, after which the nozzles and bores must be blown through with compressed air.

On the R 75/6 and R 90/6 models, remove the domed cover, plunger and diaphragm, idling jet, main jet holder, main jet, needle jet and atomizer, clean all parts in clean fuel and blow through jets and bores with compressed air.



13 10 100 Carburettors, Left and Right, Removing and Refitting

On the R 60/6 and R 90 S models, unscrew the carburettor cover and draw the throttle valve out of the chamber. Loosen choke fastening and pull out with the starter slider. On the R 75/6 and R 90/6 models disengage or disconnect the choke and throttle cables.



After slackening the hose clamps lay the carburettor to one side.



2 1

13 10 370 Choke Chamber, Removing and Refitting

Carburettors, left and right, remove and refit 13 10 100.

Slacken the four lentil head countersunk screws and take off the choke carburettor chamber with rotary slide valve and gasket.

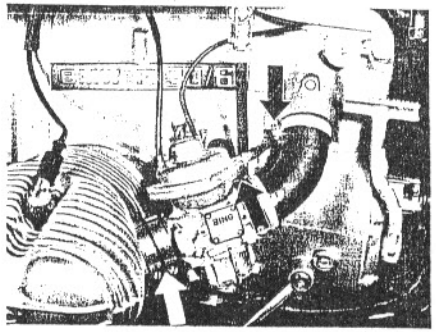
Take care not to interchange the left and right hand choke carburettor chambers.

1 = left-hand choke carburettor chamber
2 = right-hand choke carburettor chamber

■

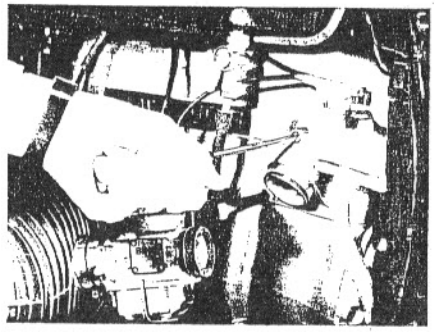
13 72 000 Air Filter Element, Removing and Refitting

Slacken the hose clamps on the left of the air line and take off the air line after pushing back the rubber sleeve.



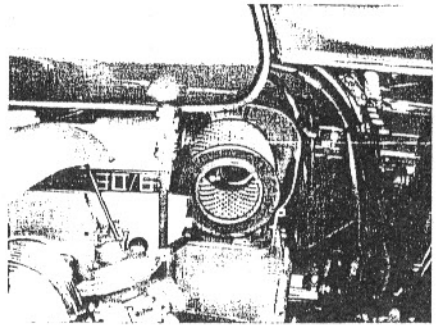
■

Tie the kick starter securely to the footrest. Unscrew the cylinder head bolt from the air filter chamber on the left and take off the chamber half shell.



■

Take out the filter element.



■

81

16 Fuel tank and lines

Technical Data . . . . . page 16– 0/3
16 11 030 Fuel tank – removing and refitting 16–11/1

82

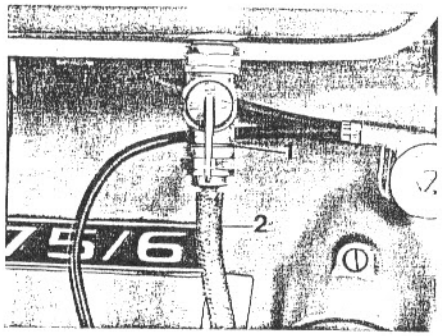
Technical Data

Fuel tank and lines

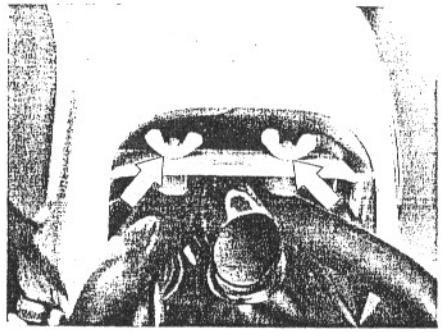
Type	R 60/6	R 75/6	R 90/6	R 90 S
Tank capacity, Ltr (Imp. gall/US gall)	18 (3.5 / 4.3)			24 (5.3 / 6.2)
Including reserve, Ltr (Imp. gall/US gall)	2 (0.44 / 0.53)			2 (0.44 / 0.53)

16 11 030 Fuel Tank, Removing and Refitting

Close fuel petcocks (1) and take off hoses (2).



Lift the twin seat, unscrew the wing nuts, raise the fuel tank slightly to the rear, lift forward and remove.



18 Exhaust system

Technical Data . . . . . page 18– 0/3
18 00 020 Exhaust system – removing and refitting 18–00/1
18 11 321 Silencer – renewing 18–00/2

Exhaust system

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Silencer diameter, mm(in)	87 (3.39)			
Exhaust pipe diameter, mm(in)	38×1.5 (1.482×0.058)			

Tightening torques mkp (ft/lb)

Star nut for exhaust 20÷22 (144.6÷159.1)

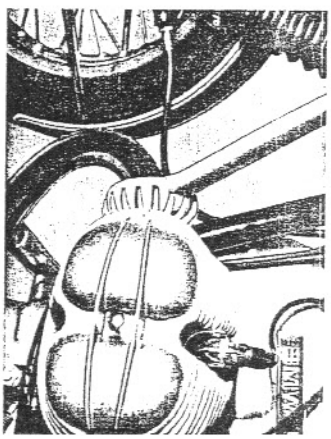
All remaining bolts, screws and nuts are to be tightened in accordance with the normal values specified in the manufacturer tables or in accordance with the latest BMW Standard Specification 60002.0.

85

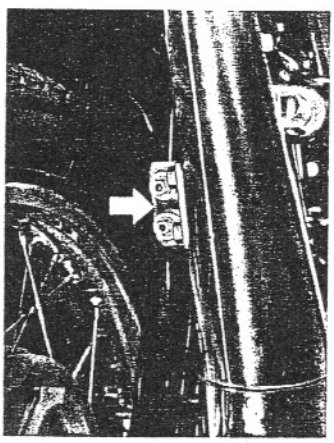
18-0/3

18 00 020 Exhaust System, Removing and Refitting

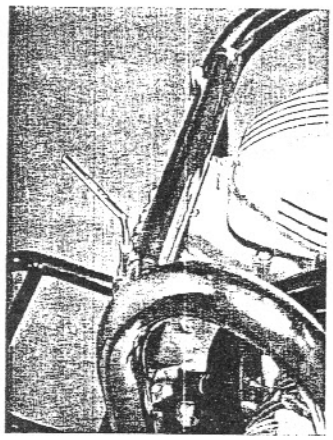
Use the special BMW No. 338/2 exhaust spanner to detach the exhaust nut from each cylinder head.



■ Unscrew the hexagonal nuts on the footrest and unscrew the hexagonal socket head bolts from the frame.

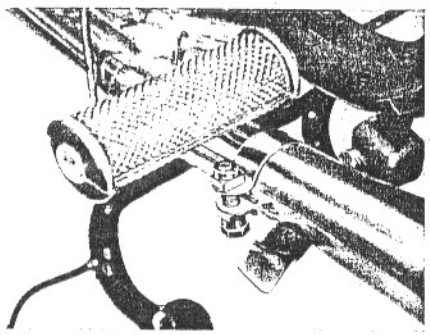


■ Slacken the hexagonal socket head bolt on the cross pipe and remove exhaust system.



86

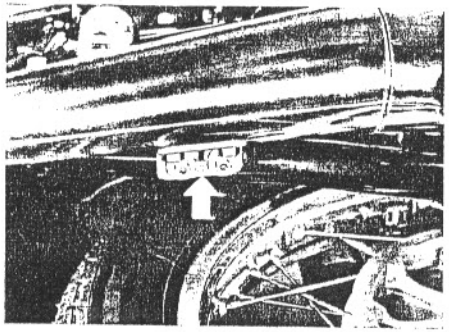
18-00-1



18 11 321 Silencer, Renewing

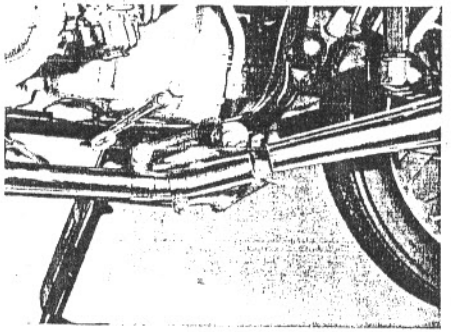
Slacken the hexagonal bolt on the pipe clamp and push back the pipe clamp.

■



Unscrew the hexagonal socket head bolts on the frame.

■



Pull off the silencer to the rear.

■

21 Clutch

Technical Data . . . . . page 21–0/3
21 21 000 Clutch – removing and refitting . . . . . 21–2 /1
21 51 020 Clutch throwout lever – removing and refitting . . . . . 21–5 /1

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Type	Single plate dry type clutch with diaphragm spring			
Material thickness (disc spring) mm(in)	2.6 (0.101)		2.8 (0.109)	
Disc spring pressure when fitted, kp	175÷200		217÷236	
Height of disc spring (relaxed) mm(in)	19.0±0.5 (0.741±0.019)			
Test specification for disc spring	When the edge of the disc is laid on the gauge plate the height differences in the spring tabs should be a maximum of 0.3 mm (0.011") or when the spring tabs are laid on the gauge plate the height deflection of the disc rim should be a maximum of 0.8 mm (0.031").			
Overall thickness of clutch plate mm(in) (segment and lining)	6±0.25 (0.234±0.0097)			
Minimum thickness of clutch plate, mm(in)	4.5 (0.175)			
Maximum lateral wobble of clutch plate at outer diameter, mm(in)	0.15 (0.0058)			
Maximum vertical play of clutch plate, mm(in)	0.3 (0.011)			
Maximum deflection of diaphragm driver plate, mm(in)	0.1 (0.0039)			
Maximum imbalance of clutch plate, cmg	6			
Clutch travel at throwout lever (cable), mm(in)	2 (0.078)			

89

21–0/3

21–0/4

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S

Tightening torques mkp (ft/lb)

Clutch lever adjusting screw locknut	2.0÷2.3 (14.46÷16.62)
Clutch at flywhel	2.3 (16.62)

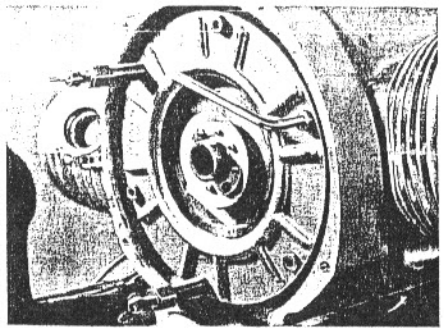
All other screws, bolts and nuts are to be tightened in accordance with the normal values indicated in the manufacturers tables or in the latest BMW Standard Specification 60002.0.

90

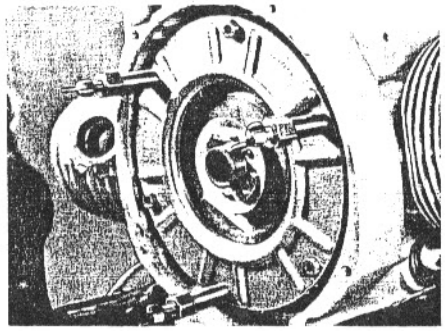
21 21 000 Clutch, Removing and Refitting

First possibility: Engine removed 11 00 050.
Second possibility: Gearbox removed 23 00 020. (Engine remains in frame.)

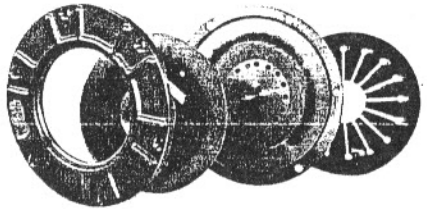
Illustrations and text prepared after this preliminary work. Use an Allen key to slacken six hexagonal socket head bolts, unscrew alternate fastening bolts and replace by three BMW No. 534 clamping bolts and screw down their nuts to contact the thrust ring.



Remove the remaining three fastening bolts and turn back the clamping bolt nuts uniformly until the spring disc is fully relaxed.

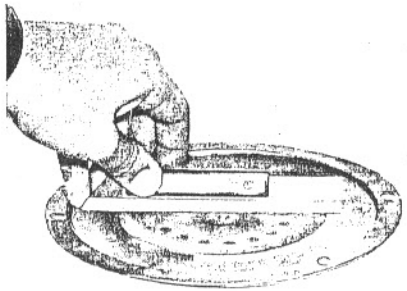


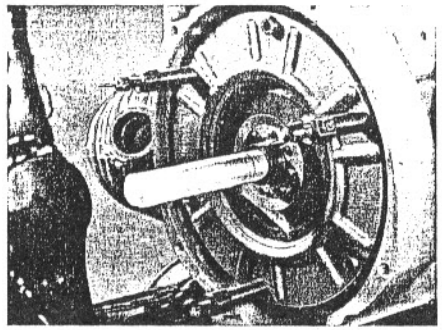
Remove the thrust ring, spacer rings, clutch plate, pressure plate with diaphragm and the spring disc.



Checking and Repair

Check the clutch plate and diaphragm for wear and distortion and the spring disc for clamping force when fitted; check the driven plate for lateral wobble, wear tolerances and play, see Technical Data section.



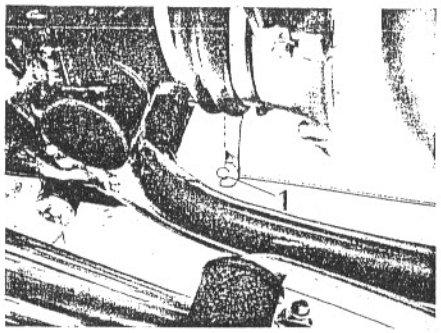


When re-assembling use the BMW 529/1 centring arbor to locate the clutch plate. See Technical Data section for tightening torques.

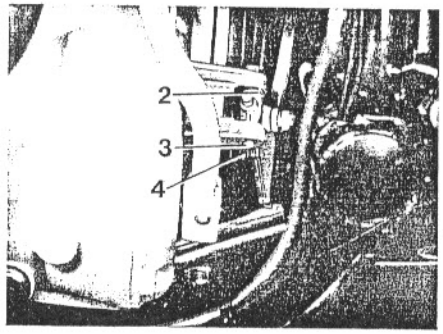
Lightly coat the inside toothing of the clutch hub with "Molykote Longterm 2" lubricant.

21 51 020 Clutch Throwout Lever, Removing and Refitting

Disconnect the clutch cable (1)



Extract cotter (2), take out bolt (3) and lay the parts with thrust spring (4) to one side.



23 Gearbox

Technical Data . . . . . page 23- 0/3
23 00 020 Gearbox – removing and refitting 23-00/1
23 11 040 Gearbox housing cover – removing and refitting/sealing 23-12/1
23 22 001 Gear train – renewing 23-21/1
23 31 001 Selector forks – renewing 23-31/1
23 31 210 Selector bracket – removing and refitting 23-31/1
23 31 861 Selector discs – renewing 23-31/2
23 31 881 Gearshift – renewing 23-31/2
23 31 401 Neutral indicator – renewing 23-31/3
23 51 010 Kick starter – removing and refitting 23-31/3

Gearbox

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Gearbox:	5-speed gearbox with dog clutch integral with engine, drive moment damped in all four gears			
Gear shift system	Hooked lever shift			
Transmission ratios: 1st gear 2nd gear 3rd gear 4th gear 5th gear	 4.4 : 1 2.86 : 1 2.07 : 1 1.67 : 1 1.50 : 1			
Type of oil – over 5° C Below 5° C	Branded hypoid gearbox oil SAE 90 Branded hypoid gearbox oil SAE 80			
Filling capacity, litres (Imp/US pints)	0.8 (1.4/1.7)			
Drive shaft: Axial float, mm(in)	0÷0.1 (0÷0.0039) (adjust with shims)			
Layshaft: Axial float, mm(in)	0÷0.1 (0÷0.0039) (adjust with shims)			
Output Shaft: Axial float, mm(in)	0÷0.1 (0÷0.0039) (adjust with shims)			
Ballbearing seating in gearbox	Press fit (heat gearbox case to about 100° C for assembly)			
Axial play of the free-running pinions in the shaft mm(in)	0.15÷0,30 (0.005÷0.010)			

23-0/3

23-0/4

Gearbox

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Bushes on output shaft mm(in)	0.005÷0.035 (0.00019÷0.0013)			
Driving flange radial play, mm(in) Face wobble, mm(in)	±0.05 (±0.0019) ±0.05 (±0.0019)			
Power transmission from gearbox to rear wheel	Enclosed universal shaft in right-hand swing arm tube, universal joint at gearbox end, hypoid geared clutch bell at axle drive end			
Axial float of foot-operated gear shift lever shaft, mm(in)	0.1 (0.0039)			
Overshift clearance between ratchet and selector points on the cam selector plate 1 st to 5th gear, mm(in)	approx. 0.5 (0.019)			

Tightening torques mkp

Mounting on engine	2 ÷ 2.3 (14÷16.6)	Gearbox case/gearbox cover	0.8÷0.9 (5.7÷ 6.5)
Stop bolts for tie rod arms	1.7÷ 1.9 (12.2÷137)	Kick starter lever nut	2.0÷2.3 (14÷16.6)
Selector fork mounting	2.3÷ 2.5 (16.6÷18)	Oil filler plug	2.8÷3.1 (20÷22.4)
(driver flange) on the gearbox output shaft	22.0÷24.0 (159÷173)	Oil drain plug	2.3÷2.6 (14÷18.7)

All other, bolts screws and nuts are to be tightened with the values recommended in the manufacturer's tables or the latest BMW Standard Specification 60002.0

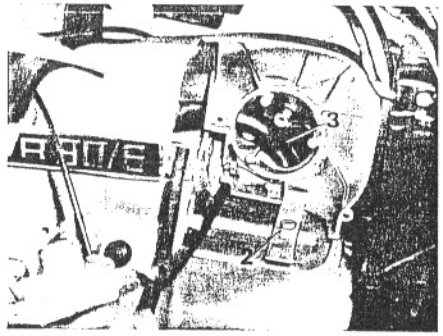
23 00 020 Gearbox, Removing and Refitting

Stand the motorcycle on its parking stand and fit an additional support behind the parking stand.

Air filter – remove and refit 13 72 000.

Disconnect both choke cables at the carburettors and lay the left-hand half shell of the air filter housing with choke cables to one side.

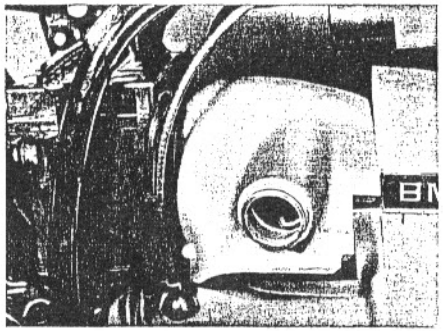
Unscrew nut (1) with straight ring spanner, slacken hexagonal bolt (2)



■

and take off the right-hand half shell of the air filter housing, at the same time pushing back breather hose (3).

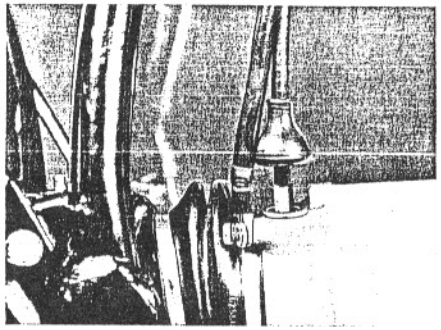
Remove carburettor.



■

Push back the rubber protective cap on the speedometer drive and, after releasing the retaining screw and disconnecting the battery earth lead, withdraw together with the washer.

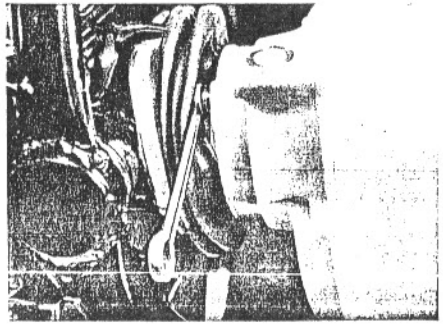
Battery – remove and refit 61 21 010.
Battery bracket – remove and refit 61 21 000.



