284

REPAIR MANUAL

REPARATURANLEITUNG

MANUEL DE REPARATION

MANUAL DE REPARACIONES

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MODELS

R 50 · R 50 S · R 60 · R 69 S

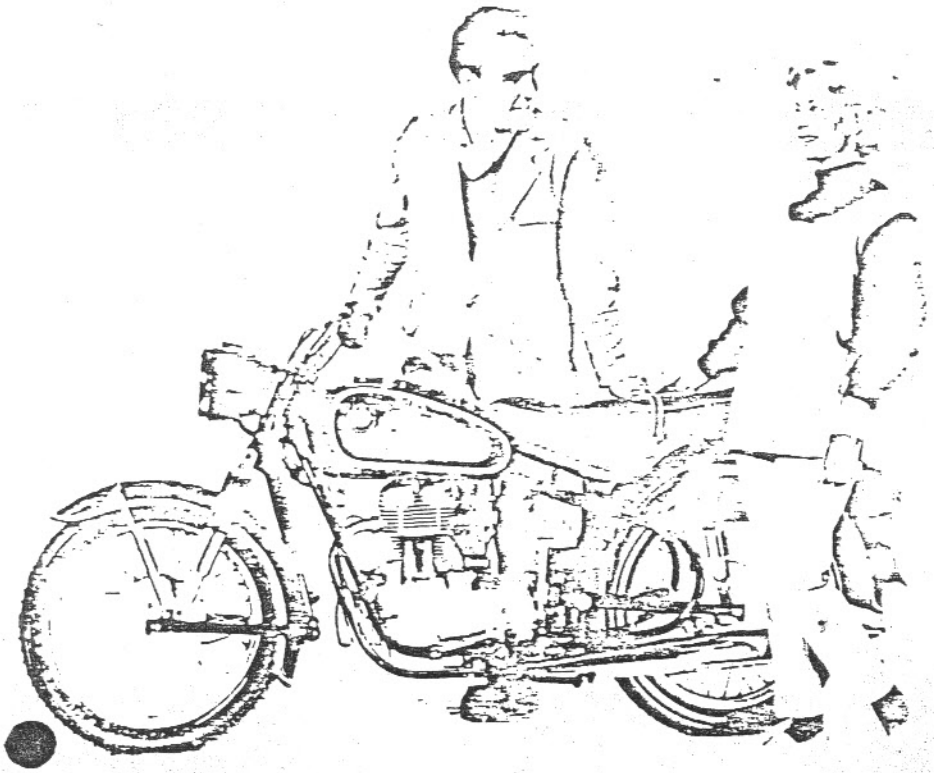
FOR MODELS R50 US - R60 US - R69 US
SEE SUPPLEMENT - PAGE

Announcement

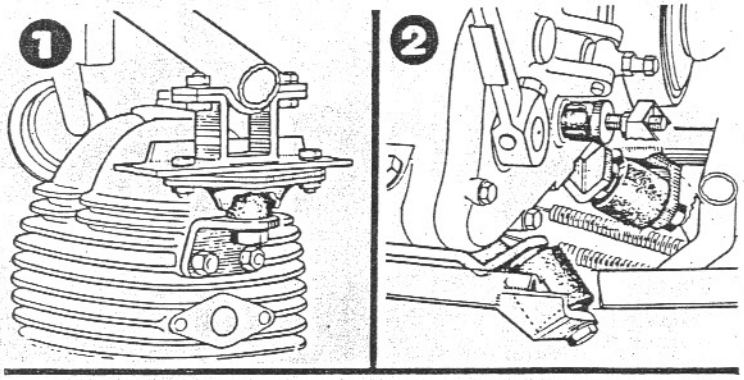
This is probably one of the most complete shop manuals ever published, as it pertains to servicing and maintenance of the famous BMW Motorcycles built in Munich, Germany. The text and picture captions are printed in four languages—English, German, French and Spanish—and is a reproduction of the shop manual covering the following models: R50, R50S, R60, R60S, R26, and R27. It is actually two books in one. The first section covers the twin models. The single cylinder models data starts on page 160.

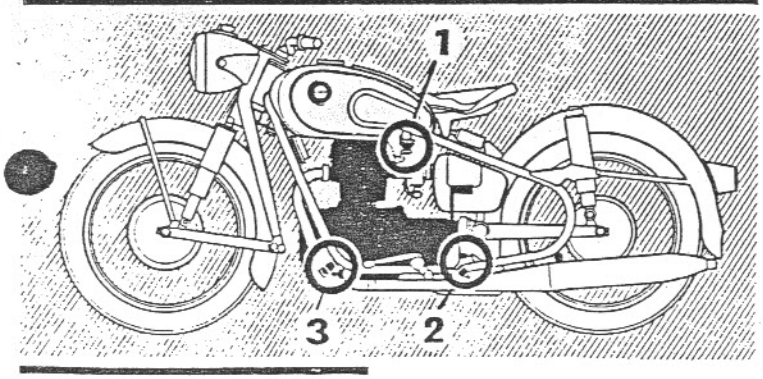
This manual is not intended to make the BMW owner an expert mechanic, but to give him a better understanding of the fundamentals of what many experts in every country consider to be the finest motorcycle available. BMW models are unique, have a long life with seldom needed repairs and, due to few yearly changes, they have an exceptionally high resale value.

