BMW Motorcycles

R 51/3 · R 67 · R 67/2

WORKSHOP REPAIR MANUAL

BAYERISCHE MOTOREN WERKE AG. MÜNCHEN 13

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Disassembly and Assembly Group

Special Tools

One hook spanner 49 mm ∅ for exhaust nut . . . . . Matra No. 3381

Shop-made Tools

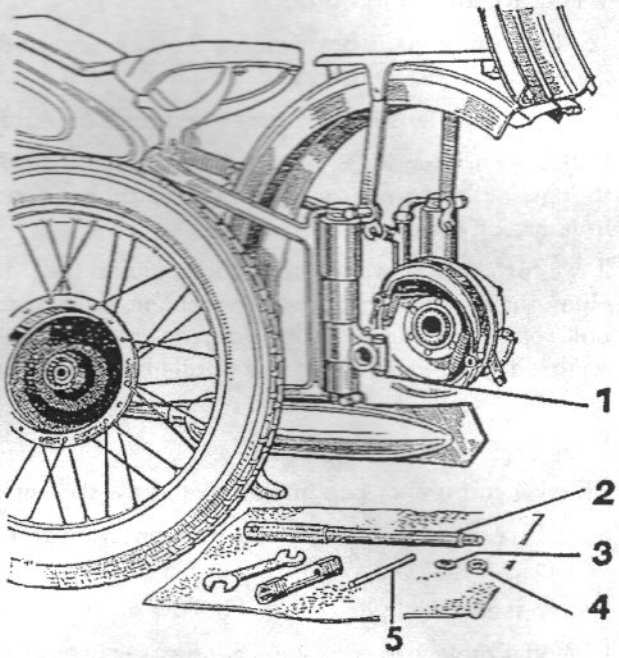
One punch for guiding tube of rear wheel spring assembly . . . . W 5013
One dynamo armature puller screw . . . . . W 5030
One assembly stand . . . . . V 5043

Disassembly

Put motor cycle on the assembly stand (drawing V 5043).

Disassembly of rear wheel drive:

Loosen set screws of mudguard stays and raise end of rear mudguard.



Unscrew hub spindle nut (4) on drive side and remove together with washer (3).

Slacken clamp screw on left axle holder and withdraw hub spindle axle by means of pin (5).

Remove wheel.

Unscrew winged nut from brake conduit on brake pedal.

Depress pedal so that brake rod slides off the brake arm.

Remove bolt from brake operating lever, put it in the brake rod bore and screw on winged nut.

On R 51/3 of 1952 and R 67/2 models, unscrew cap nuts from upper spring retainers.

Loosen upper clamp screw on right rear spring bracket.

Remove lower clamp screw together with nut and washer on right rear spring bracket.

Withdraw right silencer.

Drive right guiding tube of rear wheel spring assembly cautiously from downwards to upwards by means of punch W 5013 (shop-made tool).

Press rear wheel drive assembly to left downward and remove it rearwards from the rubber coupling of the shock absorber.

If needed, dismount left hub spindle holder and spring following the same procedure.

Disassembly of Gear Box:

Disconnect battery.

Unhook battery holder and remove battery.

Withdraw speedometer shaft from drive bushing after loosening its set screw.

Unhook clutch cable.

Remove thrust spring between clutch lever and gear box housing.

Withdraw induction lines.

Turn out air filter holder screw and disassemble air filter.

Remove rubber plug from hand change mechanism cover on right side of gear box and loosen binding screw for neutral indicator cable with a small screw driver.

Withdraw cable backwards.

To disassemble gear box unscrew 3 nuts on rear side as well as screw on front and save them together with washers.

Loosen kickstarter stop on frame and turn it outwards.

Withdraw transmission assembly from engine crankcase backwards, unhook retractive springs for brake operating lever and centre stand on gear box housing and remove transmission assembly to left side.

If eye for clutch Bowden cable abuts against the frame, unscrew coupling nuts of exhaust pipes, remove both rear and front engine holding screws and loosen upper engine fixing bolt. Now the engine including gear box may be lifted on rear and the latter can be removed. For reassembling, file a trifle the eye for Bowden cable.

Disassembly of Engine:

Unscrew carburettor cap nut and withdraw slide unit from carburettor.

Slacken exhaust pipe coupling nuts on cylinder heads by means of a hook spanner 49 mm ∅ Matra No. 338/1.

Loosen feed-pipe by turning out hollow screw on petrol tap.

Dismount protective cap from timing case cover after two slotted nuts are removed.

Take care that all leads coming from main motorcycle wiring be disconnected from dynamo and ignition magneto.

Push back carbon brushes of dynamo and jam them sidewards by means of spring.

Loosen two set screws for dynamo body and remove body.

Slacken dynamo armature set screw and drive out armature by screwing on puller screw W 5030 (shop-made tool).

Insert armature into dynamo body (do not put it on winding) and wrap unit in clean rags or paper.

Protect it from chips.

Unscrew upper cover from engine crankcase and withdraw disconnected wiring cable.

Turn out engine top clamp bolt.

Loosen nuts on engine rear bolt, remove foot rests and exhaust pipe clips, withdraw exhaust pipes, drive out bolt and remove distance pieces left between frame and engine crankcase.

Unscrew left nut on engine front bolt.

Support engine and drive out bolt cautiously. Remove distance piece left and bolt bushing (in case of solo machines) from frame eye right and slide them on bolt.

Tilt engine cautiously forward, lift it on clutch side and remove carefully from frame.

When removing engine, care must be taken that centrifugal governor of ignition magneto does not streak anywhere.

Reassembly

Re-installing the engine:

Lift engine, without protective cap and dynamo, clutch side raised, from left into the frame. Take care that centrifugal governor of ignition does not streak.

Run engine front bolt through from right after bushing (solo machines) is inserted in frame eye, and fit distance piece between engine crankcase and frame.

Push or drive engine rear bolt from left through frame, distance piece and engine crankcase.

Replace engine top bolt and tighten.

Install properly cleaned dynamo armature on likewise cleaned tapered end of crankshaft and secure with clamp screw.

Position dynamo body, carbons withdrawn and jammed, pole pieces properly cleaned, upon armature on timing gear case cover.

Run main motorcycle wiring through engine crankcase, connect blue cable wire to terminal post 61, red wire to terminal post 51 and black wire to terminal post 30 or both wires to double terminal post 30/51 on dynamo, green-red wire to terminal post 2 on ignition coil and brown ground wire to ground terminal post on dynamo (in case such post is not designed, to right clamp screw of dynamo).

Fit springs on carbon ends.

Replace protective cap on timing gear case cover and secure with 2 slotted nuts.

Position top cover upon engine crankcase and tighten by means of knurled nut.

Insert slide in carburettor and tighten cap nut. Make sure rubber seal ring in spigot nut and splash cap on Bowden cable terminal are fitted properly.

Reconnect the fuel supply line to the petrol tap.

Reassembly of Transmission:

Lift transmission assembly with clutch thrust rod from left into the frame and fit it lightly on clamp screws.

Be sure that cork gasket for air channel on partition facing is inserted.

Install clutch thrust rod with the help of pliers in square passage of pressure plate, then secure definitely gear box housing to crankcase rotating simultaneously transmission in top gear by means of shock absorber flange so that key-ways of drive shaft and clutch plate engage each other.

Tighten transmission unit with screw and three nuts including washers.

Position air filter, cork gasket and tighten with handle screw.

Insert speedometer drive take-off assembly, secure with clamp screw and place terminal cap.

Run cable for neutral indicator in cover, tighten with screw bolt and seal the passage for terminal post by means of rubber plug.

Insert compression spring between crankcase and clutch release lever and attach clutch cable on lever.

Hook brake lever spring in bolt on gear box bottom right.

Fasten center stand spring on stand as well as on the bolt of gear box bottom left.

Adjust kickstarter stop to correct position and clamp same on frame.

Assemble exhaust pipes including traverse tube and run down coupling nuts a finger tight on the graphite grease-coated threads of cylinder head pipe connections. The graphite grease paste must have been mixed with water.

Position long foot rest on right side and short foot rest on left side on engine rear bolt, attach exhaust pipe clips, place lock washer including nut on bolt and tighten foot rests after adjustment.

Secure nut of engine front fixing bolt.

Tighten coupling nuts of exhaust pipes with the help of hook spanner Matra No. 338/1.

Assembly of Rear Wheel Drive:

Position lower spring covering together with eventual distance washer on housing cover and take care to screw-in the rear spring, so that its end is seated at the bore on the lower spring covering.

Select a distance washer of such a thickness that the spring end protrudes through the bore on covering, thus being accessible for latter removal of spring.

Screw upper spring retainer on rear spring and place upper spring covering.

Assemble bottom covering on lower end of springing mechanism, together with rubber buffer and washers as needed for proper accomodation of the covering.

Treat rubber coupling of shock absorber with talcum powder to facilitate the entering of flange pegs. No oil or grease must be used.

Set the complete rear wheel drive unit from inside frame respectively shock absorber flange and insert.

Insert upper spring retainer in frame eye and drive the greased guiding tube, the recess for the lower clamp screw at backside, from top downwards.

Place lower clamp screw, hook silencer butt-strap on screw and tighten clamp screw.

On R 51/3 of 1952 and R 67/2 models, secure upper spring retainer and spring covering by means of cap nut, then tighten upper clamp screw.

Assembling left Hub Spindle Holder:

Assemble spring, coverings, rubber buffer as done on rear wheel drive housing cover, and install the springing mechanism on frame.

On R 51/3 of 1952 and R 67/2 models, secure upper spring retainer and spring covering by means of cap nut, then tighten upper clamp screw.

Installing Rear Wheel and Clamping Upper Spring Retainer:

After rear wheel is assembled charge the motorcycle until the upper coverings of springs left and right abut. Then only tighten the upper clamp screws on the springing assemblies (is ceased on R 51/3 of 1952 and R 67/2).

Engine Group

Technical Data

Model	R 51/3	R 51/3	R 67	R 67/2
Year of construction	1951	1952	1951	1952
Engine numbers starting with	522 001	526 210	610 001	612 001
Number of cylinders	2		2	
Cylinder-arrangement	opposed type		opposed type	
Bore	68 mm		72 mm	
Stroke	68 mm		73 mm	
Capacity	490 c. c.		590 c. c.	
Compression ratio	6.3 : 1		5.6 : 1	6.5 : 1
Continuous power	24 h. p. 5,800 r. p. m.		26 h. p. 5,500 r. p. m.	28 h. p. 5,600 r. p. m.

Valve timing (measured at 2 mm = .79" valve clearance) **of R 51/3, R 67 and R 67/2**

intake valve opens after top dead centre	4° – 9°
intake valve closes after bottom dead centre	30° – 35°
exhaust valve opens before bottom dead centre	31° – 35°
exhaust valve closes before top dead centre	5° – 10°

operating valve clearance (measured on cold engine)
intake 0.15 mm = .006"
exhaust 0.20 mm = .008"

Carburettor: 2 inclined carburettors, air fed from joint air filter with starter slide

Model		R 51/3	R 51/3 (1952)	R 67	R 67/2
Type of air filter		Knecht	Eberspächer	Knecht	Eberspächer
left carburettor	Bing	1/22/41	1/22/61	1/24/15	1/24/25
right carburettor	Bing	1/22/42	1/22/62	1/24/16	1/24/26
carburettor passage		22 mm		24 mm	
main jet „solo"		100	105	100*)	110
„ „ „side-car"		100	105	105	110
idling jet		40		40	
needle jet		1208		1208	
mixing chamber cap		5		5	
jet needle		standard		No. 2	
needle adjustment		1		3	
idling air screw		1 – 2 turns opened		1 – 2 turns opened	
weight of float mechanism		7 g		7 g	

*) For solo sports riding of R 67 a main jet 105 can be used. This results by lying position of the rider in a higher terminal velocity with moderate increase of consumption at top speed.

Ignition:	**R 51/3**	**R 67**
Magneto ignition	Noris MZ ad/R	Noris MZ ad/R
max. spark advance	39° ± 2° before top dead centre	36° ± 1° before top dead centre
spark retard	9° ± 1° before top dead centre	6° ± 1° before top dead centre
gap of contact breaker	0.4 ± 0.05 mm	0.4 ± 0.05 mm
spark plugs	Bosch W 240 T 1	Bosch W 240 T 1
spark plug-electrode gap	0.6 mm	0.6 mm
dynamo	Noris 6 volts L 45/60 L	Noris 6 volts L 45/60 L
clutch	single disc dry clutch	
fuel	gasoline of at least 70 octane	
lubricant and filling quantities	see lubricating plan	

Fuel Consumption

Speed in Miles per hour	Miles per Imp. gallon approx.			
	R 51/3		**R 67/2**	
	Solo	with Side Car	Solo	with Side Car
30	109	81	97	83
40	91	56.5	88.5	66
50	74.5	42	76.5	49
60	60	32	61.5	36.5
70	47		47	

Engine Group

Fits and Tolerances

Cylinder:

	R 51/3	R 67 and R 67/2
bore of ground cylinder		
normal	68.00 mm dia.	72.00 mm dia.
next oversize	68.50 mm dia.	72.50 mm dia.
2nd next oversize	69.00 mm dia.	73.00 mm dia.
tolerances on ground cylinder bores	0.03 mm max. conicity (top diameter shorter) out of round ± 0.01 mm max.	
piston clearance in cylinder bore:	**R 51/3**	**R 67 and R 67/2**
solo motorcycles (max. smoothness)	0.05 – 0.06 mm = .002 – .0027"	0.06 – 0.07 mm = .0024 – .0028"
sidecar motorcycles machines for public authorities and competitions (max. running-in and operating safety)	0.06 – 0.07 mm .0024 – .0028"	0.07 – 0.08 mm = .0028 – .0032"
permissible total wear of cylinder bore and piston	0.12 mm beyond piston assembly clearance	

Piston:

	R 51/3	R 67 and R 67/2
Piston ring gap clearance	0.2 – 0.4 mm = .008 – .016"	0.2 – 0.4mm = .008 – .016"
piston ring side clearance:		
at 1st compression ring	0.04 mm = .0016"	0.04 mm = .0016"
at 2nd and 3rd compression ring	0.03 mm = .0012"	0.04 mm = .0016"
at oil scraper piston rings	0.02 mm = .0008"	0.02 mm = .0008"

Valves:

valve stem dia.	intake and exhaust 7 $^{-0.050}_{-0.065}$ mm
valve head dia.	intake 34 mm = 1.34", exhaust 32 mm = 1.26"
permissible runout on valve head	0.03 mm = .0012"
thickness of valve head brim	1 mm = .04" minimum
angle of valve seat	45 degrees
outer correction angle on valve seat	15 degrees
width of valve seat	2 mm = .08"
valve stem clearance	0.05 – 0.085 mm = .002 – .0034"
permissible wear	0.10 mm = .004" beyond valve clearance
press fit of valve guides	0.03 – 0.05 mm = .0012 – .002"
press fit of valve seat inserts	0.125 – 0.175 mm = .005 – .007"

Valve springs:	inside	outside
assembly length	30.50 mm = 1.2"	34.50 mm = 1.36"
unloaded length	37.50 mm = 1.48"	46.00 mm = 1.81"
wire gage dia.	2.80 mm = .12"	3.50 mm = .14"
coil outer dia.	23.80 mm = .94"	32.70 mm = 1.29"

Connecting rod bearings:	
crankpin dia.	R 51/3 = $32 \pm \frac{0.000}{0.016}$ mm R 67 and R 67/2 = $36 \pm \frac{0.000}{0.016}$ mm
permissible wear of crankpin	0.03 mm = .0012"
diametrical clearance of bearing rollers in roller cage	0.05 – 0.15 mm = .002 – .006" (important when assembling oversize rollers)
end play of rollers	0.10 – 0.20 mm = .004 – .008"
bearing rollers	7 mm dia., 10 mm length
oversize rollers	7.01 – 7.02 – 7.03 – 7.04 – 7.05 – 7.06 mm dia.
width of roller cage	15 mm (.0595") = 0.2 mm (.008") less than width of connecting rod
fit of connecting rods	no clearance, but must turn freely
end play of connecting rods	0.07 – 0.10 mm = .0028 – .004"
play of connecting rod bushing on piston pin	0.01 – 0.02 mm = .0004 – .0008"

Timing Mechanism:	
assembly operating clearance of valve tappets (cam followers)	0.02 – 0.04 mm = .0008 – .0016"
assembly backlash for new timing gears	0.01 – 0.02 mm = .0004 – .0008"

Oil Pump:	
backlash of oil pump gears	0.03 – 0.05 mm = .0012 – .002"
end play of oil pump gears	0.01 – 0.04 mm = .0004 – .0016"

Electrical Equipment:	
max. permissible runout on commutator of dynamo	0.06 mm = .0024"
max. permissible runout on commutator pin of magneto for centrifugal governor	0.03 mm = .0012"

Special Tools for Group Engine

a) Tools for Engine without overhauling the Crankshaft:

1 ea	puller for rear ball bearing of crankshaft	Matra No. 282
1 „	valve insert extractor with set of taps (3 items)	„ „ 287
1 „	flywheel locking fixture (including 3 fixture bushings V 5032, shop-made tool)	„ „ 292
1 „	valve seat cutter, 45°, 36 mm ∅	„ „ 294
1 „	valve reseating cutter, 15°, 36 mm ∅	„ „ 295
1 „	graduated dial to be fitted on the clutch hub for adjustment of ignition timing	„ „ 298
1 „	flywheel puller	„ „ 311
1 „	spindle assembly of device Matra No. 355 for camshaft puller clamp V 5033 (shop-made tool)	„ „ 355
3 „	clamping screws for clutch assembly (turn hub on used thrust screws to 14 mm ∅)	„ „ 357
1 „	wooden plate for valve removal and reinstallation (with valve spring lifter V 5034, shop-made tool)	„ „ 361
1 „	valve holder for valve grinding 7 mm ∅	„ „ 368
1 „	valve seat cutter shank 7 mm ∅	„ „ 431
1 „	valve guide reamer 7 mm ∅	„ „ 442
1 „	puller for timing case cover, camshaft gear, oil pump driving gear and front bearing cover	„ „ 499
1 „	torque indicating wrench with square extension and insert sockets of 11 mm and 14 mm clearance respectively	No. 348747 – 10

b) Tools for Crankshaft Overhaul (Hydraulic Press):

1 ea	crank web support for horse-shoe plate for crankshaft disassembly R 51/3 by means of hydraulic press	Matra No. 293/1
1 „	horse-shoe plate for crankshaft disassembly	„ „ 293/2
1 „	crank web support for horse-shoe plate for crankshaft disassembly R 67	„ „ 293/3
1 „	intermediate plate for crankshaft assembly by means of hydraulic press	„ „ 293/4
1 „	drift punch for removal and installation of crankpins	„ „ 293/5
1 „	steel bushing for press operations	„ „ 331/1
1 „	dial device for centering of crankshaft	„ „ 353A
2 „	gauge supports with stands for 353A	„ „ 353B
2 „	dial gauge sets with 0.01 mm scale	„ „ 353C

Shop-made Tools

1 ea	gudgeon pin drift punch	W 5002
1 „	piston ring compressor	W 5003
1 „	feeler gauge for checking clearance between Woodruff key and flywheel	L 5008
1 „	arbour for centering of clutch plate	W 5009
1 „	adjustable assembly cradle for engine and transmission	V 5014
1 „	drift bushing for oil seal in crankcase	W 5020
2 „	praying forks for aligning connecting rods	W 5021
1 „	graduated dial for adjustment of ignition timing with indicator (graduated dials can be purchased from BMW Service Department at DM 5. – per unit)	V 5029
1 „	puller screw for dynamo armature and ignition magneto rotor	W 5030
3 „	holder bushings with clamping screws for fixture Matra No. 292	V 5032
1 „	camshaft puller clamp (including spindle assembly for puller device Matra No. 355)	V 5033
1 „	Valve spring lifter	V 5034
2 „	wooden guards for connecting rod	V 5035
2 „	parallel bars for alignment of connecting rods	L 5036
1 „	hexagonal plug wrench 5 mm SW (clearance) for hollow screw	W 5037
1 „	pressure bushing for assembly of ball bearing in front bearing cover on crankshaft	W 5039
1 „	mounting bushing for assembly of crankshaft gear	V 5040
1 „	driver for disassembly and reassembly of cam follower bushings	W 5041
1 „	gudgeon pin extractor	commercial type

Disassembly of Engine

Drain oil from oil well.

Unscrew both carburettors from cylinder heads.

Locate engine on assembly stand V 5014.

Removing rocker covers:

Loosen cap nut together with two 6 mm nuts and spacer washers on each rocker arm cover and remove cover.

For better judgement of eventual later defects, the present ignition timing is to be re-checked as follows:

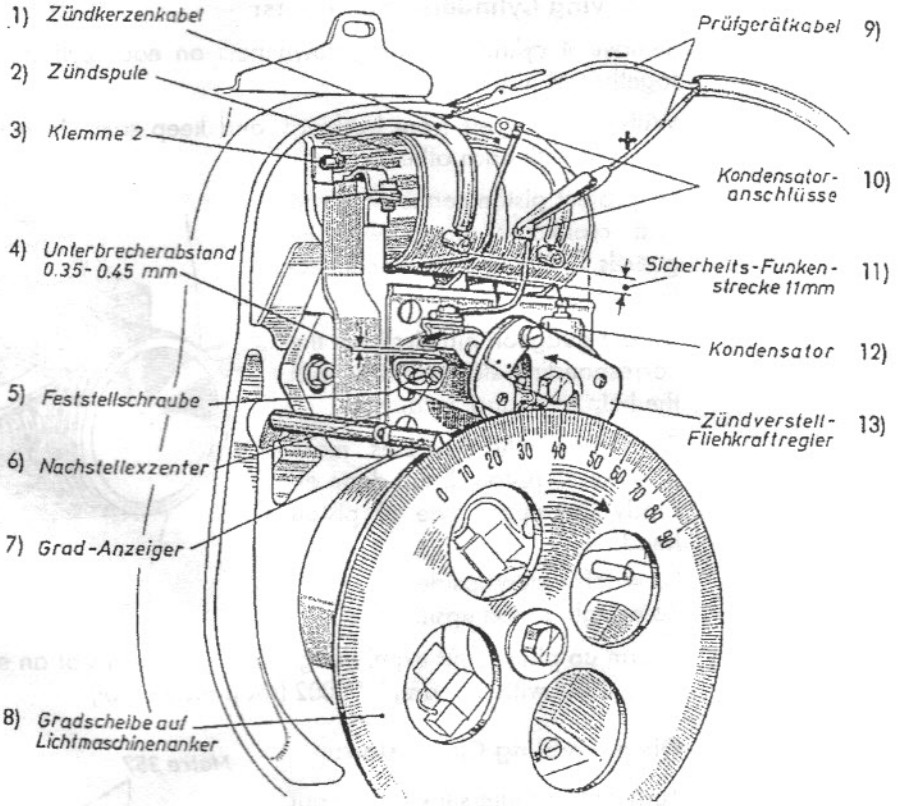
Unscrew sparking plugs.

Take off rubber plug in inspection opening on left side of engine housing.

Insert graduated dial Matra No. 298 in clutch hub or screw a graduated dial V 5029 (shop-made tool, the dial is supplied by BMW Service Department) on the hub of the dynamo armature and fit a stationary indicator in both cases. Align mark O. T. (top dead centre) on flywheel with mark in inspection opening.

At this crankshaft position set now the graduated dial at zero degrees and jam.

Disconnect the two red wires from ignition coil and contact breaker on condenser to avoid that the magneto rotor voltage is reduced by alien current.



1) spark plug cable
2) ignition coil
3) terminal 2
4) contact breaker gap (.014 – .018")
5) fixing screw
6) adjusting excentric
7) degrees indicator
8) graduated dial on dynamo armature
9) tester cable
10) condenser connexions
11) safety spark gap
12) condenser
13) centrifugal ignition governor

Turn crankshaft by means of the flywheel contrary to rotation of engine by about 50 degrees.

Turn crankshaft with collapsed centrifugal weights in direction of engine rotation until the test lamp is even cut out or lights. At this crankshaft position then comes the instant of retarded ignition (correct value on R 51/3 = 9° ± 1° before top dead centre, on R 67 and R 67/2 = 6° ± 1° before top dead centre).

Re-check breaker gap at opened contact breaker (correct value 0.4 ± 0.05 mm .014 – .018").

Re-checking the valve timing:

In cases of extremely irregular cylinder operation it is recommended that the valve clearances be checked, (correct value intake .006" and exhaust .008") and valve timing data are ascertained by measuring crankshaft angle degrees at equal opening of exhaust and intake valve during the overlapping on both cylinders. (Equal overlapping valve opening should be within the range of T. D. C.)

Removing Cylinder Heads:

Unscrew 4 hexagon head screws on each cylinder and withdraw them together with rocker supports, rocker arms and push rods. Do not change push rods for they have already been run-in.

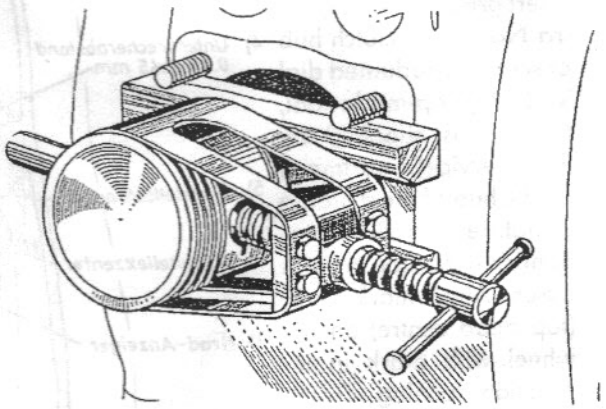
Slacken cylinder heads with light blows of a Belzerit hammer and remove.

Removing Cylinders and Pistons:

Remove 4 cylinder holding-down nuts on each cylinder base and withdraw cylinders together with gaskets.

Withdraw tappets from bushings and keep same in a way that they cannot be interchanged with each other.

To protect piston connecting rod and crankcase apply wooden guards V 5035 at cylinder connection flanges.



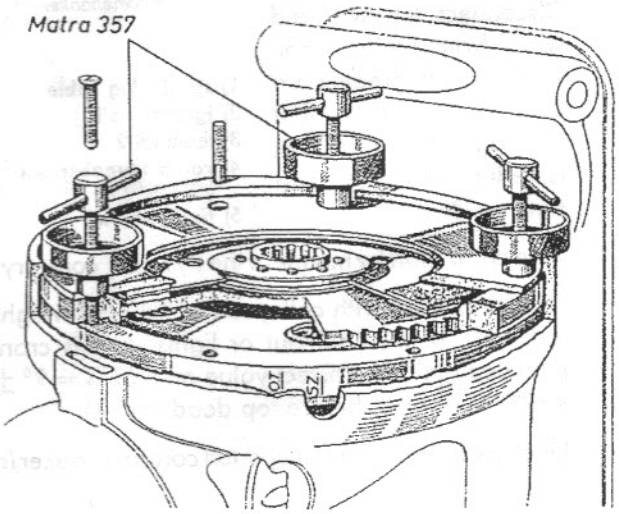
Lift out gudgeon pin circlip at the corresponding slot in piston with the help of a mark scraper.

For reassembly purposes mark position of piston, if not done already, on upper side of piston head

Lo = left piston upside
Ro = right piston upside

Warm up piston and expel gudgeon pin by means of an extractor of commercial type or drive it out with mandrel W 5002 (shop-made tool).

Disassembling Clutch Unit:



Turn three countersunk screws out from clutch in triangular order and replace them by three clamp screws Matra No. 357.

Then slacken other countersunk screws and discharge clutch by loosening clamp screws uniformly.

Remove pressure ring, clutch plate, pressure plate and internal gear tooth ring.

Clamp flywheel in crankcase by means of fixture Matra No. 292 with 3 holder bushings V 5032 (shop-made tools) mounted upon.

Removing Ignition Magneto and Dynamo:

Disconnect both' ignition wires from ignition coil terminal posts.

Unscrew fixing main screws for centrifugal governor, magneto rotor and dynamo armature with a socket wrench (a screw wrench would deteriorate the adjuster spring).

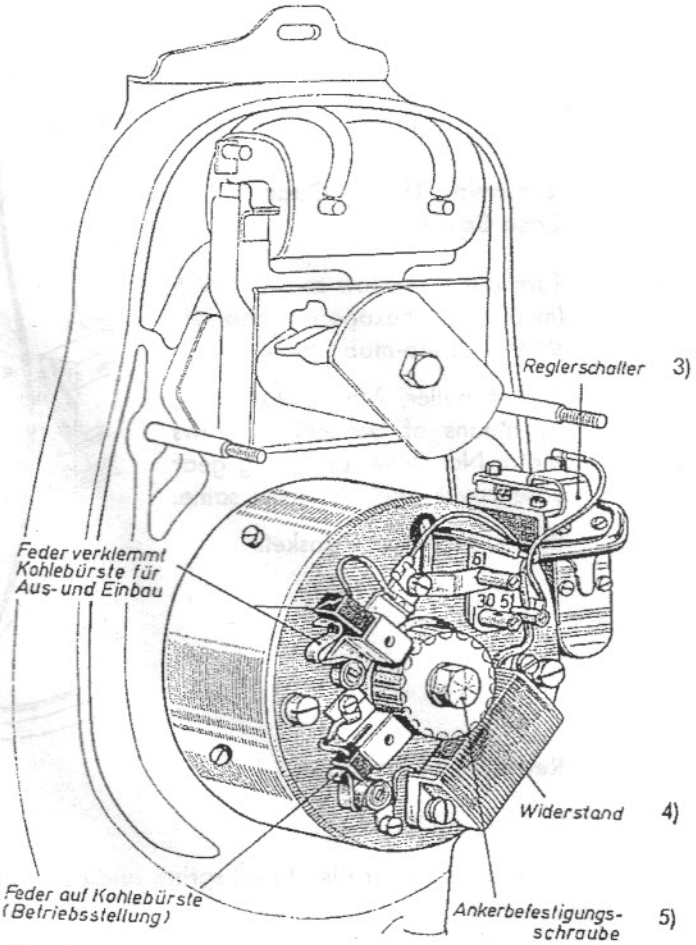
Grip and withdraw centrifugal governor by means of breaker cam only for otherwise centrifugal weight springs might be injured.