■

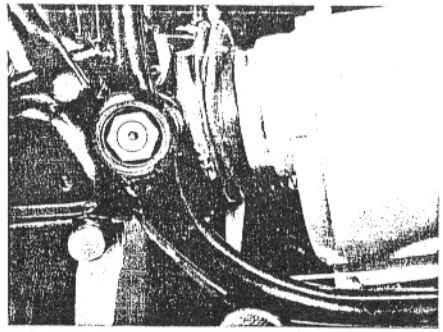
Slacken the rubber gaiter clamp on the gearbox and push back the gaiter as far as possible, not forgetting to place an oil drip tray in position.

Unscrew the four 12-sided bolts with a ring spanner and lay to one side with washers. Depress footbrake to hold the universal shaft.



■

23–00/1

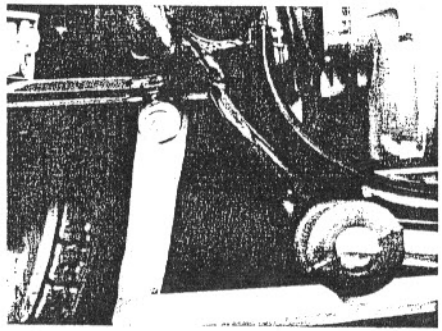


Take off the from the swinging arm mounting. Slacken the locknuts to the left and right of bearing journals and unscrew both bearing journals.

When refitting the swinging arm care must be taken to ensure that the two thrust collars do not project.

See Technical Data section for tightening torque.

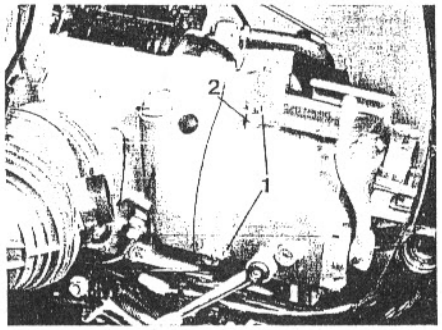
■



Remove footbrake lever, at the same time holding securely at the bearing bolt and unscrew the locknut.

Clutch throwout lever, remove and refit 21 51 020.

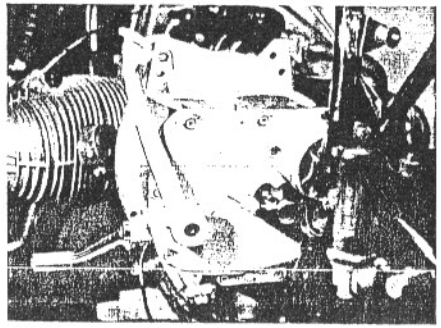
■



Unscrew the two hexagonal socket head bolts 1 and one hexagonal socket head through bolt on the lower right of the gearbox.

When re-assembling remember tab 2.

■



With the aid of a wooden wedge (approx. 20 mm², 400 mm long) inserted between the tyre and rear section of the frame, secure the swinging arm in its rearmost position.

Carefully remove the gearbox to the kick starter side, place on footrest, disconnect lead for idling check.

Take out gearbox completely.

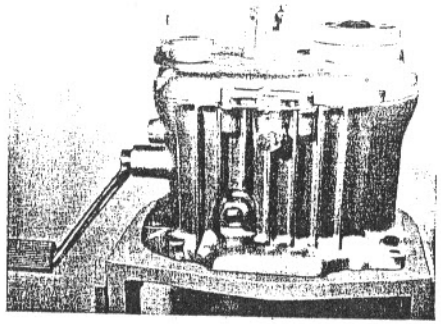
■

23–00/2

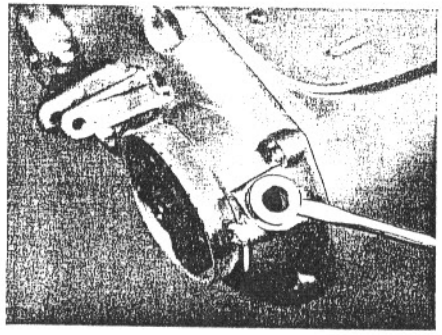
23 11 040 Gearbox Housing Cover, Removing and Refitting/Sealing

Gearbox, remove and refit 23 00 020.

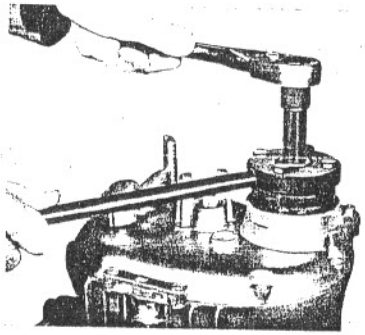
Fit BMW No. 6005/1 mounting for engine and gearbox in a combination BMW No. 6000 assembly stand. Fasten the gearbox on the mounting with two bolts at opposite corners.



After removing the retaining bolt use two screwdrivers pressed against the opposite side of the bush collar, press out the speedometer helical gear bush and remove the helical gear.

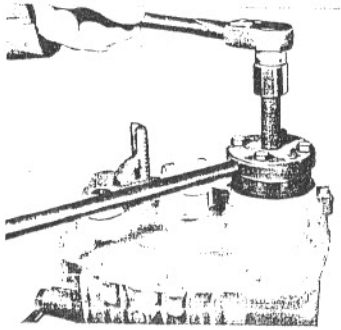


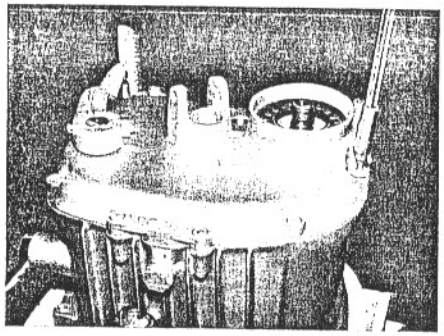
Use four bolts to fasten the BMW No. 234 back plate holding device to the driver flange of the output shaft. Release the locknuts.



After bolting on the BMW No. 232 extractor press, press out the driver flange with four bolts. If necessary release the taper seat with a gentle knock on the spindle.

Note when fitting: When refitting the driver flange, clean the tapered seats with trichlorethylene and refit in dry condition.



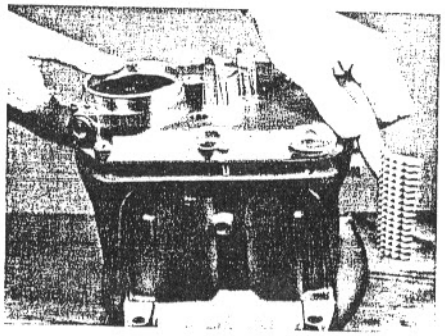


Remove the clutch pressure plate assembly with ring seal, ball race, pressure plate and thrust rod with felt ring.

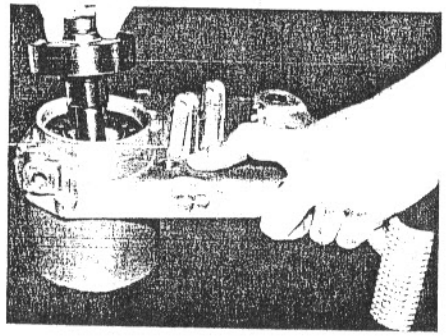
Remove the nine hexagonal socket head bolts from the gearbox cover with washer.

When assembling insert the thrust rod with felt ring from the flywheel end to protect the felt ring from damage. Rub hot bearing grease into the felt ring.

When fitting the clutch pressure plate assembly care must be taken to ensure that the two lips of the ring seal are not buckled.



Heat the gearbox to approx. 100° C and take off the gearbox cover with the kick starter pressed slightly downward. If necessary use a rubber hammer to assist in tapping out the speedometer drive at the eyelet.



Remove the shaft axial float shims from the cover and take out the defective output flange radial seal. Knock in new radial seal with the aid of the special BMW No. 23 tool. The open side of the radial seal faces the drive output flange.

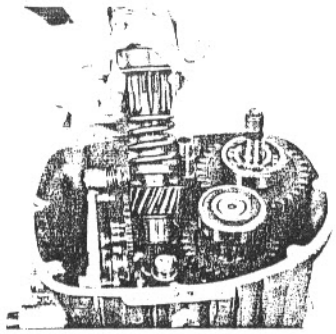
23 22 001 Gear Train, Renewing Complete

Gearbox, remove and refit 23 00 020.

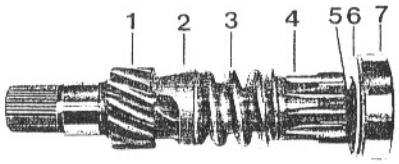
Gearbox housing cover, remove and refit 23 10 040.

Selector bracket, remove and refit 23 31 210.

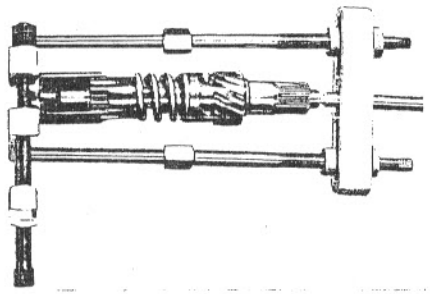
Use a rubber hammer on the front end of the shaft to gently tap out the input shaft from the housing, which still should be warm.



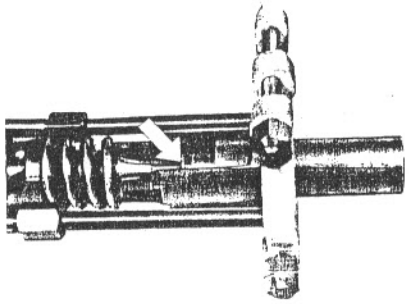
Remove bearing 7 of the input shaft and cover plate 6 using universal extracting tool Kukko 17/K.

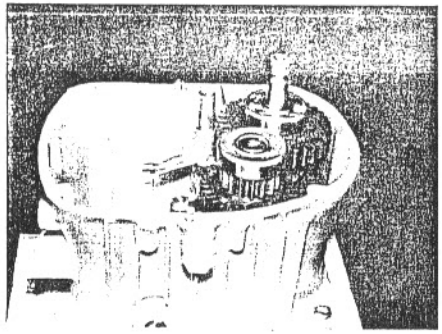


Compress thrust spring 3 with universal extracting tool Kukko 17/K and lift out retaining ring 5 from groove. Remove drive gear for kick starter 4, thrust spring 3, thrust piece 2 and drive gear 1.



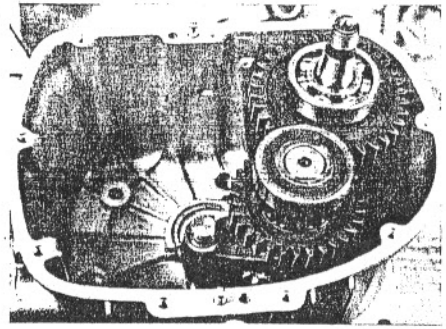
When re-assembling input shaft compress thrust spring 3 with the BMW universal extracting tool. Fit retaining ring 5 onto guide sleeve and, using the fitting sleeve to press the retaining ring to the groove.





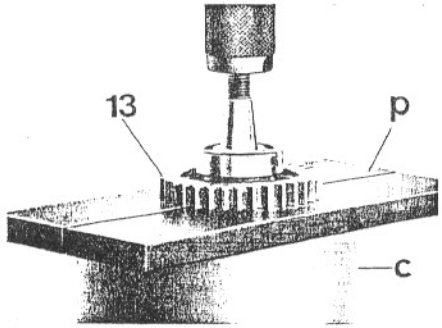
Unscrew Phillip's screw for oil guide cover and remove cover. Withdraw shaft for selector forks 1-2-5 and remove forks.

Note when fitting: When fitting the selector forks match the short guide ends of the forks together.

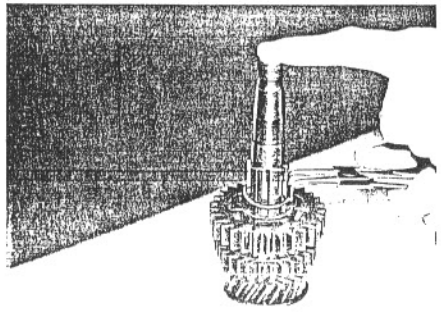


Heat the main shaft and lay-shaft bearing seats in the gearbox to 100° C and remove both shafts with selector fork for 3–4 gear.

Note when fitting: When fitting the selector fork the long guide end should point downwards into the housing.

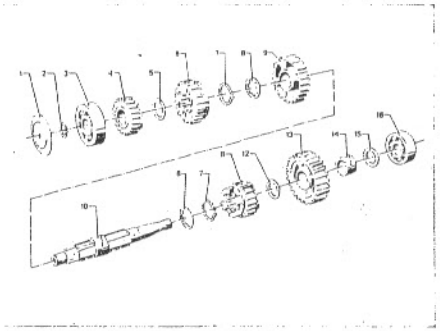


Remove oil baffle 1 from the base of the ball-bearing bore of the output shaft in the casing. Arrange a divided plate p below the first gear wheel 13 and set the divided plate on a suitable press cylinder c. Press out the gear wheel together with thrust washer 15 and ball-bearing 15.

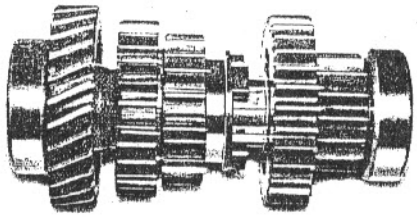


Take off the floating bush 14 for the first gear wheel, the second thrust washer 12 and the fourth gear wheel 11. Remove circlip 7 for the second and third gear wheel with thrust washer 8, and the second gear wheel 9.

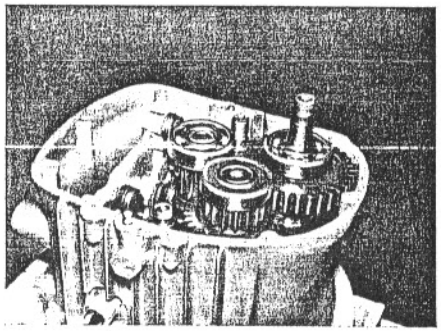
Lift off circlip 2 on the front shaft end. Lay the divided plate between gear wheel 4 and 6, and lay the divided plate on a suitable press cylinder. Press off ball-bearing race 3 with a suitable arbor. Remove the fifth gear wheel 4 with washer 5, the third gear wheel 6 and 7 as well as washer 8. If the collar bush for second and third gear pressed on to the splined keyway is faulty the output shaft must be replaced.
Assembly in reverse sequence.



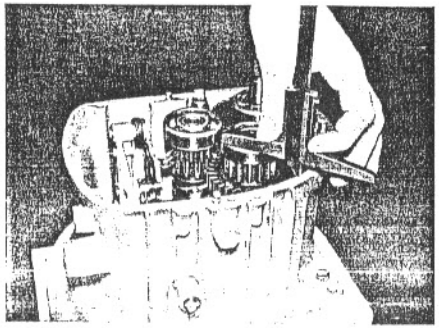
Heat the lay shaft to 100° C and withdraw bearing race. If it is faulty the whole shaft should be renewed.

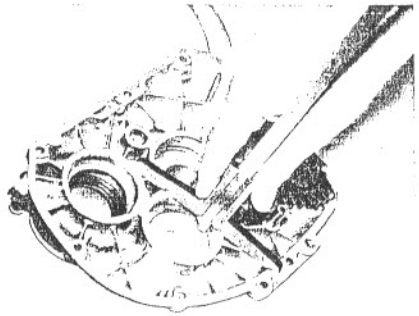


Before fitting the output shaft lay oil retainer in the ball-bearing bore of the housing.
Fit the **output and lay shafts** together with the selector fork for third and fourth gear in the housing.
Care must be taken to ensure that the selector fork does not jam. Then insert the selector fork for first and second gear.
Fit the selector bracket to neutral and fit the input shaft.



To determine the axial play of the output shaft use a depth gauge to measure the gap between the ball-bearing race and the housing joint surface.

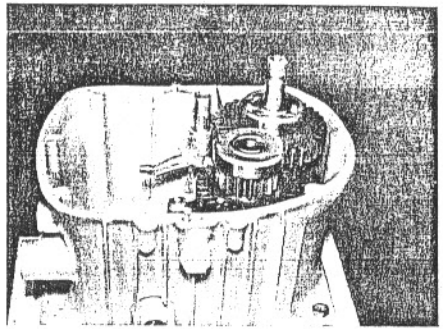




Now measure the distance between the housing cover contact surface and the base of the ball-bearing seating in the cover and compensate any discrepancy with appropriate shims down to a clearance of 0.1 mm. It is advisable to stick the shims in the bearing seat of the gearbox with the aid of a little grease.

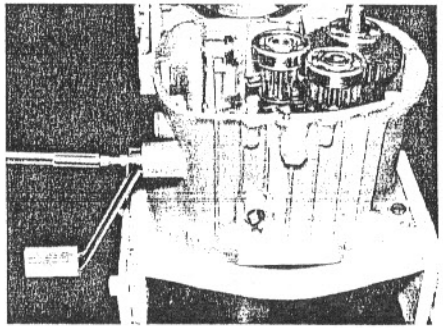
23 31 001 Selector Forks, Renewing

Gearbox, remove and refit 23 00 020.
Gearbox housing cover, remove and refit/seal 23 11 040.
Selector bracket, remove and replace 23 31 210.
Withdraw the shaft for selector forks 1-2-5 from the still warm housing and lay aside together with the selector forks. In order to replace selector fork 3–4 the gear train must be removed.

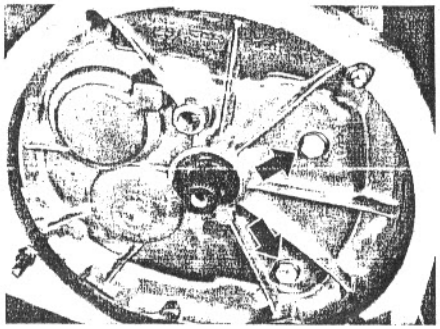


23 31 210 Selector Bracket, Removing and Refitting

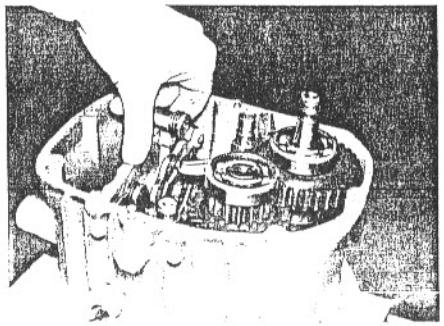
Gearbox, remove and refit 23 00 020.
Gearbox housing cover, remove and refit/seal 23 11 040.
Unscrew hexagonal socket head screw with screwdriver and withdraw selector lever.

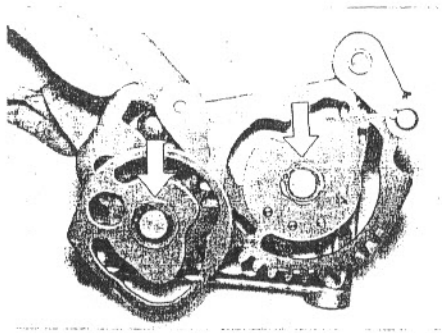


Loosen the two fit screws (arrows) for the selector bracket attachment.



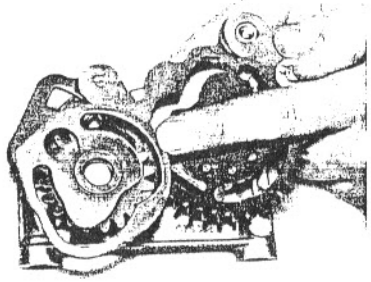
Tilt the selector bracket so that the selector forks are released. Withdraw the selector bracket.





23 31 861 Selector Discs, Renewing

The repair work outlined in previous chapters shoulc be carried out only where necessary. Remove the two retaining rings (arrows) of the selector camplate mounting.

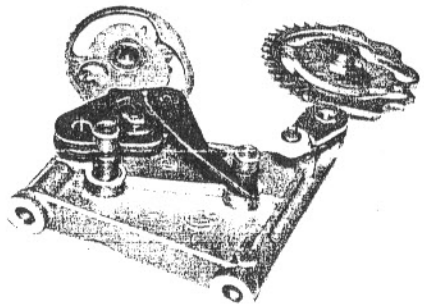


Renew the selector disc, ensuring that the first teeth ol the selector discs are in mesh.