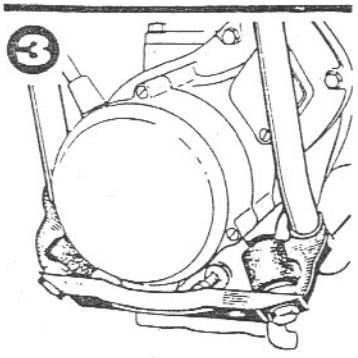
When service is needed, we urge every rider to go to the nearest BMW dealer, as most of them have the necessary special tools to do a proper job and mechanics trained in factory methods. They also have genuine BMW factory parts.



This economical, vertical-cylinder single has long been a favorite of riders who desire economy, dependability and moderate performance.







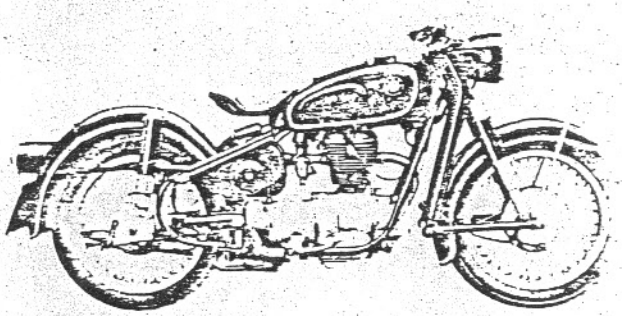
Die neue BMW R 27 mit Schwebemotor, 250 ccm, 18 PS

»Schwebemotor«, eine alte BMW Tradition – aber ein neuer Begriff im Motorradbau.

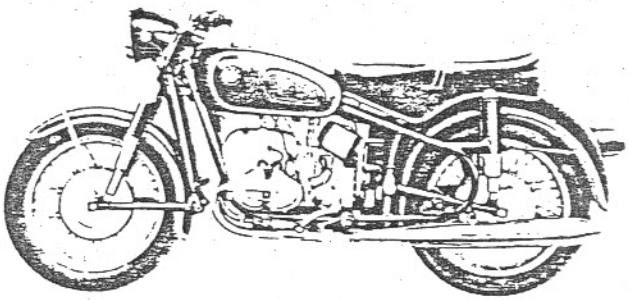
Der Schwebemotor der BMW R 27 ruht auf 4 schraggestellten, hochelastischen Gummiblocken. Die Schwingungsanschläge werden am Zylinderkopf durch einen Topfgummi begrenzt, die Längsverschiebung des Schwebemotors durch 2 Gummiblocke. Rahmen und Lenker sind von störenden Schwingungen isoliert.

BMW Werkzeichnung
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BMW R27 floating engine described here in a German magazine.



BMW R27 with rubber-mounted floating engine. Single seat and short bars are foreign rider preferences.



BMW R69S Sport with dual-seat and short handlebars.

Foreword

The increasing competition on the motorcycle market requires more than ever careful attending of the customer in order to give him satisfaction with his motorcycle and to maintain his confidence in dealer and factory.

It is a most important factor for good service to repair the clients' vehicles correctly in a well organized and clean repair shop equipped with all necessary special tools. In such a workshop also qualified specialists who have been trained in the BMW service school will feel happy. Herewith the best guarantee is given for competent and quick execution of repair work to the satisfaction of the customer and the management.

It is the purpose of this workshop manual to serve this aim by indicating the competent working order with the use of the corresponding special tools.

The workshop manual therefore ought to be always within the workshop being at hand of every mechanic working on BMW motorcycles.

BAYERISCHE MOTOREN WERKE
Aktiengesellschaft
München 13

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The purpose of this workshop manual and its illustrations is to explain the operations necessary for disassembly, repair and reassembly as far as this work can be carried out in a well organized repair shop for motorcycles by mechanics trained in the BMW Service School.

In order to hold the description as clear as possible the basic and already well known working operations are summarized in only short explanations.

The repairs are classified in main groups as for instance M = Engine, G = Transmission a.s.o. Each main group is further divided into subgroups, such as M 1, M 2, a.s.o.

The same abbreviated specifications are also used in the Flat Rate Manual.

Repairs on the engine and transmission especially should be carried out in dust-free places.

During breaks disassembled transmissions and openings leading to the inner engine parts or lubrication holes should be protected from dust by clean rags.

In order to obtain first-rate work and to decrease at the same time the working hours, the listed special tools and the tools made on drawings must be applied. For unscrewing and tightening of bolts and nuts, box or ring wrenches should be used whenever possible.

On disassembling of parts attention has to be paid to the arrangement of lockwashers on screws and nuts, spacing washers, gaskets, rubber mounts a.s.o. If necessary mark mating parts in order to guarantee correct assembly.