Unscrew two clamp nuts, together with washers of magneto body and remove the latter by hand. 1)

Care to keep away watches from magneto rotor to avoid magnetization.

Expel magneto rotor with puller screw W 5030 (shop-made tool).

Insert magneto rotor in magneto body and wrap in clean rags or paper to protect same from chips and dirt. 2)



1) spring jams carbon for removal and installation
2) spring placed on carbon (operating position)
3) regulator
4) rheostat
5) armature clamp screw

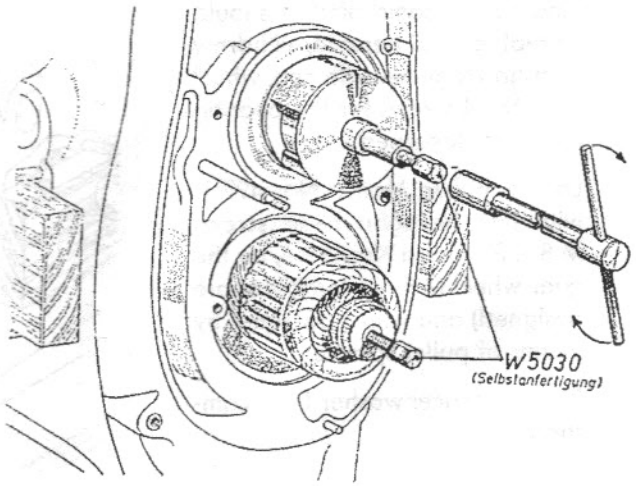
Turn out two dynamo clamp screws.

Withdraw dynamo carbon brushes and jam them sidewards with leaf springs.

Remove dynamo body.

Loosen fixing main screw of dynamo armature from crankshaft with puller screw W 5030 (shop-made tool), placed instead of the former.

Insert armature in dynamo body for safekeeping and wrap the unit in clean rags or paper to protect it from chips and dirt.

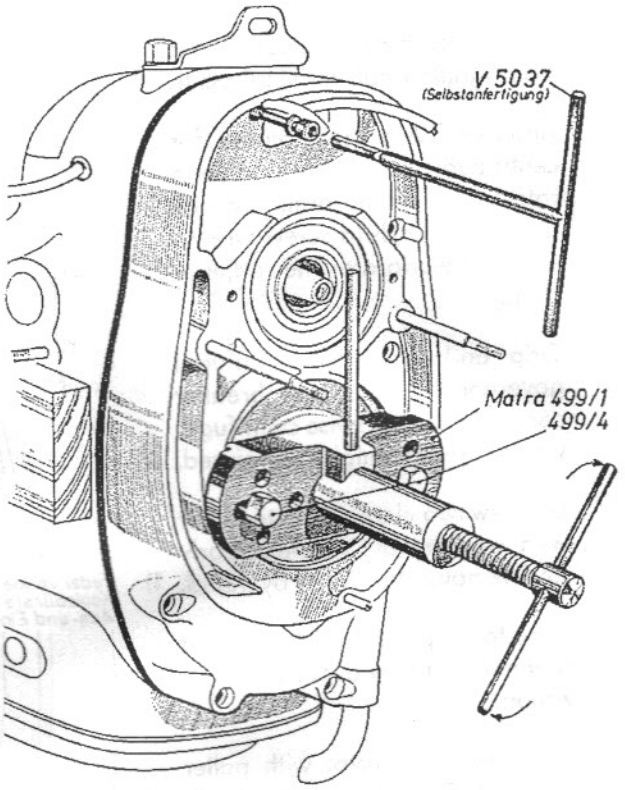


Removing Timing Gear Case Cover:

Turn out 12 hollow screws SW 5 (mm) with hexagonal spanner W 5037 (shop-made tool).

Mount puller, Matra No. 499/1, by means of two collar screws Matra No. 499/4, on timing gear case cover and withdraw same.

Remove crankcase gasket.



Removal of Breather:

Remove circlip.

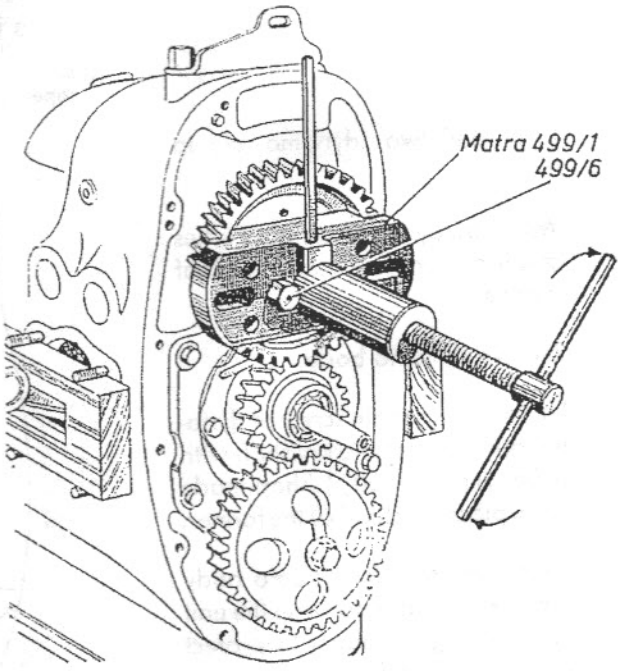
Take off breather disc, thrust spring and covering disc.

Withdrawing the Gear Wheel from Camshaft:

(Withdraw gear wheel only, if either same, the ball bearing behind it or the camshaft itself should be replaced. Otherwise, withdraw camshaft together with gear wheel after the 4 screws for the bearing cover are loosened.)

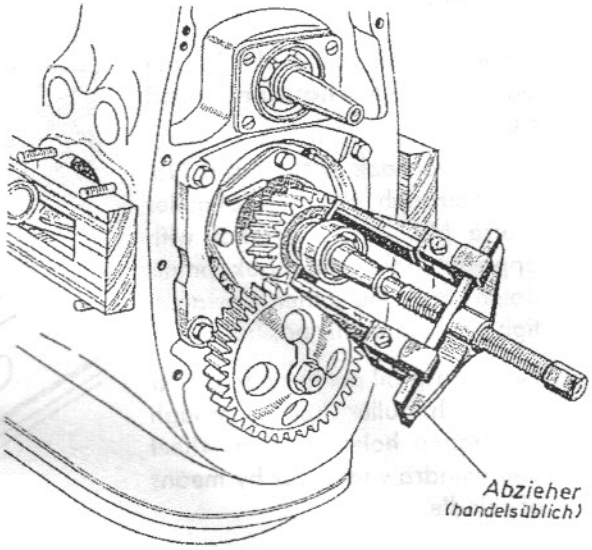
Locate puller Matra No. 499/1, with two hexagon head screws M 8 × 33 Matra No. 499/6, on the gear wheel (2 threaded bores are designed) and withdraw same by means of puller spindle.

Remove spacer washer from camshaft.



Withdrawing Ball Bearing 6203 from Crankshaft:

For expelling this ball bearing, use two strong screw drivers, one at each side of ball bearing and supported on the gear wheel, and remove the bearing on both sides so far that it can be grasped at rear end and definitely withdrawn by means of a regular puller.

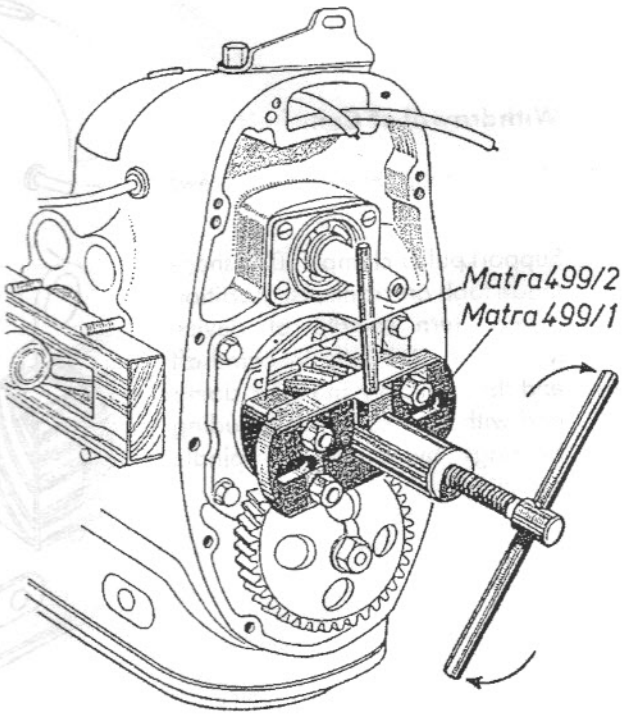


puller
(commercial type)

Withdrawing Gear from Crankshaft:

Lift out Seeger ring in front of gear and spare same, together with the washer.

Grasp the gear on opposed sides with two puller jaws Matra No. 499/2 (turn out screw for bearing bush support if necessary). Fix puller Matra No. 499/1 on the screws of puller jaws, tighten it with 4 nuts and withdraw the gear by means of puller spindle.

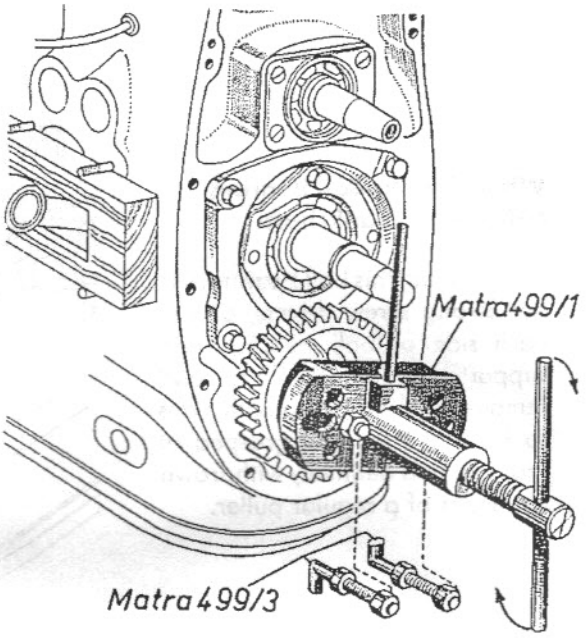


Withdrawing Driving Gear of Oil Pump:

Straighten tab washer of fixing nut and unscrew **left handed thread nut.**

Insert two hook bolts Matra No. 499/3 through inner holes of puller Matra No. 499/1, so that with opposed bolts one hook points down and the other upwards; tighten them in this position.

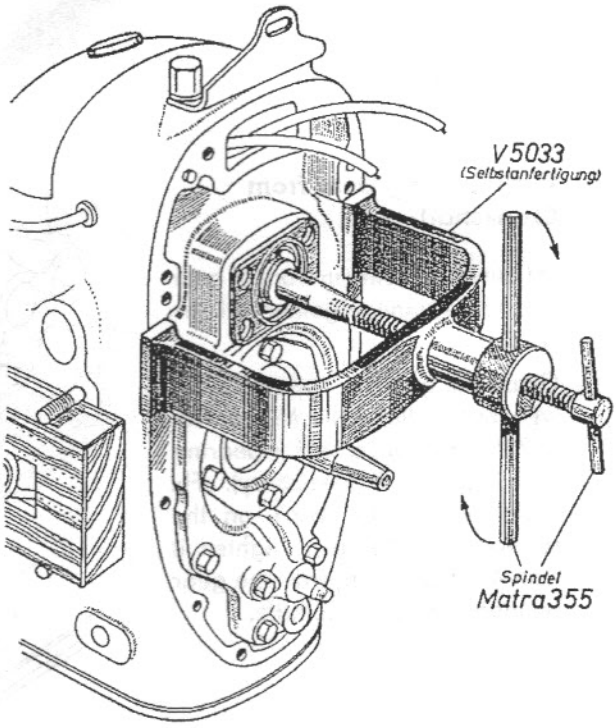
Now grasp oil pump gear at rear side with puller hooks through evacuation holes in gear wheel and withdraw the gear by means of spindle.



Withdrawal of Camshaft:

Unscrew four cheese-head screws for camshaft bearing.

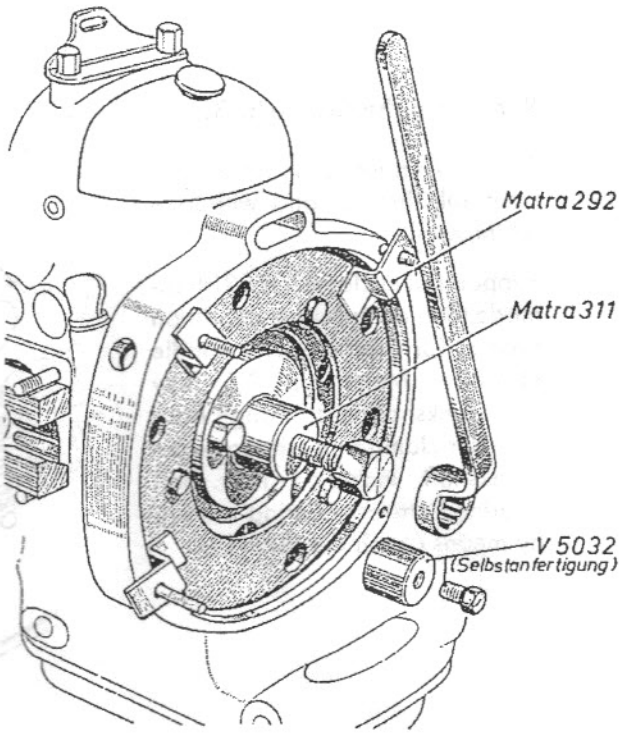
Support puller clamp V5033 (shop-made tool) on crankcase partition facing, turn spindle of device Matra No. 355 fully in camshaft end through bore in puller clamp and withdraw camshaft including bearings by means of spindle assembly.



Removing the Flywheel:

Straighten tab washer on hexagon head and loosen fixing screw with socket wrench SW 36 (mm) or offset ring spanner.

Set Matra device 311 with its two screws length 20 mm (0.8") on flywheel and pull same. Remove fixture Matra No. 292, flywheel and spring washer behind the flywheel.



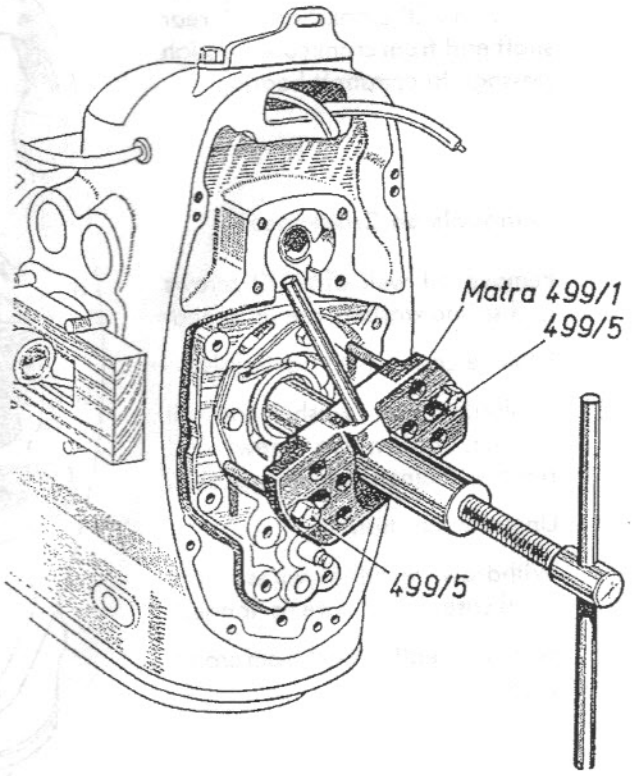
Removal of Front Bearing Cover:

Turn out eight fixing screws for bearing cover and spare them together with spring washers.

Fix puller Matra No. 499/1 with two screws M 8 × 72 Matra No. 499/5 on bearing cover (2 threaded bores are designed) and pull same including ball bearing with spindle.

Take off bearing cover and remove oil pump gears.

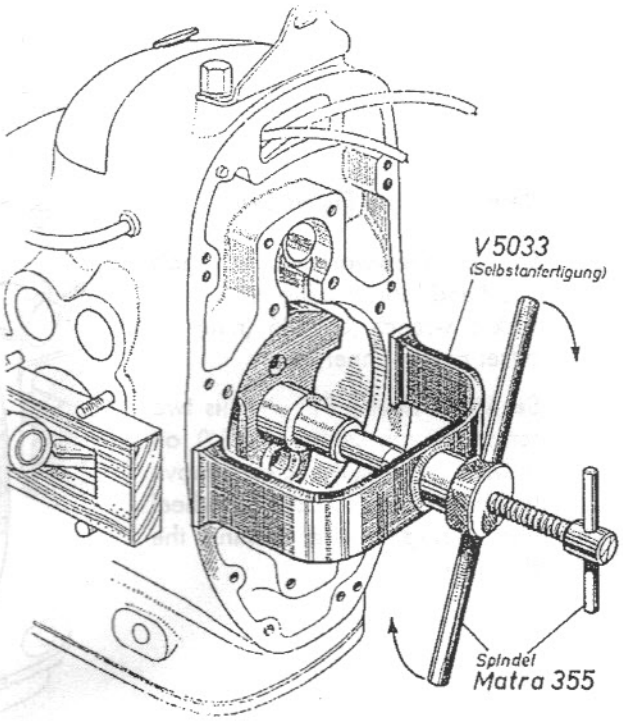
Remove spacer washer and shim from crankshaft.



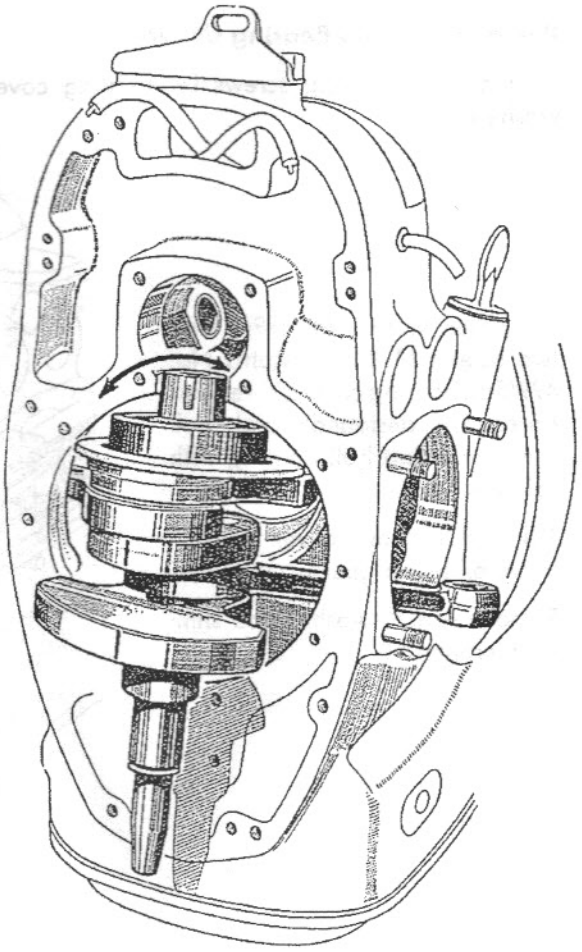
Removing the Crankshaft:

Turn out countersunk screw for front oil thrower and withdraw oil thrower.

Support puller clamp V 5033 (shop-made tool) on crankcase partition facing. Turn spindle with handle of device Matra No. 355 fully into crankshaft end through bore in puller clamp and withdraw the crankshaft including rear ball bearing from rear bearing housing by means of spindle assembly.



Grasp crankshaft with front counterbalance in top position on front shaft end, tilt it strongly downward and lift crankshaft with rear shaft end from crankcase through passage to camshaft bearing.



Removals on Crankcase:

Remove oil well after 12 screws and spring washers are loosened.

Remove cork gasket cautiously.

Straighten tab washer on oil strainer, slacken two screws and remove strainer including gasket.

Unscrew dip stick.

Withdraw ignition wires from crankcase (right wire is longer).

Remove breather filter from crankcase top.

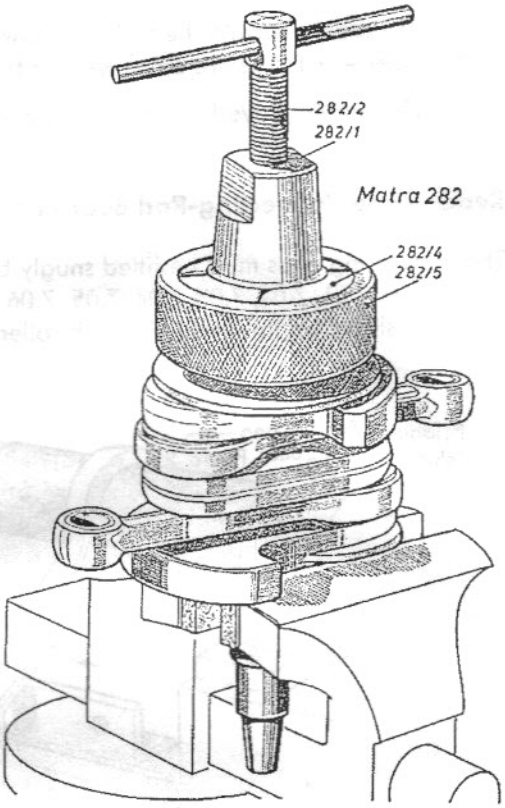
Crankshaft Overhaul

Disassembly of Crankshaft:

Withdraw rear ball bearing with puller Matra No. 282. For this end embrace ball bearing and collar of support nut 282/1 with split puller bush 282/4, push retainer ring 282/5 upon the bushing and pull the ball bearing with spindle 282/2.

Remove shim behind the bearing from crankshaft.

Turn out countersunk screw for rear oil thrower and remove thrower.



For reassembly purposes draw a clean line using a square in the centre of the counterbalance across both crank webs, separately for each crankpin.

Also mark connecting rods for true replacing on left and right side of crankshaft.

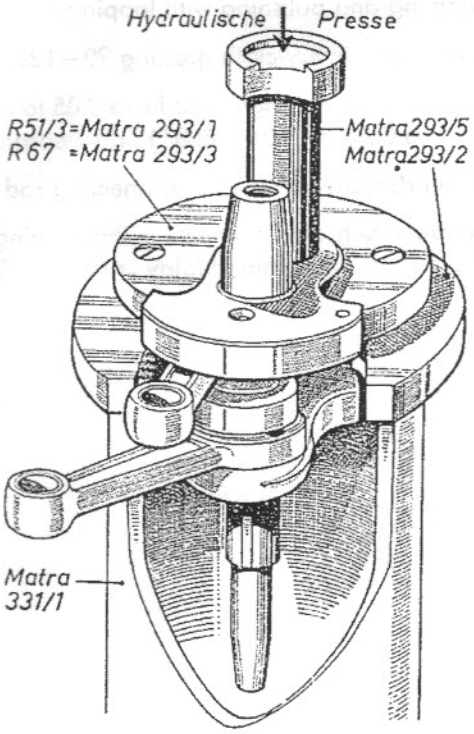
Place pressure bushing Matra No. 331/1 under the hydraulic press.

Upon it, locate horse-shoe plate Matra No. 293/2 with fitted crank web support Matra No. 293/1 for crankshaft R 51/3, and for crankshaft R 67 position horse-shoe plate Matra No. 293/2, with mounted crank web support Matra No. 293/3.

Sustain crankshaft on web support at inside throw of outer crank web, employ drift punch 293/5 with tenon on the crankpin and force same including connecting rod from outer web.

Withdraw connecting rod and roller bearing.

Pull second outer crank web in same order.



Replacement of Crankpins:

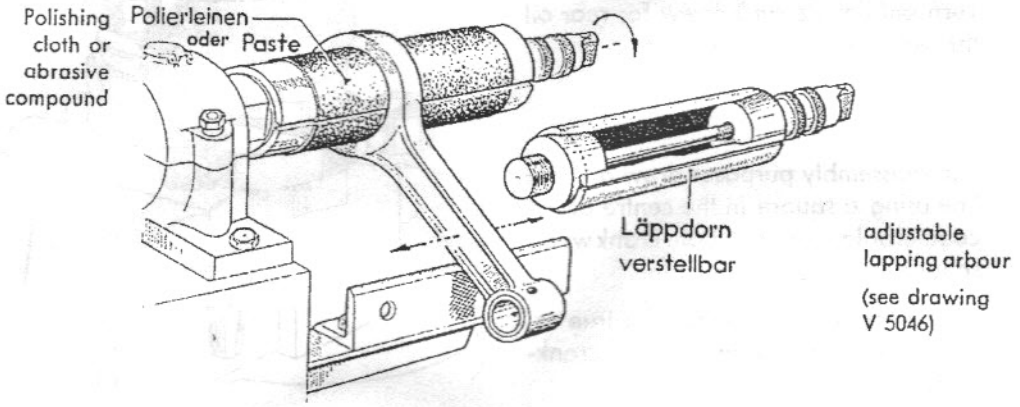
In case roller bearing surfaces of crankpins are defective or wear exceeds a 0.03 mm (.0012") limit, the crankpins must be discarded.

Force new crankpins with the oil bore showing outwards into bore – slightly greased with suet of deer – of the centre crank web, so far that they protrude 1 mm (.04") at crank web.

Use devices as employed on pulling from the outer crank web.

Readjusting Connecting-Rod Bearings:

The connecting rods must be fitted snugly but remain easy to rotate (select suitable oversize rollers 7.01, 7.02, 7.03, 7.04, 7.05, 7.06 mm ∅) so that the connecting rods may be smoothly slided on the crankpins with roller cage and rollers inserted.



Eventual slight differences of size between two oversize roller types must be compensated by reaming and polishing with lapping arbour.

Reaming with emery cloth grading 90 – 120 and polishing with polish cloth MO 3.

The new rollers in cage must have 0.05 to 0.15 mm (.002 – .006") diametrical clearance and 0.1 to 0.2 mm (.004 – .008") side clearance.

Press out defective piston pin-connecting rod bushings.

Ream pressed-in new connecting-rod bushings with reamer in exact alignment until snug fit of piston pin is obtained (play = 0.01 – 0.02 mm = .0004 – .0008").

Assembly of Crankshaft

When assembling the crankshaft be certain that there will be fitted together only webs marked with the same number and in such a manner that the numbers of webs can be read on one side in the same direction.

If a crank web is found defective, e. g. owing to loose seat of ball bearing, the crankshaft must be sent to the factory for replacement and proper straightening.

In order to press crankpin and web together, the web bores are to be greased lightly with suet of deer, but be careful that tallow does not penetrate oil bores.

Assembly of outer crank webs with hydraulic press:

Slide front and rear connecting-rod including roller cage and rollers properly lubricated on the corresponding crankpin of the centre crank web so that oil grooves on front facing show to centre web.

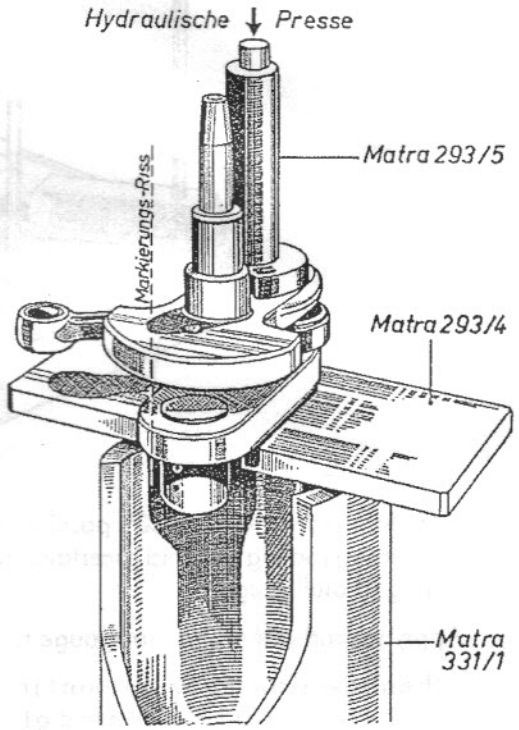
Set intermediate plate Matra No. 293/4 upon pressure bushing Matra No. 331/1.

Sustain crankpin on intermediate plate and set outer crank web on crankpin, so that the marks on both counterbalances align.

Press it in about 3 mm = .12", with drift punch Matra No. 293/5, then check alignment of marks and readjust if necessary.

Now drive in crankweb until a 0.07 – 0.10 mm = .0028 – .004" clearance between connecting rod and crank web is obtained all around the crankpin.

When assembling the second outer crank web proceed in same order.



Straightening the Crankshaft:

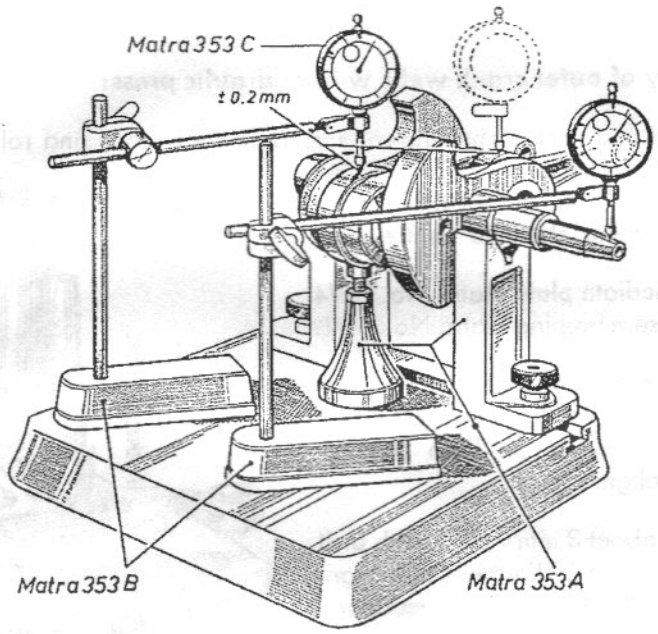
Set the shaft on parallel bars of crankshaft centering device Matra No. 353A and test both crankshaft ends for straightness by means of stand 353B and dial gauge 353C.

Out-of-line in direction of crank web longitudinal axis, if counterbalance and out-of-line tend upwards, is compensated by forcing the shaft end counterbalance away from centre web. When out-of-line tends in contrary direction, the counterbalance is to be pressed towards the centre web.