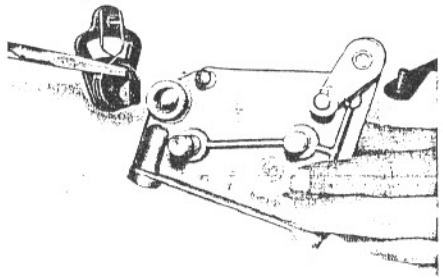
23 31 881 Gearshift, Renewing

The repairs outlined in previous chapters should onl; be carried out where necessary.

Remove selector discs.



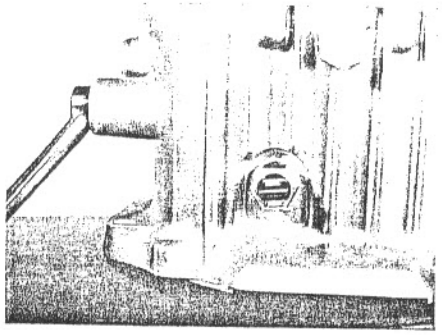
Withdraw the selector segment from guide and renove the spring.



23 31 401 Neutral Indicator, Renewing

Gearbox, remove and refit 23 00 020.

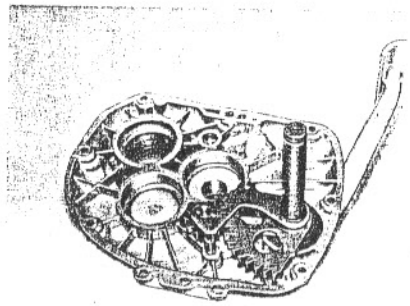
After tilting the gearbox to the side the neutral indicator switch can be removed.



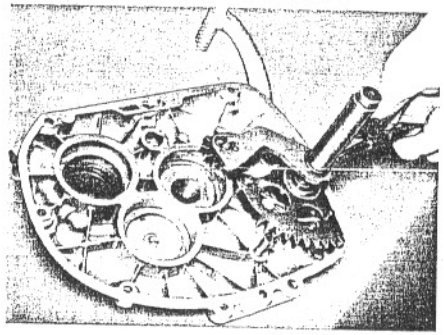
23 51 010 Kick Starter, Removing and Refitting

Gearbox housing cover, remove and refit/seal 23 11 040.

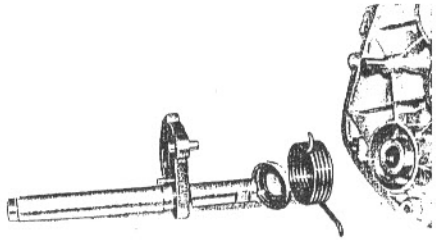
The repair jobs shown in previous chapters should only be carried out if necessary.



Remove the circlip for the intermediate gear and take off the intermediate gear of the kick starter.



Loosen the splined bolt of the kick starter lever and remove lever. Lift out the kick starter from the cover with the washer and spring.



26 Drive shaft

Technical Data . . . . . page 26- 0/3
26 11 000 Drive shaft – removing and refitting 26-11/1

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Arrangement	Enclosed drive shaft in the right-hand swinging arm, with needle bearing universal joint at the gearbox end and hypoid gear coupling at the input end			
Type of oil, over 5° C below 5° C	Branded hypoid gearbox oil SAE 90 Branded hypoid gearbox oil SAE 80			
Filling capacity, ltr (Imp. pints/US pints)	0.1 (0.17 / 0.21)			

Tightening torques mkp (ft/lb)

Hexagonal nuts on coupling bell housing	24÷26 (173.5÷188)
Twelve-sided bolt	2.4÷2.6 (17.3÷18.8)

All other bolts, screws and nuts are to be tightened in accordance with the usual figures as recommended by the manufacturers or in accordance with the latest BMW Standard Specification 60002.0.

26 11 000 Drive Shaft, Removing and Refitting

Rear wheel swinging arm, remove 33 17 350.

Clamp the rear wheel swinging arm in a bench vice fitted with jaw pads. Insert toothed back plate holder BMW No. 508 in the inside toothing of the coupling bell housing and unscrew the nut from the drive shaft with the aid of the appropriate socket wrench.

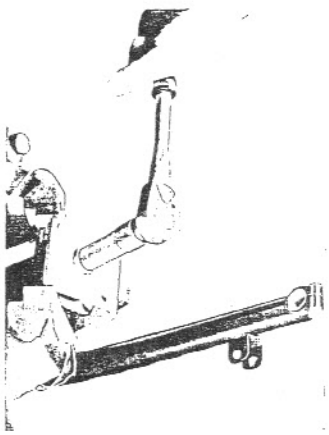
■

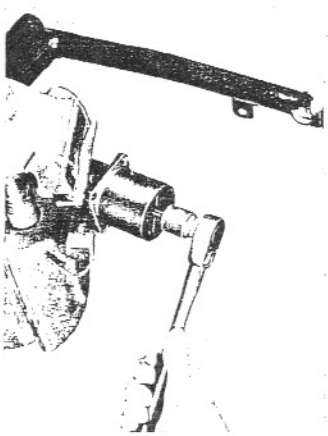
Using Kukko extractor 261 pull the coupling bell housing off the drive shaft. If the housing is seated very securely tighten the thrust spindle and give it a sharp blow. Remove drive shaft and housing.

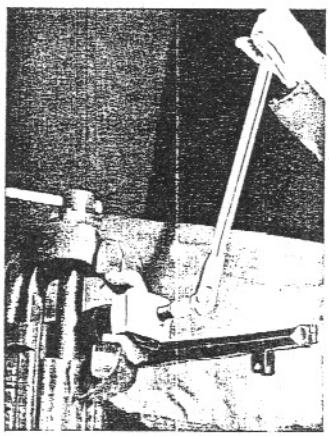
■

Note when fitting:
Before fitting the housing it is essential to clean the inside and outside cone with trichlorethylene (do not use petrol). See Technical Data section for tightening torque.

■







31 Front axle

Technical Data . . . . . page 31– 0/3
31 42 009 Telescopic fork – measuring 31–42/1
31 42 050 Steering damper – removing and refitting 31–42/2
31 42 100 Telescopic fork – removing and refitting 31–42/2
31 42 103 Telescopic fork – dismantling and re-assembling 31–42/5

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Wheel bearing lubrication	Branded multipurpose lubricating grease with 180° C drip point			
Front wheel castor, mm(in)	approx. 93 (3.62) (unchangeable)			
Steering lock	approx. 40° to either side			
Front fork lock angle	42°			
Spring travel (75 kg (165 lb) load) mm(in) Upward mm(in) Downward mm(in)	208 (8.11) 110 (4.29) 98 (3.82)			
Test fitting length (measured from top of support tube to the machined surface on the lower fork mount) mm(in)	160 (6.24)			
Fork stand tube	hard chromed			
Fork sliding tube	light metal casting			
Fork bridge, lower	light metal forging			
Oil capacity per fork column, litre (Imp/US pints)	0.28 (0.5 / 0.6)			
Type of oil	Shock absorber oil, Shell 4001, BP Olex HL 2463 (BP aero hydraulic)			
Telescopic fork stand tube (hard chromed) Outer diamter mm(in)	$36^{-0.050}_{-0.075}$ $\left(1.404^{-0.00195}_{-0.00292}\right)$			
Stand tube for telescopic fork (maximum permissible deflection in mm) (in)	0.1 (0.0039)			
Fork sliding tube inside diameter mm(in)	$36^{+0.025}_{0}$ $\left(1.404^{+0.00097}_{0}\right)$			
Running play of fork sliding tube on fork stand tube, maximum, mm(in)	0.1 (0.0039)			

Front Axle

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Plunger to the damper tube outer diameter, mm(in)	27.7 ± 0.1 (1.080 ± 0.0039)			
Fork stand tube (inside diameter, mm/in)	28 ± 0.15 (1.092 ± 0.0058)			
Running play of plunger in fork stand tube, mm(in)	0.05÷0.55 (0.0019÷0.0214)			
Length of fork carrier spring (relaxed) mm(in)	53+12 (2.067+0.468)			

Tightening torque mkp (ft/lb)

Centering nut for telescopic fork	12.0÷13.0 (86.76÷93.99)	Bottom screw coupling in sliding tube	12÷13 (86.76÷93.99)
Clamp bolt on clamp ring	1.0÷ 1.2 (7.23÷ 8.67)	Nut M8×1 (connecting damper – bottom – screw coupling – sliding tube)	2.3÷2.6 (16.62÷18.79)
Top spring seat for telescopic fork	12.0 (86.76)	Axle clamping bolt	1.5+0.2 (10.84+ 1.46)
Clamp bolts on the lower fork yolk	3.3÷ 3.5 (23.85÷25.30)	Top splash plate stirrup	2.3 (16.62)
Screw plugs on bottom of damper tube and top of plunger (spring seat)	2.5÷ 2.7 (18.07÷19.51)		

All other bolts, screws and nuts are to be tightened according to the customary values shown in the manufacturers tables or in accordance with latest BMW Standard Specification 60002.0.

31 42 009 Telescopic Fork, Measuring

Telescopic fork, dismantle and assemble 31 42 103.

In the event of damage to the fork it is essential to inspect the upper and lower fork yolk, fork stand tubes and sliding tubes for any possible hair cracks.

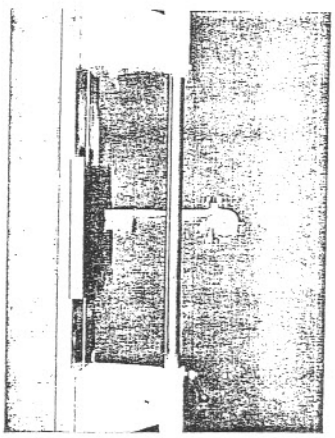
After removal, check the stand tubes for deflection, laying both ends in prism blocks or between points, see Technical Data section for maximum permissible deflection.

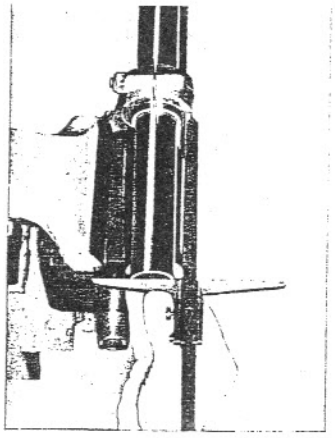
Warning! No attempt must be made to straighten distorted stand tubes, as these represent a permanent danger.

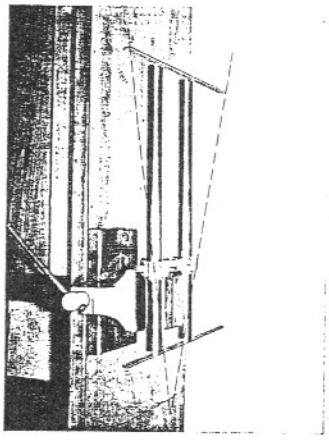
To check the lower fork yolk, clamp in two new stand tubes (test fitting length 160 mm, measured from top edge of carrier tube to the machine surface on the lower fork mount).

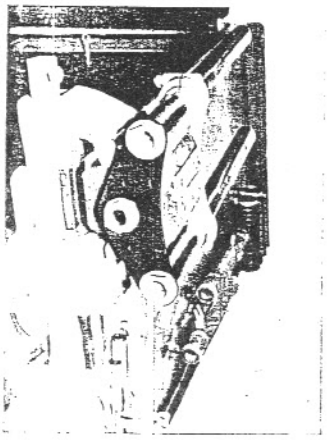
Lay two BMW No. 548 straight edges transversely over the ends of the fork carrier tubes and take a sight reading to determine distortion.

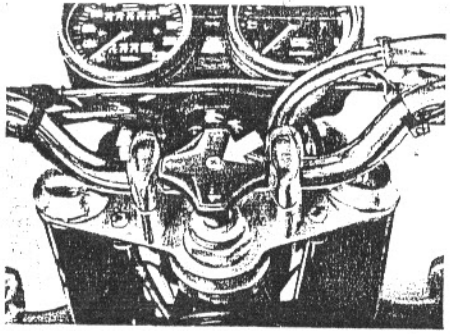
Check the fitted stand tubes for parallelism with the aid of a slide gouge. Check the fork carrier tube for precise alignment with the stand tubes. For this purpose fit the upper fork yolk. Both upper spring seatings (each with shim) and the centring nut must screw on without any signs of stress.





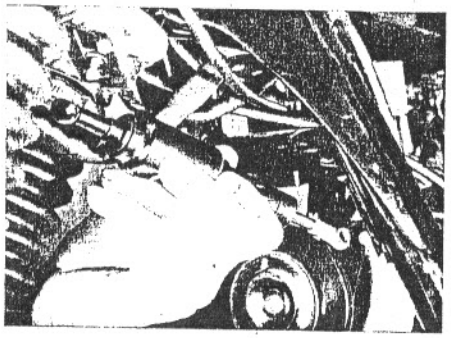




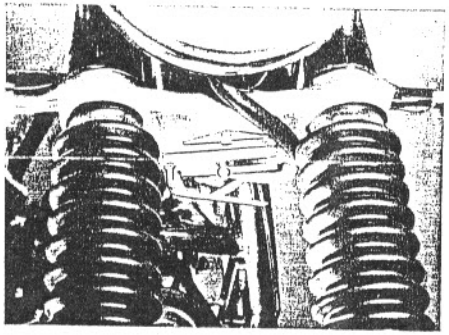


31 42 050 Steering Damper, Removing and Refitting

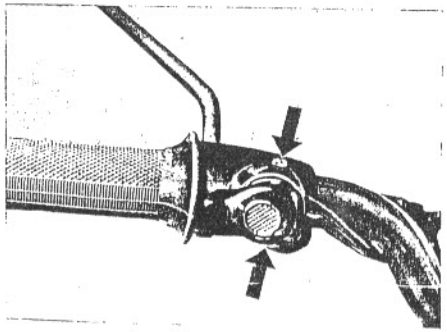
Remove lentil-head screw from the adjusting grip and lift off the adjusting grip and the rubber piece.



Pull off retaining clip and press the damper out of the ball joint.



Slacken the two cheese-head screws on the plate, remove plate with slider and lock. Remove gear downwards.



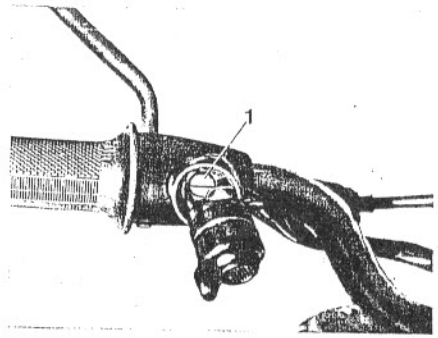
31 42 100 Telescopic Fork, Removing and Refitting

Front wheel, remove and refit 36 30 300.
Front wheel mudguard, remove and refit 46 61 000.
Steering damper, remove and refit 31 42 050.
Detach the battery earth lead.
Unscrew the combination electrical switch by removing the upper and lower slotted screws on the left steering handle.

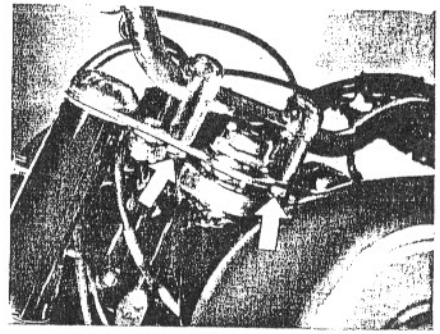
Detach the fork mountings from the handlebar, remove switch from housing and unscrew the inside slotted screw (1).

Remove the switch from the right steering handle in the same way.

Note when fitting: When changing a switch, care must be taken to ensure that the rotary protective lugs are seated perfectly in the switch fittings. If necessary chamfer about 0.3 mm away from the four edges of the switch before fitting.

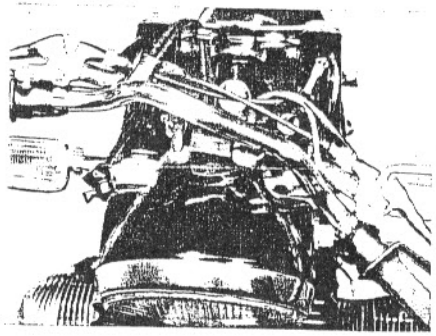


Remove two nuts with spring washers from the clamp mountings for the handlebar. Lay aside the handlebar with fittings and attached cable controls on the tank on a suitable soft underlay.



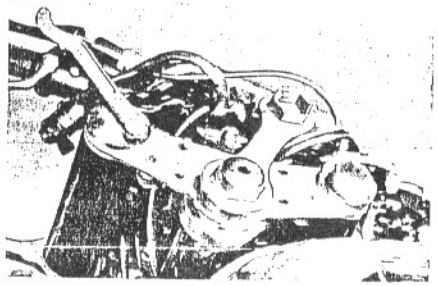
Remove one screw with washer, two rubber rings and rubber sleeve from the left and right of the headlamp, allow the headlamp to hang downward.

Note when fitting: Headlamp beam alignment 63 10 004.



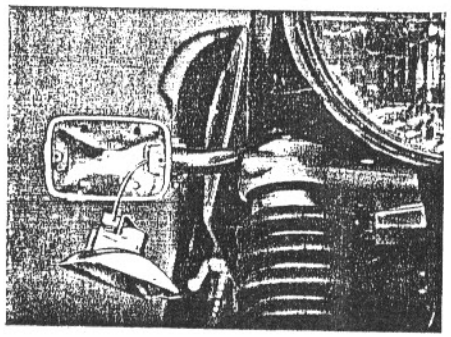
Unscrew the two light metal caps left and right with the aid of a socket wrench.

Remove centring nut (see Technical Data section for tightening torque.)

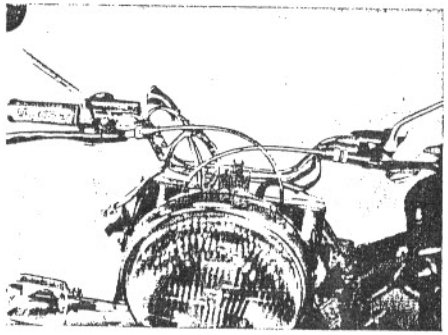




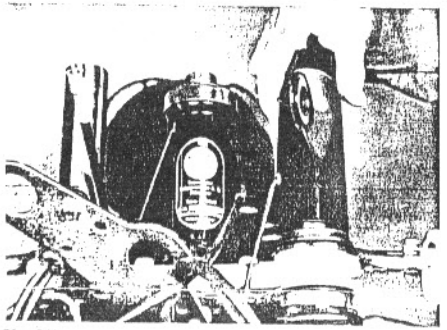
Unscrew the two upper spring seatings with their shims (see Technical Data section for tightening torque) and take off the upper fork yoke.



Unscrew the lenses from the left and right turn indicators and detach the leads from the reflectors.



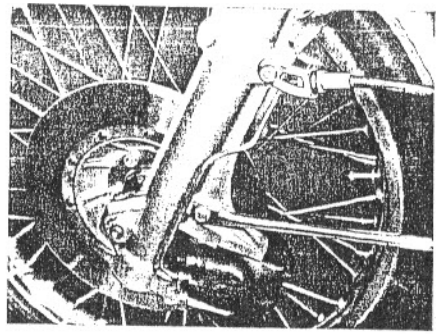
Note when fitting: When refitting care must be taken to ensure accurate positioning of the control cables.



Remove headlamp mounts left and right with rubber rings and turn indicator leads (the bottom rubber rings are provided with bores for breather capillaries in the fork yoke and bores for leads to the turn indicators).

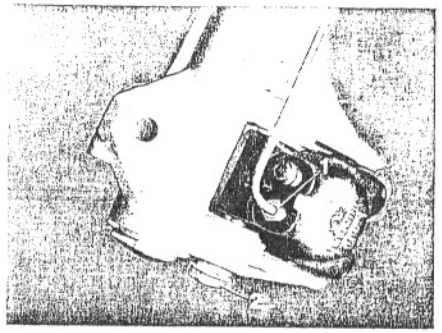
Remove turn indicator housing with mount.