Valves, valve springs, spring retainers, rockers, pushrods, tappets, pistons, connecting rods and bearings should be put away in suitable boxes.

Disassembled parts have to be cleaned and thoroughly checked for the following:

Sliding and rolling surfaces for wear and freedom from scoring marks, all metall parts, particularly castings, tempered parts and welded joints as well for cracks and corrosion, and rubber parts for suitableness.

As a rule all gaskets and tab washers are to be replaced on reassembling.

As the reassembly has to be carried out precisely in the reverse order it has not been considered necessary to separately explain the assembly. Variations herefrom as well as necessary gauging or special measures which have to be respected on assembly are mentioned under the remark "Caution" or "Important".

Engine:

Type of engine: Opposed type two cylinder, four-cycle engine, with V-type overhead valves.

Models	R 50	R 50 S	R 60	R 69 S
Nominal rated horsepower	26	35	30	42
at engine r.p.m.	5800	7650	5800	7000
Bore (mm.)	68	68	72	72
Stroke (mm.)	68	68	73	73
Piston displacement (c.c.)	490	490	590	590
Compression ratio	6.8:1	9.2:1	7.5:1	9.5:1

Valve timing, with valve clearance of 2 mm. (.08"), (tolerance ± 2.5 deg.):	R 50 + R 60	R 50 S + R 69 S
Intake opens	6 deg. aft. T.D.C.	4 deg. aft. T.D.C.
Intake closes	34 deg. aft. B.D.C.	44 deg. aft. B.D.C.
Exhaust opens	34 deg. bef. B.D.C.	44 deg. bef. B.D.C.
Exhaust closes	6 deg. bef. T.D.C.	4 deg. bef. T.D.C.

Valve clearance (as measured when engine is cold):	
Intake	0.15 mm. (.006")
Exhaust	0.20 mm. (.008")

Lubrication system:	Combined force-feed/centrifugal lubrication, operated by geared pump; oil sump.
Lubricants:	Brand-name SAE 10 W 30 HD oils for gasoline engines, summer and winter
Engine oil capacity	2 liters (.52 U.S.gal. or .44 Imp.gal.)

Carburetors:	R 50	R 50 S	R 60	R 69 S
Type	Two inclined BING carburetors with sliding throttle and needle valve			
BING model left	1/24/45	1/26/71	1/24/125	1/26/69
BING model right	1/24/46	1/26/72	1/24/126	1/26/70
Venturi (mm.)	24	26	24	26
Main jet	105	135	110	135
Needle jet 45–251/	1308	1208	1308	2108
Jet needle 46–	255	934,Nr.4	255	934,Nr.4
Needle position	3	2	3	2
Idling jet	35	35	35	35
Idling mixture adjusting screw	proper position: open 1 to 2½ turns			
Sliding throttle	22–470	22–531	22–470	22–531
Weight of float	7 gms. ¼ oz.	7 gms. ¼ oz.	7 gms. ¼ oz.	7 gms. ¼ oz.
Intake air filter	Common micronic dry filter, with sliding choke (strangler) for R 50 and R 60, without sliding choke for R 50 S and R 69 S			

Ignition	BOSCH MZ ad/R magneto
Drive	direct from camshaft, at half engine speed
Contact breaker gap	0.4 mm. (.016")
Ignition timing	Automatic centrifugal advance and retard unit on camshaft
Firing point	9 deg. before T.D.C. (with governor weights in stationary position)
Timing range	30 deg. of crankshaft
Max. advance	39 ± 2 deg. before T.D.C.
Spark plugs R 50 and R 60	BOSCH W 240 T 1, or BERU 240/14
R 50 S and R 69 S	for running-in period: BOSCH W 240 T 1, or BERU 240/14, afterwards: BOSCH W 260 T 1, or BERU 260/14
Electrode gap	0.6 mm (.024")
Generator (Dynamo)	BOSCH LJ/CGE 60/6/1700 R 5, with integral voltage regulator
Drive	direct from crankshaft
Horn	KLAXON ETF/4 D
Battery	6 volts/8 ampere-hours

Lighting System

Headlights	BOSCH LE/MTA 160×2 (48/3)
Bulb data	
Country and traffic	Bilux lamp (twin-filament), 6 V, 35/35 watts
Parking light	Pilot lamp, 6 V, 2 watts
Neutral indicator	Pilot lamp, 6 V, 2 watts
Charging indicator	Pilot lamp, 6 V, 2 watts
Speedometer illumination	Pilot lamp, 6 V, 1.2 watts
Tail and stop light	Twin-filament lamp, 6 V, 5/18 watts
License plate illumination	Round-bulb lamp, 6 V, 5 watts
Blinker unit	HELLA BI 81
Blinker bulb	Tubular lamp, 6 V, 18 watts
Jack (socket), one-pole	under saddle; for sidecar lighting or work (inspection) light

Clutch	Single-disc, dry plate clutch with disc-type central spring
Transmission	Four-speed, with sliding dog clutches, integral with engine, torque-dampened in all gears
Gearshift	Positive-stop, sequential, foot-operated

Gear ratios		R 50 + R 60 with sidecar
1st	4.171 : 1	5.33 : 1
2nd	2.725 : 1	3.02 : 1
3rd	1.938 : 1	2.04 : 1
4th	1.54 : 1	1.54 : 1

The transmission housings containing the "Solo" or "Sports" ratio gear cluster are marked with the sign "S" at the oil filler plug.