Out-of-line traverse to crank web longitudinal axis, if out-of-line tends up, is compensated with a hammer blow against the lower counterbalance point of crankshaft clamped in vise at centre web.

Rotation Test for 180 degrees offset of crankpins:

Set the shaft with horizontal webs on parallel bars and keep both connecting rods during subsequent rotation also in horizontal position. Locate jack support pertaining to device Matra No. 353A under one of the connecting-rod big ends and turn set screw until both big ends measured with stand and dial gauge indicate the same top level.



Now turn crankshaft by 180°, position jack support with same adjustment under the other connecting rod big end and ascertain levels of both big ends without changing the original setting of dial gauge.

Apply second stand and dial gauge to measure out-of-line on front crankshaft end.

When rotation measurement indicates too high front crankpin level, the crankshaft must be mounted at its centre web in a vise and straightened by means of a blow from beneath:

well against both counterbalance points when rotation is true,

against front counterbalance point when rotation out-of-line tends up, and

against rear counterbalance point when rotation out-of-line tends down.

Rotation measurement is to be repeated after each readjustment operation.

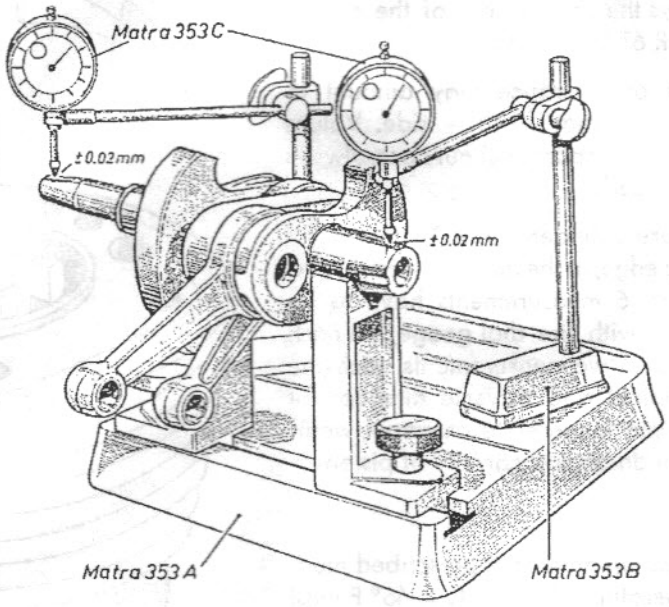
Admissible crankshaft out-of-line is within a 0.2 mm (.008 ") limit measured on connecting rod big ends at rotation.

Readjustment for true rotation:

In case crank shaft offset is correct, the true rotation of both crankshaft ends is obtained as follows:

When with vertically positioned crank webs both shaft end out-of-true and the corresponding counterbalance tend up, the latter must be forced away from the centre web.

When shaft end out-of-line shows upwards, the corresponding counterweight, however, tends down, the balance weight is to be pressed towards the centre web of crankshaft clamped in vise.



As in both cases the opposite side is influenced by the centering operation, it is advisable to readjust first the shaft end which was found out of true, then the opposite counterbalance, and finally true once again the end which was found out of line.

For readjustment of intermediate positions proceed logically with proper alteration of above rules.

Out-of-true limit on shaft ends is 0.02 mm = .0008".

After straightening of crankshaft check side clearance of connecting rods, correct the clearance and straighten crankshaft again, if necessary.

Fix rear oil thrower with countersunk screw and secure the latter with a notched-bar impact.

The oil thrower ring, press-fitted in crankpin bore, must snugly rest against the crank cheek and distance between ring plate and lip must be 5 – 5.5 mm = .20 – .22". Flare ring lip if necessary.

Measuring the Cylinder

The cylinder bore (desired value)
on the R 51/3 = 68 mm ∅ and
on the R 67 = 72 mm ∅ (standard bores)

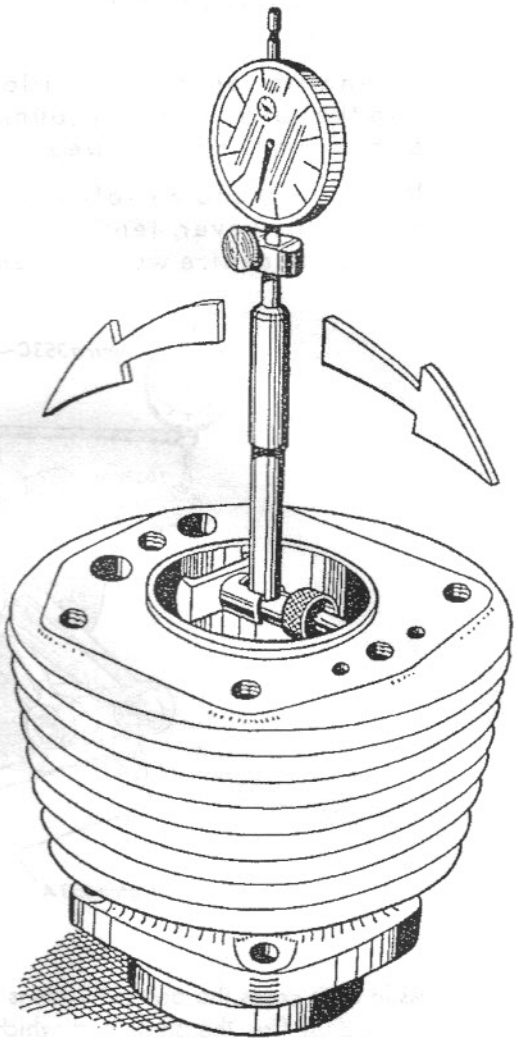
The manufacturing deviation from the desired value is hewn in the cylinder base, e.g. 005 means that the new cylinder R 51/3 in question has a „real bore" of 68.005 mm or 02 says the „real bore" of the corresponding R 67 is 72.02 mm.

The limit of tolerance may amount to 0.03 mm on either + or − side. Values hewn in cylinder base, without signs, always must be added.

To measure cylinder bores 10 mm = .4" below top edge, in the middle of travel and on bottom, 6 measurements have to be carried out with the dial gauge, on each measure level two measurements, each one in longitudinal and traverse direction of gudgeon pin in order to ascertain wear, out-of-roundness and conicity of piston.

Caution:

For all measurements the prescribed measure temperature of + 20° C — 66° F must be absolutely observed.



Register the measured values as shown in the following index
(For instance R 51/3 with cylinder base stamp 005):

cylinder bore measure spot	in longitudinal direction of the gudgeon pin	in traverse direction of the gudgeon pin
top:	68.025 mm	68.050 mm max. value
middle:	68.015 mm	68.030 mm
bottom:	68.005 mm min. value	68.010 mm

Total wear = maximum value minus minimum value makes 0.045 mm = .0018" in this case.

Measuring the Piston

The piston is to be measured only on the lower piston skirt end traverse to the gudgeon pin, by means of a micrometer.

The piston diameter, measured on lower piston skirt end, is always hewn into the piston head.

The piston assembly clearance for the different models and performance requirements ranges from 0.05 mm to 0.08 mm = .002 – .0032". (See „Fits and Clearances"). On the R 51/3 Solo with cylinder value 68.005 e. g. a piston with value 67.95 must be fitted in.

For instance:

The number hewn in the cylinder head is 67.95 mm

Measurement taken on the piston (real value) 67.90 mm

= 0.05 mm piston wear

When ascertaining the piston wear, please hold in mind that new pistons are oval generally on lower piston end by 0.14 mm to 0.16 mm = .0056 – .0064", the short axis in direction of the gudgeon pin.

If the value measured on lower piston end in gudgeon pin direction exceeds the value hewn into piston head minus 0.14 mm = .0056", a piston deformation at lower end is given, though of minor importance, which might induce you to presume an excessive wear when being measured traverse to the gudgeon pin.

Cylinder wear amounts to (see example cylinder measurement) 0.045 mm = .0018"

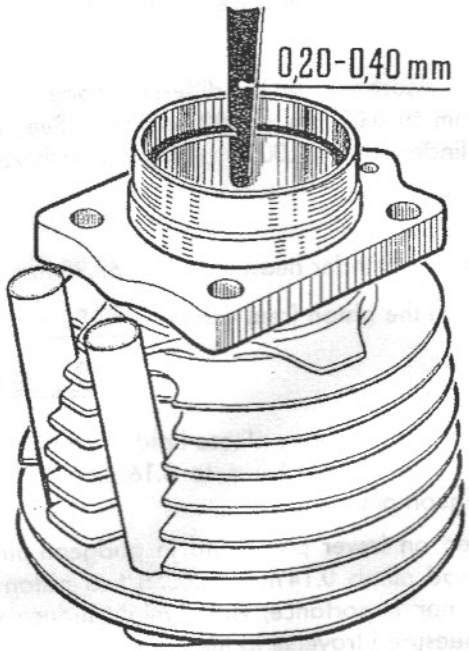
Piston wear amounts to 0.050 mm = .0020"

this makes a total wear on cylinder and piston of 0.095 mm = .0038" beyond the piston assembly clearance.

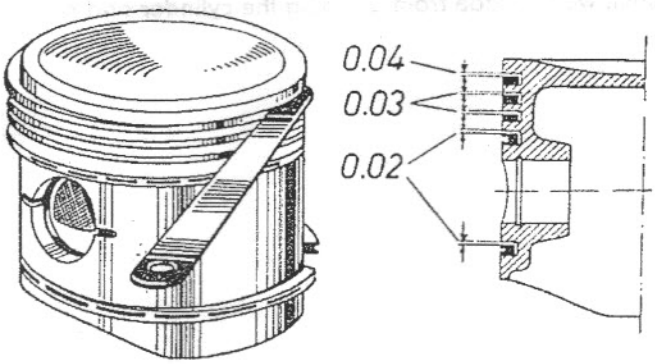
If, with a total wear up to 0.12 mm = .0048" oil consumption data are still kept within a reasonable limit, we dissuade from grinding the cylinder and replacing the piston.

Replacement of Piston Rings

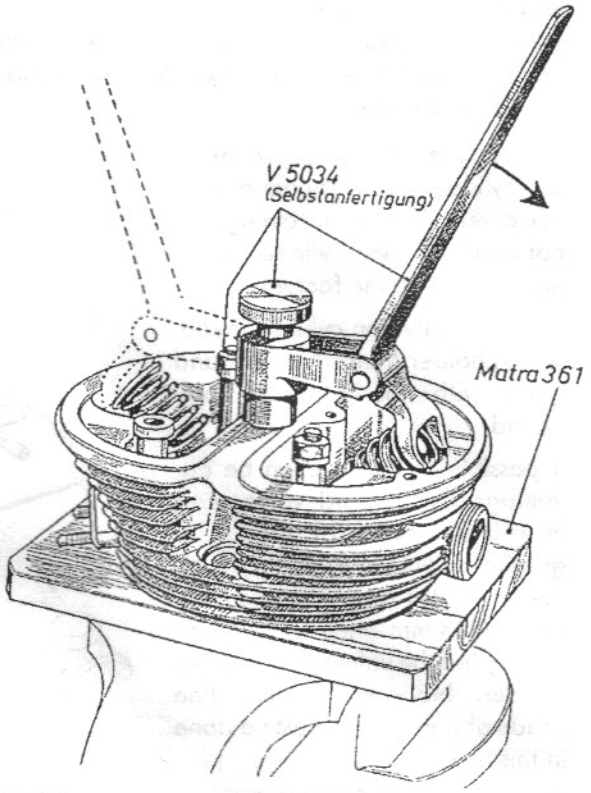
When installing new piston rings care for proper piston ring end gap and side clearance.



Piston ring end gap		= 0.2 – 0.4 mm = .008 – .0016"
Piston ring side clearance	on top compression ring	= 0.04 mm = .0016"
" " " "	on 2nd and 3rd compression ring	= 0.03 mm = .0012"
" " " "	on both oil scraper rings	= 0.02 mm = .0008"



Cylinder head Overhaul



Disassembly of cylinder heads:

Lay cylinder heads on wooden plate Matra No. 361, depress valve springs with valve lifter V 5034 (shop-made tool) and remove valve collets.

Detach spring retainers, springs, lower spring retainers and valves.

Replacing the Valve Guides

Heat cylinder head up to about 100° – 150° C = 212° – 300° F and press out the valve guides by means of a suitable punch.

Reface new valve guides, with + 0.1 oversize on outer diameter, for press fit 0.03 – 0.05 mm = .0012 – .002" at about 20° C = 66° F.

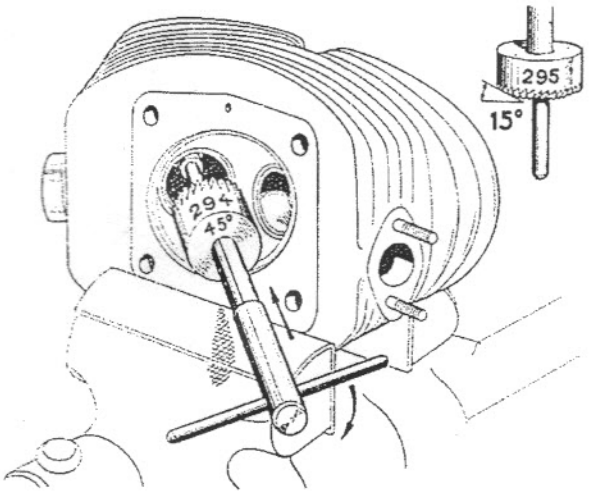
Drive the prepared new guides (lock ring fitted) in still warm head (100° – 150° C).

After the head has cooled down, ream valve guides with valve guide reamer Matra No. 442 and true in valve seats with valve reseating cutters.

Valve seat Overhaul:

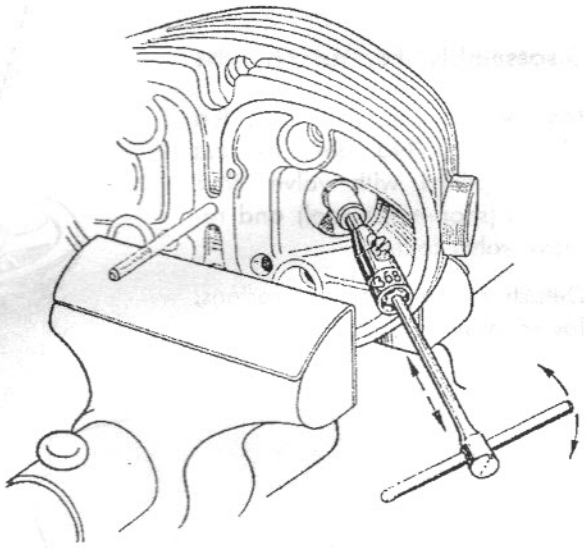
When valve seats do not fit properly (low compression, insufficient performance, inert idle running, high fuel consumption, high temperature, back-firing and popping in the carburettor), re-mill seats with cutter 45°, 33 mm ∅ Matra No. 294. Then re-mill with valve reseating cutter 15°, 36 mm ∅ Matra No. 295 until the required seat width (normal 2 mm = .08") is obtained.

Valve seat inserts on valve seats which prove to be too small owing to repeated refacing operations must be replaced.



Further tap some threads in the worn valve seat insert with set of taps pertaining to valve insert extractor Matra No. 287, heat cylinder head up to 200° C = 390° F, screw extractor device with gag into the worn valve seat insert, hold the gag and withdraw the valve seat insert from cylinder head by turning hexagon nut with spanner. Drive the new valve seat ring(snug fit 0.125 – 0.175 mm = .005 – .007" at about 20° C = 68° F) with adjuster punch centrically in cylinder head heated up to 220° C = 425° F. Remill and reface the valve seat insert.

In case the necessary provisions for cylinder head heating and valve seat ring withdrawing are not available, the cylinder heads may be sent to the factory.



Insert the valves in cylinder head, jam in holder Matra No. 368 and grind with fine grinding compound.

If possible, it would even be advantageous to grind valve seats in cylinder head by means of grinder „Centropunkt" made by Messrs. Matra (grinding accuracy up to 0.03 mm =.0012") and to finish grind the valves on the valve grinder. No grinding with fine grade of compound must be done in this event.

Check the valves for seat tightnes by replenishing the valve chambers with petrol.

Test valve springs for equal length in uncharged state.

Max. minus tolerance for data indicated on page 4 = 3 mm (.12").

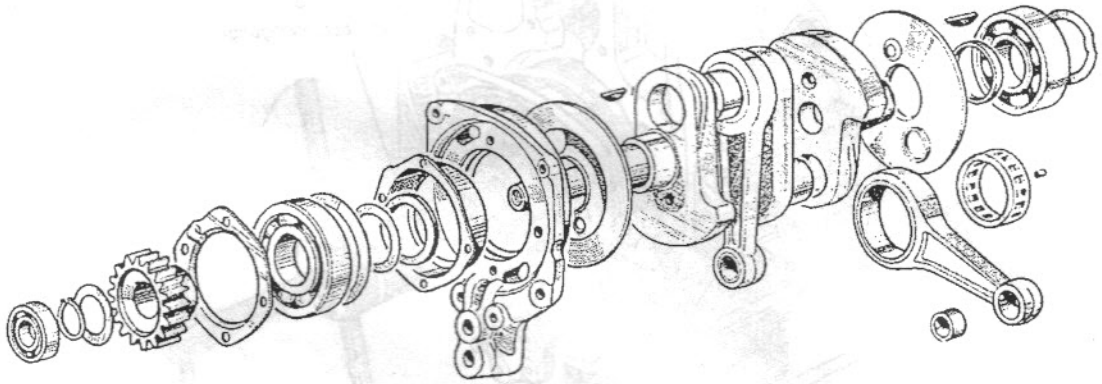
Clean cylinder heads with petrol, purge with compressed air, lay the heads on wooden plate Matra No. 361. Place lower valve spring retainers and valve springs, the ends with smaller coil distances in front, on cylinder head and install upper spring retainers including split collets with the help of valve spring lifter V 5034 (shop-made tool).

Assembly of Engine

Clean crankcase thoroughly with petrol, purge all oil bores with compressed air, check whether attaching faces and flywheel oil seal are in proper condition and that all studs sit tight.

Install Crankshaft and Camshaft:

Support rear crank web on intermediate plate Matra 293/4 and steel bushing Matra 331/1, push the rear distance washer with its facet side showing to oil thrower over the straightened crankshaft and press the rear ball bearing 6207 on the corresponding shaft end journal.



Heat crankcase to about 100° C – 211° F.

For subsequent quick installation, get handy during heating the following parts and tools:

1. Crankshaft assembled as described, without front oil thrower.
2. Front oil thrower ring (5 – 5.5 mm = .20 – .22" distance between ring plate and lip) including its countersunk screw, and suitable screw driver and a notched-bar impact tool to secure the countersunk screw.
3. Distance washer and shim.
4. Front crankshaft bearing cover with distance washer, ball bearing and flange assembled (attention to oil bores) as well as with oil pump gears installed upon (the gear with cone to be fitted in the upper bore).
5. Eight fixing screws and spring washers, for front bearing cover (4 long screws for oil pump).
6. Complete camshaft including bearing bush and 4 clamp screws.
7. Spindle assembly of device Matra No. 355 with pressure bushing W 5038 (shop-made tool).
8. Wooden guards V 5035 (shop-made tool) to be placed against cylinder flanges for protection of connecting rods, to prevent crankshaft from turning when the bearing cover is being installed.

Locate heated crankcase with engine axis in horizontal direction in the cradle frame or lay it with its oil pan attaching face on a clean wooden block.

Move the crankshaft toward crankcase so that the shaft axis stands vertically with the rear shaft end upwards and the rear counterweight facing the crankcase, slide the connecting rods through crankcase front hole in such a manner that they show in the corresponding cylinder connection bores.

Now tilt crankshaft, with its rear journal ahead through the passage leading to camshaft hole, in the crankcase, simultaneously sliding connecting rods in cylinder connection bores. Do not yet press the crankshaft in its rear ball bearing seat.

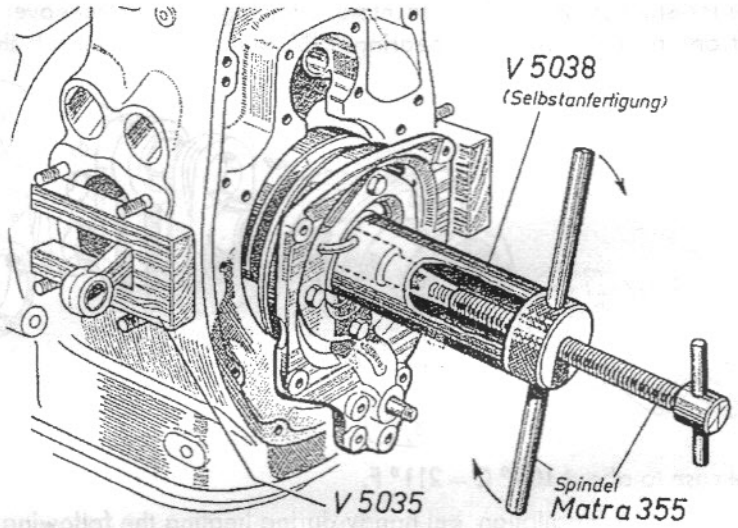
Fit wooden connecting rod guards V 5035 (shop-made tool) on both cylinder attaching flanges.

Fasten front oil thrower, fitted in crankpin bore, with countersunk screw on crankshaft and secure the latter with notched-bar impact.

Slide shim and distance washer, the side with inner facet showing towards the oil thrower, over crankshaft.

Insert oil pump gear provided with cone in upper bearing bore and oil pump gear with regular shaft stub in the lower bore of front crankshaft bearing cover.

Slide complete bearing cover together with ball bearing over crankshaft.



Apply pressure bushing W 5038 (shop-made tool) on ball bearing and inner ring, turn spindle screw, through pressure bushing, fully in crankshaft end and use handle nut to press ball bearing and bearing cover over crankshaft.

Lift crankshaft with bearing cover, fit rear ball bearing in housing and simultaneously install bearing cover centrically in crankcase by pulling down two fixing screws diagonally. Make sure oil pump gears are fitted in a way to secure proper mesh. Tighten fixing screws (4 long screws on oil pump) with spring washers.

Push camshaft including ball race in crankcase, install camshaft and slide bearing bushing centrically in seat with 2 screws and then lock with all 4 screws.

Install Flywheel:

Make sure that oil seal packing is in proper condition.

Oil seals generally are replaced before crankshaft assembly is performed at thorough overhauls, in repair cases, however, replacement is made with installed crankshaft by means of drift bushing W 5020 (shop-made tool).

Install a new oil seal so that it protrudes on crankcase rear end by 0.5 – 1 mm = .02 – .04" all around its circumference

Slide spring washer over crankshaft and diffuse on oil drop on seal and outer diameter of flywheel hub.

Install flywheel (non-oiled) and washer on cone

Check with feeler gauge L 5008 (shop-made tool) whether there exists between Woodruff key and groove bottom a clearance of 0.15 mm = .006" to assure trouble-free mounting of flywheel. Install tab washer and turn fixing screw in crankshaft end.

Use fixture Matra No. 292 with 3 holder bushings V 5032 (shop-made tool) screwed in to prevent flywheel from turning, tighten flywheel clamp screw with offset ring spanner or socket wrench SW (= clearance) 36 and bend tab on washer. The reading of dial gauge indicating diametrical out-of-true, taken on circumference of flywheel, must not exceed 0.15 mm = .006".

Attach Oil Pan:

Place gasket on flange of oil suction line, fix oil strainer with two screws and secure with lock plate.

Position oil pan provided with serviceable cork gasket and clamp it by means of 12 hexagonal screws and spring washers evenly in cross order.

Check oil drain screw for tightness.

Turn in oil dip stick together with its seal.

Install Timing Gears:

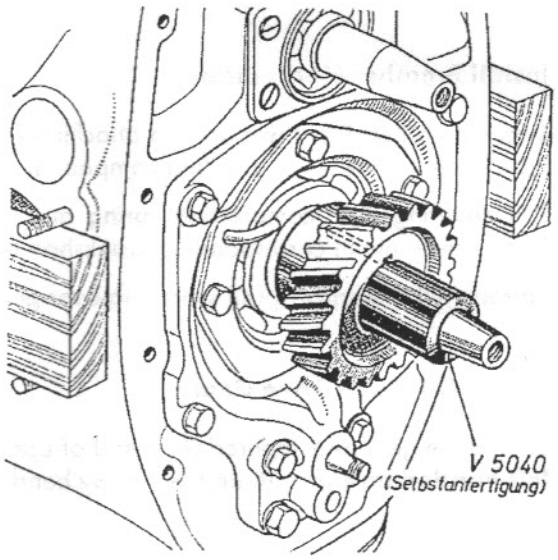
To ensure their noseless operation, crankshaft and camshaft gears are manufactured with special care and they are assembled in true observation of the required tolerances. Therefore in case of replacement both gears must be changed. To order the right type of spare gears for an engine either a + or a – number is hewn in crankcase top in front of the frame holder link. When ordering spare gears do therefore never omit indicating this number and its + or – sign.

Heat crankshaft gear to 120 – 150 ° C = 247 – 302 ° F.

Pull replacer V 5040 (shop-made tool) over lubricated crankshaft journal.

Approach heated drive gear to shaft so that the key groove aligns exactly with the key and slide drive gear quickly over the shaft for otherwise the gear would shrink too fast and should be withdrawn again.

Slide shim of thickness as needed, and also the front circlip over crankshaft.



Turn crankshaft until timing punch mark on drive gear stands topside, then prevent it from rotating by means of fixture Matra No. 292.

Be certain that distance washer between camshaft ball bearing and camshaft gear is inserted and that the Woodruff key seats properly in camshaft.

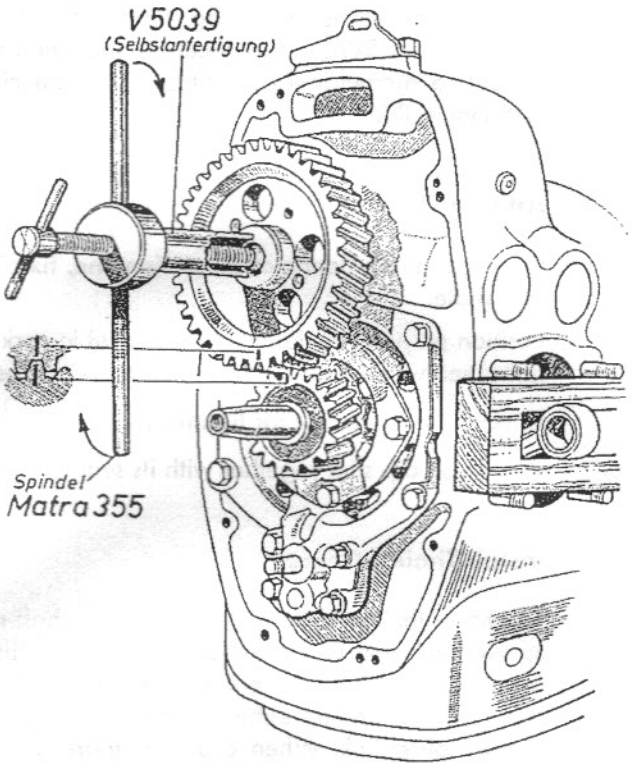
Heat DURAL camshaft gear (without bushing) to 100 – 150 ° C = 210 – 300 ° F, slide same upon camshaft (attention to marks) and drive to final position. The aluminium camshaft gear (with bushing) must not be heated.

When installing timing gear on camshaft take care that key groove is lined up with the key.

Place pressure bushing W 5039 (shop-made tool) against crankshaft hub.

Turn spindle screw with handle nut of device Matra No. 355 fully in crankshaft end, press camshaft gear toward drive gear so that they are in a position to nearly mesh, turn timing punch marks on teeth together and pull in the camshaft gear until it abuts against stop.

The backlash on newly installed timing gears should be 0.01 – 0.02 mm = .0004 – .0008 ". A light humming noise, if any, of new gears having little backlash must not worry the rider and after a certain running-in period this will change into an almost noiseless operation.



Install Breather Mechanism:

When breather disc shows uneven attaching face, it must be equalized in its seat on gear case cover by means of grinding compound.

Pull covering disc, compression spring and breather disc over crankshaft hub, further insert dowel pin in corresponding crankshaft bore.

To secure the breather push snap ring over gear hub.

Attach Oil Pump Drive Gear:

Slide drive gear over tapered shaft end of upper oil pump gear, place tab washer, tighten **left handed thread nut,** and secure by bending tab on washer.

Install Timing Gearcase Cover:

Place cover gasket slightly greased on crankcase.

Heat ball bearing 6203 in oil bath and slide it over crankshaft journal.

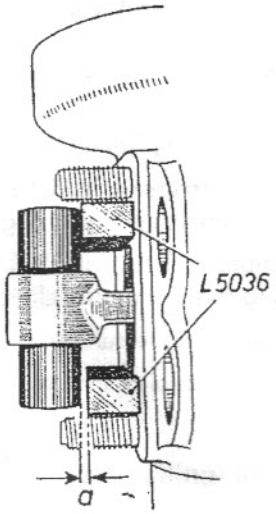
Heat timing gearcase cover to 60 – 80 ° C = 138 – 175 ° F, install it on crankcase, respectively ball bearing 6203 and tighten with 12 hollow (hex.) screws.

Install Piston and Cylinder:

Before installing pistons check whether piston pins stand square with connecting rods, respectively parallel with the cylinder attaching faces.

Slide piston pin through small end bore and place two parallel bars (straight edges) against cylinder attaching faces.

Check, in the vicinity of the bottom dead centre, whether the piston pin rests on both parallel bars.



If needed, straighten connecting rod with two pry forks W 5021 (shop-made tool) applying them in opposite position on the rod.

Insert gudgeon pin lock or snap ring on each piston.