Unscrew the brake line holder on the left fork sliding tube.



Note when fitting: Do not unscrew the brake line screw (1) otherwise the brake system must be bled.

Unscrew the cap (2) and remove with spring. Pull off the eccentric bolt (see floating caliper, removing and refitting 34 11 020).



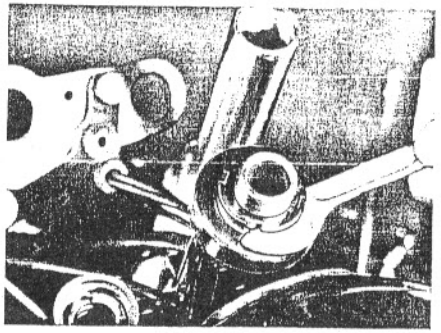
Unscrew slotted nut and remove protective ball race cap.

Draw the fork downward out of the frame, possibly assisting by gentle tapping with a rubber mallet on the fork guide tube. Avoid misplacing the angular-contact roller bearings. The outer races for the top and bottom roller bearing remain in the frame tube.

Note when fitting: For fitting the races and roller bearings must be greased.

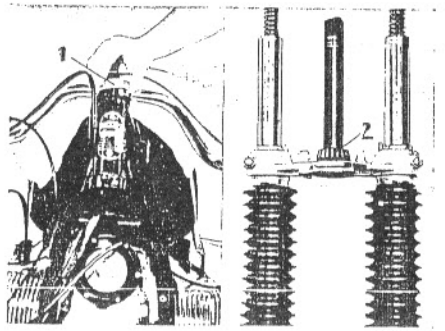
Fit the upper angular-contact roller bearing (1), insert the fork carefully into the frame complete with the lower angled roller bearing (2).

Reminder: Note the make of bearings.



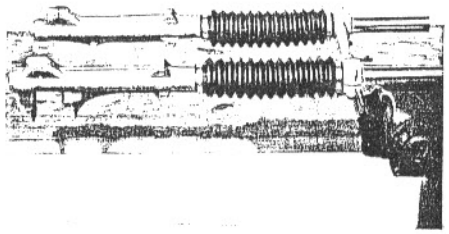
The wiring harness, speedometer shaft and rev. counter drive shaft must run below the lower fork yolk.

Screw on the protective cap for the upper angular-contact roller bearing and slotted nut. Tighten down the slotted nut until the steering system is free of play. Strike the bottom and top of the fork guide tube several times with a rubber mallet. When tightening the cap nut ensure that the threads of the slotted nut engage deeper into the thread on the fork guide tube, thus subjecting the bearings to stronger bias. If necessary slacken off the slotted nut about ⅓ turn and retighten cap nut. The steering is correctly adjusted if the fork can be moved to either side easily **with cap nut tightened** but without displaying any perceptible play in the bearings.

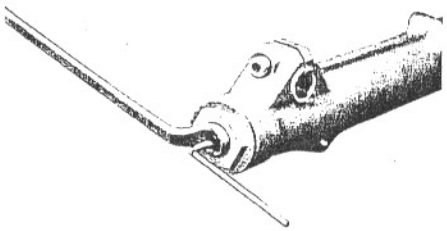


31 42 103 Telescopic Fork, Dismantling and Re-assembling

Telescopic fork, remove and refit 31 42 100.



After removal, empty the fork by pumping motions with the sliding tubes. Clamp the fork in a bench vice with the BMW No. 545 clamping block.

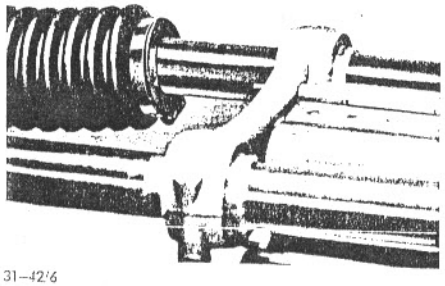


Loosen off two clamping straps each on the left and right of the rubber gaiter. Remove the rubber caps from the bottom screw couplings, unscrew the M 8×1 damper fastening nut (see Technical Data section for tightening torque) at the same time holding firmly in place with an Allen key.



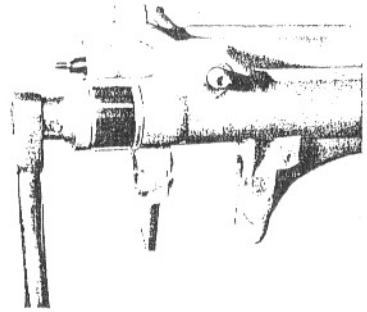
Draw off the sliding tubes, remove rubber gaiter.

Note when fitting: Use BMW tool No. 547 to tap in a new cap-type gasket.



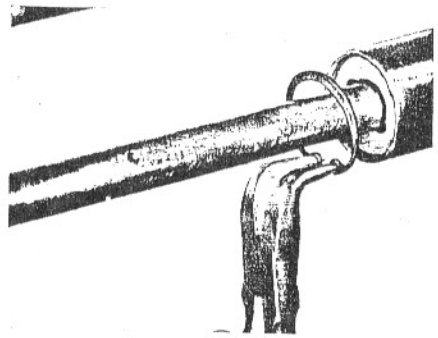
When fitting the rubber gaiter slide the appropriate vent aperture on to the clamping pin in the lower fork guide.

Remove the bottom screw plug.



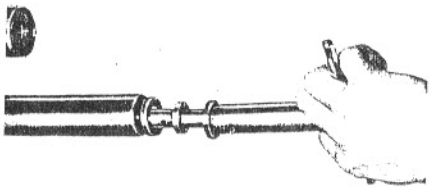
Note when fitting: When assembling tighten the screw plug to the prescribed torque rating (see Technical Data section).
Remove soft metal sealing washers from the end bolts of the damper.

Note when fitting: Always use new sealing washers for re-assembly.



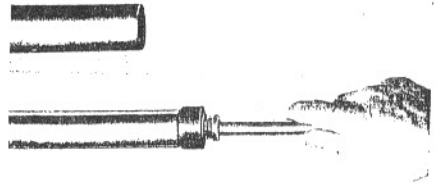
Lift out circlip on the damper nozzle.

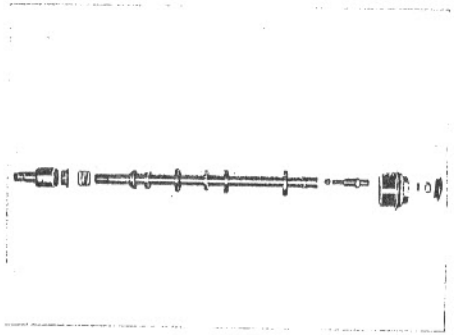
Remove the floating damper nozzle consisting of two threaded rings and damper ring with BMW No. 237 socket wrench.
Always note tightening torque ratings when fitting (see Technical Data section).



Withdraw the damper with plastic stop and carriers springs **downward.**

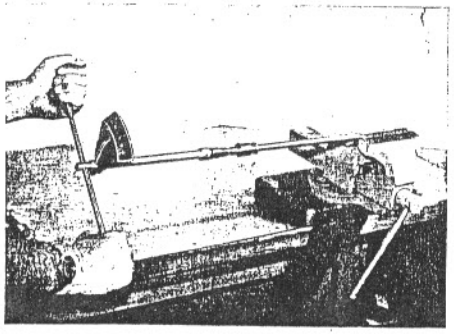
Note when fitting: When refitting the complete damper unit use the BMW No. 546 assembly sleeve to protect the plunger rings.





Telescopic fork measuring 31 42 009.

Clamp the complete damper at the hexagon of the end bolt and unscrew the spring seating on the top of the damper tube.
Remove in sequence: spring seating with plunger rings, damper valve and valve spring.
Remove ball valve: clamp the damper tube at the damper stop carefully between soft metal jaw pads and unscrew the end bolt. Take out the thrust spring and ball.



Note when fitting: Clamp the damper tube at the end bolt hexagon and use a torque wrench on the spring seating hexagon to tighten both screw couplings to the prescribed torque rating (see Technical Data section).

Fill 280 cc. of the prescribed grade of oil (see Technical Data section) in each fork column of the ready assembled fork unit and depress the fork strongly 4–5 times to allow any air to escape.

Note when fitting: If the lower fork yolk is to be renewed it is necessary for correct installation of the stand tube for the lower and upper fork yolks to be fitted in the frame complete together with preset steering bearings (with slotted nut and centring nut tightened). Only then are the fork stand tubes pushed through the lower fork yolk to come into full contact with the upper fork guide.
Tighten the clamping screws fastening the stand tubes to the prescribed tightening torque (see Technical Data section).
If only one single fork stand tube is renewed the exact fitting height can be taken from the opposite stand tube.

32 Steering

Technical Data . . . . . page 32– 0/3
32 00 454 Steering – adjusting 32–00/1
32 71 000 Handle bars – removing and refitting 32–71/1
32 73 030 Throttle cable – removing and refitting 32–73/1

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Steering lock	42° to each side			
Width of handlebar mm(in)	600 (23.4)			
Width of US handlebar version mm(in)	680 (26.52)			
Handlebar tube diameter mm(in)	22 (0.858)			
Steering damper	hydraulic steering damper, adjustable in 2 stages			

Tightening torque mkp (ft/lb)

Cap nut for telescopic fork	12.0 (86.76)

All remaining screws, bolts and nuts are to be tightened in accordance with the customary values recommended in the manufacturers' tables or in accordance with the latest BMW Standard Specification 60002.0

32 00 454 Steering, Adjusting

Remove the lentil-head screw from the adjusting grip and lift off the adjusting grip.

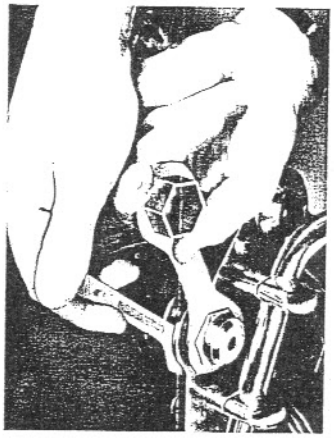
Slacken the four hexagonal nuts of the bearing mounts for the handlebars so that the ring spanner fits over the centring nut.

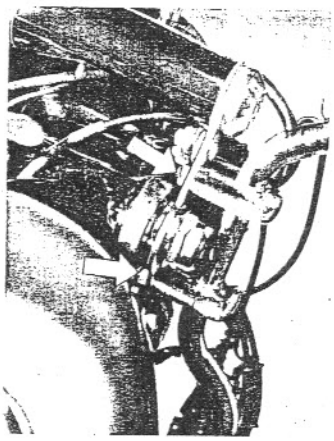
Slacken centring nut and adjust steering play at the slotted nut using the special wrench.

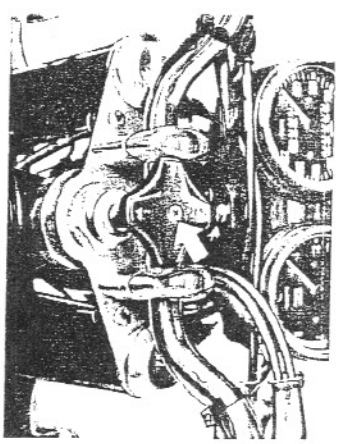
Prevent the slotted nut from moving when tightening the centring nut.

Check play again; when properly adjusted, the fork should fall to the left or to the right full lock position by its own weight.

Note when fitting: See Technical Data section for the tightening torque for the centring nut.



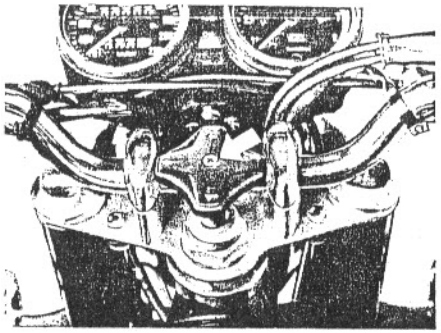




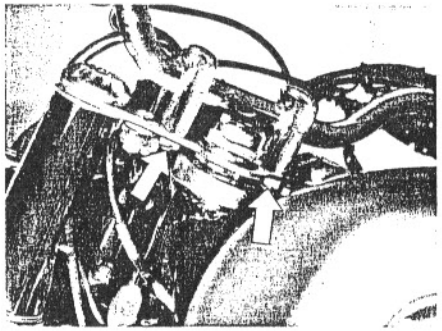
32 71 000 Handlebars, Removing and Refitting

Disconnect the battery earth lead.

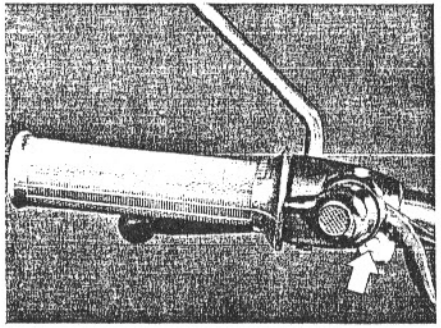
Remove the lentil-head screw from the adjusting grip and lift off the adjusting grip.



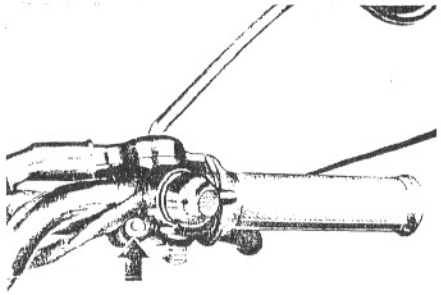
Remove two nuts each with spring washers from the handlebar clamp mounts (arrows).



Lay aside the handlebar with instruments and control cables on the tank on a suitable soft underlay.
Take off the handle grip. Unscrew the hexagonal socket head bolt (arrow) on the pivot joint and draw the pivot joint off the handlebar, noting the key for clamp connection.



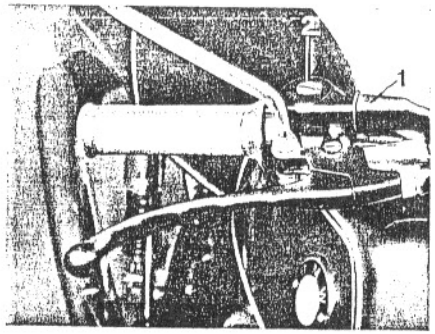
Unscrew the right-hand hexagonal socket head bolt on the housing for the throttle twist grip and brake lever and draw off the housing as a complete unit, noting the key for the clamp connection.



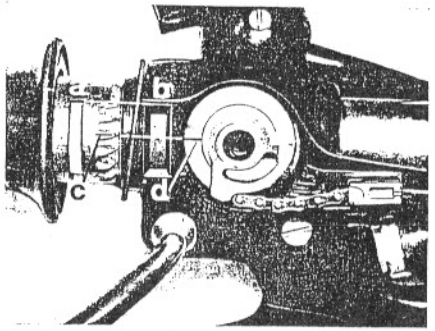
32 73 030 Throttle Cable, Removing and Refitting

Push back the splash guard cap 1 and unscrew cover 2.

Disconnect the throttle cable.



Note when fitting: Before assembly grease the adjusting cam and toothing on the throttle grip. When refitting care must be taken to ensure that slot end "a" in the throttle grip coincides with the rearward end of recess "b" in the grip. Thread the lower control cable through the double nipple and fit, together with the tension chain and adjusting cam, in the grip so that the "c" and "d" markings are opposite each other on the cam and the grip. Fit the upper throttle cable in the double nipple. Replace cover and at the same time pull back the upper throttle cable sleeve sufficiently to allow the throttle cable end sleeve to engage in its seat in the cover recess. Screw down the cover and push on the splash guard cap. Only if this procedure is followed is the full functional travel of the throttle cables ensured.

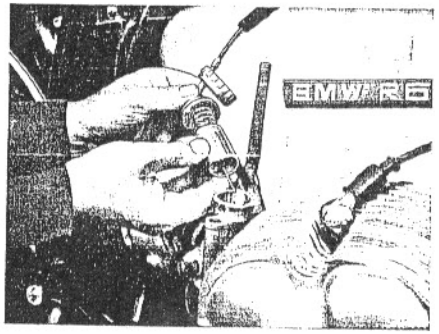


Fuel tank, remove and refit 16 11 030.

R 60/6, R 90 S

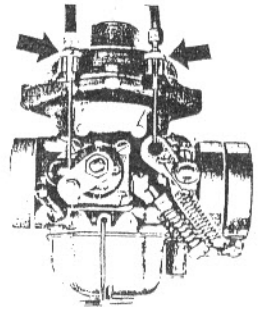
Unscrew the cover from the carburettor housing and remove with spring and throttle valve.

Disconnect the throttle cable.



R. 75/6, R. 90/6

Unscrew both Bowden cable adjusting screws 2 on the carburettor cover. Disconnect the control cable with nipple on the throttle flap lever, disconnect the choke cable at the choke lever.



Final Drive

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Toothing system	Klingelnberg Palloid helical toothing			
Number of teeth	11 : 37	10 : 32	11 : 34	11 : 33
Transmission ratio	1 : 3.36	1 : 3.2	1 : 3.09	1 : 3.0
Type of oil: initial filling	Branded running in hypoid gear oil SAE 90			
After the first oil change, over 5° C	Branded hypoid gearbox oil SAE 90			
below 5° C	Branded hypoid gearbox oil SAE 80			
Filling quantity, ltr (Imp pints/US pints)	0.25 (0.44/0.53)			
Tooth backlash, mm(in)	0.15÷0.20 (0.0058÷0.0078)			
Lateral play in crown wheel	play-free (without seal)			
Rear wheel suspension	Long swinging arm with spring streets with triple adjustment and double-acting hydraulic shock absorbers.			
Spring travel, mm(in)	125 (4.875)			
Maximum length, mm(in)	316±2 (12.32±0.78)			
Minimum length, mm	216±2 (8.42±0.78)			
Shock absorber test				
Test stroke, mm(in)		25 (0.975)	75 (2.925)	50 (1.950)
Revs per minute		100	100	382
Tensile stage, kp		30±5	58±5	80±10
Compression stage, kp		5±3	9±3	28±5

12 2

33 10 050 Rear Wheel Drive, Removing and Refitting

Rear wheel, remove and refit 36 30 320.

Place a supporting block below the swinging arm bearing.

Unscrew the right-hand spring strut fastening bolt (arrow) and lay aside with washer.

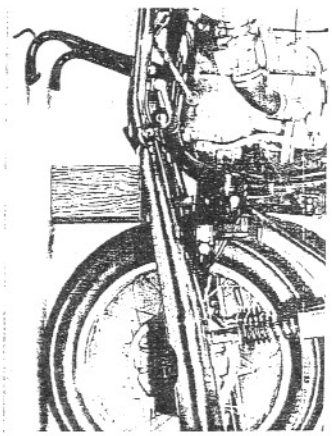
Unscrew the drain plug (2) and drain oil from right-hand rear swinging arm. For ventilation and to facilitate oil drainage unscrew filler plug (1).

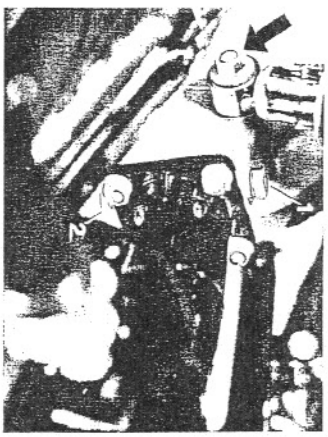
Note when fitting: After reassembly fill with 0,1 litres of oil (see Technical Data section for oil type).

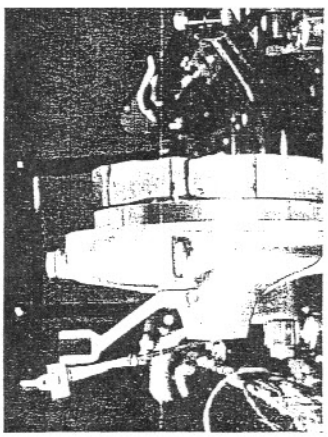
Unscrew the wing nut from the brake linkage, pull the brake arm from the lever bolts, take the hollow bolt out of the lever, fit on brake arm and secure with wing nut.