Lubricant	Engine oil as specified for engine
Capacity	0.8 liters (.21 U.S. gal. or .18 Imp. gal.)
Power transmission from gearbox to rear drive	Universal shaft from gearbox to rear drive, fully enclosed in oil-bath right-hand rear swinging arm. Coupling to gearbox shaft by universal joint on needle bearings, internally-splined coupler gear to rear drive.
Lubricant in right-hand rear swinging arm	Brand-name SAE 40 engine oil, summer and winter
Capacity	150 c.c. (9 cu. in.)
Rear-axle drive	Spiral bevel gears in oil-bath

Bevel gear ratios	R 50, R 60	R 50 S	R 69 S
Solo	3.13 : 1	3.58 : 1	3.13 : 1
No. of teeth	8/25	7/25	8/25
Sidecar	4.33 : 1	(4.33 : 1)	(4.33 : 1)
No. of teeth	6/26	(6/26)	(6/26)

Lubricant	Brand-name SAE engine oil, summer and winter
Capacity	150 c.c. (9 cu. in.)

Frame, Suspension, Wheels

Frame	Welded duplex-tube steel frame

ing employing multi-rate coil springs and dual-action hydraulic shock absorbers. (For sidecar work set pivot into front eye of front fork and upper telescopic leg mounting into the lower position on the fork. Install the stronger coil springs.)

Trail (castor) of Front Wheel

Solo	95 mm. = 3.74" (swinging arm pivot in the rearward location on the fork and spring leg mountings in the upper position on the fork)
Sidecar	60 mm. = 2.4" (swinging arm pivot in the forward location on the fork and spring leg mountings in the lower position on the fork)
Rear Suspension	Pivoted swinging arm springing employing multi-rate coil springs and dual-action hydraulic shock absorbers. Two-position adjustment for load on rear shock absorbers. (For sidecar work, install the stronger coil springs.)

Wheel Rims

Solo	Light-alloy drop-center rims, 2.15 B x 18 (40 spokes)
Sidecar	All wheels: steel drop-center rims; front 2.15 B x 18, rear 2.75 C x 18, sidecar wheel 2.15 B x 18

Tires (Tyres)	R 50, R 60	R 50 S and R 69 S
Solo, front and rear, sidecar motorcycle, front, and sidecar wheel	3.50–18	3.50–18 S
Sidecar motorcycle, rear	4.00–18	(4.00–18)

Max. unbalance	9 gms. (.32 oz.), as measured at inner rim diameter

Tire Pressures (psi)	Front Wheel	Rear Wheel	Sidecar Wheel
Driver alone	20 (24)*	24 (28)*	–
Driver and passenger	20	33	–
Driver with occupied sidecar	21	27**	27
Driver and passenger plus occupied sidecar	21	38**	27

* for R 50 S and R 69 S at high speeds

** with 4.00×18 tire

	with integral gray-cast iron rings. Front: duplex brake (2 leading shoes), rear: simplex brake
Brake drum	Diam. 7.8", width 1.4"
Effective brake lining area	28.2 sq.in.

Dimensions (without load)	
Overall width*	26", R 69 S = 28.4" engine width
Width of solo handlebar*	26"
Width of sidecar handlebar*	29.3"
Overall width of motorcycle with attached sidecar*	64"
Overall height	38.6"
Saddle height	28.5"
Overall length	83.6"
Overall length of motorcycle with attached sidecar	94.4"
Wheelbase, solo	55.7"
Wheelbase, with sidecar attached	57"
Track width, motorcycle with attached sidecar	43.3"
Ground clearance	5.3"

* without blinkers

Weights

Curb weight*	R 50, R 50 S, R 60	R 69 S
Solo	436 lbs.	445 lbs.
With sidecar	705 lbs.	714 lbs.
Permissible total weight**		
Solo	794 lbs.	794 lbs.
With sidecar	1,323 lbs.	(1,323 lbs.)
Permissible axle loads,		
front	331 lbs.	331 lbs.
rear	496 lbs.	496 lbs.
Rear, with sidecar***	705 lbs.	(705 lbs.)
Sidecar wheel	353 lbs.	(353 lbs.)

* Curb weight = weight of the motorcycle with fuel, lubricants and tool kit.