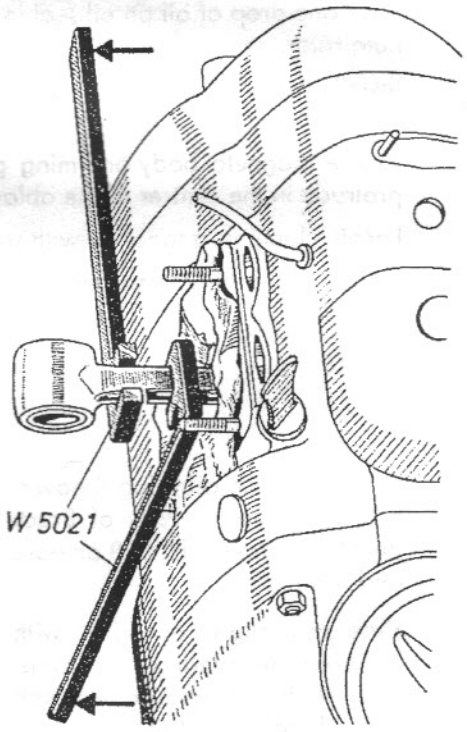
Heat pistons to about 80 – 100 ° C = 174 – 211 ° F.

Slide pistons with gudgeon pins inserted at one side only to connecting rods of the corresponding cylinders conformably to disassembly marks, insert gudgeon pin entirely and secure with second snap ring.

Position cylinder base gaskets, lubricate piston rings and set piston ring gaps 120 ° apart from each other.

Insert oiled camshaft followers in their guides and place rubber grommets for cam follower guidings.

When cam follower guide bushings are to be replaced, push them inwards with drift punch W 5041 (shop-made tool) and press in new bushings with same punch.



Ream installed new bushings until a cam follower lateral play of 0.02 – 0.04 mm = .0008 – .0016 " is obtained.

Press piston rings with compressor W 5003 (shop-made tool) into piston, thus assembling oiled cylinders and pistons. Make sure that push rod guiding tubes are properly inserted in rubber grommets.

Fasten cylinders evenly on crankcase by means of the corresponding 4 nuts on each side.

Install Clutch Assembly:

Check clutch springs for equal length and tension (springs must have one and the same colour).

Insert springs, flared coils ahead, in respective flywheel bores.

Install pressure plate, clutch plate, toothed ring gear and pressure ring so that spring recesses, teeth and screw bores align with their counterparts on flywheel.

Compress clutch with 3 clutch clamping screws Matra No. 357 triangularly placed, centering simultaneously clutch plate with arbour W 5009 (shop-made tool).

Position countersunk screws and pull them down progressively.

After removal of clamping screws tighten all countersunk screws.

Install Ignition Magneto:

Run ignition cable in crankcase (longer cable to right hand cylinder).

Set flywheel mark SZ for retarded ignition in line with mark in inspection hole of crankcase.

Clean magneto rotor carefully from chips, dirt and oil.

Give one drop of oil on oil seal in bearing cover and one on seal attaching face of magneto rotor.

Install magneto rotor with the mark vertically placed on top, loose upon cleaned tapered camshaft end.

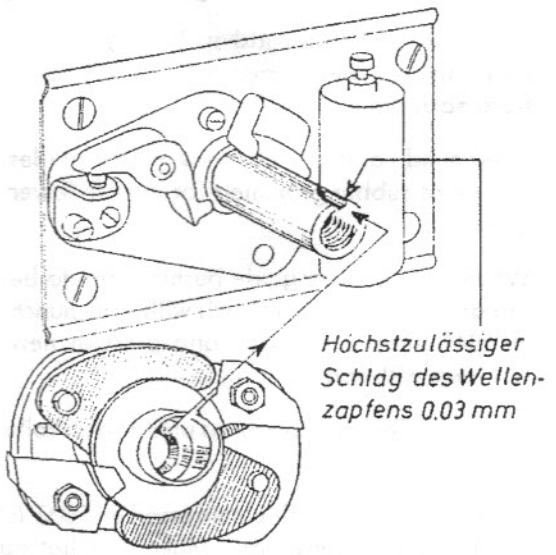
Locate magneto body on timing gearcase cover in such a manner that the fixing screws protrude in the centres of the oblong holes.

Locate clamp nuts together with washers and tighten slightly.

Apply a drop of oil on lubricating felt for contact breaker cams.

Carefully clean centrifugal governor and place a trace of Bosch distributor grease Ft 1 v 8 on bore and rotor shaft.

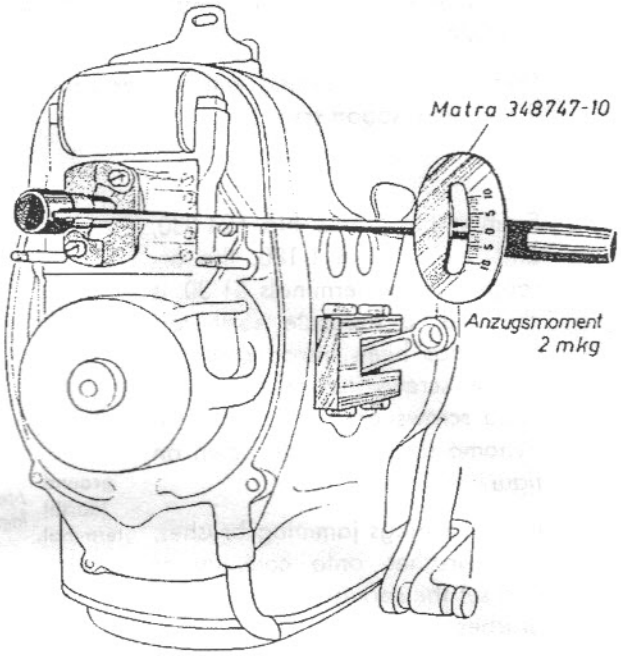
Slide centrifugal governor with its bore nose entering in recess of rotor shaft end and tighten with main clamp screw but a trifle.



Shaft end out-of-true
must not exceed 0.03 mm = .0012"

When marks are not in line, turn magneto rotor still sitting loose on camshaft by means

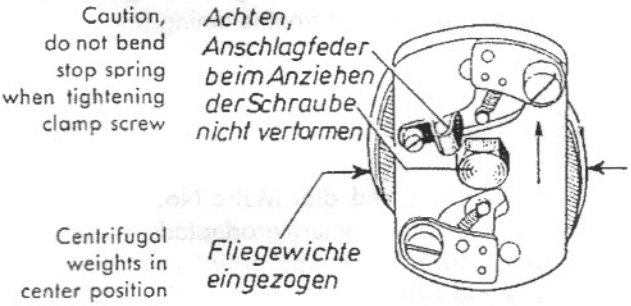
of centrifugal governor while holding flywheel until magneto rotor mark is lined up with mark on magneto body front plate.



At this position tighten centrifugal governor and magneto rotor by turning clamp screw with torque wrench 2 mkg (do not use screw wrench or ring spanner to prevent governor stop spring from bending).

torque moment 2 mkg

Check whether centrifugal weights can be easily raised by hand to their outer position (advanced ignition) and after release be easily swung back to their center position (retarded ignition), and whether the end play of contact breaker cams on rotor shaft end is 0.2 – 0.6 mm = .008 – .024". If not, the rotor clamp screw must be loosened and the centrifugal governor is to be withdrawn cautiously (using contact breaker cam only for this end).



When end play of contact breaker cam proves to be insufficient, shorten cam a bit by sliding same to and fro a plain piece of fine emery cloth.

When contact breaker cam seats too tight on rotor shaft end, polish front half cam bearing surface of rotor shaft end carefully with fine emery cloth until contact breaker cam can easily rotate on shaft end. Check shaft end of magneto rotor for straightness. Out-of-true must not exceed 0.03 mm = .0012".

Be certain that dowel pin in governor plate rests in rotor groove.

After refacing operations, if any, clean scrupulously rotor shaft end, governor and governor cam, lubricate again with Bosch distributor grease and refasten as prescribed above.

Turn centrifugal governor and rotor by means of flywheel to left until contact breaker just has opened.

When measuring contact breaker gap (0.35 ± 0.45 mm = .014 – .018") contacts must be clean and even. Reface and re-adjust if necessary.

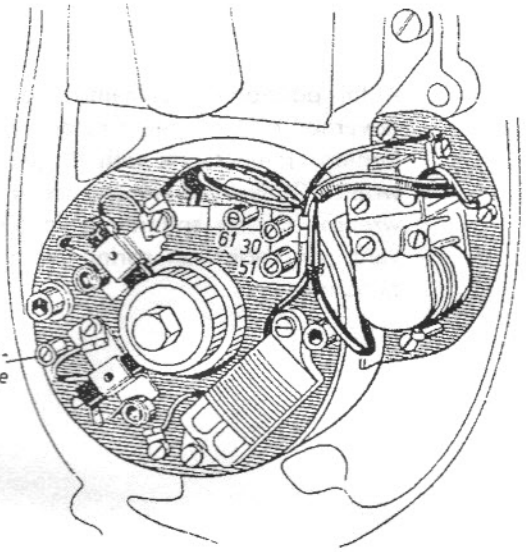
Dynamo Assembly:

Slide cleaned dynamo armature over also cleaned tapered crankshaft end and tighten with main clamp screw on shaft end. Commutator out-of-true must not exceed 0.06 mm = .0024 ".

Install dynamo housing with center brushes drawn rearward and fasten by means of 2 hollow hexagon screws.

From engine R 51/3, No. 524 030, and R 67, No. 611 180, the arrangement of terminals 51/30 is changed, a separate earth terminal has been introduced and hollow screws instead of round-head screws are being used for dynamo attachment as shown on figure at side.

Loosen springs jamming brushes, slide brushes onto commutator and set the springs upon ends of brushes.



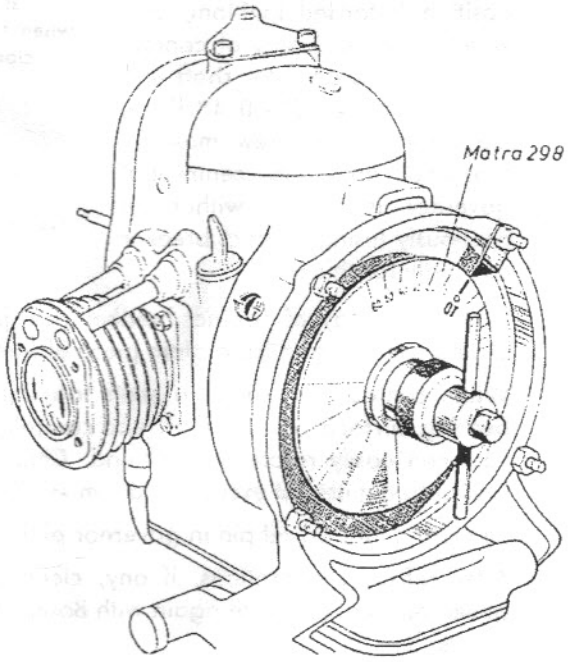
Timing Ignition:

As it may occur that owing to the tightening of main clamp screw proper firing order is no longer ensured, an engine timing test and fine readjustment must be achieved as follows:

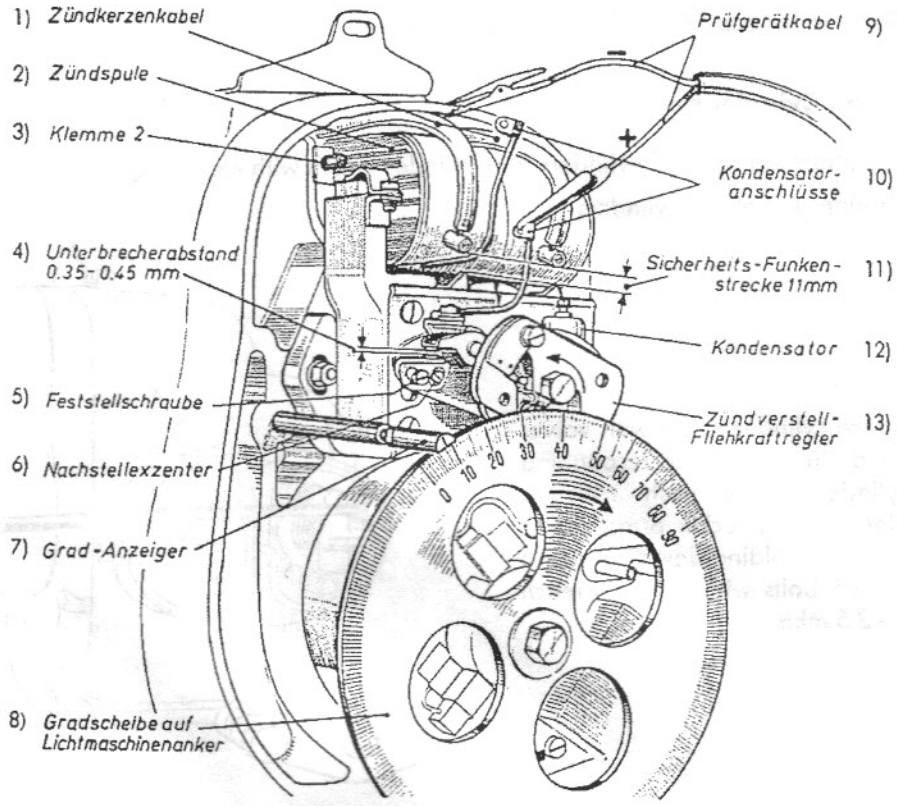
Insert graduated dial Matra No. 298 in clutch hub or turn graduated dial V 5029 in dynamo armature hub and fasten a stationary indicator in both cases.

Align mark o. T. (top dead center) on flywheel with the corresponding mark in inspection hole.

When the crankshaft stands in this position set graduated dial at zero degrees to indicator and tighten.



Disconnect two red cables from ignition coil on condenser to prevent voltage of magneto rotor being dropped by alien current.



1) spark plug cable
2) ignition coil
3) terminal 2
4) contact breaker gap (.014 – .018")
5) fixing screw
6) adjusting excentric
7) degrees indicator
8) graduated dial on dynamo armature
9) tester cable
10) condenser connexions
11) safety spark gap
12) condenser
13) centrifugal ignition governor

Connect positive pole of ignition tester to red cable leading to contact breaker and connect negative pole to earth.

Turn crankshaft by means of flywheel about 50° contrary to direction of engine rotation.

Turn crankshaft with centrifugal weights drawn centerwards in direction of engine rotation until test lamp is just cut out or lights.

This crankshaft position coincides (see indicator) with the point for retarded ignition (ideal value for R 51/3 = 9° ± 1° before top dead center and for R 67 = 6" ± 1° before top dead centre).

After one cylinder has been tested for proper ignition, the crankshaft must be rotated a full turn 360°. Check other cylinder for correct timing following the same procedure.

Deviation of ignition points on cylinder 1 in relation to cylinder 2 must not exceed 3 crankshaft angle degrees.

When firing points differ from the indicated ideal values for firing instants, the magneto body is to be turned after clamp screws have been loosened. Turning the magneto body clockwise viewing same will increase, contrary rotation will decrease ignition retarding.

After timing is done tighten ignition magneto clamp nuts.

Reconnect two red cables coming from ignition coil and contact breaker to condenser. Test and re-adjust safety spark gap (10 – 11 mm = .4 – .44") between sheet metal points on magneto body and cable terminals.

Install protective cap (dust cover) on its place upon timing gearcase cover to protect ignition magneto as well as dynamo unit and tighten with two slotted nuts.

Fasten breather filter and joint with leaf spring into crankcase.

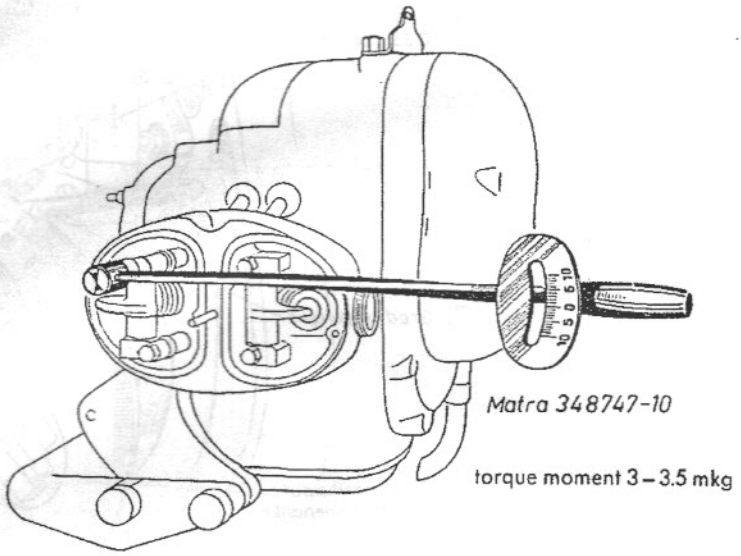
Place upper cap on crankcase and tighten.

Install Cylinder Heads:

Dry attaching faces of cylinders and cylinder heads with clean rags.

Position gaskets on cylinders.

Attach cylinder heads with valves fitted in to the corresponding cylinders, slide push rods in place, install rocker arms, rocker brackets, holding-down bolts, and tighten bolts with torque wrench 3 – 3.5 mkg.



Adjust valve clearance for each cylinder at ignition dead center, for admission 0.15 mm = .006 in. and for exhaust 0.20 mm = .008 in.

Check Valve Timing:

Turn crankshaft to top dead center position and check by slightly moving flywheel to and fro whether valve lifts of both admission and exhaust valves on one cylinder match each other at dead center position with overlapping valves.

Install Rocker Covers:

Oil carefully valve stems, valve stem ends, push rods, dished contact ends of adjusting screws and fill bores of rocker arm shafts with oil.

Locate rocker cover gaskets on covers and install rocker covers on cylinder heads, tighten with center nut and spring washer as well as with two M 6 nuts on each side and respective spring washers.

Turn sparking plugs and washers in cylinder heads.

Install carburettors and gaskets on cylinder heads.

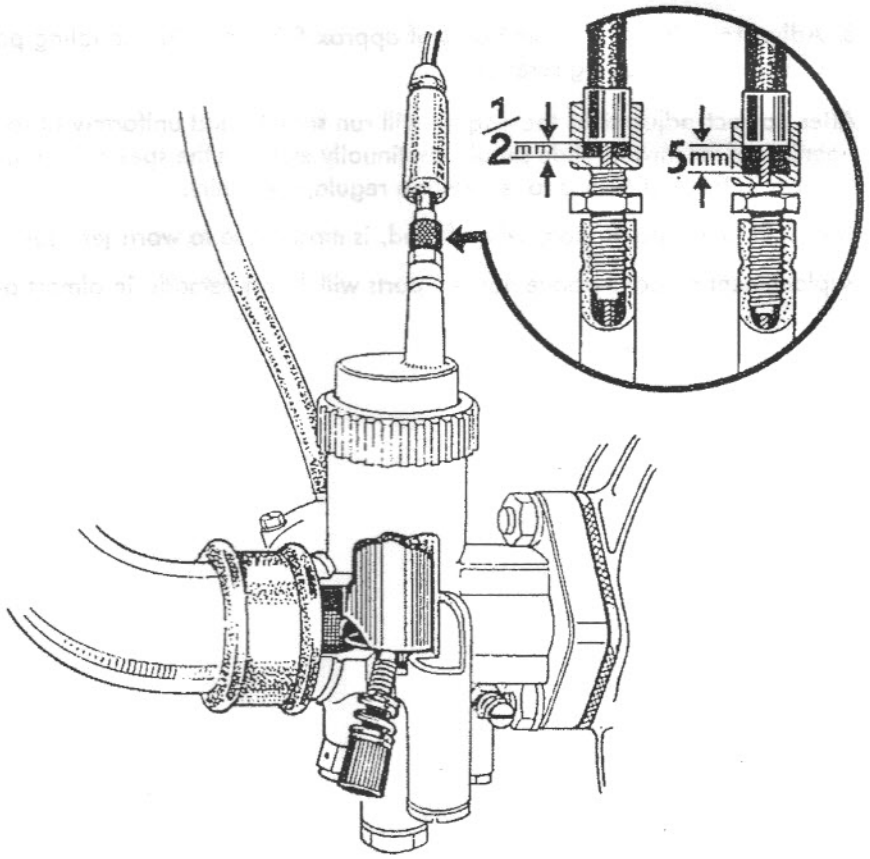
Fill 2 litres engine oil in crankcase as per lubricating chart (2 litres = .44 Imp. gall. = .53 U. S. gall.).

Carburettor

The carburettors cannot achieve their tasks unless ignition timing and valve clearance have been adjusted to their prescribed values. Moreover, only use BMW service proven types and sizes of sparking plugs and jets which must be in excellent condition.

Model		**R 51/3**	**R 51/3** (1952)	**R 67**	**R 67/2**
Type of air filter		Knecht	Eberspächer	Knecht	Eberspächer
l. h. carburettor	Bing	1/22/41	1/22/61	1/24/15	1/24/25
r. h. carburettor	Bing	1/22/42	1/22/62	1/24/16	1/24/26
carb. passage		22 mm		24 mm	
main jet solo		100	105	100 *)	110
main jet side car		100	105	105	110
idling jet		40		40	
needle jet		12/08		12/08	
jet needle		standard		No. 2	
needle adjustment		1		3	
mixing chamber cap		5		5	
weight of float		7 grams		7 grams	

*) For solo sports riding of R 67 a main jet 105 can be used. With the driver crouched low this will allow to attain a higher maximum speed while fuel consumption increase at peak speed is moderate.



Carburettor Adjustment:

Before adjusting carburettors clean them with petrol.

Wash also common air filter with petrol or kerosene and re-oil metal screen after cleaning. To prevent disturbing irregular air suction make certain that suitable gaskets are inserted between the attaching flanges and also care to tighten clamp nuts evenly.

Make it a rule to regulate idling only with the engine brought up to normal operating temperature. Adjustment is to be done as outlined below:

1. Tighten up Bowden cable adjusting screw upon pipe connections of carburettor cover plates (free travel of piston slides approx. 5 mm = .20 ").
2. Pull down throttle stop screws until throttle slides rest no longer on screws, but upon mixing chamber bottom.
3. Turn stop screws clockwise until screws just touch the throttle slides. With the suction pipes detached this position can be clearly seen. Now rotate stop screws two more turns so that the throttle slides will be lifted thereby.
4. Turn pilot air screws clockwise fully in, tighten slightly and rotate them anticlockwise $1^1/_2 - 2$ turns.
5. Crank the engine and let it run.
6. Regulate idling with throttle stop screws so that both cylinders operate uniformly.
7. In case there are still some slight discrepancies in engine operation, clear them one after the other separately for each cylinder (remove spark plug cable from opposite cylinder) by cautiously turning the pilot air screw until uniform idling on both cylinders is obtained. Turn the pilot air screw clockwise for richer mixture, and out, for leaner mixture.
8. Adjust for a Bowden cable travel of approx. 0.5 mm = .02 " in idling position by means of the cable adjusting screws.

After correct adjustment the engine will run smooth and uniformly at low speed. A slow opening of the throttle slide should continually increase the speed. Even with a large handful of grip the engine has to respond in regular flexibility.

Too high fuel consumption, when found, is mostly due to worn jet needles or needle jets.

Replacement of both above named parts will bring remedy in almost all of these cases.

Transmission Group

Technical Data

Transmission	4-speed type with gear dog clutch, casing bolted to engine. Shock absorption by resilient mainshaft in top speed.		
Shifting mechanism	ratched type foot-operated shifting mechanism with hand-operated auxiliary shifting lever.		
		R 51/3 · R 67	**R 51/3** (1952) · **R 67/2**
Gear ratios	1st gear	3.6 : 1	4.0 : 1
	2nd gear	2.28 : 1	2.28 : 1
	3rd gear	1.7 : 1	1.7 : 1
	4th gear	1.3 : 1	1.3 : 1
Speed reduction between transmission and rear wheel			
R 51/3	solo driving	3.89 : 1 = No. of teeth 9/35	
	side car driving	4.57 : 1 = No. of teeth 7/32	
R 67 · R 67/2	solo driving	3.56 : 1 = No. of teeth 9/32	
	side car driving	4.38 : 1 = No. of teeth 8/35	
Power transmission from gears to rear wheel	fully enclosed propeller shaft with elastic coupling and spiral bevel gears.		
Quantity of oil required	see lubricating chart		
End plays	mainshaft 0.2 mm = .008 "		
	layshaft 0.2 mm = .008 "		

Special Tools

1 ea fixture for removing ball bearing and collar of mainshaft	Matra No. 288/1
1 ea fixture for removing inner ring of mainshaft roller bearing	„ „ 288/2
1 ea drift punch, mainshaft	„ „ 288/3
1 set (2 items) replacer bushings, mainshaft oil seal	„ „ 297/1/2
1 ea tensioner tool, kickstarter spring	„ „ 326
1 ea steel bushing for press operations	„ „ 331/1
1 ea puller, speedometer bushing	„ „ 359
1 ea puller for shock absorber flange on transmission end	„ „ 422 A
1 ea fixture including spanner to tighten round nut on mainshaft	„ „ 494

Shop-made Tools

1 ea cradle frame for transmission	V 5014
1 ea fixture plate for transmission	W 5017
1 ea drift and replacer bushing, mainshaft oil seal	W 5024
1 ea drift bushing, mainshaft oil seal	W 5026
1 ea inspection cover (dummy) for transmission adjustment	V 5031

Dismantling Transmission

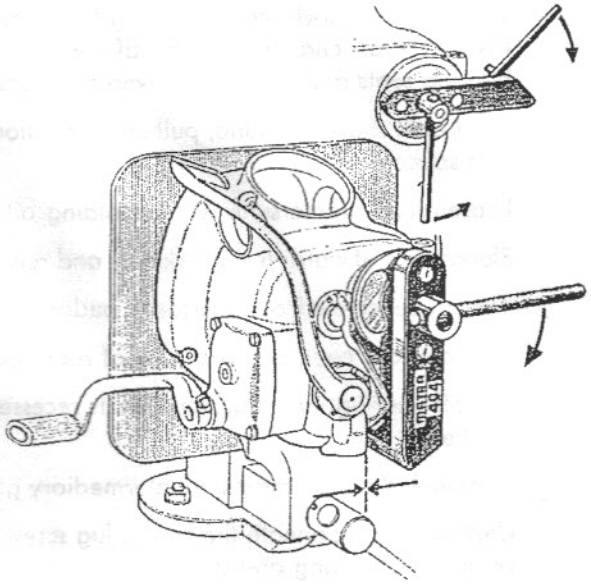
Fasten transmission on cradle frame V 5014 or fixture plate V 5017 (shop-made tool).

Drain transmission lubricant.

Pull push rod backward and remove it together with thrust unit, ball cage, end piece including ball and felt ring.

On R 51/3 (1952) and R 67/2 models, take off protection cap for rubber joint on shaft drive after the hex. hollow screws have been removed with Inbus plug wrench W 5037 (shop-made tool).

Use fixture Matra No. 494 to loosen round nut locking coupling flange, jamming at a time with a strong mandrel on counterside (see figure).

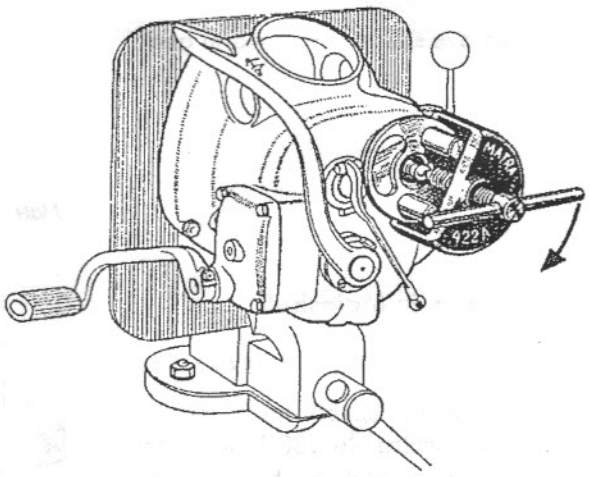


Take off round lock nut and toothed washer.

Withdraw coupling flange by means of puller Matra No. 422 A.

When flange seats tight, give a blow on spindle head.

When removing flange take care to prevent oil seal from being damaged.



Remove four screws from foot gear change mechanism cover, take off cover and shifting pedal.

Loosen set screw on auxiliary hand shift lever and remove lever.

Turn out six countersunk screws from hand gear change mechanism cover and remove cover.

Slide washer and compression spring on hand shifting side off selector shaft.

Remove pawl from guiding spindle and unhook tension spring together with pawl.

Lift selector shaft on cam plate and draw out.

Run out set screw securing selector fork guide bar of beneath the case and drive the bar from driving side rearward; take care that the forks do not jam.

Remove selector forks.

Remove two countersunk screws from kickstarter front bearing flange, slacken front bearing with a blow on kickstarter pedal and withdraw.

Take out kickstarter pedal return spring.

Turn out seven lock screws holding front case cover, tape with a Belzerit hammer against layshaft rear end until mainshaft, layshaft and front bearing cover are free of their bearing seats and can be removed from case all together.

Hold both shafts by hand, pull cover cautiously with Belzerit hammer, taking care not to lose spacers.

Loosen four countersunk screws holding oil catch cover (flange) and tap same off cover.

Slacken nut of clutch lever lock ring and remove lock ring together with clutch release lever.

Remove set screw from kickstarter pedal and withdraw pedal.

Turn out four countersunk screws of rear bearing for kickstarter shaft.

Pull off bearing, pressing same on its recesses by means of two screw drivers oppositewise applied.

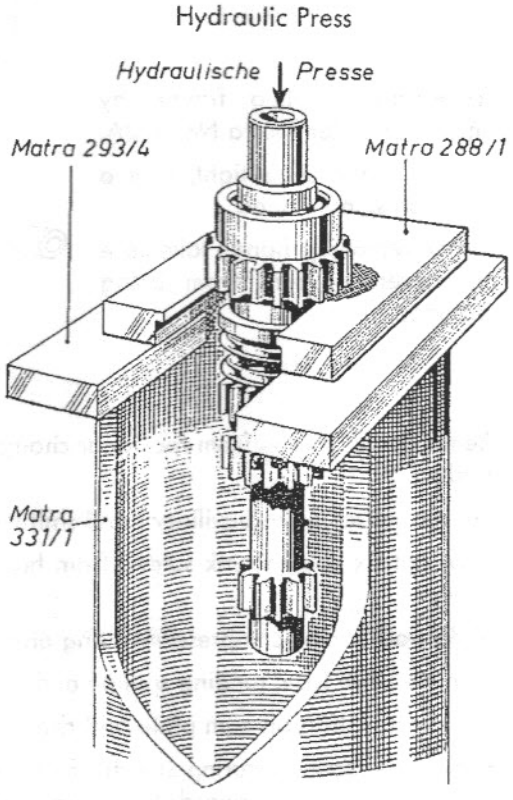
Remove kickstarter shaft and intermediary gear toward front, lifting shaft slightly.