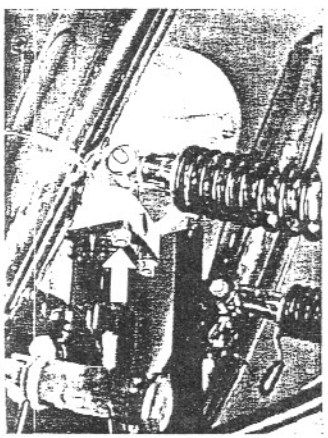
Unscrew the top spring strut fastening bolt, unscrew the four nuts with spring washers from the fastening bolt on the right-hand swinging arm.

On assembly these four nuts must first be tightened if the axle is inserted through the rear wheel drive and axle clamp.









13 1

33 Rear axle

Technical Data . . . . . page 33– 0/3
33 10 050 Rear wheel drive – removing and refitting 33–10/1
33 10 113 Rear wheel drive – dismantling and re-assembling 33–10/2
33 12 051 Crown wheel and pinion – renewing 33–12/1
33 17 350 Rear wheel swinging arm – removing and refitting 33–17/1
33 17 381 Taper roller bearing of rear wheel swinging arm – renewing 33–17/2
33 52 120 Spring strut – removing and refitting 33–17/2
33 53 580 Coil spring – removing and refitting 33–17/2

Technical Data

Final Drive

Type	R 60/6	R 75/6	R 90/6	R 90 S
Toothing system	Klingelnberg Palloid helical toothing			
Number of teeth	11 : 37	10 : 32	11 : 34	11 : 33
Transmission ratio	1 : 3.36	1 : 3.2	1 : 3.09	1 : 3.0
Type of oil: initial filling	Branded running in hypoid gear oil SAE 90			
After the first oil change, over 5° C	Branded hypoid gearbox oil SAE 90			
below 5° C	Branded hypoid gearbox oil SAE 80			
Filling quantity, ltr (Imp pints/US pints)	0.25 (0.44/0.53)			
Tooth backlash, mm(in)	0.15÷0.20 (0.0058÷0.0078)			
Lateral play in crown wheel	play-free (without seal)			
Rear wheel suspension	Long swinging arm with spring streets with triple adjustment and double-acting hydraulic shock absorbers.			
Spring travel, mm(in)	125 (4.875)			
Maximum length, mm(in)	316±2 (12.32±0.78)			
Minimum length, mm	216±2 (8.42±0.78)			
Shock absorber test				
Test stroke, mm(in)		25 (0.975)	75 (2.925)	50 (1.950)
Revs per minute		100	100	382
Tensile stage, kp		30±5	58±5	80±10
Compression stage, kp		5±3	9±3	28±5

Rear Axle

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Bearing spring Fitting length, mm(in)	199.1 (7.764)			
Length relaxed, mm(in)	251 (9.789)			
Spring outer diameter, mm(in)	49.6 (1.934)			
Spring inner diameter, mm(in)	41.8+0.3 (1.630+0.0117)			
Wire thickness, mm(in)	7.5±0.04 (0.2925±0.0015)			
Spring compression at 120.2 mm spring travel, kp mm²	105			
Long swinging arm Type of oil over 5° C below 5° C	Branded hypoid gearbox oil SAE 90 Branded hypoid gearbox oil SAE 80			
Filling capacity, ltr(Imp/US pints)	0.15 (0.26/0.32)			

Tightening torques mkp (ft/lb)

Nut on drive pinion	10÷11 (72.3 ÷79.5)	Oil drain plug rear wheel drive	2.3÷2.6 (16.62÷18.79)
Threaded ring on drive pinion	10÷12 (72.3 ÷86.76)	Oil filler plug on swinging arm	1.4 (10.12)
Hexagonal nuts on coupling bell housing	24÷26 (173.5÷187.9)	Oil drain plug on swinging arm	1.4÷1.7 (10.12÷12.29)
Oil filler plug on rear wheel drive	2.8÷3.1 (20.24÷22.41)	Universal cover nut	1.8÷2.1 (13.01÷15.18)
Bearing bolts on swinging arm	1÷1.2 (7.23÷ 7.95)	Locknut for swinging arm bearing bolts	10÷11 (72.3 ÷79.5)
Shock absorber rod on spring strut eyelet, top	3.0÷3.4 (21.69÷24.58)	Clamp screw for rear spindle	1.4÷1.8 (10.12÷13.01)

All other bolts, screws and nuts are to be tightened in accordance with the customary values indicated in the manufacturers tables or according to the latest BMW Standard Specification 60002.0

33 10 050 Rear Wheel Drive, Removing and Refitting

Rear wheel, remove and refit 36 30 320.

Place a supporting block below the swinging arm bearing.

Unscrew the right-hand spring strut fastening bolt (arrow) and lay aside with washer.

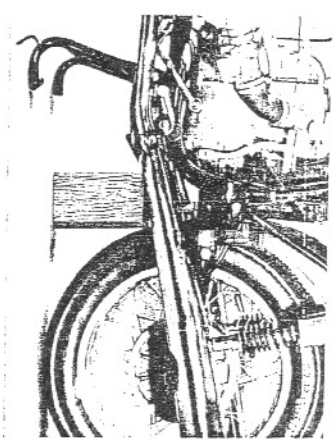
Unscrew the drain plug (2) and drain oil from right-hand rear swinging arm. For ventilation and to facilitate oil drainage unscrew filler plug (1).

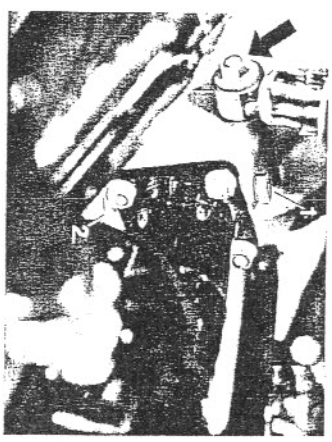
Note when fitting: After reassembly fill with 0,1 litres of oil (see Technical Data section for oil type).

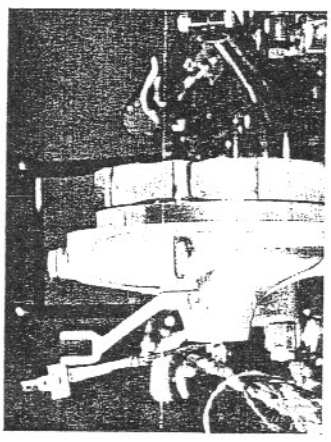
Unscrew the wing nut from the brake linkage, pull the brake arm from the lever bolts, take the hollow bolt out of the lever, fit on brake arm and secure with wing nut.

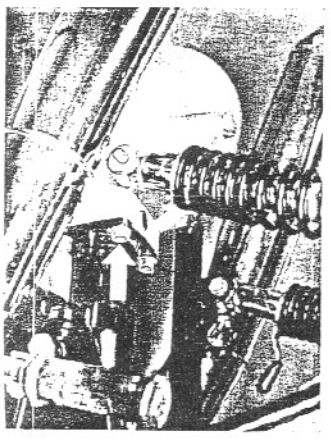
Unscrew the top spring strut fastening bolt, unscrew the four nuts with spring washers from the fastening bolt on the right-hand swinging arm.

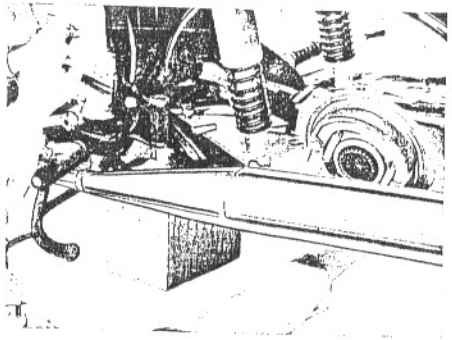
On assembly these four nuts must first be tightened if the axle is inserted through the rear wheel drive and axle clamp.





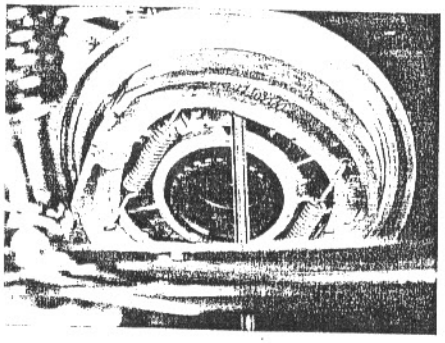






Draw the rear wheel drive off the swinging arm and lay aside.

Note when fitting: When fitting the rear wheel drive on the swinging arm engage one of the gears and use the kick starter to turn the drive shaft so that the toothed coupling is able to mesh.

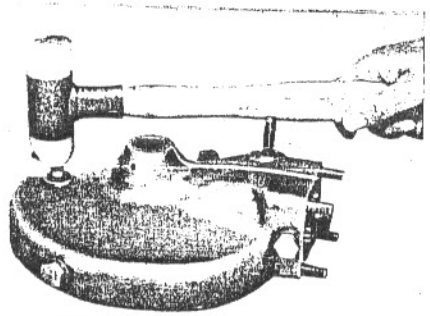


33 10 113 Rear Wheel Drive, Dismantling and Re-assembling

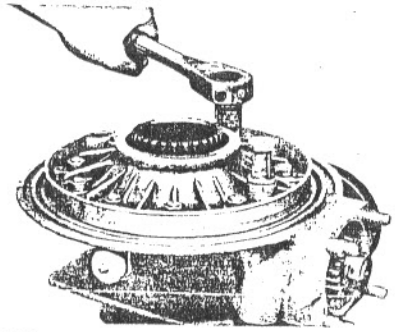
Rear wheel drive, remove and refit 33 10 050.

Note when fitting: After refitting fill with 0.25 litres of oil as indicated in the Technical Data section.

Draw the rear wheel brake shoes to the housing. First use a screwdriver to tilt away from the housing the brake shoe lying against the flattened collar washer of the brake cam and take off both brake shoes.

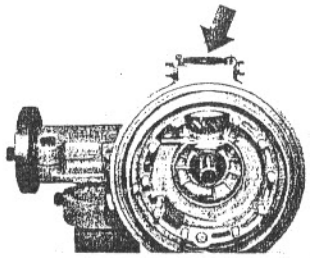


Unscrew the clamp screw from the brake lever and lay aside with tooth washer. Detach brake lever and take out the brake cam.

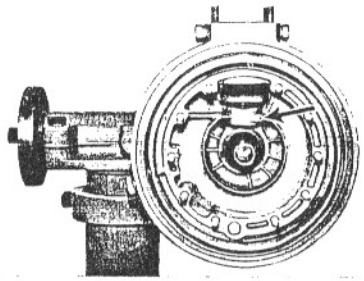


Mount housing with BMW tool No. 261 on the assembly stand BMW No. 6000. Unscrew ten nuts from the rear wheel drive housing cover and lay aside with spring washers.

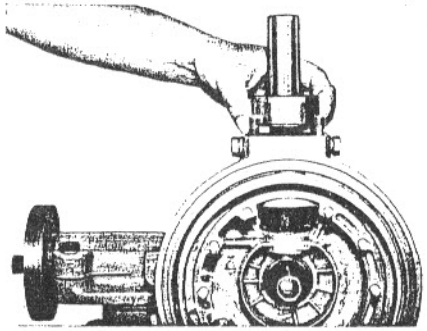
Heat housing to approx. 120° C and remove pinion with angular-contact ball bearing.



Replace pinion needle bearing in rear wheel drive housing. Loosen screw (arrow) and remove. Heat housing to approx. 100° C and extract pinion needle bearing.

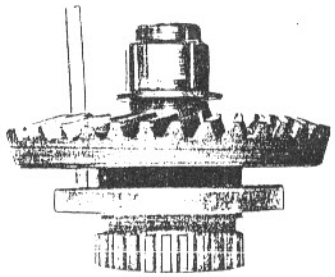


Note when fitting: Fit the pinion needle bearing with arbor and BMW guide sleeve No. 252.



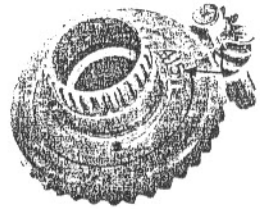
Use a soft metal rod to tap out uniformly the grooved ball-bearing on the crown wheel through the bores provided for that purpose.

Note when fitting: Heat the grooved ball-bearing to approx. 100° C.



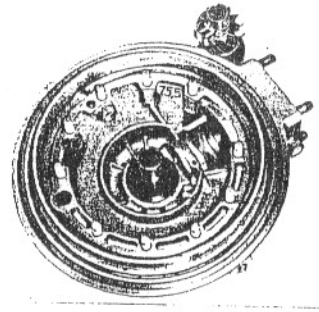
33 12 051 Crown Wheel and Pinion, Renewing

Rear wheel drive, dismantle and re-assemble 33 10 113. The crown wheel and pinion must always be used as a mated pair. Note pairing number (arrow).



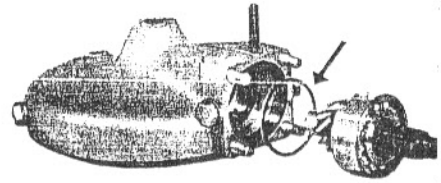
The pairing number indicates which pinion belongs to which crown wheel. When testing both parts tolerances were laid down which ensure quiet running and correct blacklash when the crown wheel and pinion are fitted.

The basic measurement is 75.5 ± 0.05 mm, measured from the angular-contact roller bearing shoulder on the pinion to the centre of the crown wheel axis.

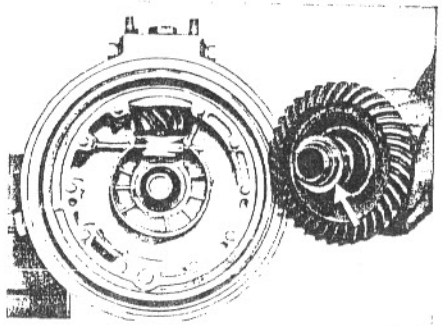


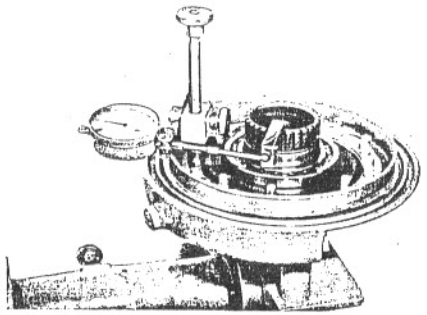
The dimensions inscribed in the housing and the toothing face side of the pinion are to be deducted from each other.

The difference between the two amounts corresponds to the required shim thickness (arrow) between the angular-contact ball-bearing shoulder and the seating base in the housing.

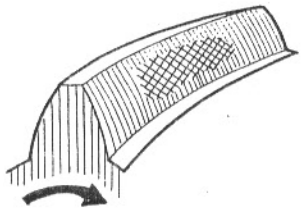


To adjust the gear backlash a bronze thrust washer (arrow) is to be fitted between the collar of the needle bearing inner race on the crown wheel and the wide contact surface of the needle bearing outer race to allow the actually required thickness of the bronze thrust washer used to ascertain the gear backlash to be determined as described hereunder.

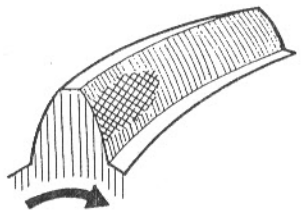




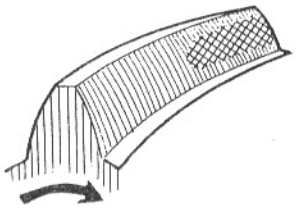
Check the gear mesh and backlash (see Technical Data section) around the outer diameter of the crown wheel with a dial gauge and BMW jig No. 5104 with BMW clamp No. 260.



Check the contact pattern on the leading flank of the pinion after applying Prussian blue. A correct contact pattern of the leading flank on the pinion is in the centre of the tooth length slightly closer to the thicker end of the tooth.

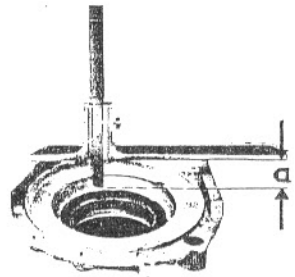


If the contact pattern on the leading flank of the pinion is at the thicker end of the tooth this indicates that the pinion must be spaced further from the crown wheel centre by the use of thicker shims and the tooth backlash will have to be corrected by fitting a thinner bronze shim between the needle bearing inner race and the needle bearing outer race on the crown wheel.

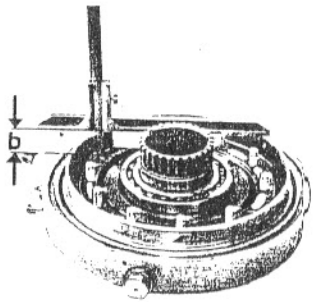


If the contact pattern lies at the thinner end of the tooth the pinion spacing from the crown wheel centre will have to be reduced by the use of thinner shims at the ball-bearing outer race and the tooth backlash corrected by a thicker bronze shim at the needle bearing.
The tooth contact pattern must then be checked once again. Owing to pressure on the bearings the pinion should be removed and refitted only after the housing has been heated.

Now adjust the crown wheel to eliminate lateral play. For this purpose use a depth gauge and any intermediate measuring aids which may be required to measure the distance (a) between the grooved ball-bearing seating base and the cover contact surfaces.



On the rear wheel drive housing, without a gasket on the contact surface, measure the distance (b) of the grooved ball-bearing on the crown wheel to the contact surface. Play can be eliminated by fitting an appropriate number of shims between the grooved ball-bearing and the seating base in the cover. The required shim thickness is obtained by deducting dimension (b) from dimension (a). The required play is obtained after fitting the gasket; the crown wheel must not be under pressure.



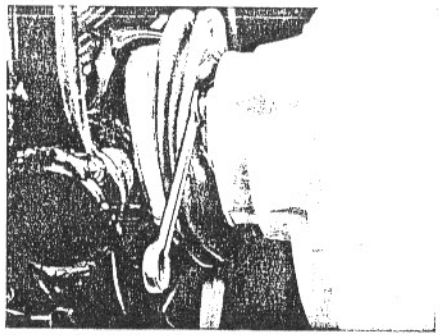
33 17 350 Rear Wheel Swinging Arm, Removing and Refitting

Rear wheel, remove and refit 36 30 320.

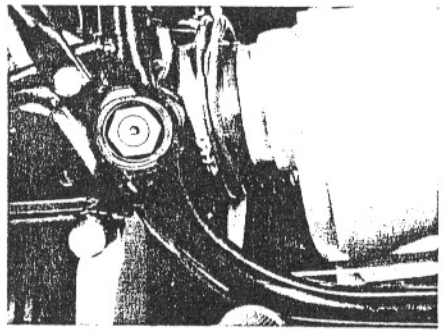
Rear wheel drive, remove and refit 33 10 050.

Detach the lower left-hand mounting of the spring strut.

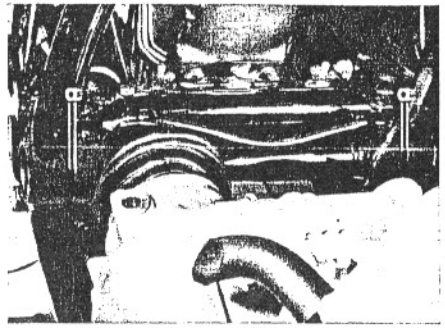
Release the rubber collar between the gearbox and swinging arm on the gearbox side and push back as far as possible. Use a ring spanner to unscrew the four connecting bolts on the universal joint and lay aside with spring washers. Note the torque rating in the Technical Data section when refitting.



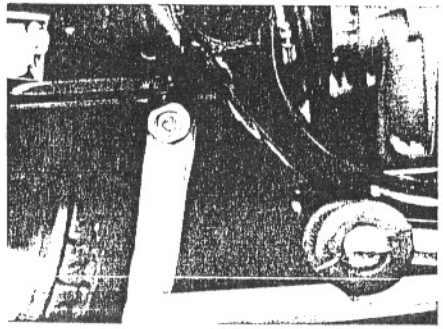
Remove right and left swinging arm bearings. Take off caps and slacken locknut. Screw out the swing bearing journal.