** Permissible total weight = curb weight + passengers + luggage.

*** with 4.00×18 tire.

R 50 and R 60

Indicated mileage	Axle Drive Ratio for	Speed in m.p.h. in 1st	2nd	3rd	4th
0 to 600	solo operation	22	34	50	62
	sidecar operation	12.5	22	34	47
over 600	solo operation	31	47	69	–
	sidecar operation	19	31	50	–

R 50 S

Indicated mileage	Axle Drive Ratio for	Speed in m.p.h. in 1st	2nd	3rd	4th
to 600	solo operation	22	34	47	60
	sidecar operation	19	28	40	50
over 600	solo operation	34	53	78	–
	sidecar operation	25	44	62	–

R 69 S

Indicated mileage	Axle Drive Ratio for	Speed in m.p.h. in 1st	2nd	3rd	4th
0 to 600	solo operation	25	37	53	69
	sidecar operation	19	28	40	53
over 600	solo operation	37	60	85	–
	sidecar operation	25	44	62	–

Speeds

The speeds given below are maximum speeds of already run-in motorcycles. The speed is largely dependent on the air resistance caused by the rider's size, position, clothing, etc.

	R 50	R 50 S	R 60	R 69 S
Solo, normal sitting position	81 m.p.h.	90 m.p.h.	84 m.p.h.	100 m.p.h.
Solo, racing position	87 m.p.h.	100 m.p.h.	90 m.p.h.	109 m.p.h.
Sidecar attached	62 m.p.h.	–	69 m.p.h.	–

0 to 31 m.p.h.	3.2	3.2	4.5	2.6 sec.
0 to 37 m.p.h.	4.1	4.1	6.0	3.3 sec.
0 to 50 m.p.h.	6.8	6.1	10.3	5.3 sec.
0 to 62 m.p.h.	10.3	9.2	16.5	7.5 sec.
0 to 75 m.p.h.	14.3	12.9	—	11.1 sec.
0 to 87 m.p.h.	—	19.5	—	16.0 sec.
1,000 m. (.62 miles) with standing start	33.6	31.0	39.9	30.1 sec.

* with sidecar and 132 lbs. of ballast

Fuels and Lubricants

Fuel

R 50 and R 60	Regular
R 50 S and R 69 S	Super
Fuel tank capacity	4.5 U.S.gals. = 3.75 Imp.gals. including a reserve of approx. ½ gal.

Lubricants

Engine	Brand-name SAE 10 W 30 HD engine oil for gasoline engines, summer and winter; quantity: .52 U.S.gal. = .44 Imp.gal.
Transmission	Brand-name SAE 10 W 30 HD engine oil for gasoline engines, summer and winter; quantity: .21 U.S.gal. = .18 Imp.gal.
Drive shaft housing	Brand-name SAE 40 engine oil, summer and winter; quantity: 9 cu.in.
Bevel drive	Brand-name SAE 40 engine oil, summer and winter; quantity: 9 cu.in.
Wheel hubs and other grease point:	Brand-name multi-purpose grease (drip temperature 356 F = 180°C)
Contact breaker lubricating wiper	BOSCH Grease Ft 1 v 4
Advance unit (centrifugal governor)	BOSCH Grease Ft 1 v 30

Engine

Cylinder Bore	R 50, R 50 S	R 60, R 69 S
Standard size	68.000 mm.	72.000 mm.
1st oversize	68.500 mm.	72.500 mm.
2nd oversize	69.000 mm.	73.000 mm.

Machining divergences ±0.01 mm. = .0004" out of round
Taper, not over −0.03 mm. = .0012" (top diameter smaller)

Diameter divergence from correct size marked on cylinder foot

Piston Skirt Clearance

	normal	for authorities and sidecar operation
R 50, R 60	0.05–0.06 mm.	0.06–0.07 mm.
R 50 S	0.08 mm.	–
R 69 S	0.08–0.09 mm.	0.09–0.10 mm.

max. total wear of cylinder and piston: 0.12 mm. over piston skirt assembly clearance

Clearances of Piston Rings

Piston ring gap clearance: 0.25–0.40 mm.

Clearance between rings and sides of grooves in piston:	R 50 (5 piston rings)	R 50 S, R 60, R 69 S (3 piston rings)
Piston ring 1 (top)	0.06–0.08 mm.	0.07–0.10 mm.
Piston ring 2	0.03–0.05 mm.	
Piston ring 3 (2) (angular ring)	0.03–0.05 mm.	0.07–0.10 mm.
Oil rings 4 and 5 (3)	0.03–0.05 mm.	0.03–0.05 mm.

Fit of Pin

in piston	0.002 mm. (.00008") tight to 0.004 mm. (.00016") loose. Mating pistons and piston pins are marked with black or white colour dots and must not be interchanged.
in connecting rod	0.007–0.026 mm. loose
Piston pin arrangement in the piston	
R 50, R 50 S	1.5 mm. (.06") offset. Small side is pressure loaded on working stroke
R 60, R 69 S	central

Fit of connecting rod bearing on crankpin	No clearance, but must turn freely
Oversize rollers	4.994/4.996/4.998/5.000 5.002/5.004/5.010/5.020 5.030 mm. in diameter
Diameteral clearance of bearing rollers in roller cage	0.05–0.15 mm. (.002"–.006")
End play of rollers in cage	0.10–0.20 mm. (.004"–.008")
End play of connecting rod on crankpin	0.07–0.10 mm. (.0028"–.004")