Unscrew, from beneath the case, plug screw holding stop pin for kickstarter shaft, remove compression spring and stop pin.

Loosen lock screw holding speedometer bushing, draw out speedometer bushing with puller Matra No. 359.

Remove speedometer worm gear.

Hydraulic Press



Dismantle Mainshaft:

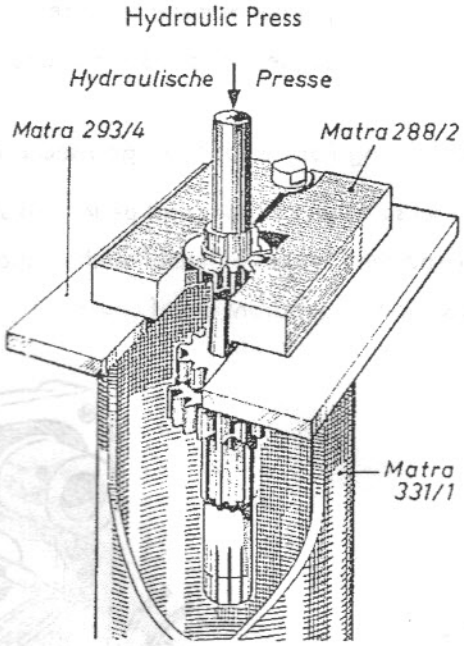
Lift out snap ring in front of collar.

Locate top speed spur gear in fixture Matra No. 288/1, and press spur gear, washer, ball bearing and collar out of shaft.

Remove thrust piece and shock absorber spring.

Use fixture Matra No. 288/2 to press washer and inner race of roller bearing off shaft.

Place low speed gear so that it is in mesh with the notches on fixture device, close device for press operation, support it upon steel bushing Matra No. 331/1, apply pressure to rear end of mainshaft and pull same out.



Dismantling Layshaft:

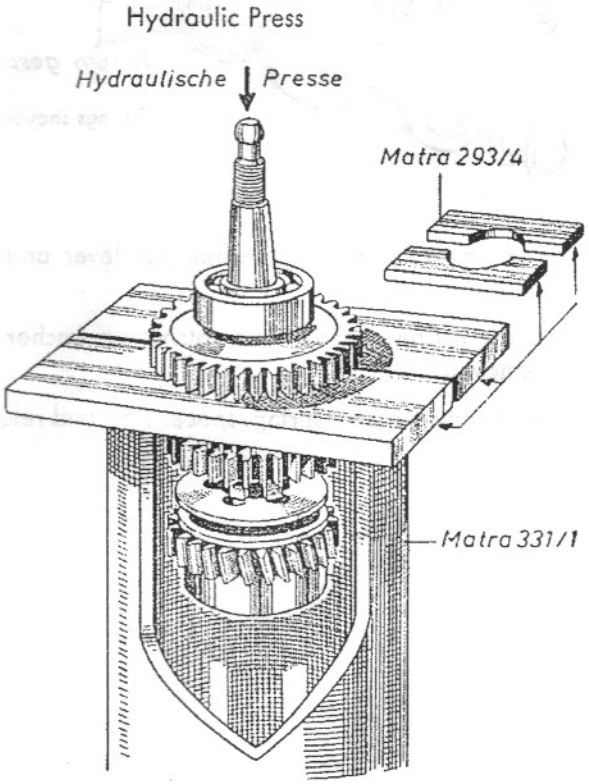
Remove Woodruff key for coupling flange, position low speed spur gear upon transverse plates, support on steel bushing Matra No. 331/1 and press spur gear and ball bearing off shaft.

Remove dog clutch for low and second.

Place top speed spur gear upon two transverse plates, support on steel bushing Matra No. 331/1 and press gear, spacer and ball bearing off shaft.

Remove top speed gear bush, dog clutch for third and top including spacer.

Press low speed gear bush, splined hub together with gears for third and second off shaft.



Remove both Woodruff keys and withdraw bush for third speed gear and second speed gear including spacer ring.

Dismantling Kickstarter Shaft:

Drive notched pin out of distance piece.

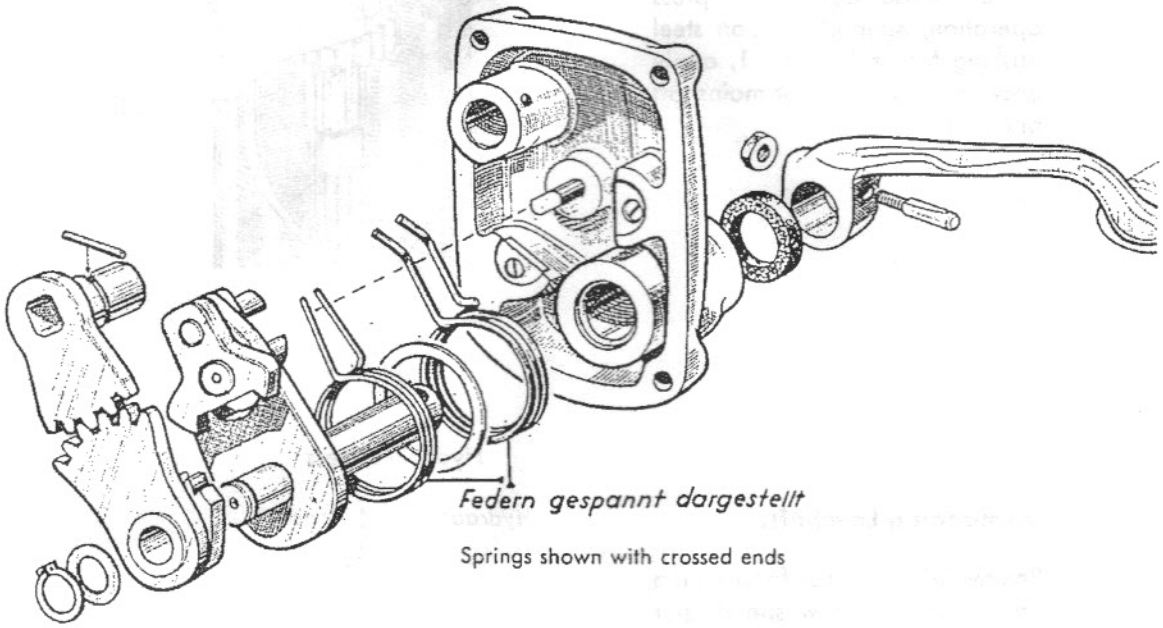
Remove distance piece and kickstarter intermediary gear together with bushing.

Dismantling Foot Gear Change Mechanism Cover:

Turn set screw out of gear shift pedal and slide pedal off anchor-type lever shaft.

Force notched pin out of hub of toothed quadrant fitted on inner end of gear selector shaft.

Draw toothed quadrant out of cover.



Springs shown with crossed ends

Press pedal shaft with anchor-type lever and toothed quadrant (ratchet carrier) out of bearing.

Draw ratched carrier and ratchet off anchor-type lever shaft after snap ring has been removed.

Withdraw support spring, spacer ring and return spring (scissor springs).

Repair and Assembly of Transmission

Clean all transmission components thoroughly and inspect the parts if they are still useful, particularly check seal rings for clean and smooth surfaces and make a test, whether ball and roller bearings operate easily.

Recondition damaged parts and replace them.

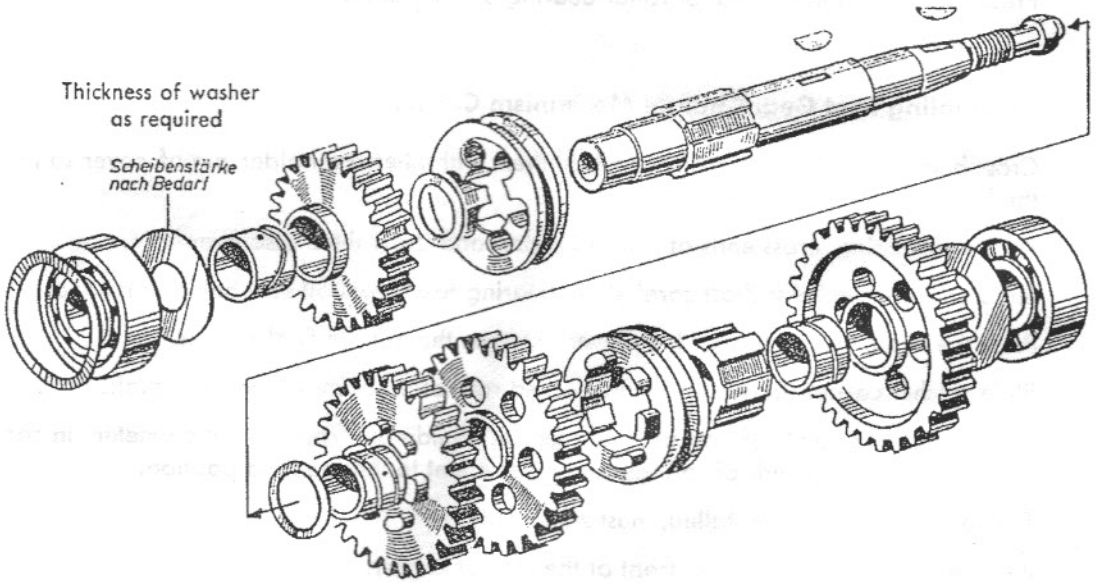
Change damaged mainshaft oil seals by means of drift bushing W 5024 and for layshaft use drift bushing W 5026 (shop-made tool).

Assembly of Layshaft:

Push shim and bushing for 2nd and 3rd speed gears on shaft.

Slide gears for third and second upon bushing.

Press splined hub on shaft making certain splines align with Woodruff keys and see to it that bushing is not upset while being pressed.



Install dog clutch for low and second speed.

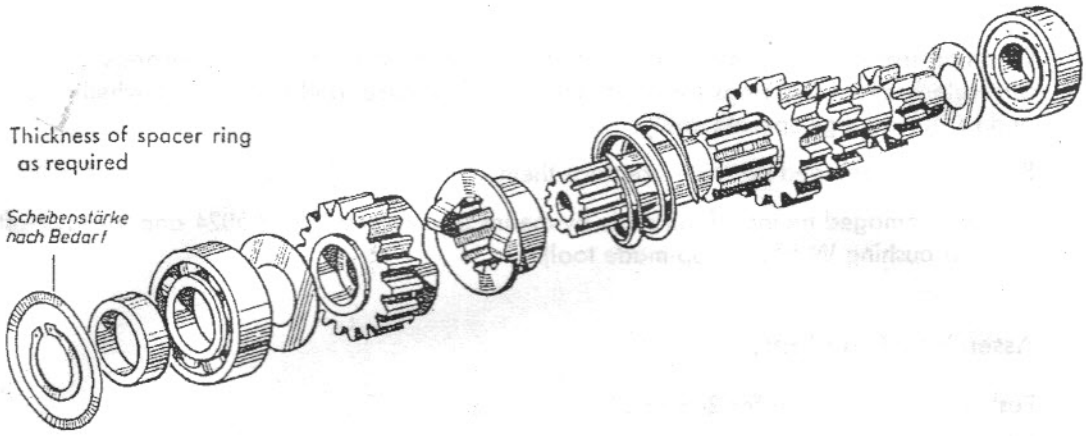
Slide low speed gear bushing, low speed gear, ball bearing washer on shaft and press ball bearing into place.

Install dog clutch for third and top speed, press spacer and top speed gear bushing on shaft, install top speed gear and washer and press ball bearing into place.

Insert Woodruff key in rear end of shaft.

Assembly of Mainshaft:

Install shock absorber compression spring, thrust piece and top speed gear including washer.



Press first ball bearing and then collar on mainshaft, using a replacer bushing.

Insert snap ring in front of collar on mainshaft.

Press washer and inner race of roller bearing on rear end of shaft.

Assembling Foot Gear Change Mechanism Cover:

Cross bent ends of return spring and set them with pliers on holder pin of cover so that the bent ends stand off the cover.

Place spacer ring, cross ends of support spring and draw them also over holder pin.

Slide anchor-type lever shaft carefully in bearing to prevent oil seal being damaged.

Press the two claws of anchor-type lever between the four ends of springs.

Slide ratchet carrier (quadrant) and annexed ratchet on anchor-type lever shaft.

The two anchor points of anchor lever must be equidistant from ratchet diameter. In case distances differ, the ends of springs are to be rebent to the required position.

The spring ends, when installed, must stand parallel.

Insert spacer and snap ring in front of the ratchet carrier.

Install hub of toothed quadrant of hand shift lever shaft in cover and secure by means of notched pin.

Position pedal on anchor lever shaft and lock with set screw.

Assembling Kickstarter:

Slide intermediary gear with bushing and distance piece on kickstarter shaft and drive in notched pin so that its protruding portion shows in direction of kickstarter pawl.

Assembly of Transmission

Fasten gear box housing on cradle frame V 5014 or fixture plate V 5017 (shop-made tool).

Run down oil plug tightly.

Insert pin stopping kickstarter shaft together with compression spring and plug screw on underside of gear box housing.

Slide kickstarter shaft with intermediary gear in housing.

Install rear bearing with gasket and oil seal so that one of the two recesses shows to near bore eye on housing.

Tighten shaft bearing with four countersunk screws.

Install mainshaft and layshaft together in housing and press them slightly in their respective bearing bores.

Use a Belzerit hammer to tap mainshaft in bearing bore, lifting the shaft and sliding it at a time in the roller bearing.

Cement front cover gasket to gear box housing on same using grease.

Checking End Clearance of Mainshaft and Layshaft in Gear Box Housing:

To prevent damages resulting from axial thrusts utmost care must be taken that the prescribed shaft end play of 0.2 mm = .008 " for both shafts is obtained.

a) **Mainshaft:**

Use depth gauge to measure distance from ball bearing of fully installed mainshaft to attaching face on gear box housing with gasket fitted upon (= value A).

Measure distance from upper edge of bearing bore in cover to bore inner shoulder for mainshaft ball bearing (= value B).

Measure distance from upper edge of bearing bore to attaching face (= value C).

With an end clearance of 0.2 mm = .008 " the requisite thickness of shim = B – A – C – 0.2 mm; the shim should be inserted between ball bearing outer race and bearing cover casting.

Install cover on gear box housing. For this end apply replacer bushing V 5024 (shop-made tool) against collar to prevent rubber seal from being damaged by collar.

Fasten cover on housing by means of 7 screws.

b) **Layshaft:**

Tap layshaft fully into place; measure distance from attaching face for oil catch cover to ball bearing outer race using depth gauge (= value A).

Measure height of bearing bore on oil catch cover with gasket fitted upon (= value B).

With an end play of 0.2 mm = .008 " the requisite thickness of shim = A – B – 0.2 mm; the shim is to be inserted between ball bearing outer race and oil catch cover.

In the event that no shim would be necessary between oil catch cover and ball bearing, a further gasket 250 1 31 017 04 must be inserted between gear box housing and oil catch cover. This enables a shim of convenient thickness to be fitted in so that ball bearing inner race will not streak on inner shoulder of oil catch cover.

Cement gasket with a jointing compound to oil catch cover and fasten the latter by means of 4 countersunk screws, the heads of which are also covered with jointing compound.

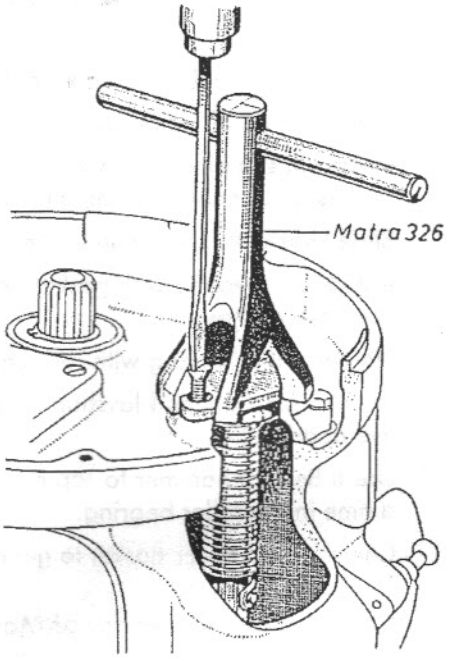
Installing Kickstarter:

Install coil spring for kickstarter shaft with front bearing cover and gasket.

Place tensioner tool Matra No. 326 on front bearing cover flange for kickstarter shaft and give spring an initial tension by turning anti-clockwise 180 – 270 degrees.

Fasten flange with this initial tension by means of two countersunk screws.

Slide kickstarter pedal on shaft and secure with set screw.



Installing Gear Shift Mechanism:

Install gear selector fork which embodies the shifting peg on its side, in dog clutch for 3rd and top speed, the gear selector fork with the peg on hub side in dog clutch for low and second speed, the pegs showing always outward. Tap selector fork guide bar from rear in housing, sliding in at a time gear selector forks taking care that they do not jam.

Secure selector fork guide bar with set screw in annular groove.

Slide coupling flange on layshaft making certain that the space between anti-dust lip and seal lip on Simmerring (oil seal) has been previously filled with heat-resistant grease, that key groove meets with Woodruff key of shaft and oil seal is not damaged during this procedure.

Put toothed washer and round nut on rear end of layshaft and tighten round nut by means of fixture Matra No. 494.

Install speedometer driving worm, tap bush in housing and secure with screw.

Slide gear selector shaft with cam plate in case and install pegs of gear selector forks in milled cam grooves at low speed position.

Hook tension spring of pawl with its short end on gear box housing to the effect that the open end shows outward.

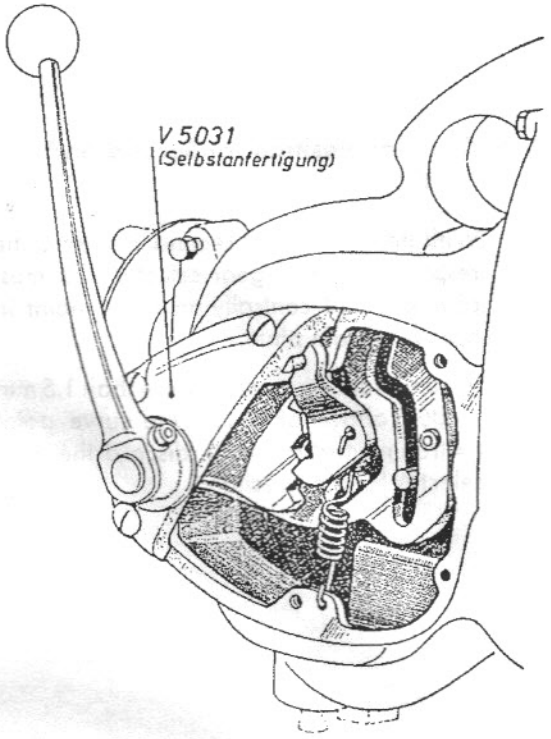
Fit pawl on spring and press it upon guiding spindle fixed in gear box housing.

Adjustment of Gear Shift Mechanism:

Mount gear selector shaft on complete foot gear change mechanism cover provisionally installed with only 2 screws, and on inspection cover (dummy) W 5031 (shop-made tool) at hand lever side (do not yet slide spring on gear selector shaft at hand lever side).

Fit hand gear shift lever on gear selector shaft and secure with set screw.

Put gear locating quadrant on outer side of cam plate in line with pawl.



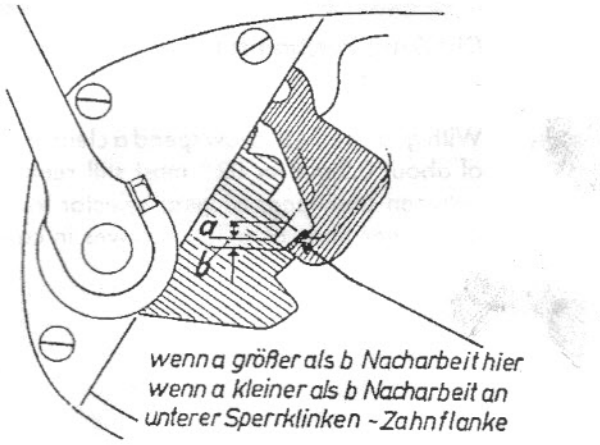
a) **Checking Neutral Position:**

Shift with hand lever to neutral position (small notch) while turning on shock absorber (coupling) flange.

Move shift lever slowly toward low speed position until with rotating at a time the layshaft on coupling flange the clicking of dog clutch on low speed gear becomes audible. At this conjuncture mark position of pawl point on gear locating quadrant.

Now move shift lever slowly toward second until with simultaneously turning the layshaft the clicking of dog clutch will be heard and mark also this position of pawl point on gear locating quadrant.

If both marks (a) and (b) are equidistant from root of neutral notch, the dog clutch stands centrally between low and second speed gear, i. e. in the right position.



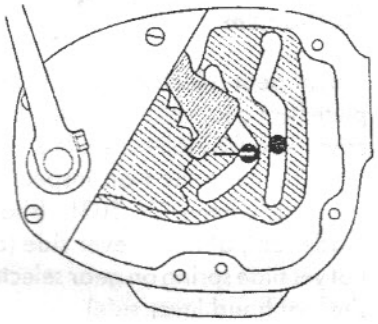
if a exceeds b reface here
if b exceeds a regrind lower contact side of pawl.

When distances (a) and (b) differ, and low speed mark is nearer to neutral position, i. e. (a) exceeding (b), the upper contact side of pawl must be refaced.

In reverse case the lower contact side of pawl is to be ground.

second speed

2.Gang



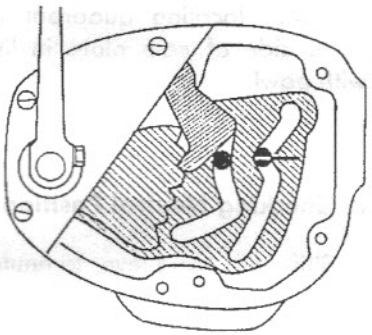
b) **Checking Position for Second and Third:**

With gears shifted to second and third the respective peg of gear selector fork must always stand centrally on curve point in groove of cam plate.

When a fork peg stands more than 1.5 mm = .06" above or below the curve point (= true neutral position), discard the gear selector fork in question.

third speed

3. Gang

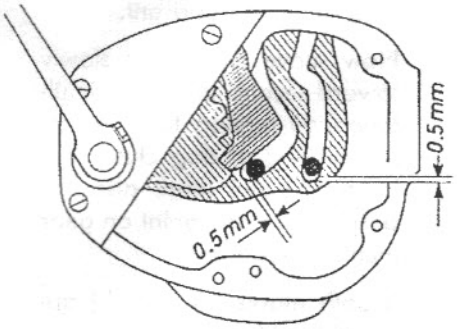


low speed

1.Gang

c) **Checking Position for Low and Top Speed:**

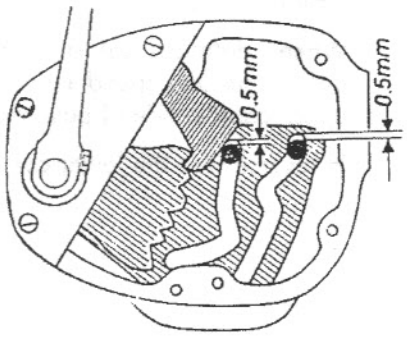
With gears shifted to low speed a clearance of about 0.5 mm = .02" must still remain between both pegs of gear selector forks and lower ends of guide grooves in cam plate.



top speed

4.Gang

With gears shifted to top speed there must still exist a clearance of approximately 0.5 mm = .02" between both fork pegs and upper ends of cam grooves.



Checking Backlash of Gear Shift Mechanism:

When shifting with pedal onto stop plate and holding at this position, a backlash must be available at each shifting operation between pawl and respective notch of gear locating quadrant.

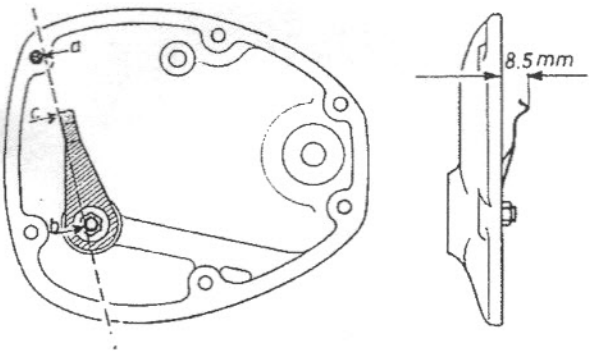
If backlash on shifting from low to second, third and top speed is smaller than 0.5 mm = .02" on a notch, the **rear stop plate** for the anchor-type lever in foot change mechanism cover must be filed until a backlash of 0.5 – 1 mm = .02 – .04" is obtained.

If during gear shifting from top to third, second and low speed there results on a notch a smaller backlash than 0.5 mm = .02", the **front stop plate** for anchor-type lever on foot change mechanism cover is to be filed.

If shift backlash on one of the notches exceeds 2 mm = .08", a new stop plate must be installed and refaced for a backlash of approximately 1 mm = .04".

When values of shift backlash are correct, remove cover for foot change mechanism and inspection cover (dummy).

Installing Cover for Hand Gear Shift Mechanism:



Before installing cover for hand gear shift mechanism check whether contact leaf spring for neutral indicator stands so that the outer edge of spring end c aligns with tangent line leading from screw bore a to bolt b. The distance from joint face of cover to contact point of uncharged spring should be 8.5 mm = .34".

Slide compression spring and spacer washer at hand gear shift lever side on gear selector shaft and pull hand gear shift mechanism cover on gear selector shaft.

Take care to prevent Simmer ring (oil seal) from being damaged.

Install hand gear shift mechanism cover and see to it that the two short screws will be put in centre of cover, one on top, the other on bottom.

Slide hand gear shift lever on gear selector shaft and press same through from pedal side against spring pressure so that set screw for hand gear shift cover can be inserted and run down without applying force.

Installing Foot Gear Shift Mechanism:

Place cover for foot gear change on housing and fasten.

Assembling Clutch Push Rod Mechanism:

Slide push rod with felt ring, end piece with ball fitted in, ball thrust bearing and thrust unit including oil seal from rear into gear box casing, respectively on mainshaft.

Place lock ring with clutch release lever on gear box housing and secure.

From engine R 51/3 No. 523 530 and engine R 67 No. 610 580, the clutch release lever is fitted with an adjusting screw which enables direct clutch adjustment through thrust unit of push rod. With this several items have been altered as per circular-letter „Survey 2/51".

Check oil-pan drain-plug for tightness.

To lubricate gear box, a quantity of 0.8 litre = .18 Imp. gall. of engine oil is to be filled-in according to lubricating chart.

On R 51/3 (1952) and R 67/2 models, replace protection cap for coupling flange (rubber joint) on gearbox end and tighten by means of 3 hex. hollow screws.

Rear Wheel Drive Group

Technical Data

Power transmission from gears to rear wheel	fully enclosed propeller shaft with elastic coupling and helical bevel gears.	
Speed reduction between transmission and rear wheel:		
For R 51/3	solo driving	3.89 : 1 (No. of teeth 9/35)
	side car driving	4.57 : 1 (No. of teeth 7/32)
For R 67 and **R 67/2**	solo driving	3.56 : 1 (No. of teeth 9/32)
	side car driving	4.38 : 1 (No. of teeth 8/35)
Quantity of oil required	see lubricating chart	
Rear wheel springs	**solo driving**	**side car driving**
Wire gage	7.25 mm = .285" ∅	8.00 mm = .315" ∅
Unloaded length of spring	145 mm = 5.71"	141.5 mm = 5.57"
Indentification colours	yellow	blue

Fits and Tolerances

Backlash disc gear to pinion (Klingelnberg toothing)	0.15 – 0.22 mm = .006 – .009"
Ideal adjustment value in housing	77 ± 0.1 mm
Manufacture tolerance of bevel gears	± 0.30 mm A pair of two correlative bevel gears has always the same number hewn in disc gear and pinion, manufacture tolerances are stamped in disc gears as ± numbers in hundredth of mm.
Distance between transmission shock absorber flange and shock absorber flange mounted on propeller shaft (shaft in horizontal position).	31 ± 1 mm = 1.22 ± .04"

Special Tools

1 ea pin spanner for threaded ring on propeller shaft assembly .	Matra No. 283
1 ea pin spanner, universal joint cover and spring coverings . .	„ „ 284
1 ea replacer, rubber oil seal in rear wheel drive	„ „ 289
1 ea dial gauge	„ „ 353C

Shop-made Tools

1 ea drift punch for guiding tubes	W 5013
1 ea backlash metering device	V 5042

Dismantling Rear Wheel Drive

Drain oil from housing.

Mark brake shoes and remove.

Only if necessary, unscrew lower spring covering including spring with pin spanner Matra No. 284.

Unscrew bell-shaped cover (left hand thread) of universal joint from threaded ring by means of pin spanner Matra No. 284.

After removal of castellated nut drive key screw out of universal joint duly supported and withdraw propeller shaft. Do not lose shim for ball bearing.

Turn threaded ring (left hand thread) out of drive housing with pin spanner Matra No. 283 and spare same with seal ring.

Take off thrust washer behind threaded ring.

Run seven countersunk screws out of oil catch cover on wheel side of housing.

Remove oil catch cover with rubber seal and coil spring ring.

Unscrew six nuts from housing cover and spare them with washers.

Heat drive housing to 60 – 70 deg C = 139 – 157 deg F.

Withdraw pinion and ball bearing from warm housing. For this end clamp splined shaft of pinion in vice fitted with alu jaws and tap housing off by means of Belzerit hammer. Take care not to lose 28 bearing needles and shim for ideal adjustment value.

Still with Belzerit hammer tap housing cover with final coupling flange and disc gear out of housing (do not lose bearing needles, 44 in all).

Remove bronze thrust ring (for backlash adjustment) from final coupling flange.

Hold final coupling flange and drive off cover with Belzerit hammer.

Remove spacer washer for end play.

Press distance piece out of final coupling flange.

Clamp final coupling flange in light metal jaws, remove lock wire and slacken screws.

Take disc gear off final coupling flange.

Use drift punch to drive ball bearing out of final coupling flange applying drift punch through bores of flange.