Note when fitting: Screw in the bearing journal so that a uniform distance (a) is provided to the left and right between the swinging arm hub and the frame. At the same time the drive shaft should be centred in the swinging arm tube so that it cannot make contact with full compression and extension. Where necessary the spacings (a) can be set with marginal differences.
Now tighten by about 1/8 turn the bearing journal screwed firmly home to its limit stop on one side to obtain the necessary bearing bias, lock the bearing journal nut on both sides and refit cap. Under no circumstances may the tapered roller bearings be allowed any play, but at the same time the bias may not be too great.



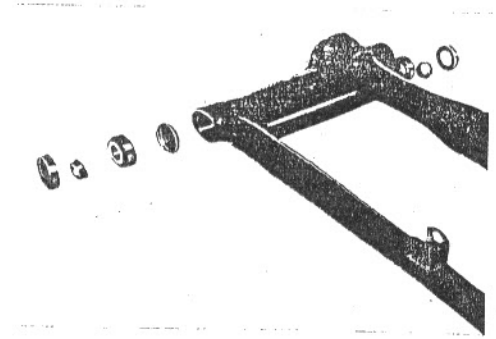
Remove the foot brake lever, at the same time supporting at the bearing bolt, and unscrew locknut.



33–17/1

34 Brakes

Technical Data . . . . . page 34– 0/3
34 00 446 Bleed brakes 34–00/1
34 11 000 Brake pads, removing and refitting 34–00/1
34 11 001 Brake pads, renewing 34–00/1
34 11 020 Floating caliper, removing and refitting 34–11/1
34 11 100 Front wheel brake holder, complete, removing and refitting (R 60/6) . 34–11/2
34 31 000 Brake master cylinder, removing and refitting 34–11/2



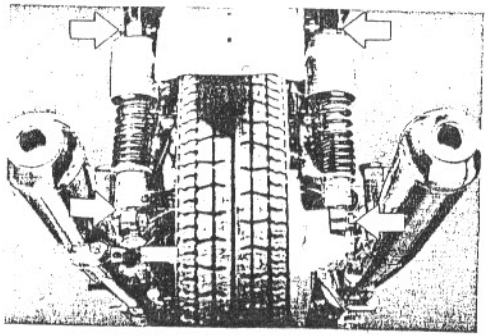
33 17 381 Tapered Roller Bearing of Rear Wheel Swinging Arm, Renewing

Rear wheel swinging arm, remove and refit 33 17 350.

Drive shaft, remove and refit 26 11 000.

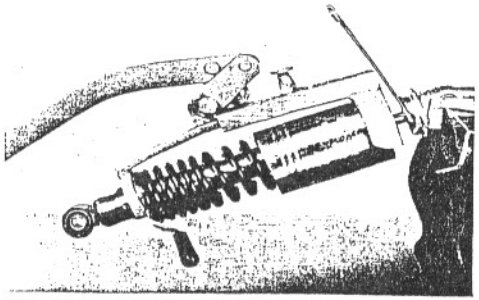
Remove the rubber ring seals with spacer collar and tapered roller bearing inner race with roller cage out of the swinging arm.

Note when fitting: When assembling clean and thoroughly grease the tapered roller bearings.



33 52 120 Spring Strut, Removing and Refitting

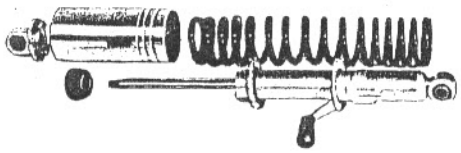
Unscrew the hexagonal nuts with washers and take out the top bolt. In the case of the left hand spring strut the machine must be pressed additionally downward before removing the bottom bolt.



33 53 580 Coil Spring, Removing and Refitting

Spring strut, remove and refit 33 52 120.

Set the adjusting plate handle to "solo". Mount the BMW biasing tool No. 550 on the spring cover of the shock absorber. Clamp the upper fastening eyelet in a bench vice and push a bar through the arm of the tool and the lower shock absorber eyelet. Swing the lever until it remains stationary even when the shock absorber is compressed. Use an open-ended spanner to unscrew the shock absorber rod out of the top spring strut eyelet. See Technical Data for torque ratings.



Note when fitting: Note the sequence of parts when assembling. The metal/rubber mount in the spring strut eyelet may be pressed out only where necessary.
Before refitting check the spring length for resiliency of the carrier springs (see Technical Data). The shock absorber must be stiffer under traction and easier under pressure but in both instances always uniform. In compressed end position the shock absorber may not be subjected to more than 500 grammes pressure, as otherwise interior damage could be caused. If traction and compression require an equally small amount of force or if there is any tendency toward jerky movements this indicates leaks which necessitate replacement of the shock absorber unit.

34 00 046 Bleeding the Brake System

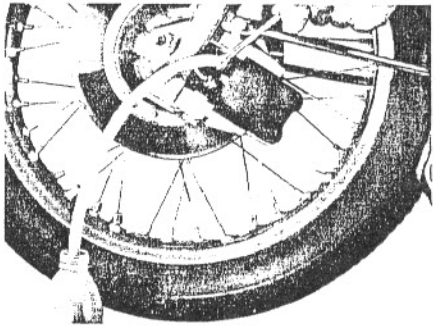
Brake fluid must be renewed annually.

Brake fluid is hygroscopic and therefore absorbs moisture from the atmosphere through the air hole in the reservoir. This reduces the boiling point of the brake fluid from 240° to 160÷180° C.

Warning: Do not let the brake fluid come into contact with the motorcycle's paintwork.

Front wheel, remove and refit 36 30 300.
Remove tank and top up brake fluid reservoir.

Mount the bleed hose on the bleed screw and put other end of hose in a vessel.



Apply the handbrake lever several times until the brake pressure is detected. Hold the lever applied against this pressure and open the bleed screw, at the same time pulling firmly on the lever. Do not release the lever until the bleed screw has been closed.

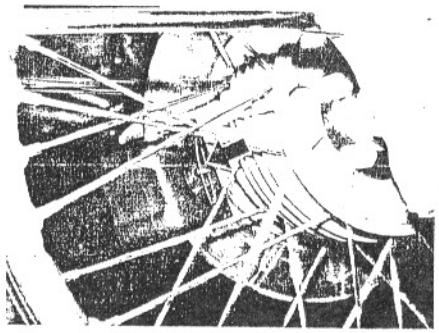
Repeat this process until brake fluid emerges from the hose into the vessel entirely free of air bubbles. Tighten bleed screw.

Warning: Do not pump the brake fluid reservoir dry or air will penetrate the brake system again.

34 11 000 Brake Pads, Removing and Refitting

Front wheel, remove and refit 36 30 300.

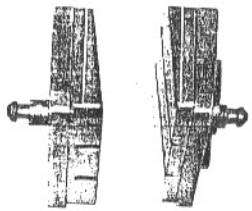
Remove the retaining spring of the inner pad and remove both pads from the brake caliper.



34 11 001 Brake Pads, Renewing

Brake pads, remove and refit 34 11 000.
Colour marks on the brake pads indicate the permitted wear limit. When this point is reached on one brake pad, both pads must be renewed.

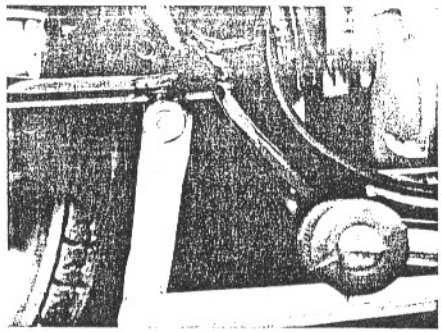
Note when fitting: Before inserting the new brake pads push back the brake cylinder piston with a screw clamp. Grease the outer pad guide pin slightly (with Molykote) and mount the O-ring before installing the outer pad. Secure the inner ring with the retaining spring, the angled end of which must face down.



35 21 000 Foot Brake Lever, Removing and Refitting

Unscrew locknut while supporting on the bearing bolt.

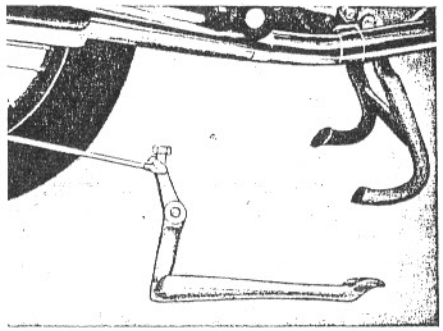
Take off the foot brake lever.



Detach the ES bolt from the brake pull rod and remove pull rod.

Foot brake adjustment:

Adjust the wing nut at the end of the pull rod until the rear wheel just starts to brake. Turn the wing nut back by 3 to 4 turns.



35 Foot controls

35 21 000 Foot brake lever – removing and refitting . . . . . page 35–21/1

36 Wheels and tyres

Technical Data . . . . . page 36– 0/3
36 30 300 Front wheel – removing and refitting 36–30/1
36 30 320 Rear wheel – removing and refitting 36–30/2
36 31 321 Spokes of a road wheel (front or rear) – renewing 36–31/1
36 30 028 Wheels – static balancing 36–31/2
36 31 381 Wheel bearings of rear wheel – renewing 36–31/2
36 31 391 Wheel bearings of front wheel – renewing 36–31/3

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Type of rim	aluminium deep well rim			
Rim size front	1.85 B × 19			
Rim size rear	2.15 B × 18			
Number of spokes	40			
Max. radial run-out mm(in)	0.5 (0.019) measured at the rim flange			
Max. lateral run-out mm	0.2 (0.0078) measured at the rim flange			
Tyre size front	3.25 S 19		3.25 H 19	
Tyre size rear	4.00 S 18		4.00 H 18	
Max. tyre imbalance measured at the inner rim diameter cmp which in g(oz) is	170 8–9 (0.28—0.32)			
Max. permissible run-out of central groove mm(in)	1.5 (0.0585)			
Tyre pressures: Front wheel solo psi(bar) with pillion passenger psi(bar)	27 (1.9) 28.5 (2.0)			
Rear wheel solo psi (bar) with pillion passenger psi(bar)	28.5 (2.0) 32 (2.25)			
Testing with tyres warm up to psi(bar)	4.25 more (0.3)			
Travelling at max. speed over long period psi(bar)	2.9 more (0.2)			
Wheel bearing grease	high quality multi-purpose grease with 180° C dropping point			
Quantity of grease per wheel g(oz)	10 (0.3)			

Wheels and tyres

Technical Data

Type	R 60/6	R 75/6	R 90/6	R 90 S
Permissible wheel load solo front with 27 psi kg(lb) rear with 28.5 psi kg(lb)	160 (352) 245 (539)			
Permissible wheel load with pillion passenger front with 28.5 psi kg(lb) rear with 32.0 psi kg(lb)	178 (392) 270 (594)			

Tightening torques mkp (ft/lb)

Friction moment of wheel bearing with stipulated tightening torque of axle nut cm/kp.	1.5÷3.0 (10.84÷21.69)
Quick release axle front and rear	4.5÷4.8 (32.5 ÷34.7)

All other screws and nuts in accordance with the standard values in the tables of the manufacturers' or the new BMW Standards Sheet 60002.0

36 30 300 Front Wheel, Removing and Refitting

Put the motorbike on its stand and support it at the oil sump.

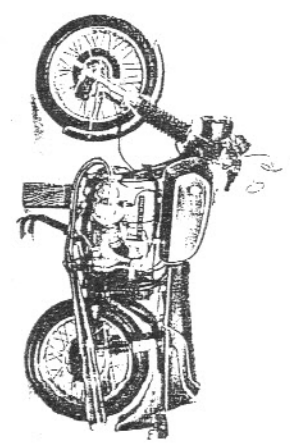
Remove the top stop nut and spring washer including the hexagonal socket head bolt at the brake torque stay rod (only on R 60/6).

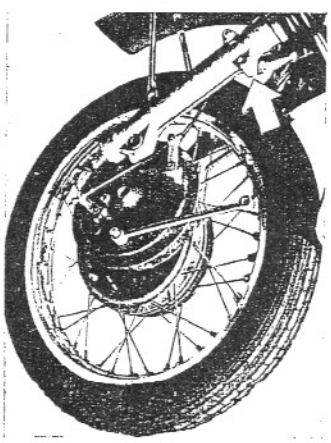
Remove axle nut (1) and washer, loosen the clamp screw (2) of the front axle (hexagonal socket head bolt) with spring washer and withdraw front axle (3) with a drift.

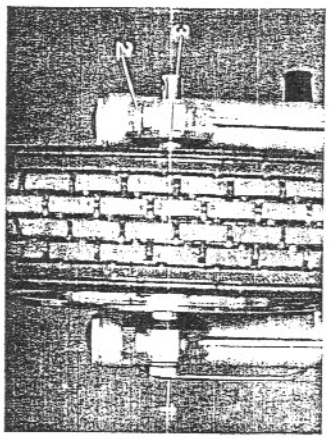
Note when fitting: When refitting the lightly greased front axle, first tighten the axle nut (if necessary with the aid of an arbor). Vigorously push the fork down through the spring range several times and then tighten the clamp screw. In this way distortion of the fork sliding tube is avoided.

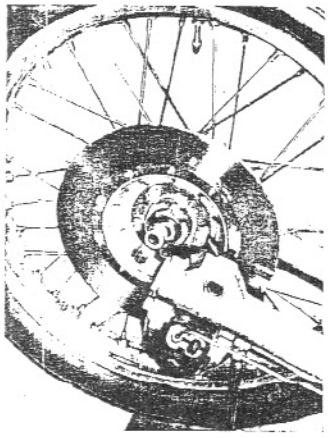
The direction of rotation of the wheel should not be changed on the R 90 S model (twin disc brake) otherwise the floating calipers would have to be readjusted.

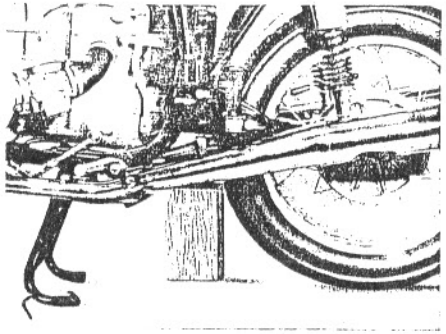
Withdraw front wheel forwards.





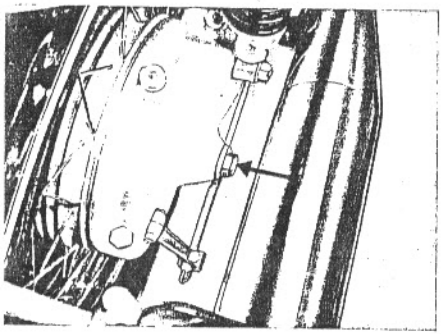




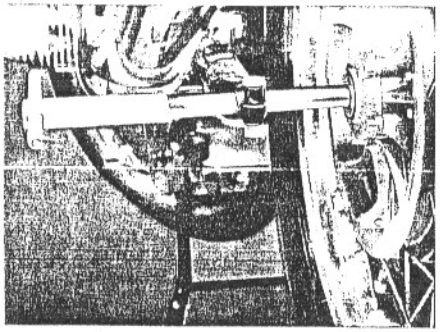


36 30 320 Rear Wheel, Removing and Refitting

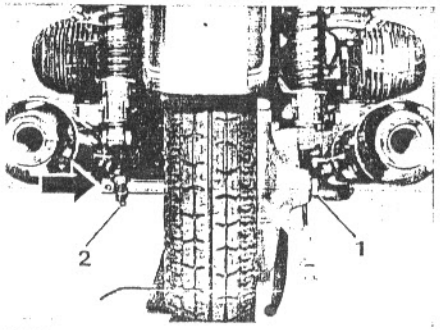
Place the motor cycle on its centre stand and provide additional support.



Unscrew quick release axle nut and remove plus washer.



Unscrew quick release axle clamp-screw nut on the left-hand swinging arm and remove including the hexagonal socket head bolt and spring washer. Extract quick release axle with a drift.

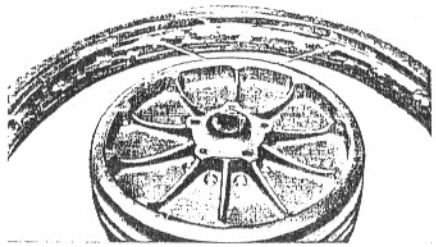


Note when fitting: Thoroughly clean axle and gearing when assembling and lightly coat with a viscous grease. Rotate axle when sliding in. After tightening the axle nut (1) activate the spring action and then tighten the clamp screw (2). The transverse bore in the axle end must point to the rear (arrow).

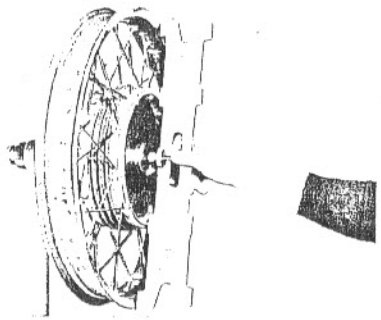
Remove rear wheel from drive. When doing this tilt machine slightly to the right.

36 31 321 Spokes of a Road Wheel (front or rear), Renewing

Front wheel – remove and refit 36 30 300.
or rear wheel – remove and refit 36 30 320.
The motor cycles R 60/6, R 75/6, R 90/6 and R 90 S have aluminium rims as standard equipment. See Technical Data section for dimensions. The spoke fitting gauges BMW No. 252/1 and BMW No. 252 are necessary for the rear and front wheels respectively.
The wheel hubs supplied as replacements have an undersize inside diameter which must be turned out to a nominal size of 200+0.185 mm after the spokes have been fitted and the wheel hubs centred. To do this mount the hub axle centre in a lathe and turn the surface as finely as possible. The unavoidable distortion of the wheel hub caused during spoke fitting is corrected in this way. The maximum permissible run-out of the brake surface-to-wheel hub is 0.02 mm.
Place wheel hub together with bearings on the work bench with the brake drum side facing downwards. Push a pair of spokes with packing plate which cross at the hub through the hub, noting that the spoke holes in the hub are not at the same level.



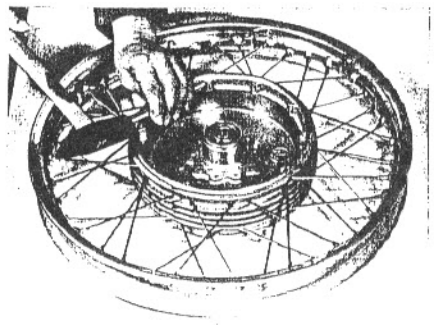
Position the rim in such a way that the stamp mark on the inside of the rim flange is on the brake drum side and the arrow is facing in the normal direction of rotation. The pressed-in nipple locating holes must point exactly in the direction of the spokes inserted in the hub. The higher spoke must coincide with a higher locating hole in the rim and the lower spoke must line up with a correspondingly lower locating hole in the rim. The other spokes are inserted and fitted with nipples in the same way.
Tighten the nipples to a uniform torque reading. Place rim and hub with knockout spindle in BMW jig No. 5106-2. Adjust distance from rim to hub using a spoke fitting gauge positioned on the brake drum side.

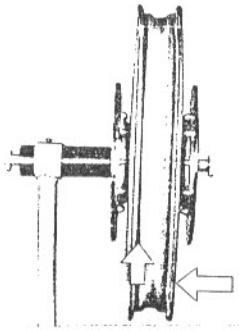


Combination spoke fitting gauge BMW No. 551/552 for front wheel (1.85×19 in.) and rear wheel (1.85×18).

Combination spoke fitting gauge BMW No. 556/556-1 for rear wheel (2.15×18 in.) and front wheel with disc brake (1.85×19 in.).

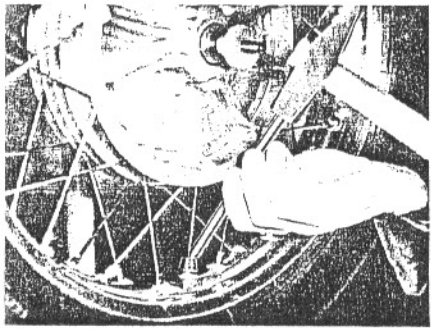
Note when fitting: Bed in the spoke ends with a suitable punch.





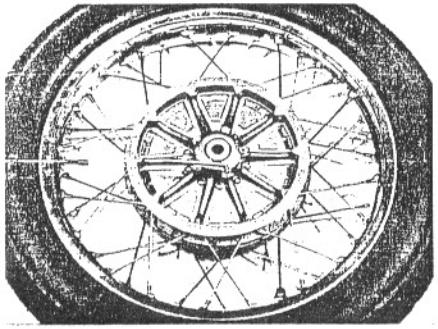
Maximum radial and lateral run-out measured at rim flange (see Technical Data).