Crankshaft and Bearings

Crankpin standard diameter	**R 50, R 50 S**	$32\ ^{+\ 0.000}_{-\ 0.018}$ mm.
	R 60, R 69 S	$36\ ^{+\ 0.000}_{-\ 0.020}$ mm.
Press power equired for ting crankpin in crankweb	9,000–13,000 lbs.	
Max. allowable out-of-round on crankshaft journal outer ends, with crankshaft supported on main bearing seats	0.02 mm. (.0008")	
Interference fit of main bearings on journals	0.015 mm. (.0006")	
Interference fit of crankshaft timing gear	0.013–0.035mm. (.00052"–.0014") To install, heat gear up to 390°F.	
Interference fit of ball bearings or spherical roller bearings on crankshaft	0.015–0.025 mm. (.0006"–.0010")	
Ball bearing fits in engine housing bearing bushes and in gear case cover	Slight interference fit. To install bearings, heat engine housing and cover casting up to approx. 176°F.	
lywheel clutch face runout (max.)	0.10 mm. (.004")	
Max. allowable out-of-round on generator commutator	0.04 mm. (.0016")	

Camshaft and Drive

Interference fit of ball bearings on camshaft	0.015 mm. (.0006")
Interference fit of ball bearings in engine housing and bearing bushing, and of bearing bushing in engine housing	0.015 mm. (.0006"). To install bearings, heat engine housing to approx. 176°F.
round on camshaft front end	
Interference fit of gear on camshaft	To install gear, heat it up to 176°F.

Tappets (Valve Lifters) and Valves

Diameteral clearance of tappets in bushings	0.02–0.04 mm. (.0008"–.0016")
Rocker arm bushing to rocker shaft clearance	0.01–0.045 mm. (.0004"–.0018")
on R 69 S needle bearing	playless
Side play of rocker arms	0.01–0.02 mm. (.0004"–.0008")

Valve stem (hard chrome-plated)	Diameter (mm.)	Diameteral clearance in guide (mm.)
R 50, R 60 intake and exhaust valves	$7\ ^{-\ 0.050}_{-\ 0.065}$	0.040–0.070
R 50 S intake valve	$7\ ^{-\ 0.050}_{-\ 0.065}$	0.040–0.070
R 50 S exhaust valve	$8\ ^{-\ 0.065}_{-\ 0.080}$	0.065–0.095
R 69 S intake and exhaust valves	$8\ ^{-\ 0.050}_{-\ 0.065}$	0.050–0.065

I.D. of valve guide, after shrinking-in, recooling and reaming

R 50, R 60 intake and exhaust guides	$7\ ^{+\ 0.005}_{-\ 0.010}$ mm.	(reamer 7K7)
R 50 S intake guide	$7\ ^{+\ 0.005}_{-\ 0.010}$ mm.	(reamer 7K7)
.50 S exhaust guide	$8\ ^{+\ 0.015}_{0}$ mm.	(reamer 8H7)
R 69 S intake and exhaust guides	$8\ ^{+\ 0.015}_{0}$ mm.	(reamer 8H7)

Valve head diameter	R 50, R 50 S, R 60	R 69 S
Intake valve	34 mm.	38 mm.
Exhaust valve	32 mm.	34 mm.

Maximum valve face runout (seat eccentricity)	0.03 mm. (.0012")
Interference fit of valve guide in cylinder head	0.03–0.05 mm. (.0012"–.002") To press out and in the guides, heat cylinder head up to 390–490°F.

in cylinder head

Intake valve seat ring	0.18–0.23 mm. shrink fit
Exhaust valve seat ring (material Dulenit)	0.13–0.18 mm. shrink fit
	To install new rings, heat cylinder head up to 490–550° F.
Valve seat angle	45°
Correction angle, outer	15°
Correction angle, inner	75° (only if required)

Valve seat width in head	R 50, R 60	R 50 S, R 69 S
Intake	1.5 mm.	1.5 mm.
Exhaust	2 mm.	1.5 mm.

Valve Springs:		Inner		Outer	
		R 50 R 50 S R 60	R 69 S	R 50 R 50 S R 60	R 69 S
Wire diameter	mm.	2.8	3.2	3.8	4.25
Coil outer diameter	mm.	23.8	28	33.3	38.5
Valve spring free length	mm.	37.5	42	42.3	43.25
Length, installed	mm.	30.5	35	34	35
Valve spring load, installed	(lbs.)	16.5	24	41	42.3

Torque Limits

Cylinder head bolts	25 ft./lbs.
Flywheel retaining nut	123 ft./lbs.

	R 50, R 60	R 50 S, R 69 S
Clutch cup spring load, installed	255–280 lbs.	341–363 lbs.