Assembly of Rear Wheel Drive

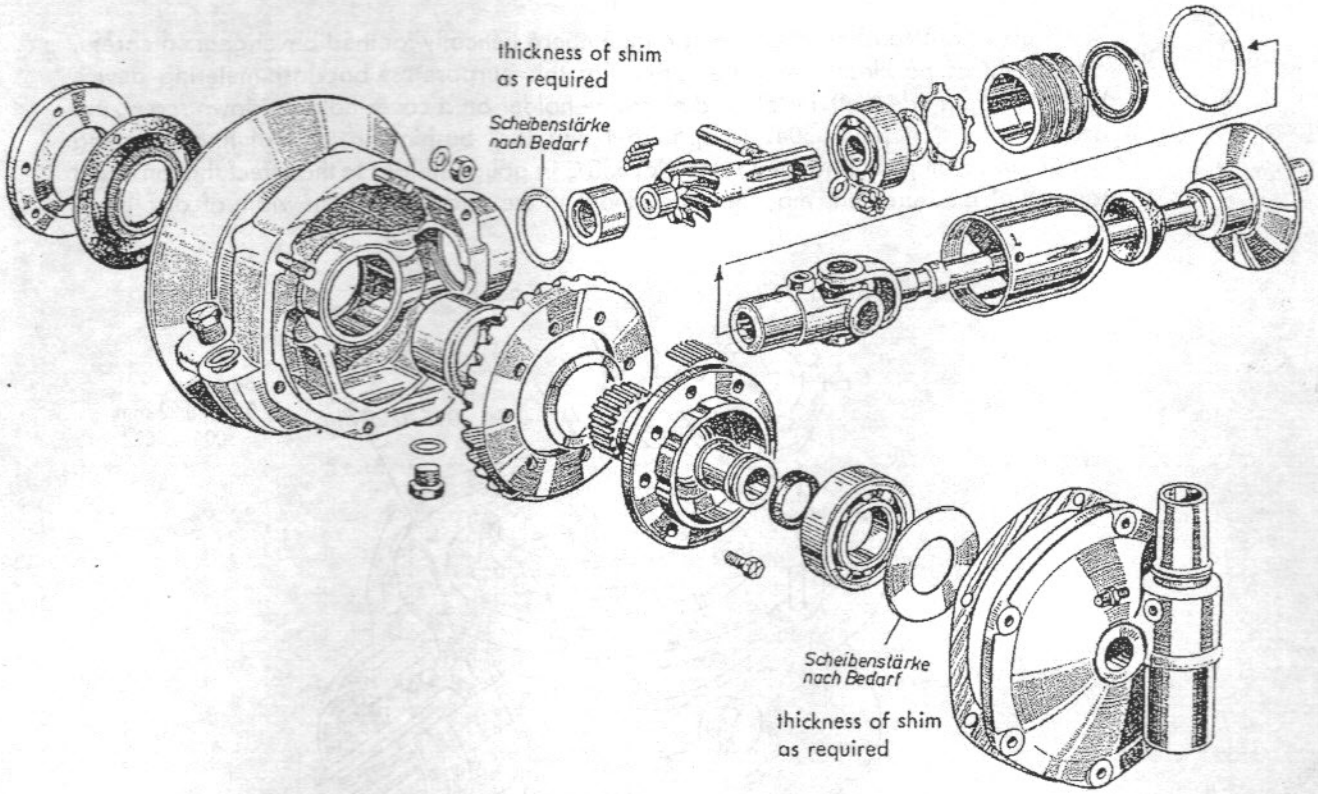
Correct adjustment vaule for pinion:

The correct adjustment value from rear of ball bearing seat of pinion to centre of disc gear is 77 $\pm$ 0.10 mm.

The respective value from shoulder of pinion shaft to centre of disc gear experienced slight alterations owing to the running-in of gears.

These alterations have been stamped electrically on disc gear, beside identification number for gear set as + or – numbers, e. g. 521 – 20.

In this case – 20 means that on assembling the driving pinion has to be set 0.20 mm more inwards, i. e. at 76.8 mm distance to the centre of disc gear.



Compensate differences by inserting a shim of convenient thickness between outer race of ball bearing and confronting inner shoulder of housing.

Install driving pinion:

Fit 28 bearing needles of driving pinion into bushing by means of grease.

Press driving pinion, ball bearing and eventual shims, with replacer tool carefully in, to prevent bearing needles from being displaced.

Insert thrust washer.

Turn threaded ring (left hand thread) with Simmerring (oil seal) and alu-asbestos washer in housing and tighten by means of pin spanner Matra No. 283.

Installing Disc Gear:

Bolt disc gear on final coupling flange and secure screws with lock wire.

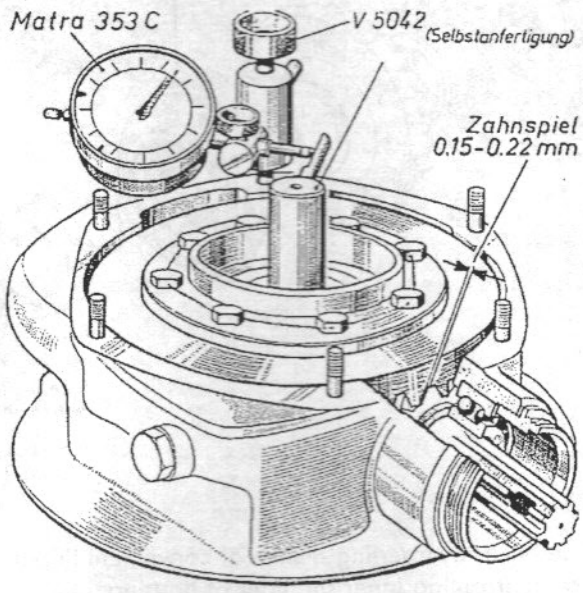
Fit bearing needles (44 in all) with grease on running surface of final coupling flange, place bronze thrust ring on bush in housing and slide final coupling flange cautiously in bushing.

Insert distance piece with oil-impregnated felt ring from housing cover side in bore of final coupling flange.

Use replacer to press ball bearing 6207 in final coupling flange.

Checking Backlash of Gears (see general rules for installation of Klingelnberg helical bevel gears):

To ensure smooth and quiet action of Klingelnberg helically-toothed bevel gears a careful adjustment of backlash is indispensable. For this purpose use backlash metering device V 5042 (shop-made tool), install its dial gauge holder on a cover-holding-down screw, put arbour with stop pin V 5042 (shop-made) and lock bushing in bore of final coupling flange and clamp dial gauge Matra No. 353 C in gauge holder to the effect that an exact tangential measurement may be carried out in the middle of tooth width of disc gear.



Backlash
0.15 – 0.22 mm
= .006 – .009 "

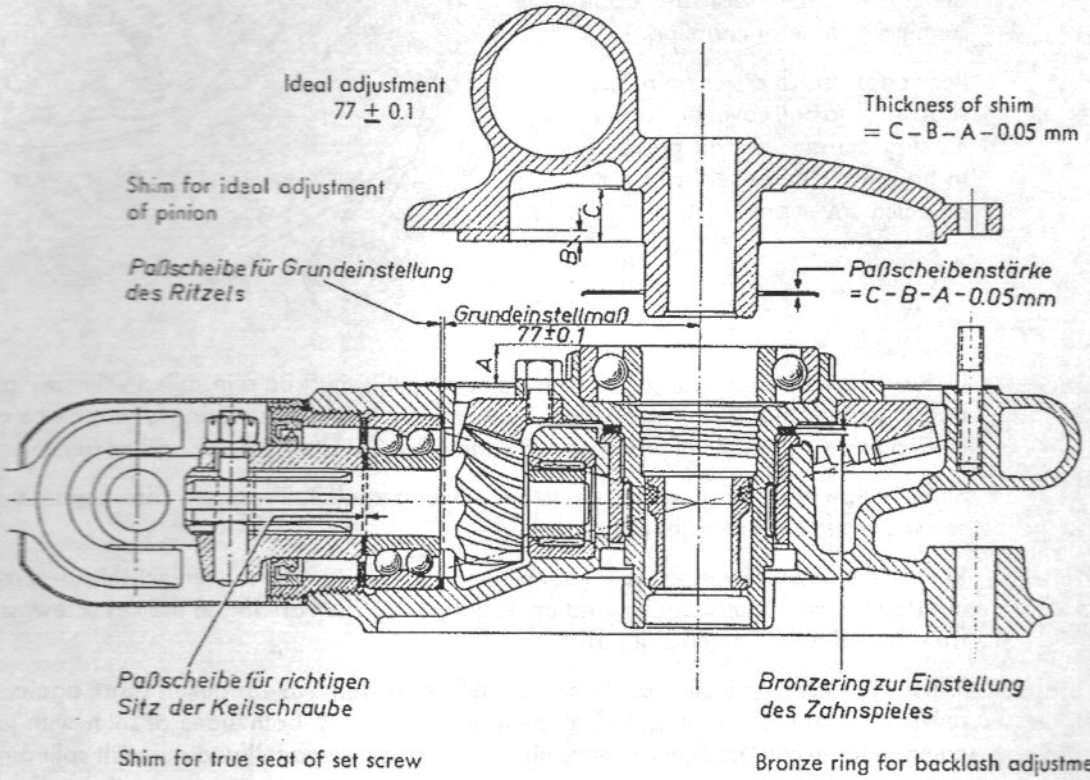
To measure backlash hold pinion sturdily, turn disc gear slightly to and fro and take reading of backlash on dial gauge stopped at the pin.

The backlash must be 0.15 – 0.22 mm = .006 – .009 ".

If this backlash is not available, insert a thicker bronze ring, if backlash is greater, insert a smaller bronze ring.

End Play of Final Coupling Unit in Housing:

Prior to definite installation of housing cover check the end play which should not exceed 0.05 mm = .002".



For this end,

position gasket between housing and cover on housing,

measure distance from ball bearing to housing joint face including gasket with depth gauge = value A,

distance from outer shoulder of housing cover to joint face measured with depth gauge = value B,

distance from housing cover outer shoulder to ball bearing attaching inner shoulder measured with depth gauge = value C.

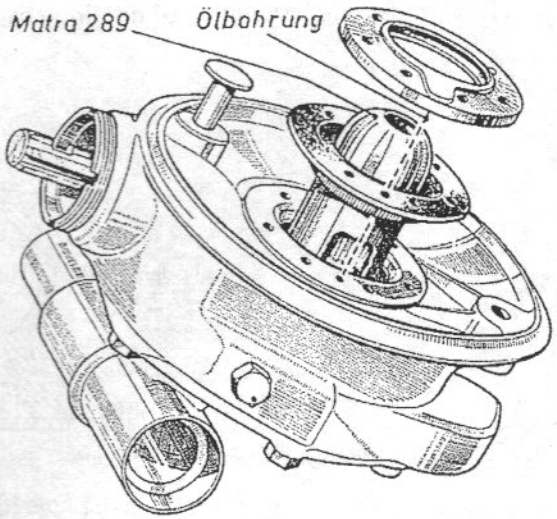
With an end play of 0.05 mm = .002" the required thickness of shim = C – A – B – 0.05 mm.

An additional end clearance of 0.05 mm = .002" is to compensate compression of gasket, so that virtually a smaller end play is existent when the gasket has been compressed.

Insert shim of the required thickness between ball bearing and cover, install cover on housing and tighten.

Check whether disc gear with final coupling is still freely rotable (cover must not jam).

Oil passage



Final Assembly:

Put seal ring replacer Matra 289 over splined hub on final coupling and slide rubber seal ring upon running surface of coupling.

Position oil catch cover on rubber seal ring and bolt cover on housing making certain that oil passages in housing, rubber seal ring and oil catch cover are in line.

In case the spring covering has been removed, this must be reinstalled with spring so on bearing cover that spring end coincides with bore in spring covering and may be caught from outside by means of pin spanner Matra No. 284 after the spring has been installed.

Slide hollow stub of propeller shaft over pinion shaft taking care that key-side of key screw corresponds with that of pinion.

In case the key screw does no longer well engage, a shim of convenient thickness must be inserted between ball bearing and universal joint. When driving in the key screw, support from beneath the universal joint.

When key screw connection has been adjusted, remove propeller shaft again, brush universal joint face pointing to ball bearing respectively both sides of shim with jointing compound, install propeller shaft definitely, and secure castellated nut with split pin.

Tighten bell-shaped cover (left hand thread) for universal joint slightly with pin spanner Matra No. 284.

When installing brake shoes pay attention to assembly marks.

Notice: In case a new propeller shaft has been installed or a new shock absorber has been pressed on the original propeller shaft, it must be taken care that the distance between shock absorber flange on propeller shaft and the counter flange on transmission end, with propeller shaft in horizontal position, amounts to 31 ± 1 mm $= 1.22 \pm .04$". It is important to check this value after assembly of rear wheel drive, for otherwise damages might occur on the rear wheel drive owing to the up and down travel of springing mechanism.

If necessary, press propeller shaft shock absorber flange farther on shaft.

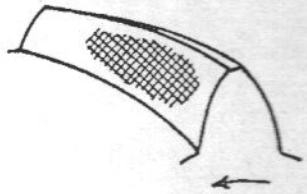
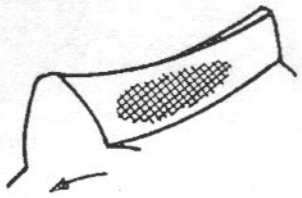
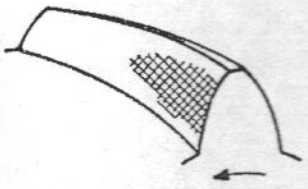
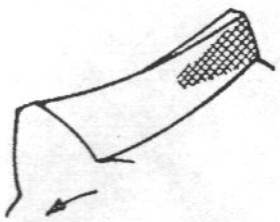
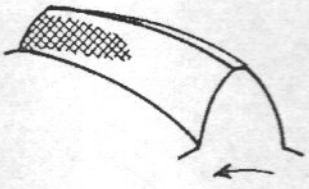
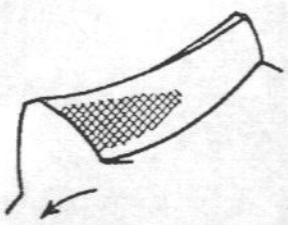
General Rules for Installation of Klingelnberg helical bevel gears.

Proper assembly adjustment of Klingelnberg helical bevel gears is very important in order to ensure smooth action and long service life.

To obtain proper meshing:

1) a backlash of 0.15 – 0.20 mm =.006 – .008" is to be observed with checking after assembly
2) the tooth bearing in longitudinal direction of teeth by ascertaining with paint the path of contact on pinion rotating clock- and counterclockwise.

Adjustments are made by altering position of pinion and disc gear at a rate of almost tenths of millimeters only. Every adjustment will influence backlash and contact area. After each adjustment check backlash and path of contact again until the most suitable value is obtained.

Front side of tooth	Description and Adjustment	Rear side of tooth
	**Proper Mesh:** Path of contact on front and rear side of tooth is a trifle nearer to thick end of tooth, in the middle of tooth side. Under load and actuation conditions the path of contact travels a little to the small end of tooth.	
	**Bias tooth bearing on front side at thick end of tooth:** Increase distance from pinion to disc gear centre and adjust backlash by reducing the distance from disc gear to pinion centre.	
	**Bias tooth bearing on front side at small end of tooth:** Reduce distance from pinion to disc gear centre and adjust backlash by increasing the distance from disc gear to pinion centre.	

Chassis Group

Technical Data

Chassis	rigidly interconnected double tube steel frame.
Front wheel suspension	telescopic fork with double-acting hydraulic shock absorbers.
Rear wheel suspension	dust-proof collapsible telescope-type rear wheel suspension.
Brakes:	
Front wheel:	
R 51/3 · R 67	internal shoe brake, dia. of drum = 7.87 ".
R 51/3 (1952) · **R 67/2**	Duplex internal shoe brake with two expanding shoes.
Rear wheel:	internal shoe-brake, dia. of drum = 7.87 ".
Rims	3" × 19", drop-centre safety rims.
Tyres	3.50" × 19", front: ribbed tyres, rear: normal tyres.
Dimensions:	
Overall width of motorcycle:	
with solo handle bar	approx. 31 "
with side car handle bar	approx. 34.5 "
Overall length of motorcycle:	approx. 84 "
Height from saddle to ground	approx. 28.5 "
Ground clearance:	
R 51/3 · R 67	approx. 5 "
R 51/3 (1952) · **R 67/2**	approx. 4 "
Weight:	
net weight, ready for operation tank filled **R 51/3**	418 lbs.
R 67 · R 67/2	422 lbs.
maximum permissible load of motorcycle	
a) solo	781 lbs.
b) increase of load on motorcycle through side car connection	1,034 lbs.
of motorcycle with side car	1,320 lbs.
Capacitiy of fuel tank	approx. 4.5 U. S. gall. = 3.75 Imp. gall.
Reserve fuel tank	approx. 1.5 U. S. qts. = .33 Imp. gall.
Lubrication of chassis	see lubricating chart
Quantity of oil required for each prong of fork	see lubricating chart

Tyre pressure:	front wheel	rear wheel	side car wheel
driver alone	21 psi	24 psi	–
driver and passenger	21 psi	27 psi	–
driver with occupied side car	27 psi	27 psi	27 psi
driver with passenger and side car	27 psi	37 psi *)	27 psi

*) 45 psi on combination fully loaded with its permissible maximum of 1,320 lbs.

Fits and Tolerances

Steering bearing	2 × 24 balls dia. 5.5 mm	
Permissible non-trust of fork prongs	0.2 mm = .008"	
Assembly distance from lower edge of fork bottom yoke to upper edge of fork tube	192 mm = 7.56"	
Assembly play of front fork top guiding bush (Ferrozell)	0.08 – 0.11 mm .0032 – .0044"	
Assembly play of front fork bottom guiding bush	0.04 – 0.08 mm .0016 – .0032"	
Fork springs:	**Solo driving**	**Side car driving**
wire dia.	5.5 mm .217"	6.5 mm .256"
unloaded length	227.5 ± 2 mm = 8.94 ± .08"	204 ± 2 mm = 8.03 ± .08"
Brake drum, dia.	200 mm = 7.87"	
Permissible non-trust of brake drum	0.1 mm .004"	
Endplay of ball bearing in wheel hub	0.1 mm = .004"	

Special Tools

1 ea pin spanner, front wheel fork spigot nut . . . . . Matra No. 285
1 ea pin spanner, front wheel fork spring retainer . . . . . „ „ 286
1 ea spanner for fork nut (spanner clearance 41 mm) . . . „ „ 316A
1 ea hook spanner, exhaust nut 49 mm dia. . . . . „ „ 338/1
1 set of wooden clamping blocks for disassembly and reassembly of front wheel fork . . . . . „ „ 362

Shop-made Tools

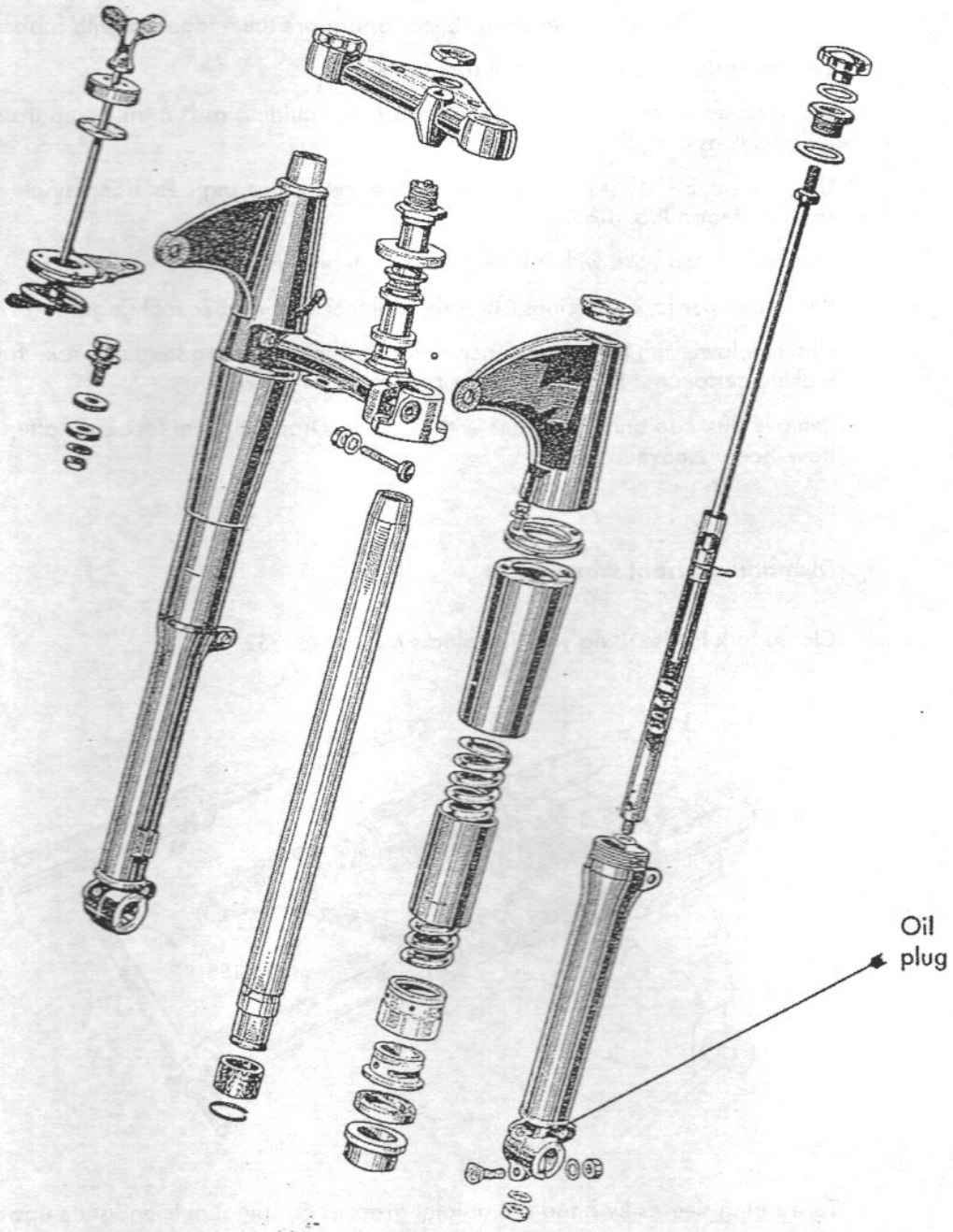
1 ea drift punch, guiding tube . . . . . W 5013
1 ea replacer, Simmerring (oil seal) in front wheel fork . . . . V 5024

Front Wheel Fork

Removing front wheel fork:

Stand motorcycle on centre stand and support frame with wooden blocks under front engine links.

Turn brake adjusting screw all the way to such a position that its slit aligns with the slit of the tube in which it rests.



Raise brake operating lever and take off cable.

Unscrew nut on hub spindle, loosen terminal clamp on left end of fork and slide out hub spindle.

Remove front wheel with brake anchorage plate.

Unscrew front wheel mudguard and front wheel stand on fork ends and remove.

Unscrew anti-dazzle switch on left handlebar grip.

Undo screws holding headlamp and put headlamp cautiously on prong of fork (do not lose headlamp mounting rubber).

Unscrew handlebar and remove from fork top yoke.

Take split pin off lower end of steering damper mechanism, remove wing-screw rod with security cap and lock washer upward, the damper bottom plate downward.

Take damper anchor plate off frame.

Remove top filler caps from the fork legs and spare them together with rubber washers.

Turn threaded insert rings out of fork top ends.

Lift unscrewed insert rings with shock absorber guiding rods a trifle, separate them from guiding rods and store with washers.

Unscrew nut SW 41 (41 mm spanner clearance) of steering stem using single open ended spanner Matra No. 316A.

Loosen fork top yoke with a blow from fork tubes and withdraw.

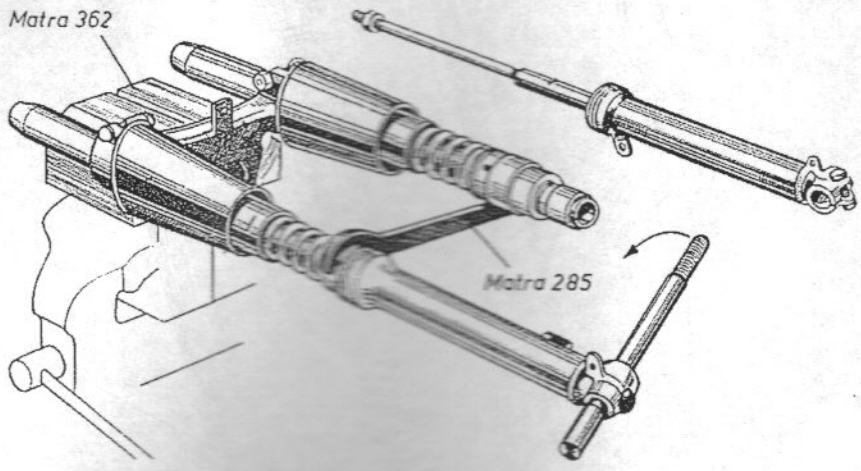
Remove upper fork coverings (shrouds) together with rubber seal rings.

Unscrew lower nut SW 41 (spanner clearance) from steering stem and take fork off frame making certain not to lose 24 balls of lower thrust bearing.

Remove dust cap and head race with 24 balls. Drain oil from fork ends after plug screws have been removed.

Dismantling front wheel fork:

Clamp fork in vise using wooden blocks Matra No. 362.



Turn spring sleeves by hand out of joint grooves on spigot nuts and slide upward.

Hold spigot nut with pin spanner Matra No. 285, unscrew fork end piece (sliding tube) with hub spindle inserted.

Withdraw fork end pieces together with shock absorbers.

Remove snap rings on lower ends of fork tubes; lower guide bushings, upper guide bushings and Simmerrings (oil seals) may be withdrawn.

Use pin spanner Matra No. 286 to remove lower spring retainers together with compression springs off upper spring retainers.

Take off lower fork coverings (shrouds).

If necessary, clamp compression spring in vice and unscrew lower spring retainer with pin spanner Matra No. 286.

Dismantling Shock Absorber Units:

Using socket wrench unscrew nuts in lower fork end pieces and spare them with lock washers.

Slide shock absorber tubes with washers and shock absorber rods out of fork end pieces.

After removal of lock springs on shock absorber tubes there may be slid out shock absorber rods with guides and shock absorber valves.

Inspection of Front Wheel Fork:

Check fork tubes for truth and smooth sliding surfaces, if necessary straighten or rectify. Out-of-true must not exceed 0.2 mm = .008".

Inspect fork end pieces; sliding surfaces should be clean, oil seals smooth (suitable lips) and shock absorber valves must function properly.

In case fork is damaged, check fork top and bottom yoke carefully for hairline cracks.

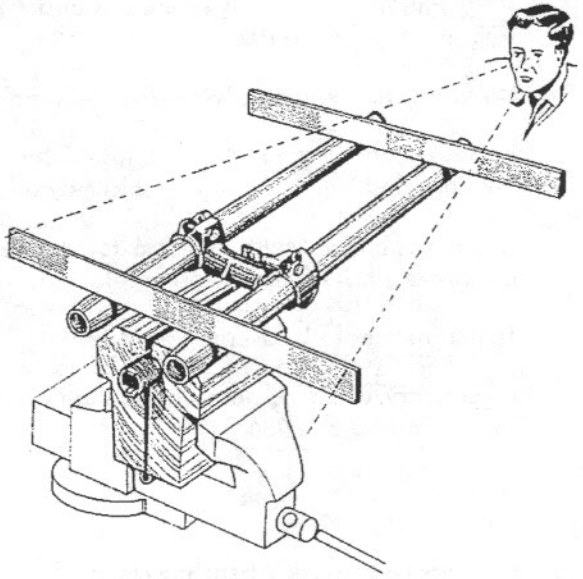
Assembling Front Wheel Fork:

To ensure easy sliding of fork end pieces you may provide adjusted tubes with new bushings (diametrical clearance upper guiding bush = 0.08 – 0.11 mm = .0032 – .0044", lower guiding bush 0.04 – 0.08 mm = .0016 – .0032").

Install adjusted fork tubes so in fork bottom yoke that the distance from lower edge of fork yoke to upper end of fork tube amounts to 192 mm = 7.56".

Tighten pinch bolts in fork yoke.

Check fork tubes for parallel position by putting each one straight edge upon both ends and aiming over.



Bolt upper spring retainer units together with lower fork coverings (shrouds) to fork bottom yoke.

Install lower spring retainers with spigot nuts fitted upon on coil springs.

Push complete coil springs with loose spring sleeves placed upon over fork tubes.

For quietening spring noise it is suggested to lubricate the coil springs with grease before mounting them on upper spring retainers.

Replenish seal rings between their seal and dust lips with heat-resistant grease and slide them on fork tube by means of replacer V 5024 (shop-made tool).

Cement paper seal with heat-resistant grease centrically on Simmerring (oil seal), slide upper and lower guide bushings on fork tubes and secure lower guide bushings with snap rings.

Insert shock absorber rods together with shock absorber valves and guide bushings in shock absorber tubes and set guide bushings by means of lock springs.

Install complete shock absorber units together with seals in fork end pieces and tighten from underneath with lock washers and nuts.

Push fork end pieces with mounted shock absorbers (right fork end piece with guide for brake plate) over guide bushings of fork tubes and, by means of pin spanner Matra No. 285 on spigot nut, and hub spindle inserted in fork end piece tighten so, that the hub spindle is set off approx. 20 deg. before final position. By that, the springs are endowed with an initial tension when installed.

Remove fork from clamping wooden blocks on vice.

Installing Front Wheel Fork:

Use grease to fit 24 balls in lower bearing in frame head lug.

Install front wheel fork in head lug.

Fit 24 balls with grease in upper bearing.

Install race with inner shoulder and dust cap with lower nut for steering stem and tighten slightly with open end spanner Matra No. 316A.

Slide upper fork coverings (shrouds) together with rubber sleeves on fork tubes.

Position fork top yoke and screw upper nut SW 41 (wrench clearance) on steering stem.

The fork must have no play in the bearings and freely turn when engaged.

Screw threaded insert rings with washers on shock absorber rods raised upward and screw insert rings in fork tubes.

For this end loosen both pinch bolts on fork bottom yoke in order that the fork top yoke may be bolted to fork tubes without being subject to any tension.