Grind off any projecting spoke ends to prevent damage to the inner tube. Re-tension the spokes after the first 1,000 km (600 miles). All road wheels must be balanced after the tyre has been fitted.



36 30 028 Wheels-Static Balancing

Mount wheel in device BMW No. 5106/2 and tighten – take out the reducing bush on the front wheel for this purpose. Spin wheel and allow it to come to rest. Knock on the balance weights with a hammer on the nipples of the top spokes. A correctly balanced wheel must remain still in every position. See Technical Data for max. out-of-balance of a road wheel.

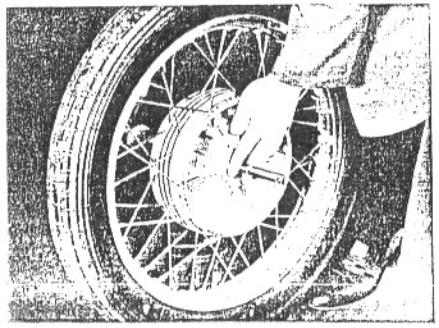


36 31 381 Wheel Bearings of the Rear Road Wheel, Renewing

Rear wheel – remove and refit 36 30 320

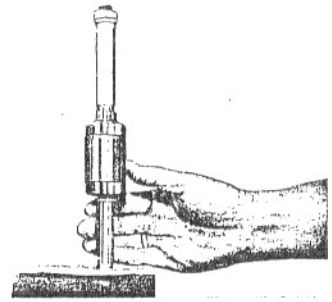
Unscrew hexagonal socket head bolts and leave to one side with spring washers.

Remove bearing cap with fitted lipped sealing ring and thrust sleeve.



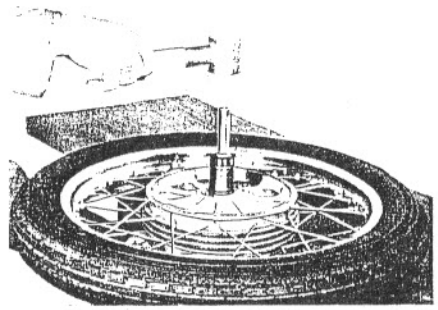
Heat the wheel hub. Insert rear wheel knockout spindle with reducing bush in wheel bearings. Push hollow drift BMW No. 5074/1 over the knockout spindle on the brake side. Counterhold the bearing assembly with one hand on the left-hand side of the hub. Knock the bearings out of the hub from the brake side.

Before refitting the bearings in the hub check whether they are free from play. To do this, clamp the rear wheel knockout spindle with clamping jaws in a vice and fit the complete bearing assembly, consisting of left-hand thrust sleeve, left-hand taper roller bearing, adaptor ring, inner spacer bush, outer spacer bush, right-hand taper roller bearing and right-hand thrust sleeve, over the spindle. Fit adjusting bush BMW No. 553 and pre-load with nut of knockout spindle.
The correct bearing setting has been reached when the outer spacer bush can be moved backwards and forwards between the two outer races of the taper roller bearings with a sucking action (tight push fit). If this is not the case the adaptor ring should be re-machined or a new ring of appropriate thickness fitted.
See Technical Data for tightening torque of the knockout spindle nut.



Remove adjusting bush BMW No. 553, coat the cleaned bearings with grease – see Technical Data.

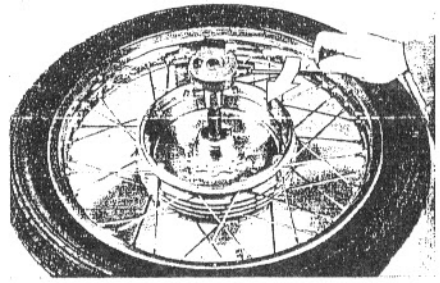
Fit the complete bearing assembly including the thrust sleeves in the wheel hub, which should be heated to 100° C. Remove knockout spindle and left-hand thrust sleeve. Tighten bearing cap with fitted lipped sealing ring, using the knockout spindle for centering. Fit the left-hand thrust sleeve.



Check bearing setting with torquemeter. To do this fit the knockout spindle in the wheel bearings. Pre-load bush BMW No. 553 with knockout spindle nut.

Fit torquemeter on knockout spindle nut.

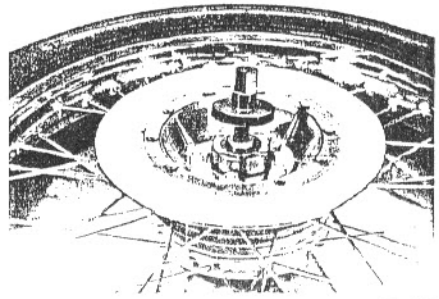
See Technical Data for coefficient of friction and tightening torque.



36 31 391 Wheel Bearings of the Front Road Wheel, Renewing

Front wheel – remove and refit 36 30 300.

Remove cap with pin spanner BMW No. 235.



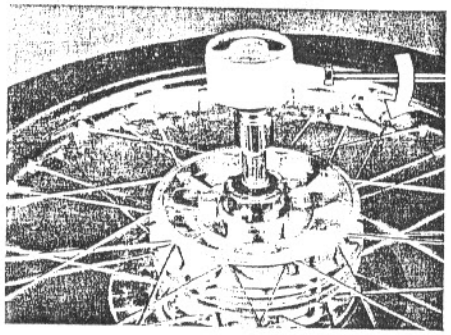




Press the guide sleeve out of the cap. Push the bearing off the sleeve.

Heat the front wheel hub to 100° C and tap out the bearing shells.

Note when fitting: Heat bearing before pushing it onto the guide sleeve.



Insert the knockout spindle with 2 spacer sleeves to the left and right through the wheel hub and preload with the knockout spindle nut.

Fit torquemeter and check.

See Technical Data section for coefficent of friction and tightening torque.

157

46 Frame

Technical Data . . . . . page 46– 0/3
46 52 000 Centre stand – removing and refitting 46–52/1
46 53 000 Side stand – removing and refitting 46–52/2
46 61 000 Front wheel mudguard – removing and refitting 46–61/1
46 62 000 Rear wheel mudguard – removing and refitting 46–61/2

Technical Data

Model	R 60/6	R 75/6	R 90/6	R 90 S
Frame	Double-loop tubular steel frame welded from oval tubes with bolted on rear frame section – not suitable for sidecars –			
Position of factory plate	on front of steering head			
Position of frame number	on right of steering head			
Motorcycle dimensions and weights Maximum width (engine) mm(in)	740 (28.86)			
Maximum height without mirror mm(in) (Motorcycle unladen)	1080 (42.5)			1210 (47.6)
Saddle height, unladen mm(in)	810 (31.9)			820 (32.3)
Maximum length mm(in)	2180 (85.8)			
Wheelbase mm(in)	1465 (57.7)			
Max. permissible non-alignment of front and rear wheels mm(in)	4 (0.16)			
Road clearance when loaded with 75 kg (165 lb) driver mm(in)	165 (6.5)			
Empty weight plus lubricants, without fuel and tools kg(lb)	200 (441)			205 (452)
Empty weight plus lubricants, full tank and tools kg(lb)	210 (463)			215 (474)
Permissible gross weight = empty weight plus rider and passenger and luggage kg(lb)	398 (877)			
Permissible wheel loadings Solo front at 1.9 kg/cm² (27 psi) kg(lb) rear at 2.0 kg cm² (28.5 psi) kg(lb) Permissible wheel loadings with pillion passenger front at 28.5 psi kg(lb) rear at 32 psi kg(lb)	 160 (353) 245 (540) 178 (392) 270 (595)			
Maximum capacity including driver	2			

46.0/3

46-0/4

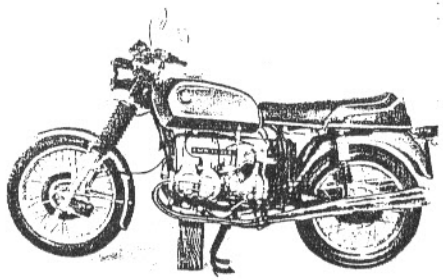
Tightening Torques in mkp (lb. ft)

Securing bolts for rear frame section	2.5 (18)	Centre stand securing bolts	3.5 (25.3)
Securing nuts for upper front wheel mudguard bracket	2.3 (16.6)	Securing bolts for lower front wheel mudguard bracket	0.25 (1.8)

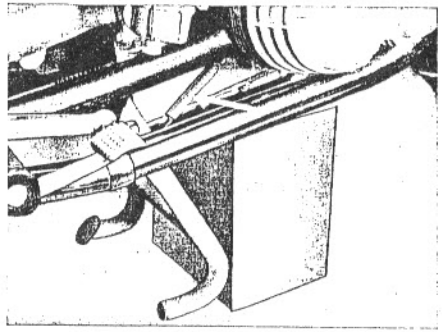
All other nuts and bolts should be tighened to the values given in the tables issued by the manufacturers or the new BMW standards sheet 60002.0.

46 52 000 Centre Stand, Removing and Refitting

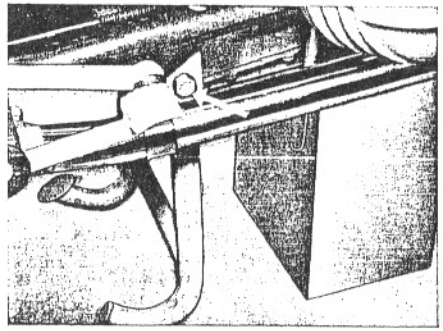
Raise motorcycle under the oil sump so that the centre stand hangs free.



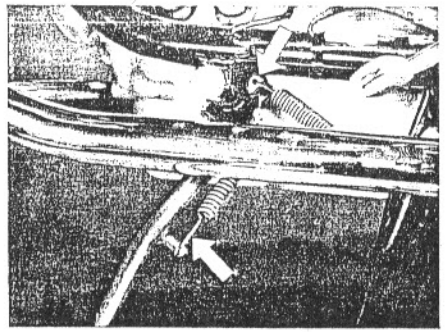
Disconnect springs on the left and right of the centre stand.



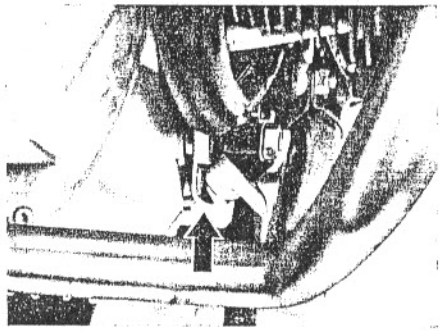
Unscrew hexagonal head bolt (arrow) on the left and right and withdraw centre stand to the rear, paying attention to the spacer washers.



46 53 000 Side Stand, Removing and Refitting



Disconnect springs for side stand and centre stand.



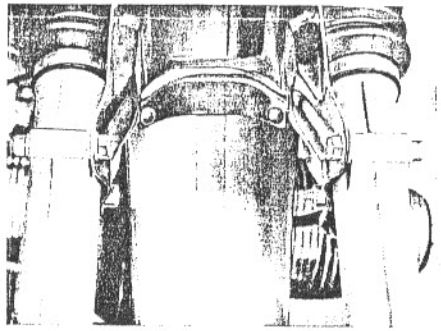
Remove left-hand hexagon nut of front engine mounting. Knock through the engine bolt so that the shackle (arrow) can be taken out.

Note when fitting: The shackle should be turned in such a way and secured so that the side stand automatically folds back into the normal position when the motorcycle is brought into the vertical position.

46 61 000 Front Wheel Mudguard, Removing and Refitting

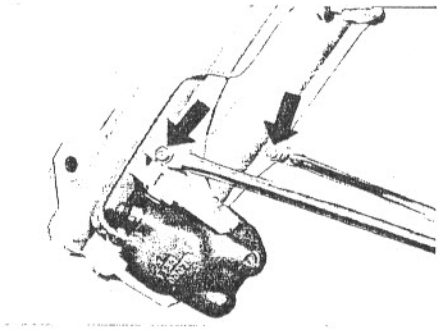
Front wheel – remove 36 30 300.

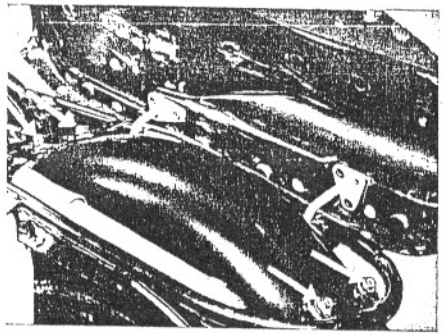
Remove the 2 hexagonal bolts on both sides of the metal section.



Remove the 2 nuts with spring washers and bolts on the lower bracket.

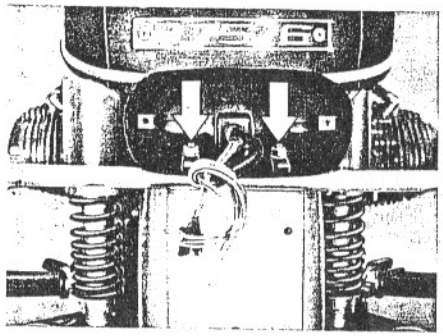
If the metal section is bent or distorted it should be replaced.





46 62 000 Rear Wheel Mudgard, Removing and Refitting

Disconnect earth lead from the battery.
Fold up the double seat, remove the 4 hexagonal bolts with washers, rubber washers and locknuts (arrows).



Remove the two Phillips screws of the rear light and remove the lens with reflector.

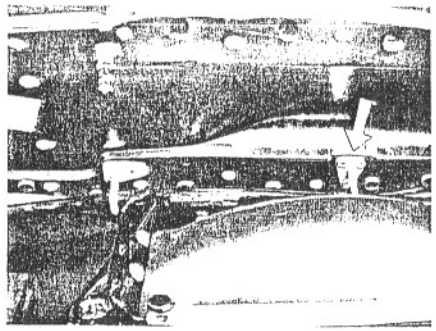
Unscrew securing bolts with washers and nuts (arrows) and take off rear light housing with the turn indicator carrier.

52 Seats

52 53 000 Double seat – removing and refitting . . . . . page 52–53/1

52 53 000 Double Seat, Removing and Refitting

Tilt up the double seat.
Unscrew the 3 hexagonal socket head bolts (arrow) from the rear hinge plate and pull double seat to the rear and remove.



61 General vehicle electrics

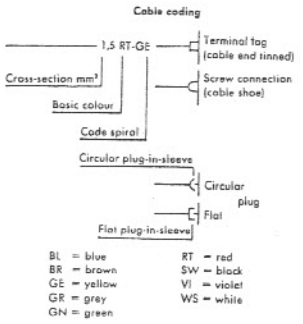
Technical Data and Wiring Diagram . . . . . page 61– 0/3
61 21 010 Battery – removing and refitting 61–21/1
61 21 100 Battery bracket – removing and refitting 61–21/1
61 31 350 Flasher unit – removing and refitting 61–21/1
61 31 400 Starter relay – removing and refitting 61–31/1
61 33 000 Horn – removing and refitting 61–31/1

Technical Data

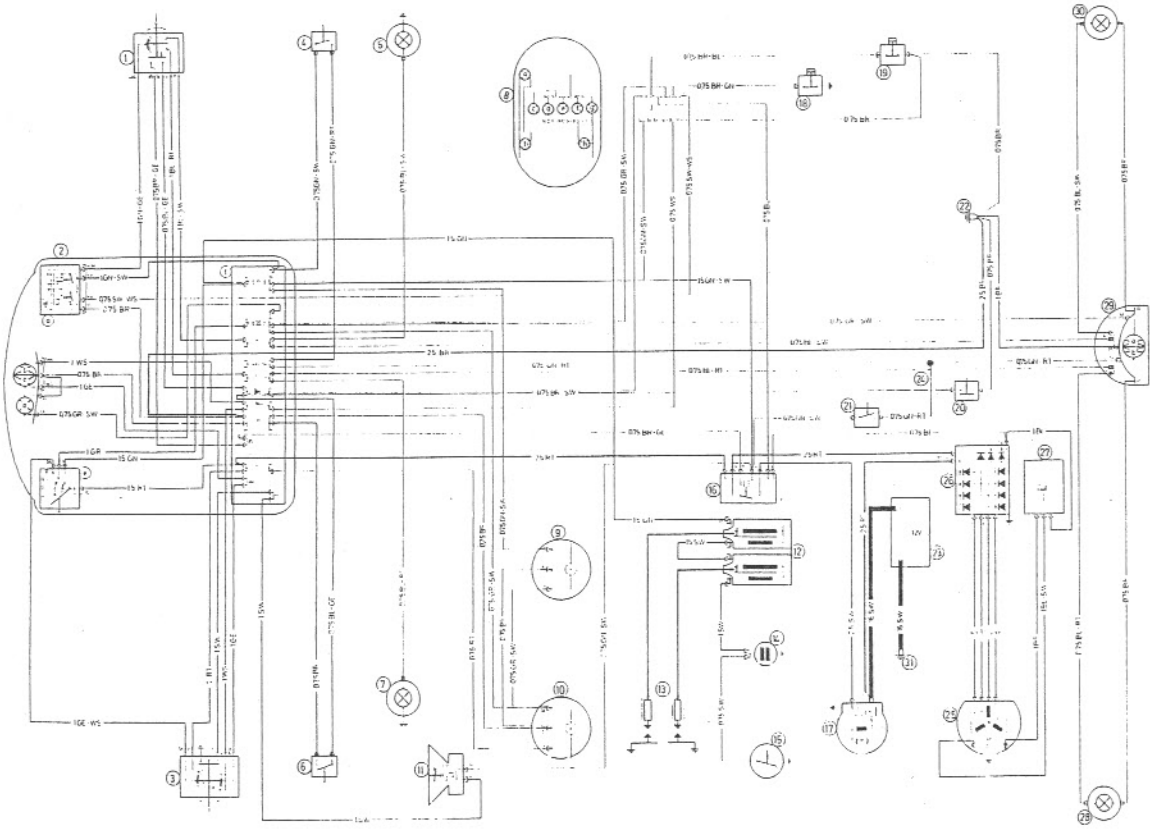
General Vehicle Elctrics

Model	R 60/6	R 75/6	R 90/6	R 90 S
Horn Type	Bosch 0320 143 025 12 V — 400 Hz			
Battery (VARTA) Voltage	12 V			
Capacity Ah	25			
Polarity	negative earth			
Lowest starting voltage	3 V			
Flasher unit (Hella)	TBB 261 — 4 × 21 W — 12 V			
Fuses	2 × 8 A			

Key to wiring diagram



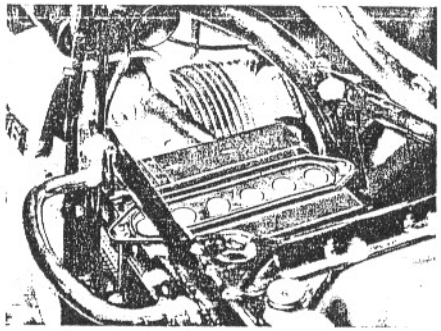
1 Turn indicator switch with starter button
2 Headlight
  a) Flasher unit
  b) High beam
  c) Low beam
  d) Parking light
  e) Ignition – light switch
  f) Contact plate with fuses
3 Dimmer switch with headlight flasher and horn button
4 Front brake stop light switch
5 Front right turn indicator
6 Clutch operated switch
7 Front left turn indicator
8 Combination instrument
  a) Speedometer illumination
  b) Revolution counter illumination
  c) Brake fluid level telltale (red)
  d) Neutral indicator (green)
  e) Charge indicator (red)
  f) Oil pressure telltale (orange)
  g) Turn indicator telltale (green)
  h) Headlight high beam indicator (blue)
  i) Connection to combination instrument
9 Voltmeter } on R 90 S only, otherwise
10 Clock } special equipment
11 Horn
12 Coils
13 Spark plugs with caps
14 Condenser
15 Contact breaker
16 Starter relay with D + terminal
17 Starter
18 Oil pressure switch
19 Brake fluid level switch
20 Neutral indicator switch
21 Brake pedal stoplight switch
22 Ground on frame at coils
23 Battery
24 Connection 54 in wiring harness
25 Alternator
26 Diode carrier
27 Voltage regulator
28 Rear left turn indicator
29 Rear light
  a) Rear and license plate light
  b) Stop light
30 Rear right turn indicator
31 Ground at gearbox



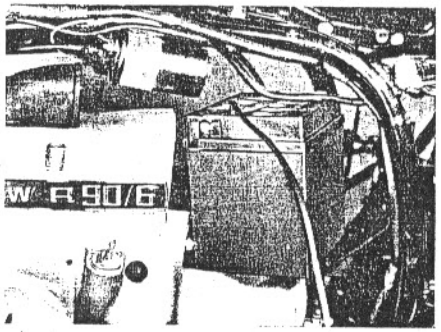
61 21 010 Battery, Removing and Refitting

Air filter element – remove and refit 13 72 000.