Generator armature (rotor) on crankshaft	14.5 ft./lbs.
Ignition magneto rotor on camshaft	14.5 ft./lbs.
Valve timing and ignition timing adjustment	See Technical Data page 10 and 12

Ball bearings on shafts	Interference fit 0.007 to 0.02 mm. (.00028"– 0008")
Ball bearings in housing	Slight interference fit (To install bearings, heat transmission housing to approx. 176° F.)
Diameteral clearance of speed gears on bushings	
1st and 3rd gear	0.04–0.09 mm. (.0016"–.0036")
2nd and 4th gear	0.02–0.06 mm. (.0008"–.0024")
Bushings on shaft	
1st and 4th gear	Interference fit 0.00–0.035 mm. (.000–.0014")
2nd and 3rd gear	Splined bushing only exchangeable together with the shaft
End play of intermediary shaft	0.2–0.4 mm. (.008"–.016")
End play of primary and output shafts	0.2 mm. (.008") to be adjusted by means of shims

Torsional Torque Damper Spring:

Length, installed	1.53"
Free length	1.75"
Coil diameter, outer	1.35"
Coil diameter, inner	.96"–.98"
Wire section	5 x 7 mm. rectangular
Spring load with 1.53" length	235 lbs.

Final Drive:

Bearing on pinion	Interference fit 0.015 mm. (.0006")
Pinion bearing in bevel drive housing	Slight interference fit (To install bearings, heat housing to approx. 176° F.)
Ball bearing on ring gear hub	Interference fit 0.015 mm. (.0006")
Needle bearing on ring gear hub	Interference fit 0.012 mm. (.00048")
Ball bearing in cover and needle bearing in housing	Slight interference fit (To install bearings, heat housing to approx. 176° F.
Backlash between pinion and ring gear (crown wheel) KLINGELNBERG	0.15–0.20 mm. (.006"–.008")
Ideal setting distance (from ball bearing shoulder on pinion to ring gear axis)	2.93" ± .002"

Rear Wheel Suspension Spring:	Solo	Sidecar
Wire diam./Coil outer diam. (mm.)	7/51	7.6/52.1
Free length mm.	272.5	271.5
Spring load, installed lbs./spring movement mm.	27/8	33/7
Spring rebound load lbs./spring movement mm.	525/121	661/120

Front wheel Suspension Spring:		
Wire diam./Coil outer diam. (mm.)	6/48	6.3/48.6
Free length mm.	284	273
Spring load, installed lbs./spring movement mm.	46/26	33/15
spring rebound load lbs./spring movement mm.	330/136	396/125

Shock Absorbers

Placed in mounting position the shock absorbers must be operated several times over the whole lift, so that the air may collect itself in the upper part. Shock absorbers should be stoked in an upright position.
On examination of the shock absorbers the higher tensile force as well as the lower pressure force should prove to be constant, i.e. motion speed should be invariable over the whole lift. If there are jerking motions this is an indication of worn condition requiring replacement of the shock absorber.
In compressed position no pressure over 1 lb. should be exercised on the shock absorber, as otherwise interior defects might result.

Test data for test machine

Shock absorber	Front		Rear	
Test stroke (mm.)	25 (.98")	75 (2.95")	25 (.98")	75 (2.95")
Rev. rate (r.p.m.)	100	100	100	100
Tensile force (lbs.)	33	88	44	132
Pressure force (lbs.)	11	22	11	44
Max. length, extended (mm.)	337 (13.26")		343 (13.65")	
Min. length, compressed (mm.)	222 (8.73")		243 (9.45")	

Hydraulic Steering Damper, cylinder ⌀ 1.22" or (.95")		
Test stroke of test machine (mm.)	25 (.98")	50 (1.96")
Rev. rate of test machine (r.p.m.)	100	100
Tensile force (lbs.)	66 (50)	73 (77)
Pressure force (lbs.)	66 (50)	73 (77)
Max. length from center of silentblock mounting hole to piston rod end (mm.)	9" (9.8")	
Min. length (mm.)	6.7" (7.5")	

A. Special Tools obtainable from the firm MATRA-WERKE GMBH., Frankfurt/Main, Dieselstrasse 30, West Germany

The most up-to-date enumeration of the mentioned tools and the specification of their applicability to the various BMW models are contained in the illustrated BMW catalogue & price list **"Special Tools."**

Matra Tool Number	Description	to be used for group					
		D	M	G	H	B	F
286	Pin wrench 45 mm. in dia. (round pin 5 mm. in dia.) for top cap of rear spring leg						x
292	Locking fixture for flywheel		x				
297 1 & 2	Installing bushings for oil seal of transmission primary shaft			x			
299a	Puller for internally-splined coupler gear on universal shaft				x		
311	Puller for flywheel, with 20 mm. screws		x				
319	Replacer for spring ring on transmission primary shaft			x			
338/1	Pin wrench 49 mm. in dia. for exhaust coupling nut R 50 and R 60	x					
355a	Puller for camshaft		x				
357a	Puller screws for cover of final drive housing				x		
368	Holder for grinding-in valves, with 7 mm. stem diameter		x				
494/2a	Grooved wrench for fixture Matra 500			x			
494/3	Insert socket for torque wrench (87–108 ft. lbs.) for flange retaining nut of transmission output shaft			x			
499	Puller for crankshaft gear, gearcase cover casting, camshaft gear and front-end bearing cover plate		x				
500	Fixture for installation of nut for coupling flange on transmission output shaft			x			
501	Puller for coupling flange on transmission output shaft			x			