Tighten pinch bolts on fork bottom yoke only after the fork top yoke has been tightly bolted on.

Engage spring coverings (shrouds) in groove-type joint on spigot nuts and secure by turning.

Fill 130 c. c. = 8 cu. in. of engine oil in each prong of fork as per lubricating chart and screw on filler caps with rubber washers

Check oil plug for tightness.

Install Steering Damper:

Screw damper anchor plate on frame.

Install damper bottom plate on damper anchor plate, respectively eye of bottom plate on bolt of fork bottom yoke, insert oiled wing screw rod with lock washer and security cap in fork yoke, let lock washer and security cap engage in steering stem, run wing screw rod down in bottom plate and secure rod end with split pin.

Screw headlamp with mounting rubber on headlamp brackets.

Install handlebar brackets on fork top yoke, locate cable guiding plates beneath the yoke on bracket ends and tighten.

Fit anti-dazzle switch on left handlebar grip.

Install Mudguard:

Screw front wheel mudguard and front wheel stand on fork end pieces.

Lubricating Wheel Hubs:

Since the wheel lubricators have been abolished because of excessive lubrication and subsequent oiling of brake, the wheel hubs must be dismantled every 3000 miles and relubricated. For this end unscrew hub cover together with felt washer off wheel hub and drive out ball bearings including distance pieces.

Wash ball bearings, hub bore and felt rings (replace worn felt washers) with kerosene. Replenish hub and bearings with new grease.

Oil felt washers slightly and reassemble hub. Make certain that brake side of hub is particularly cleaned from oil and grease.

Adjust ball bearing in wheel hub to 0.1 mm .004" end clearance by inserting shims of convenient thickness between thrust collar and bearing outer race.

Installing Front Wheel:

Insert brake anchorage plate in brake drum and install front wheel in fork, to the effect that the nose on brake plate fits in guide of right end of fork and brake operating lever stands underneath.

Insert greased hub spindle, tighten with nut and secure with terminal clamp on left end of fork.

Fit brake cable on brake operating lever.

Push cable cover with cable ferrule backward and insert cable in slit of brake adjusting screw.

Readjust brake.

Side Car Group

Attaching the BMW „Spezial" Side Car

The frame is already equipped with a connecting mechanism according to German Engineering Standard DIN 74 031 so that a side car can easily be attached.

For subsequent remodeling from solo to side car operation or vice versa, the following alterations must be made:

1. Change helical bevel gear set in rear wheel drive

   for R 51/3 from 9 : 35 teeth (solo) to 7 : 32 teeth (side car);

   for R 67 from 8 : 35 teeth (side car) to 9 : 32 teeth (solo).

2. Change speedometer adjustment for the different gear ratio

   for R 51/3 from 1.6 (solo) to 1.84 (side car);

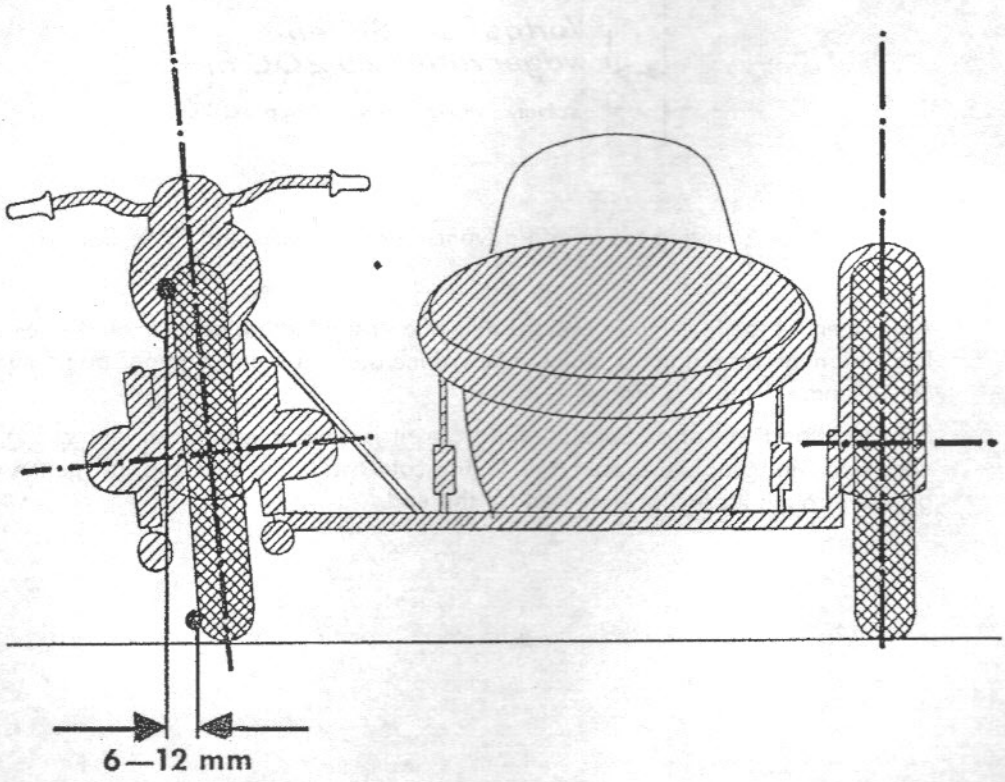
   for R 67 from 1.76 (side car) to 1.44 (solo).

   (Speedometer is mile-calibrated.)

3. Equip front and rear wheel suspension with springs for side car or solo driving, as required.
4. If motorcycle is equipped with the 790 mm = 31 " solo handlebar, change to the 875 mm = 34.5 " (measured with levers) handlebar if a side car is attached.

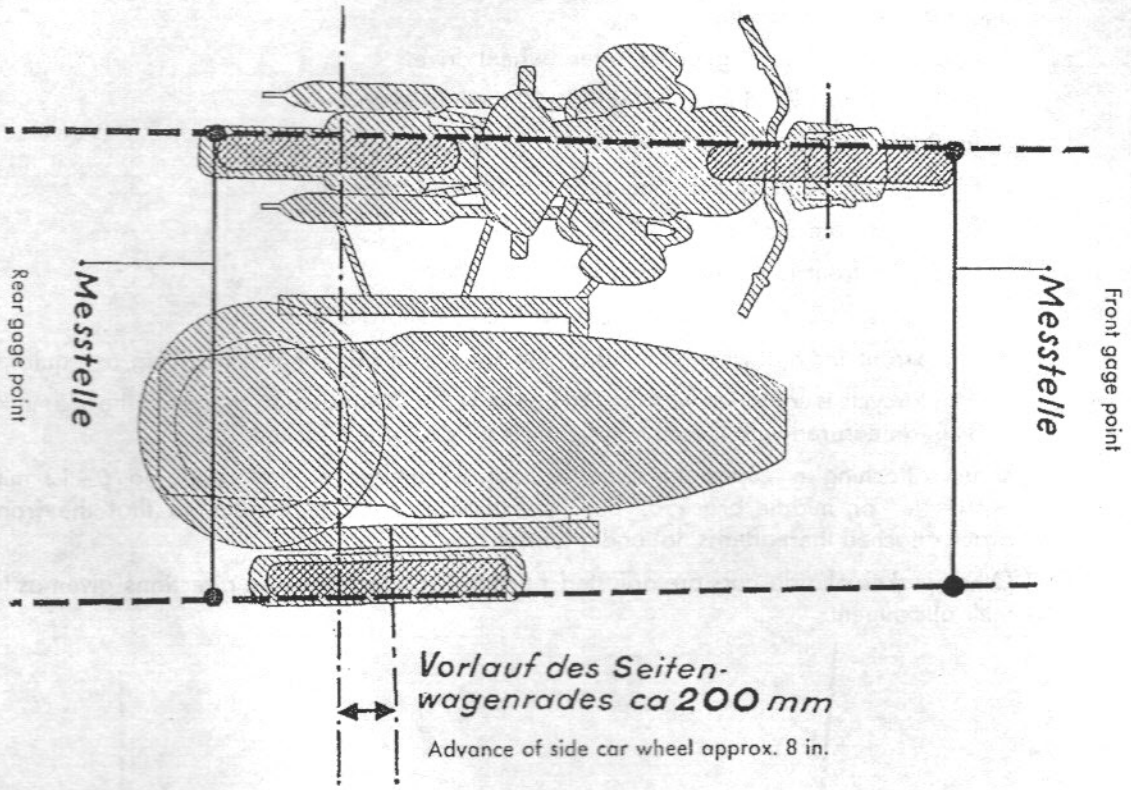
When attaching a „Spezial" side car, adjust camber of motorcycle to 6 – 12 mm = $^1/_4 - ^1/_2$ " on middle brace as per illustration inserted hereunder, so that the front brace attached thereafter is not under tension.

Other makes of side cars are adjusted pursuant to the respective directions given as to their attachment.



Adjusting Camber when connecting a Side Car.

Toe-in and advance of motorcycle, which is of great importance for the good riding quality, safety and useful life of motorcycle and tires, must be complied with in accordance with directions for side car attachment.



Adjusting toe-in and advance for BMW „Spezial" Side Car.

Adjustment of toe-in is made with the help of a straight lath placed against side car wheel. Dimension at rear gaging point minus dimension at front gaging point must equal 36 – 45 mm (1 1/2 to 1 3/4 inches).

Prior to attachment of a „Spezial" Side Car, it is advisable to open leaf spring, to treat each leaf with graphite grease and to lubricate oscillating axle support generously with grease through lubricator designed for this end.

Electrical Equipment Group

Technical Data

Dynamo:

Model	Noris L 45/60 L
Type	shunt dynamo with voltage regulator
Driven	directly by crankshaft
Rated voltage	6 volts
Maximum hot output	60 watts, 2200 r. p. m.
Rated hot output	45 watts, 1800 r. p. m.

Ignition magneto:

Model	Noris MZ ad/R	
Rotor driven	directly by camshaft at half of crankshaft speed	
Automatic timing control	by centrifugal advance mechanism	
Range of adjustment	30 crankshaft angle degrees	
	R 51/3	**R 67 and R 67/2**
Spark advance	39° ± 2° before TDC	36° ± 2° before TDC
Spark retard	9° before TDC	6° before TDC
Contact breaker gap	.4 mm	

Sparking plugs:	Bosch W 240 T1 *)
Electrode gap of spark plugs	.6 mm — .024"

Battery:	6 volts, 7 ampere hours
Electrolyte	specific gravity 1.280 (in the tropics 1.230)
Charging from an independent source of electricity	12 to 14 hours using current of .7 amperes, battery fully charged with 3 x 2.7 volts = 8.1 volts

Lighting equipment:

Headlamp	Bosch LE/MTA 160 x 2/13 headlamp with Bilux lamp, parking light, battery charge control light, neutral light and built-in speedometer with concealed (internal) illumination for dial
Bilux lamp	6 volts, 35/35 watts with dip switch
Parking light	6 volts, 1.5 watts
Battery charge control light	6 volts, 1.5 watts
Neutral light	6 volts, 1.5 watts
Speedometer light	6 volts, .6 or 1.2 watts
Tail light	tubular bulb, 6 volts, 5 watts
Electric horn	Bosch HO/FDF 6/1 horn

*) or the following sparking plugs: Lodge HHN, Champion L10 S, Champion J2, KLG-F80.

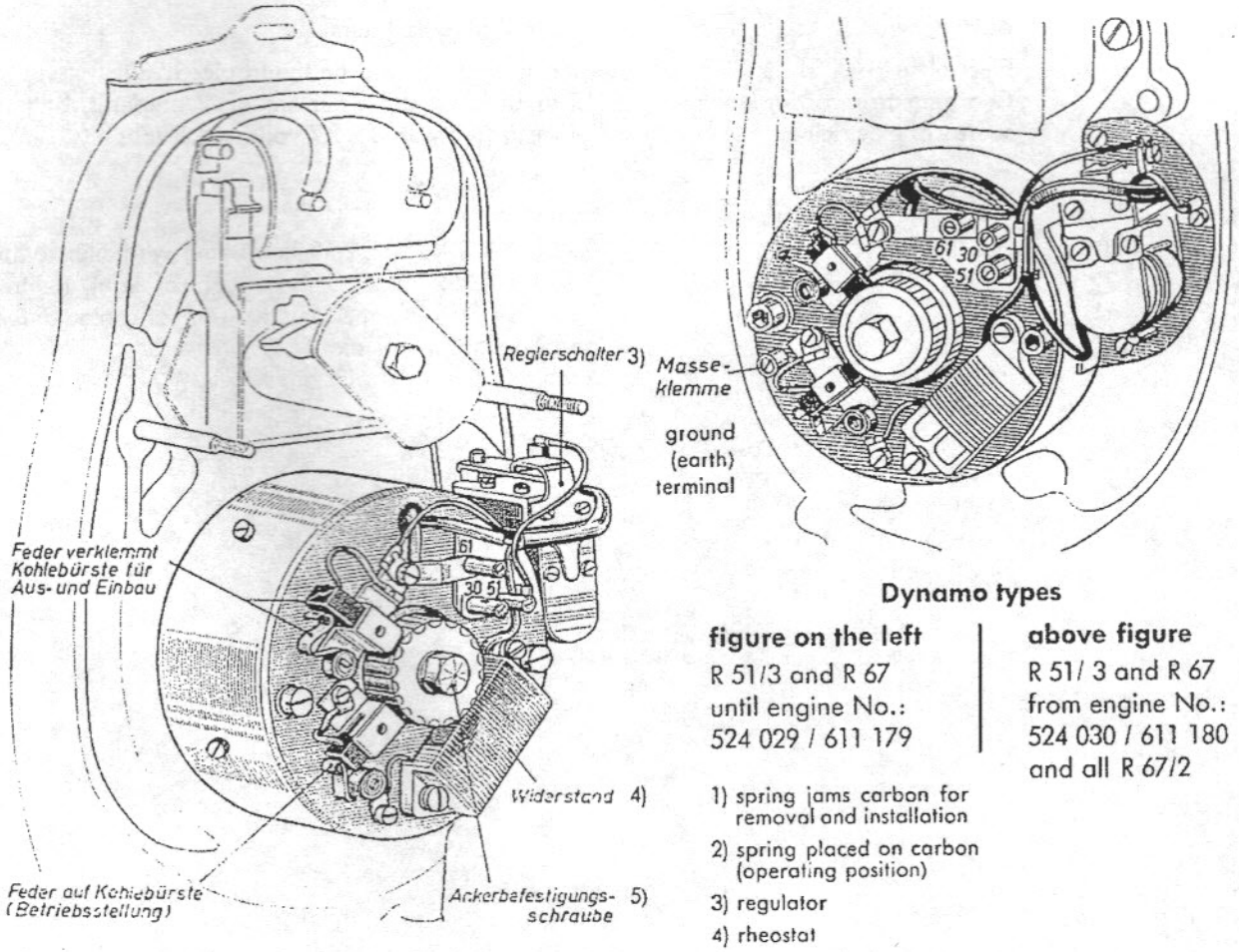
I. Description

The electrical equipment comprises a dynamo, ignition magneto, battery, lighting set, electric horn and neutral indication.

1) The **"Noris L 45/60 L" shunt dynamo** is of the compensated voltage control type and operates in conjunction with an adjacent voltage regulator for a rated tension of 6 volts. The dynamo is so mounted as to be driven by crankshaft, directly. The unit produces a rated output of 45 watts at 1800 r. p. m. and a maximum of 60 watts at 2200 r. p. m.

The rated output therefore is obtained at :

Model	Motion gear	Speed	
		rear wheel drive for solo riding m. p. h.	rear wheel drive for side car use m. p. h.
R 51/3	top	28	23.7
	3rd	21.3	18.2
	2nd	15.7	13.5
R 67 and R 67/2	top	30.5	24.8
	3rd	23.3	19
	2nd	17.4	14.1

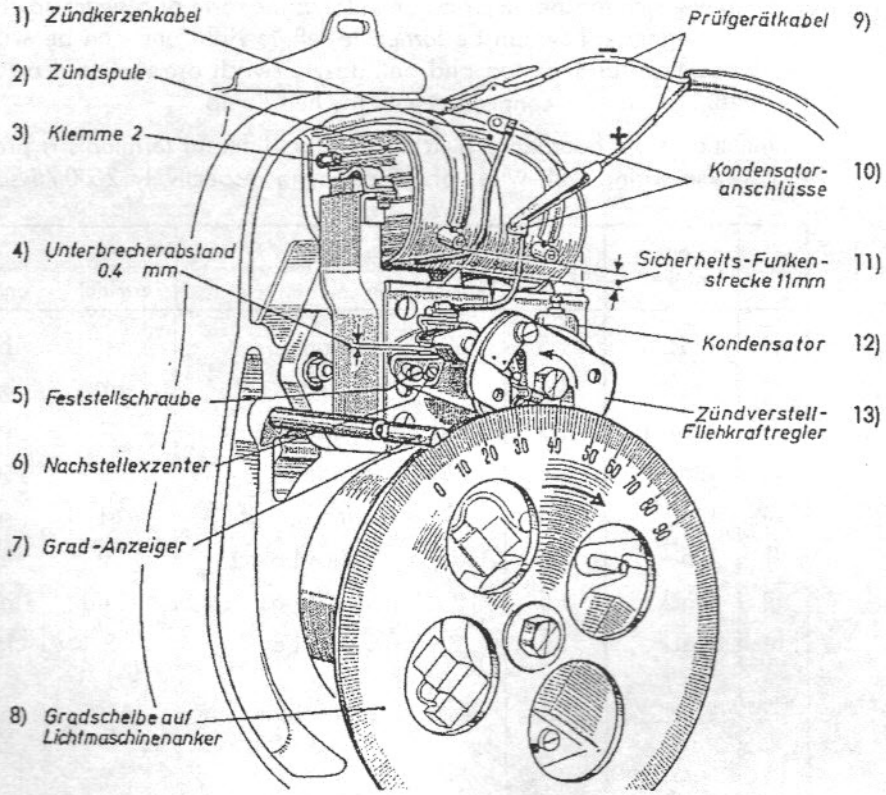


Dynamo types

figure on the left	above figure
R 51/3 and R 67 until engine No.: 524 029 / 611 179	R 51/ 3 and R 67 from engine No.: 524 030 / 611 180 and all R 67/2

1) spring jams carbon for removal and installation
2) spring placed on carbon (operating position)
3) regulator
4) rheostat
5) armature clamp screw

2) The "Noris MZ ad/R" **ignition magneto assembly** is of special design, its essential features being that its rotating components are operated directly by camshaft at half of crankshaft speed and that the assembly delivers, independently from the dynamo unit, the required ignition voltage.



1) spark plug cable
2) ignition coil
3) terminal 2
4) contact breaker gap (.016")
5) fixing screw
6) adjusting excentric
7) degrees indicator
8) graduated dial on dynamo armature
9) tester cable
10) condenser connexions
11) safety spark gap
12) condenser
13) centrifugal ignition governor

Ignition magneto shown with mounted graduated dial for adjustment of ignition timing

3) The **battery** serves as tension source while the vehicle is parked or driven at low speeds, as the dynamo supplies the lighting set only after having attained a rate of 1800 r.p.m. When the motorcycle is running at normal speeds, the battery is charged by the dynamo being converted thus into a consumer. The rated tension of the battery is 6 volts and its capacity 7 ampere hours.

4) The **lighting set** includes

a) the Bosch headlamp with Bilux lamp (main and dipped beam filament), parking light, charge indicating light, neutral light and speedometer light.

b) tail light and plug socket connection for the two side-car lamps (tubular bulbs). This switch-plug box also serves to connect a search lamp, in case of repairs.

5) **Sparking plugs** "Bosch W 240 T 1" with spark plug cable terminals.

6) **Electric horn** "Bosch HO/FDF/6/1"

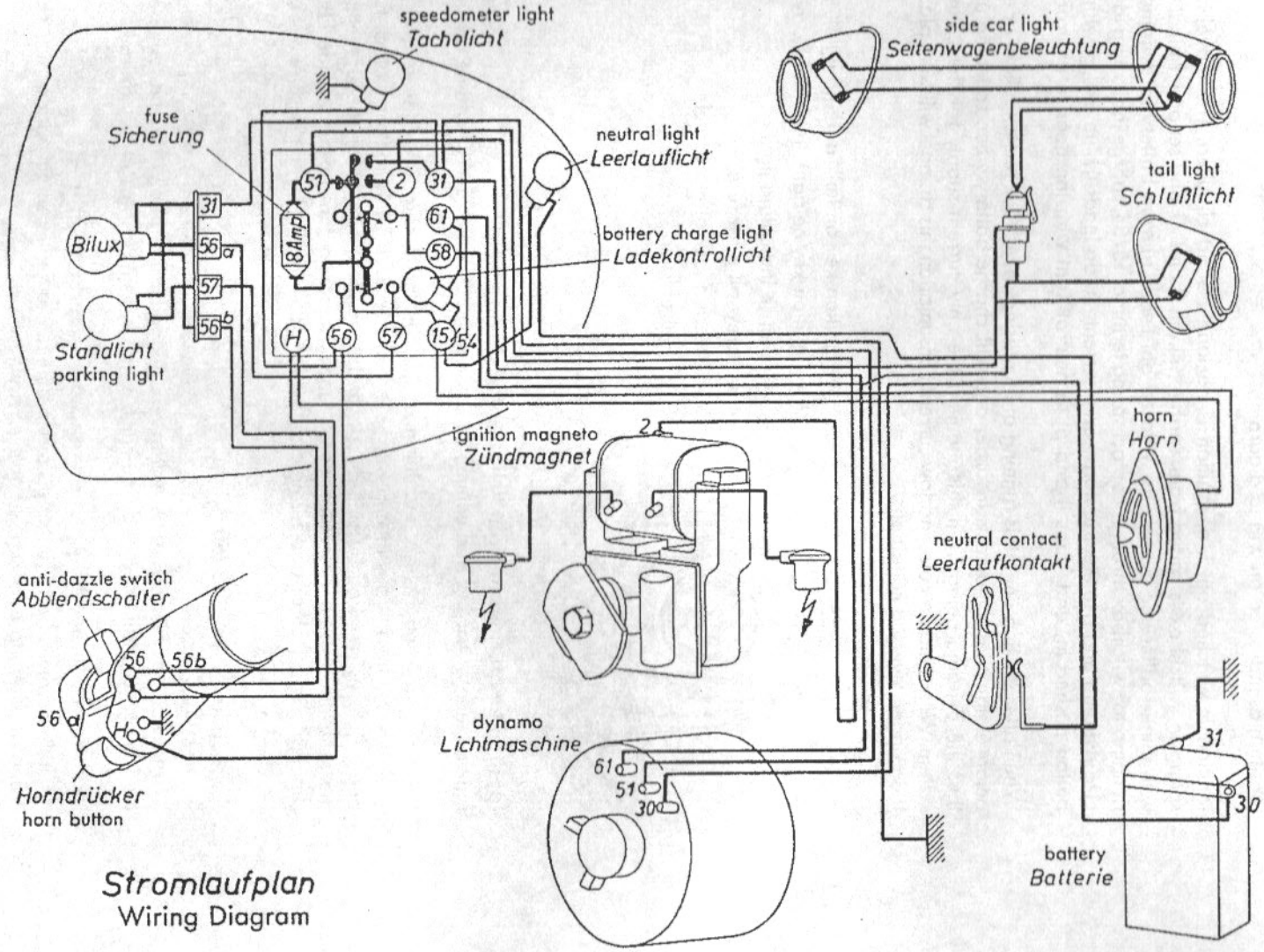
7) **Neutral contact** in gearbox with contact spring and cable passage through cover of hand gear change mechanism.

8) **Switches and leads**

The main switch for the electric system takes the form of a switchbox housed in the headlamp. The ignition key can be turned to left, to right and can be withdrawn. Besides a combined horn push-button and anti-dazzle switch are mounted on the left handlebar, the latter having wire connection with the headlamp.

Connection from headlamp switchbox to the different terminals is provided by the main motorcycle wiring with wires of 1.5 sq. mm., respectively 2 x 0.75 sq. mm., as follows:

Lead	Colour of lead	sq. mm.	from		to	
			Terminal	on	Terminal	on
a)	black	1.5	30	dynamo	+	battery
b)	black	1.5	–	battery	earth	gearbox
c)	brown	1.5	earth	dynamo	31	switch box
d)	red	1.5	51	dynamo	51	switch box
e)	blue	1.5	61	dynamo	61	switch box
f)	black	1.5	15/54	switch box	1st	electric horn
g)	black	1.5	HO	switch box	2nd	electric horn
h)	black-red	1.5	2	switch box	2	ignition magneto
i)	black	1.5	1st	neutral lamp in headlamp		neutral contact in gearbox
k)	rubber cable	2x.75				
	black strand		58	switch box	insulated	tail lamp (through socket)
	white strand		31	switch box	earth	tail lamp (through socket)
l)	rubber cable	4x.75				
	strands:					
	white		56	switch box	56	anti-dazzle switch
	blue		HO	switch box	H	anti-dazzle switch
	red		56a	anti-dazzle switch	56a	country light
	black		56b	anti-dazzle switch	56b	anti-dazzle light
m)	black	0.75	31	switch box	31	lamp holder(earth)
n)	black	0.75	57	switch box	57	parking light
o)	white	0.75	56	switch box		speedometer light
p)	black	0.75	15/54	switch box	2nd	neutral light



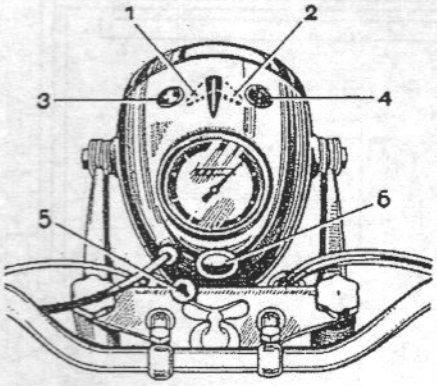
Stromlaufplan
Wiring Diagram

Switch positions of ignition key in headlamp
(see wiring diagram)

Ignition key inserted in middle position "Day-time driving"
(position as indicated on wiring diagram)

Ignition is switched on, i. e. ignition is no longer short circuited. The movable contact spring in switchbox is raised from earth terminals 2 and 31 and set on terminal 51. Herewith either battery or dynamo is switched on. Leads a) from battery to dynamo, d) from dynamo to switchbox through contact spring terminal 15/54, charge indicating lamp, leads e) to dynamo and f) to electric horn carry current. So do leads l) blue and g) with the horn button pushed in, and leads i) and p) to neutral light with the gear in neutral position.

When after starting engine is running at increasing speeds the red pilot light goes out this being a sign that dynamo is in order and will charge battery when speeding-up further, thus the dynamo being from this moment the only current supply for the entire electric system. With dynamo cold and low current consumption this change will take place sooner than under reversed conditions.



1 = ignition key on left "parking light"
2 = ignition key on right "night-time driving light"
3 = charge indicating light
4 = screw plug for fuse
5 = steering lock of motorcycle
6 = neutral lamp

Ignition key turned to right "Night-time driving light"
Ignition, contact spring and connected leads as indicated under "Day-time driving".

Furthermore, through fuse and terminal 56, current is carried by the following leads: l) white for Bilux lamp and herewith l) red for normal driving light or l) black for dipped beam light as required by anti-dazzle switch position, and o) for speedometer light. At the same time voltage is delivered to lead k) black to tail lamp and side car through rubbing contact block and terminal 58 whilst earth leads k) white and m) rest always on terminal 31.

Ignition key turned to left "city light"
Ignition, contact spring and connected leads as indicated under "day-time driving".
Moreover current is carried by lead n) to parking light through fuse and terminal 57, and lead k) black to tail lamp and side car through rubbing contact and terminal 58.

Ignition key turned to left and withdrawn "parking light"
Ignition is switched off for being short circuited. Movable contact spring rests on contacts 2 and 31. Lighting as described under "city light".

Ignition key in middle position and withdrawn "cut out"
Movable spring rests on contacts 2 and 31.
Ignition and all other electric appliances are cut out.

II. Maintenance

It must be emphasized that without regular attention the electrical equipment cannot be expected to function correctly. All non-soldered connections on terminals, battery, dynamo, ignition magneto and switch-box should therefore be kept in clean condition. Prevent battery terminals from corrosion by coating them slightly with grease. All switch-box contacts, breaker contacts of ignition magneto and contact surfaces on bulb holders must be exempt of dirt and moisture. Moreover, with respect to the different units the following instructions should be kept in mind:

1. Battery

When driving over a long distance during night-time the rider should in any case make certain that the dynamo has as high a momentum as to provide the wiring circuit with a sufficient output. This requires changing down to a lower gear at the right moment and eventually driving with city light in well-lighted streets to allow dynamo to recharge battery. Although the motorcycle is equipped with magneto ignition, it is not good practice to draw the last current reserve from the battery for this would seriously reduce its service life.

Inspect battery every 4 weeks (in the tropics at shorter intervals); if liquid level is too low top-up with distilled water. Electrolyte must not be added to the battery, unless some has been spilled accidentally.

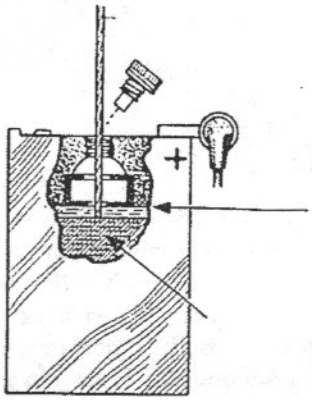
If the motorcycle is to be out of use for a considerable period, its battery must be removed and given a refreshing charge at intervals of about 6 weeks, after having been discharged previously with the help of a 6-volt/5-watt lamp.

Before being used, a new battery is to be filled with chemically pure electrolyte (specific gravity 1.280, in the tropics 1.230) making certain that its level stands inside the built-in splash protection box (on batteries of other makes top-up to about 6 mm = .24" above the top of the plates). Thereupon leave battery for 5 hours without moving it, and if level has dropped, top-up to the aforementioned value.

Electrolyte can be obtained by mixing 1 part chemically pure sulphuric acid with 2 parts of distilled water. When doing so, the acid must in any case be cautiously poured into distilled water, never proceed in the reverse order. The exact specific gravity of electrolyte is obtained by carefully adding acid or distilled water after liquid has cooled down.