Remove retaining handle on the battery.

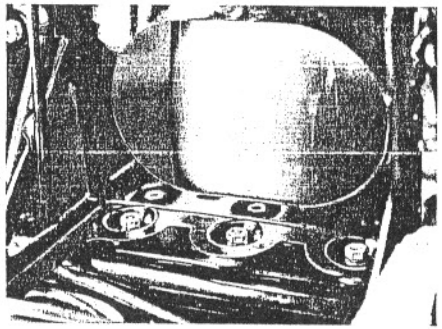


Disconnect leads and pull out battery to the left.



61 21 100 Battery Bracket, Removing and Refitting

Unscrew the three hexagonal nuts at the bottom and the left and right-hand hexagonal nuts at the top of the bracket.

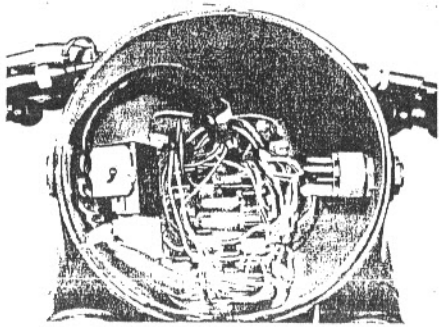


61 31 350 Flasher Unit, Removing and Refitting

Disconnect earth lead from the battery.

Prise headlamp front ring off the headlamp housing with a screwdriver.

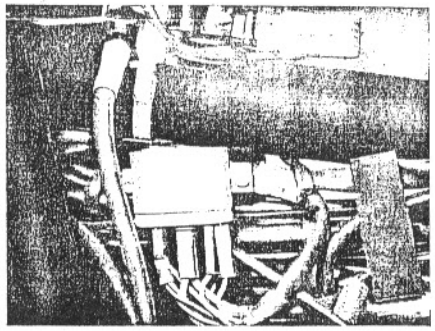
Pull flasher unit out of socket.



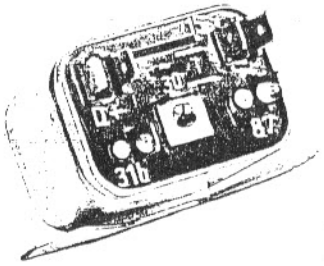
61 31 400 Starter Relay, Removing and Refitting

Fuel tank – remove and refit 16 11 030.

Disconnect earth lead from battery.
Unscrew the 2 hexagonal socket head bolts with spring washers, disconnect the leads.

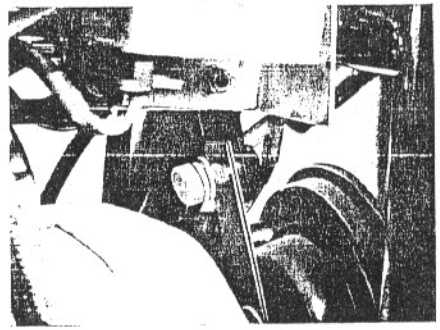


Leads:
Flat pin connection '87' = black lead
Flat pin connection '15' = green lead
Flat pin connection '30' = 3 red leads
Flat pin connection '31 b' = brown/black lead
Flat pin connection 'D+' = 2 blue leads



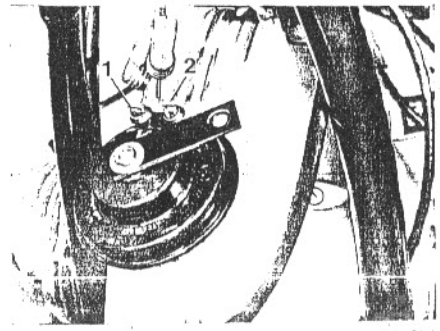
61 33 000 Horn, Removing and Refitting

Disconnect earth lead from battery. Unscrew hexagonal nut (arrow) from the horn.



Pull off protective rubber sleeve. Disconnect leads from horn.

1 = black lead
2 = green lead



173

62 Instruments

Technical Data . . . . . page 62– 0/3
62 11 000 Combination instrument – removing and refitting 62–11/1
62 12 020 Speedometer drive shaft – removing and refitting 62–12/1
62 13 020 Revolution counter drive shaft – removing and refitting 62–12/1

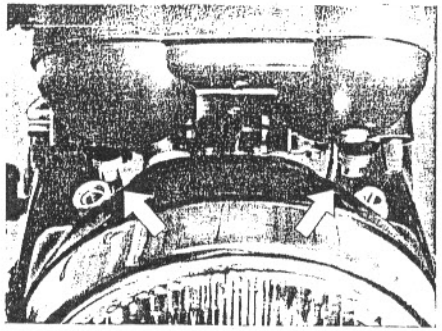
Technical Data

Instruments

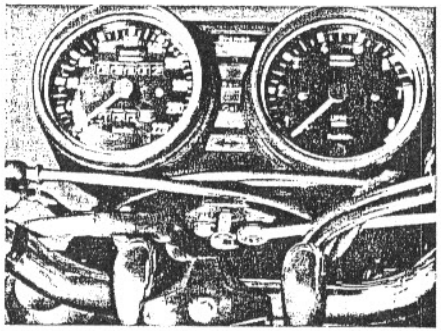
Model	R 60/6	R 75/6	R 90/6	R 90 S
Revolutions per unit distance, km indicator	0.773	0.737	0.711	0.691
Revolutions per unit distance, mile indicator	1.244	1.186	1.144	1.112
Measuring range kph	20÷220			
Measuring range mph	10÷140			
Revolution counter rpm	1000÷8000			

62 11 000 Combination Instrument, Removing and Refitting

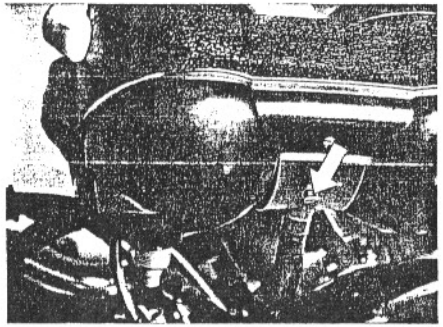
Unscrew the drive shafts for the speedometer and revolution counter.



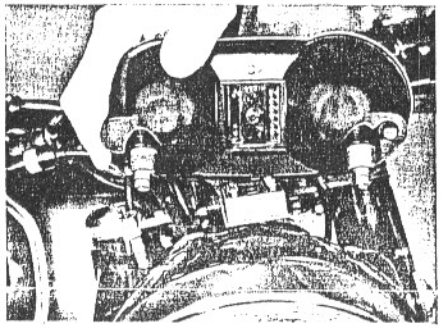
Slacken the three fastening screws and withdraw the combination instrument from its support.



Unscrew the Phillips screw of the central plug and pull off the plug.

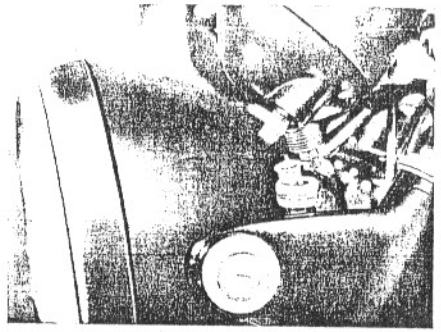


Remove combination instrument.



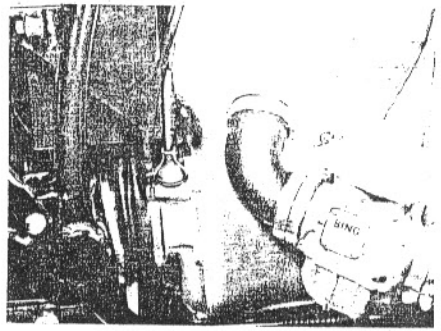
62 12 020 Speedometer Drive Shaft, Removing and Refitting

Unscrew speedometer drive shaft.



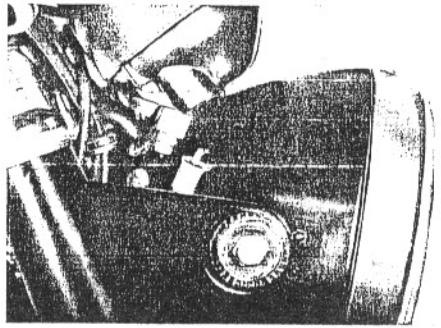
Push back protective rubber cap for speedometer drive on the gearbox. Pull out and remove speedometer drive after releasing the retaining bolt and removing the battery earth lead including washer.

Note when fitting: Make sure that the drive shaft is routed correctly along the frame.



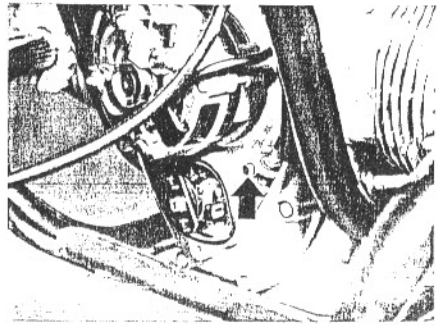
62 13 020 Revolution Counter Drive Shaft, Removing and Refitting

Unscrew revolution counter drive shaft.



Remove engine cover.

Unscrew fastening screw for revolution counter shaft and withdraw the shaft.



63 Lights

Technical Data . . . . . page 63– 0/3
63 10 004 Headlamp beam alignment 63–10/1
63 21 380 Rear lamp cluster – removing and refitting 63–10/2
63 23 170 Both turn indicators (front and rear) – removing and refitting 63–23/1
63 99 241 Bulb for headlamp – renewing 63–99/1
63 99 271 Bulb of a turn indicator (front and rear) – renewing 63–99/2
63 99 381 Bulb for rear lamp – renewing 63–99/2

Technical Data

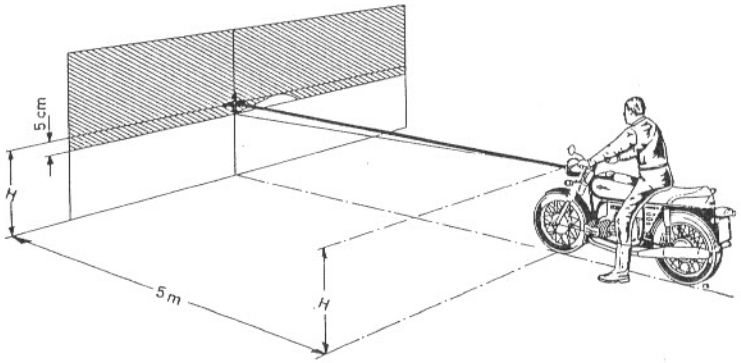
Lights

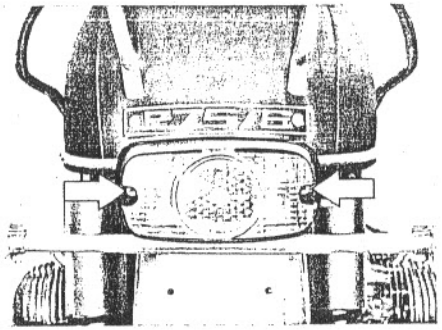
Model	R 60/6	R 75/6	R 90/6	R 90 S
Headlamp (Type)	Bosch 0 303 550 002			
High and low beams	12 V / 60 / 55 W quartz-iodine bulb			
Parking light	12 V / 4 W parking light bulb			
Idle telltale lamp (green)	12 V / 1.2 W indicator bulb			
Oil pressure telltale (orange)	12 V / 3 W indicator bulb			
Charge telltale (red)	12 V / 1.2 W indicator bulb			
High beam telltale (blue)	12 V / 1.2 W indicator bulb			
Turn indicator telltale (orange)	12 V / 13 W indicator bulb			
Instrument lighting	12 V / 1.2 W indicator bulb			
Tail and license plate light Brake light	12 V / 5 W 12 V / 21 W	two-filament bulb		
Turn indicators (2 yellow front and rear)	12 V / 21 W bulb			
Brake telltale (red)	12 V / 1.2 W indicator bulb			

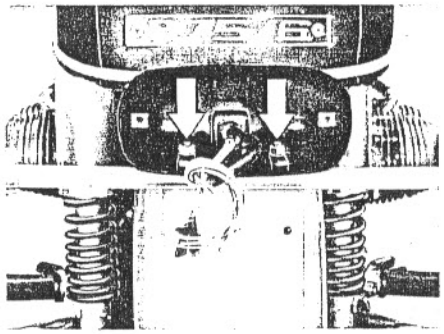
63 10 004 Headlamp Beam Alignment

After any work on the headlamp it is essential to check its alignment. If no headlamp aligning equipment is available the task can be carried out as follows.

Check tyre pressures and adjust where necessary. Position the motorcycle upright with rider astride on a level surface at a distance of 5 metres from a light coloured wall. Set the rear spring struts to solo operation. Measure the distance from the ground to the centre of the headlamp and mark this height on the wall with a cross, and a second cross 5 cm. below. Switch on low beam and align the headlamp so that the bright/dark boundary runs on the left level with the lower cross, rising to the right from the centre of the cross to reach the level of the upper cross and then fall off.







63 21 380 Rear Lamp Cluster, Removing and Refitting

Disconnect earth lead from the battery.
Unscrew both Phillips screws and remove the lens.

■

Remove leads from the rear side of the reflector and make a note of the connections where necessary.

Unscrew securing bolts with washers and nuts from the housing and take off the housing.

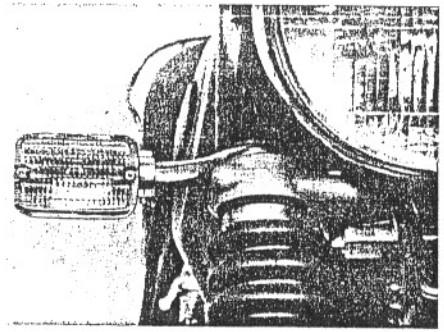
Note when fitting: Make sure that the clear lens for the license plate light is at the bottom.

■

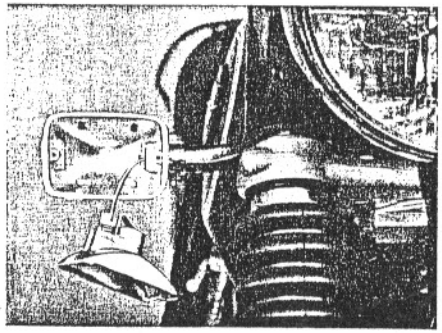
63 23 170 Both Turn Indicators (front or rear), Removing and Refitting

Disconnect earth lead from the battery.
Unscrew both Phillips screws and remove the lens.

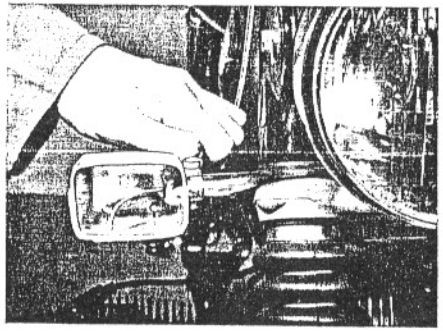
Note when fitting: When fitting the lens make sure that the marking "Top" is at the top.



Disconnect leads at the rear of the holder (arrow).

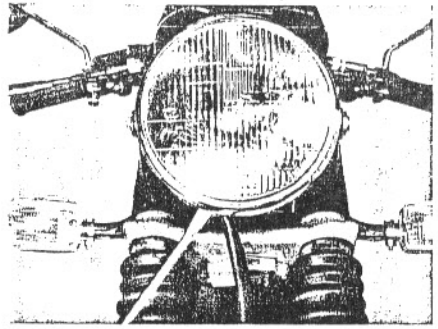


Slacken the clamp screw and remove the turn indicator housing.



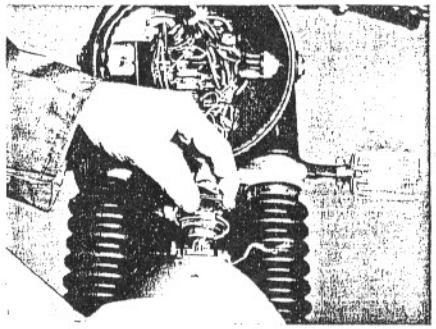
63 99 241 Bulb for Headlamp, Renewing

Prise headlamp front ring away from headlamp housing with a screwdriver.

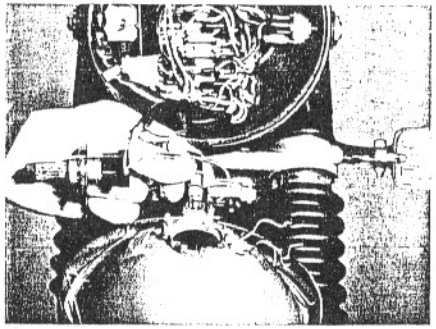


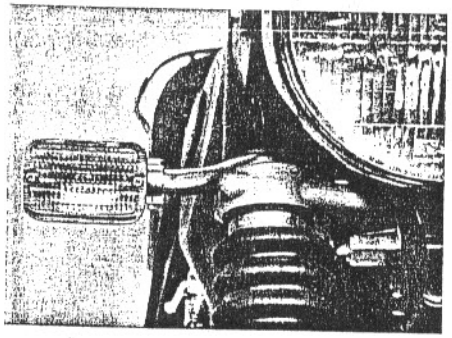
Open wire clip, release two-filament bulb from reflector and pull it out of the push-button plug.

Note when fitting: When fitting the two-filament bulbs make sure that the anti-twist lug engages in the reflector.



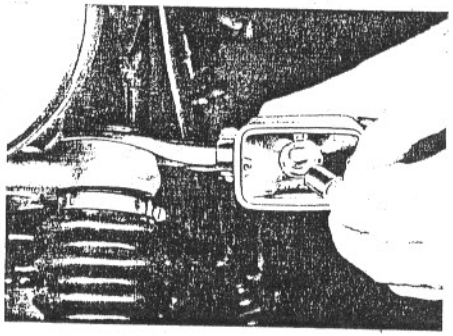
The parking light bulb is pressed out of the reflector from inside.





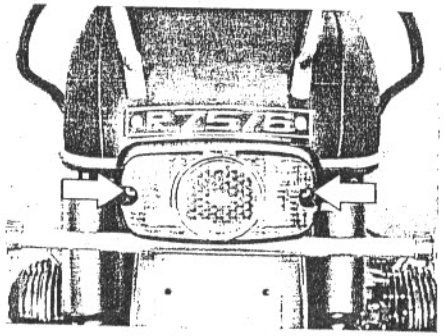
63 99 271 Bulb of a Turn Indicator (front ar rear), Renewing

Disconnect earth lead from battery.
Unscrew both Phillips screws and remove the lens.



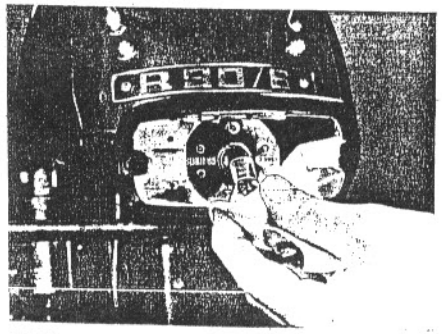
Push bulb into the holder and remove by turning it anti-clockwise.

Note when fitting: Fit the lens so that the marking "Top" is at the top.



63 99 381 Bulb for Rear Lamp, Renewing

Disconnect earth lead from the battery.
Unscrew both Phillips screws and remove the lens.



Push bulb into the holder and turn to remove.

Note when fitting: Fit the lens so that the clear lens for the license plate lighting is at the bottom.