Then connect battery (+ to + and − to −) with an independent source of electricity and charge for about 12 to 14 hours (the 7 ampere-hour battery with .7 amperes). The battery is fully charged when tension of each cell amounts to 2.7 volts so that the 6-volt battery has a total of 3 x 2.7 volts = 8.1 volts. With this voltage cells must have uniform gas development and specific gravity of electrolyte should be again 1.280 (1.230). On no account omit to unscrew the vent plugs before beginning with the charging procedure.

After having performed this charging, proceed to discharge battery with the help of a 6-volt/5-watt lamp, until bulb lights only slightly. Thereupon battery is to be recharged in a manner similar to that already described. Before screwing in the vent plugs, dip rubber

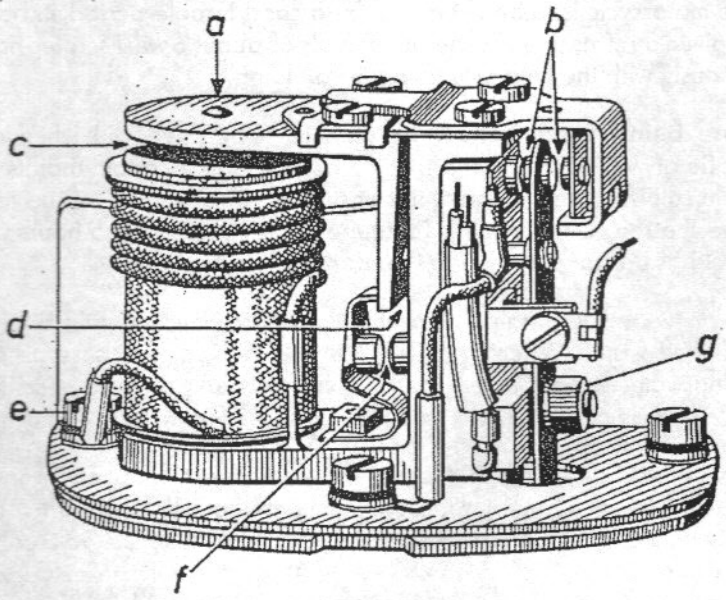


hose of hydrometer as far as possible into each battery cell until resistance is felt, so that rubber hose abuts against bottom of splash protection box, and remove electrolyte from bottom by suction. (On batteries of other makes electrolyte level must be brought to about 6 mm = .24" above the top of plates). To make certain that the last traces of electrolyte have been sucked from bottom of splash protection box, the above procedure should be repeated thrice at least. After this thorough treatment has been carried out the battery may be installed on the vehicle.

2) **Dynamo**

At intervals of about 6000 miles any deposits of carbon dust should be wiped off the dynamo. The commutator is to be cleaned only with a clean, petrol-moistened cloth. Brushes which are worn down have to be discarded (only use correct, genuine Noris brushes). The brushes must move freely in their holders and brush springs must provide a pressure of 300 to 400 grams = 10 to 14 oz. to press the brushes against the commutator.

After workshop repairs special care should be taken in cleaning off all foreign particles, particularly chips which might have found their way in to the air gap (c) between regulator armature and winding core as well as in the air gap (d). If such intruders have collected, wipe them out with a stiff paper strip.



Voltage regulator for the dynamo

a Regulator armature (to be depressed to ensure proper poling)
b Regulator contacts (to be cleaned with steel strip)
c Air gap } to be cleaned with stiff paper strip
d Air gap }
e Earth terminal of regulator
f Switch contact (to be cleaned with steel strip)
g Nut for adjustment of charging current

7) Spark plug cable terminals

The bakelite spark plug cable terminals have metallic shields on their lower ends to prevent the ingress of water even at heavy rainfalls and when riding on muddy roads. Terminals on which the metallic shields have become loose, must be replaced by new ones for otherwise penetrating rainwater will produce tension leakage to ground and irregular ignition. Besides be careful to keep inner sides of terminals in clean and dry condition.

8) Spark plug cables

As these cables are carrying high-tension current, particular care must be taken to keep their insulation in correct condition. In cases of emergency defective spots may be protected by means of a rubber hose with a thickness of at least 2 mm = .08". Make certain that rubber sleeves have been pulled over spark plug cables to provide water-tight joint with the spark plug cable terminals.

III. Locating and rectifying of possible troubles

Before beginning repair or maintenance operations on the electrical equipment, disconnect battery, except in cases where it will be absolutely needed for certain tests.

1. Ignition system

If engine fails to start or suddenly stops though it is fuelled and carburettors as well as sparking plugs function properly, the cause of the failure is likely to be in the ignition system. To locate the trouble, examine ignition system as follows:

Unscrew both sparking plugs, withdraw the two ignition cables from sparking plug terminals, rest one cable on earth (some metal part of engine) and hold the other one in about 5 mm = .2" distance from a cylinder rib whilst revolving engine. Sparks must jump now from cable to cylinder rib.

If there is no spark, the trouble may be due to some of the following causes:

Probable faults	Remedy
a) Ignition key does not work correctly. The movable contact spring in switch-box fails to come away from earth (ground) contact.	In case of emergency when attempts of rectifying this trouble in situ have failed, remove engine front cover and disconnect cable from terminal 2 on ignition coil (see figure page 3). In this case, however, engine cannot be turned off with the ignition key.
b) Cable between terminal 2 in switch-box and terminal 2 on ignition coil is earthed (tension leakage to ground).	Replace cable; in case of emergency disconnect cable from terminal 2 on ignition coil as indicated above.
c) Ignition cable is defective or earthed (tension leakage to ground).	Install new ignition cable.
d) Breaker contacts are dirty, oxidized or charred.	Remove engine front cover and clean both contacts with contact file. Check for proper breaker gap (0.4 mm = .016")
e) Heavy contact firing, i. e. excessively burned contacts owing to defective condenser.	Replace condenser (this unit cannot be repaired) and clean contacts with contact file or replace them. Adjust breaker gap as indicated under (d).
f) Breaker lever jams	Clean bearing bush and fulcrum pin of breaker lever and apply a trace of engine oil.
g) Cam fails to lift breaker lever. Rubbing blocks on lever are worn down.	Replace breaker lever and readjust breaker gap as indicated under (d).
h) Safety spark gap is too small.	Adjust for a gap of 10 to 11 mm = .4 to .44" (see figure on page 3).
i) Tension leakage from ignition coil to some outer metal part.	Insulate ignition coil by brushing it with shellac. In this way also treat engine parts surrounding ignition coil to prevent spark jumping to them.

3. Ignition magneto

The ignition magneto does not need an alien current supply. The ignition current is created by a permanent magneto rotating in the field of ignition coil. From this would result a mere alternating current, but provision is made by adopting a contact breaker and an adjacent condenser, that current cannot be produced except at a certain instant, i. e. when breaker opens. To ensure current supply at the moment of opening, the permanent magneto must always have a definite position in relation with the breaker operating cam. In case of incorrect position either no spark or only poor spark is produced. Therefore, when installing the ignition magneto assembly (engine crankshaft at retarded spark) care should be taken in making certain that mark on rotor of ignition magneto corresponds with mark on breaker plate and that ignition timing is correctly adjusted.

Make sure breaker contacts are clean and dry. For this end best insert a clean, smooth and grease-free steel strip, approximately as thick as a postcard, between the contacts, and move it to and fro for several times. Contacts which are pitted, excessively rough or burned, must be cleaned with a flat, fine-cut contact file, or be replaced. Furthermore the cam lubricating felt wick should be regreased from time to time by rubbing a trace of heat-resistant grease into the felt (using only a trace to avoid getting lubricant on contact points).

The advance weights must turn freely on their fulcrum pins. To check this, draw both advance weights with breaker contacts closed, with 2 fingers to their most extreme (full advance) position and leave them when this position is reached. Now the weights must return easily to their stationary position.

Both safety spark gaps should not underpass a limit of 10 to 11 mm = .4 to .44", whilst opening of breaker contacts should not exceed 0.4 mm = .015". Check these distances from time to time. Also, the contact breaker lever must work freely on its fulcrum pin.

4. Headlamp

First of all components of this unit inspect switch box and its contacts at regular intervals and remove carefully all signs of corrosion. Hold in mind to avoid getting grease on contacts and lamps. Check all leads in headlamp for chafing marks and other defects. The ignition lock, however, should be given a grease coating to prevent the ingress of water.

Fuse in headlamp

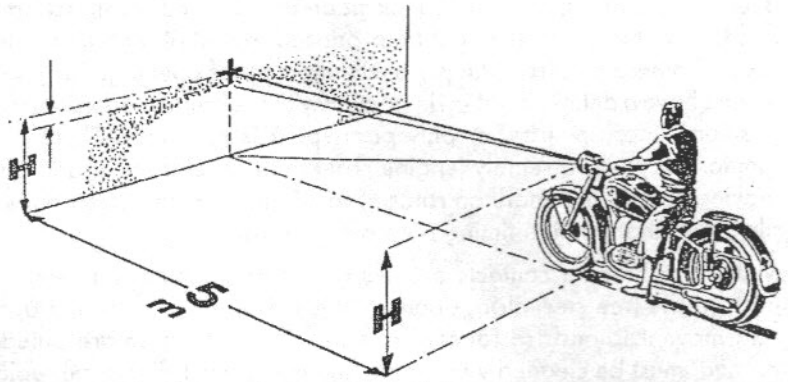
For technical reasons the 8-ampere fuse in headlamp only applies to lighting circuits 58, 57 and 56. If the fuse has blown, this may rather be caused by a defect in lead to tail lamp than by one of the headlamp bulbs.

An 8-ampere fuse only blows when the passing current exceeds a limit of 15 amperes. If for example a short circuit takes place in the vicinity of the tail lamp, owing to cable resistance and low 6-volt tension the current cannot assume such values that the fuse will blow. Though owing to their liberal size wires sustain currents exceeding 15 amperes without being damaged, such amperage would require an extremely high output from the dynamo and endanger the entire current supply. Therefore the spring of contact (f) in figure page 8 is bimetallic so that with excessively high amperage the spring becomes hot and bends, thus causing contact to open and cut out dynamo current. As the contact closes again, this interruption lasts only for short moments. This manoeuvre becomes perceptible through periodical lighting of charge indicating lamp in headlamp while driving.

Moreover, as the switch plug box mounted beneath the saddle carries current together with the tail lamp and side car lamps are eventually connected, the respective leads must also be checked for faults of this kind.

Headlamp adjustment

In order to guarantee the rider's own security and to eliminate hazards to other drivers, it is very important to check headlamp adjustment at regular intervals.



Headlamp adjustment (correctly focussed dipped beam)

Testing procedure:

Make a cross on a light-coloured wall at a height corresponding to the centre of headlamp. The height of headlamp is marked with an "H" and amounts to 35" for model R 51/3 and model R 67/2 (solo machines). The motorcycle stands on its wheels 5.45 yds. from the wall and is loaded with the driver.

Adjusting the main driving beam:

After switching on the main driving beam, adjust headlamp, so that the centre of the bright spot on the wall coincides with the marking.

Checking the dipped beam:

After switching to the dipped beam check if the border line between light and dark areas, i. e. the upper border of the brighter illuminated wall is 2" or more below the mark. If this distance is less than 2", headlamp must be readjusted.

With side car:

When a side car is attached to the motorcycle, the headlamp must be readjusted. This is done in accordance with the above directions but with motorcycle loaded with the rider and one person in the side car.

5) Main motorcycle wiring (cable harness)

Check from time to time the various leads of cable harness for proper insulation and inspect their connections on terminals of all units. Covering hoses and rubber sleeves must be in correct condition. If chafing marks are detected, the wire in question must be replaced by a new one. No insulating tap should be used except for short periods, in cases of emergency.

6) Sparking plugs

The engine in delivered trim is fitted with Bosch W 240 T 1 sparking plugs. When installing replacement sparking plugs of other makes, extreme care must be taken in selecting types with identic heat ratings.

The tops of the plugs must be kept clean and dry at all times. The electrode gap should never exceed 0.8 mm – .032". Check it from time to time and, if adjustment is necessary, tap or prise earth point on body to give the required gap of 0.5 mm – .02".

Dirty sparking plugs must not only be slightly cleaned with petrol, but in a way that also the mouth of body and the insulator foot will be freed of any sooty deposits. This is best done by applying a sand blasting procedure or by scraping clean internally with a small, hard wire brush. Never use brass brushes or soft metal objects because they leave traces of metal on insulators, which might cause tension leakage to earth with ensuing inter-mittent sparking.

Probable faults	Remedy
k) Defective ignition coil.	Replace it (unit cannot be repaired).
l) Automatic ignition timer (centrifugal advance mechanism) not functioning.	Clean rotor shaft and cam bore and apply a trace of oil.
m) If intermittent sparking occurs at high speeds only, this may be due to one of the following causes:	
Lead deposits on sparking plug insulator feet;	Continual use of leaded fuel may produce a lead deposit on sparking plug insulator feet. With cold sparking plugs such deposits are not likely to cause tension leakage to earth, but this occurs with hot sparking plugs (above 500° C = 930° F). Best remedy: Replace plugs.
Contact breaker spring is slightly distorted so that breaker lever rubs with its bushing on support or lock washer and thus cannot function properly.	Bring contact breaker spring in parallel position with engine.

2. Dynamo troubles

As adjustments on lacquer-sealed nut (g in figure page 8) and contact springs of regulator-cutout would invalidate guarantee claims, such jobs should only be done in a "Noris" workshop or in cases of emergency a specialist for electrical equipment ought to be entrusted with them.

Checking of dynamo:

Switch on full lighting, actuate electric horn.

With horn in action, lighting may only drop slightly.

Otherwise battery must be given a refreshing charge from an independent electrical supply.

Install fully charged battery, let engine run up to 2500 r. p. m., cut in full lighting and disconnect lead from battery (–) post. With cable removed lighting should increase slightly, and lower a bit when cable is replaced on battery (–) post.

If lighting reacts contrarily, dynamo output is insufficient and hexagon adjusting nut (g) on lower end of voltage regulator spring must be tightened slightly no more than one twelfth of a turn (see figure page 8).

Testing of lighting equipment with ammeter:

Use ammeter of the centre-zero type. Install fully charged motorcycle battery. Interpolate ammeter in lead between battery (–) post and earth (see wiring diagram). Thereupon cut in main driving light for a moment and ascertain direction of indication. The noted direction means "discharge", whereas contrary direction would indicate "charge".

Testing procedure:

1. First allow engine to warm up on centre stand and with transmission on top gear speed up to about 3000 r. p. m. which rate is obtained with the following speedometer indications: R 51/3 solo = 46.5 m. p. h. with side car = 39.8 m. p. h.
   R 67 and R 67/2 solo = 51.2 m. p. h. with side car = 41.4 m. p. h.
2. Cut in main driving light and hold engine speed for a short period at above named value. Ammeter must show **charge reading** within a 0 to 0.5 ampere range. If ammeter does not show charge reading,
3. first switch off main driving light, then turn off engine. If current output was too high, loosen hexagon nut (g) on lower end of voltage regulator spring (see figure page 8) slightly no more than one twelfth of a turn *).

   If current output was too low, tighten hexagon nut (g) on lower end of voltage regulator spring slightly no more than one twelfth of a turn *).

   After this readjustment repeat the test in a manner similar to that indicated above.

   If the prescribed charge reading is not reached after all, switch off lighting again, turn off engine and readjust setting of voltage regulator by means of hexagon nut (g) *).

   These adjustments should be repeated until the correct amperage (charging current of 0.2 to 0.5 ampere) has been obtained.

*) Have regulator-cutout adjusted in a „Noris" workshop only.

Troubles and their remedies

Probable faults	Remedy
a) Charge indicating lamp does not extinguish.	
Brushes not bearing upon commutator or sticking in their holders,	Adjust brush springs, replace worn brushes. If a brush is inclined to stick, remove it from its holder and clean its sides to get it working.
Commutator fouled or greasy,	Clean commutator with a petrol - moistened cloth. If dirt has accumulated in slots between commutator segments, wipe it out with a wooden stick.
Regulator contacts dirty,	Clean contacts (b, see figure page 8) by inserting a proper, thin steel strip between them and moving it back and forth. Under no circumstances file these contacts.
Field winding earthed (field winding damaged by pole-shoe edges),	If the field insulation is chafed so that the windings are exposed, insulate such spots with shellac and replace coils in same position as originally.
Defective armature winding.	Replace armature.

Probable faults	Remedy
b) Charge indicating lamp burns dimly during operation (a very slight glowing, specially with lighting cut-in is unimportant and will disappear with battery given full recharge).	
Battery discharged or defective,	Give battery a refreshing charge from an independent electrical supply or replace it.
Loose cable connections,	Tighten cable terminal screws on engine, headlamp and battery, clean earth connection on battery.
Dirty or rough contact points of voltage regulator,	Disconnect battery, clean contacts (b and f on figure page 8) by inserting a proper, thin steel strip between them and moving it back and forth. Under no circumstances file these contacts.
c) Charge indicating lamp glows brightly and burns out or electrolyte boils over (battery overheated), so bulbs burn out frequently:	
Voltage regulator not functioning due to foreign matters, particularly chips collected in air gap (c) between armature and winding core or between armature and body (see figure page 8),	Wipe out foreign matters with a stiff, smooth cartoon strip.
Voltage regulator not functioning due to loose earth connection (e),	Loosen earth terminal fixings screw (e) (see figure page 8) of voltage regulator slightly and retighten it.
Regulator contact points excessively charred, S-shaped contact spring not functioning, battery connected incorrectly (+ post to earth, dynamo poling has changed).	Connect battery correctly, (−) post to earth, depress regulator armature (a) for an instant slightly to ensure proper poling of dynamo. If voltage regulator has been replaced, also depress armature (a) of the new regulator slightly for a moment (see figure page 8). These operations must be carried out with dynamo stationary.
d) Charge indicating lamp lighting at regular intervals. Probable cause: Some of the electric leads are shorted.	First cut out lighting with ignition key inserted in middle position. When the trouble still exists, check if any of the following leads are shorted: Dynamo 51 to headlamp 51, headlamp 15.54 to neutral light and electric horn. If no fault was found there, first inspect leads to tail lamp and side car, then leads to parking lamp and headlamp. If, after having examined these leads, the cause of the trouble cannot yet be detected, switch on headlamp and inspect leads to Bilux lamp and lamp itself.

Probable faults	Remedy
e) Headlamp light flickering or extinguishing temporarily.	
Cable is broken or some terminal has become loose,	Locate source of trouble by shaking or slightly pulling the various cables. Replace defective cable, tighten loose terminal.
Battery is damaged.	Breakage of plates can easily be ascertained by slightly pulling and pressing battery posts. Replace battery.

Testing of armature (removed from dynamo frame)

1. Insulation against earth. For testing procedure either use direct (continuous) or alternating current of 100 to 500 volts. Insert incandescent lamps (do not use semi-incandescent lamps) of corresponding voltage capacity in charging circuit.

Check with test lamps and test points from the commutator to the armature lamination (one test point is placed upon commutator, the other one upon lamination). Correct insulation against earth (ground) is indicated **by failure** of the incandescent lamps to light.

2. Shorted coil in armature. A shorted coil can only be ascertained by means of highly developed testing devices (growler, etc.) or of a sound detector. No armature coil is shorted if detector remains silent.

3. Open-circuited armature. An open-circuited armature is easily detectable, since this condition produces badly burned commutator bars.

Testing of fields in dynamo frame (armature is removed)

Connect (+) post of a 6-volt battery through inserted ammeter to terminal 61 on dynamo frame (yoke assembly). Field coils are in order if ammeter shows charge reading of 1.6 amperes and if a piece of soft iron (screwdriver) used for touching the various poles is attracted by each of the 4 pole shoes with the same grade of efficiency.

Resistance coil (field coil with 4 cable ends) is in order if slightly depressed regulator armature causes ammeter to lower charge reading a bit.

1. Tension leakage to ground. Ammeter reading exceeds 1.6 amperes by far or ammeter indication increases greatly with regulator armature depressed.

2. Shorted coil. Ammeter reading exceeds 1.6 amperes slightly.

3. Open-circuited field coil. Ammeter shows charge reading only with regulator armature depressed.

4. Open-circuited resistance coil. With regulator armature depressed ammeter indication returns to zero.

Before removing the used field coils to change them for new ones mark pole shoes to make certain they are replaced in same position as originally.

Lubricating Chart

Lubricating Chart for the BMW R 51/3 and R 67

Servicing Jobs (The numberals correspond to the lubrication points in the illustrations)	miles									thereafter	
	300	600	1 200	2 000	3 000	4 000	5 000	6 000	7 000	every	miles
(1) Change oil in engine, quantity required .44 Imp. gall. Oil should reach to top mark on dip stick.	x	x	x	x	x	x	x	x	x		1 000
(2) Check oil level in transmission and replenish oil in transmission until oil level reaches the lower threads of filler gap	x		x	x	x		x	x	x		1 000
Change oil in transmission, filling quantity approx. .18 Imp. gall.		x				x					6 000
[3] Grease right and left rear wheel suspension		x	x	x	x	x	x	x	x		1 000
[4] Clean hubs of disassembled wheels and fill with new grease					x			x			3 000
△5 Check oil level in rear wheel drive and replenish until oil level reaches the lower threads of filler gap	x		x	x	x		x	x	x		1 000
Change oil in rear wheel drive, quantity required approx. 130 – 140 c. c. (8 to 8 ½ cubic in.)		x				x					6 000
(6) After repairing refill 8 cu. in. of engine oil in each prong of front wheel fork						x					6 000
(7) Oil all joints of braking mechanism	x	x	x	x	x	x	x	x	x		1 000
[8] Grease universal joint of propeller shaft	x	x	x	x	x	x	x	x	x		1 000
(9) Oil clutch operating lever on gear box		x	x	x	x	x	x	x	x		1 000
[10] Grease handlebar controls		x	x	x	x	x	x	x	x		1 000
[11] Grease brake pedal		x	x	x	x	x	x	x	x		1 000
[12] Grease saddle bearing		x	x	x	x	x	x	x	x		1 000
Side-car oscillating axle		x	x	x	x	x	x	x	x		1 000

Remarks:

Legend of different above symbols:

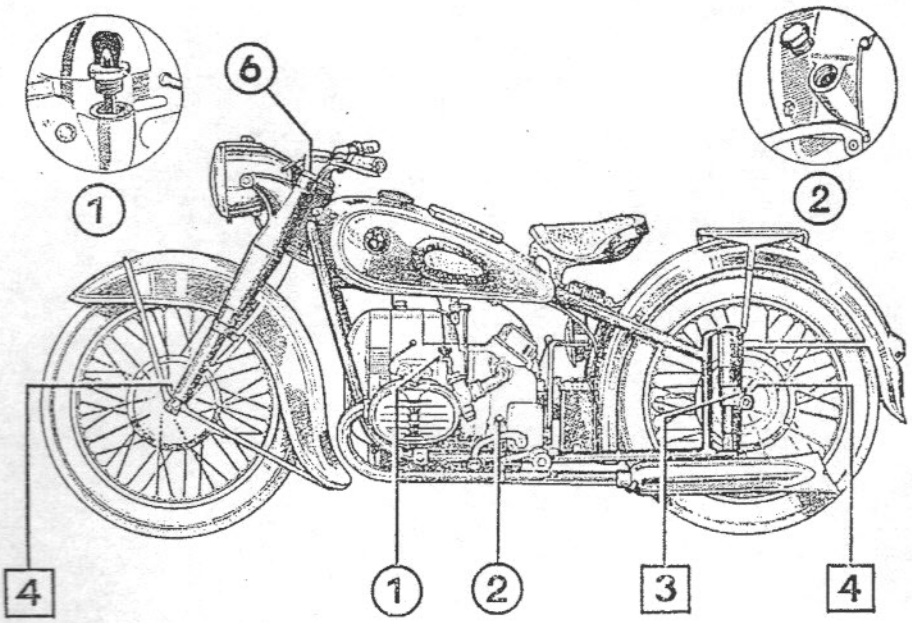
○ **Engine oil *)** engine and transmission: summer SAE 40
winter SAE 20
front wheel fork: summer and winter SAE 20
(in very cold weather mix 1 part kerosene (paraffin) with 3 parts of fork oil.)

△ **Rear wheel drive lubricating oil *)** SAE 90

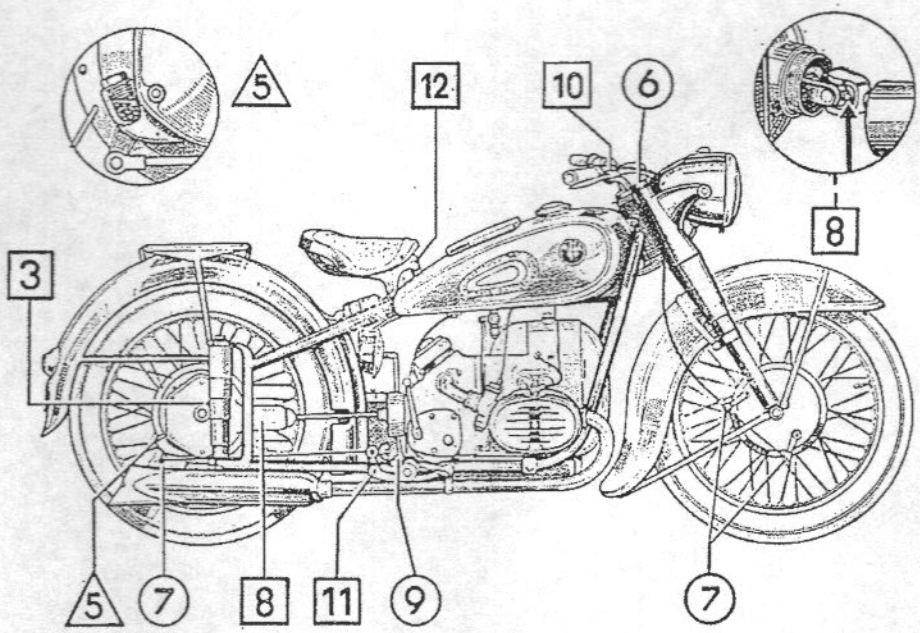
□ **Lubricating grease *)**

*) **Only use service-proven lubricants, they preserve the useful life of your motorcycle considerably.**
Our BMW agents will gladly recommend job-tested lubricants.

Lubricating Chart Group
2

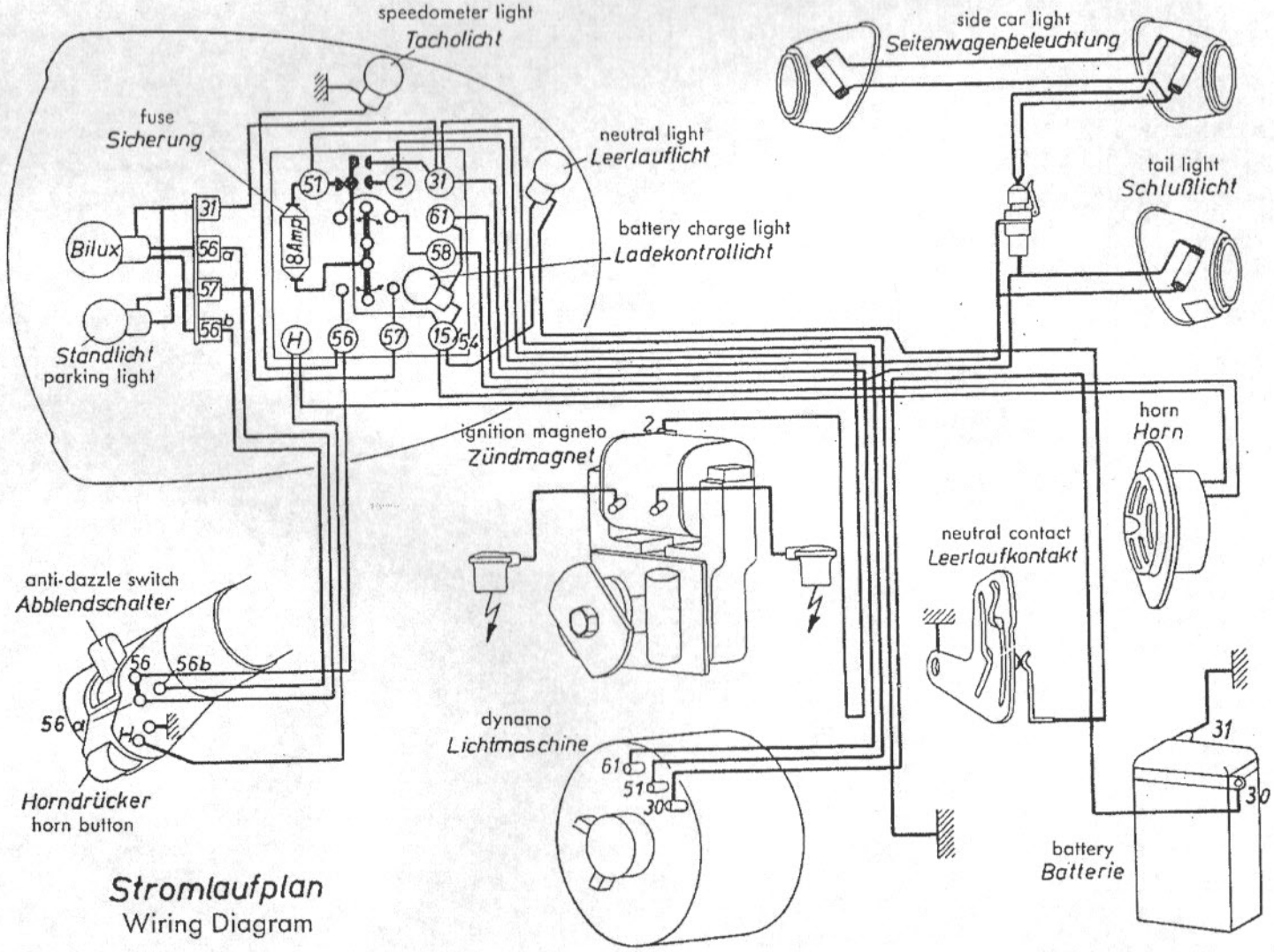


Lubrication Chart
for left side of motorcycle



Lubrication Chart
for right side of motorcycle

Wiring Diagram



Stromlaufplan
Wiring Diagram