Tool Number	Description	D	M	G	H	B	F
503	Shifting wrench SW 16 for transmission adjustment			x			
504	Setting gauge for transmission (support for output shaft)			x			
505	Installing bush for final drive cover				x		
506a	Double grooved wrench for threaded cover and threaded ring (final drive)				x		
507	Locking fixture for tightening drive shaft coupling hub				x		
508	Special wrench with holder for tightening drive shaft coupling hub				x		
509	Installing bush for oil seal in final drive				x		
511	Installing arbour for oil seal in final drive cover				x		
513	Pin wrench for adjusting of rear swinging arm bearings						x
517	Pin wrench for wheel hub cover					x	
519	Guide arbour for pivot of front swinging arm						x
529	Centering arbour for clutch		x				
530a	Installing arbour for pushrod tubes		x				
534	Clamping screws for installation of clutch		x				
535	Lever nut		x				
540	Holder for grinding-in valves with 8 mm. stem diameter		x				
3487 47-6	Torque wrench (0–43 ft./lbs.)		x				
19 D/ 14 mm	Socket wrench supplement (insert) for cylinderhead screws		x				
7809 M	Allen head wrench SW 6 (socket supplement for ½" square-headed male piece) for magneto rotor and generator armature		x				

B. Tools which may be made by the dealer corresponding to supplied drawings or purchased through BMW

The most up-to-date enumeration of the mentioned tools and the specification of their applicability to the various BMW models are contained in the illustrated BMW catalogue & price list **"Tools to be made in the dealers' own workshops."**

Tool Number	Description	to be used for group					
		D	M	G	H	B	F
5003	Piston ring collar		x				
5014 1 & 2	Cradle stand for engine and transmission		x	x			
5017	Support plate for transmission			x			
5021	Straightening tools for connecting rods		x				
5030	Puller screw for generator armature and magneto rotor		x				
5034	Valve spring installing tool		x				
5035	Guard wood for connecting rods		x				
5036	Prisms for straightening of connecting rods		x				
5038/1	Pressure bushing for installation of bearing cover		x				
5039	Pressure bushing for installation of camshaft gear		x				
5040	Installing bushing for crankshaft gear		x				
5041	Drift for tappet bushing		x				
5042	Measuring tool for backlash in final drive				x		
5043	Mounting table for motorcycles	x					
5047	Support plate for installation of ball bearings		x	x			
5048	Removing and installing ring for spherical roller bearing on crankshaft R 50 S and R 69 S		x				
5050/3	Spoke fitting gauge (2.75 C×18 steel rim)						x
5050/5	Spoke fitting gauge (2.15 B×18 rim)						x

5061	Measuring bushing for axial play of transmission primary shaft			x				
5065	Adjusting tool for shifting forks with transmission shafts installed			x				
5078	Drift for road wheel bearings					x		
5080	Installing bushing for road wheel bearings					x		
5094	Tool for disassembly and reassembly of spring legs (suspension units)							x
5095	Drive bushing for installation of primary shaft			x				
5097	Gauge for adjusting contact spring of neutral indicator			x				
5104	Measuring tool for engine and transmission		x	x				
5106	Tool for balancing of road wheels							x
5108	Drive bushing for oil seal (flywheel side)		x					
5117	Support plate for pressing ball bearing onto crankshaft		x					
5119	Installing fork for bearing cover of crankshaft (for R 50 and R 60)		x					
5127	Drift for valve guides 7 mm. in dia.		x					
5128	Drift or valve guides 8 mm. in dia.		x					
5129	Drift for piston pin (gudgeon or wrist pin)		x					
5145	Guiding bush for installation of gear on crankshaft		x					

D = Removal and Installation of Power Train

Prior to removal of power train it is useful to perform the following checks for the diagnosis of faults that might be found later:

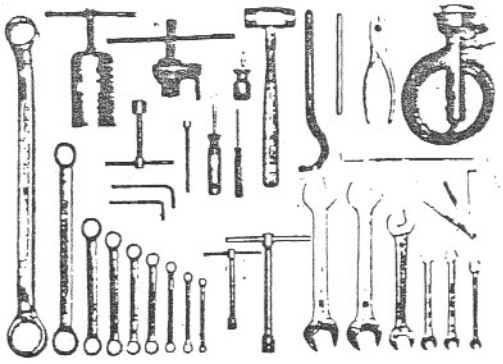
1. Check valve clearance (see page 82)
2. Check gap of breaker points and setting of spark timing (see page 84)
3. Check carburetor adjustment (see page 88)

On a reconditioned engine the same checks have to be carried out after 300 miles.

Special Tools:

Mounting table 5043, open ended wrenches SW 9, 10, 11, 14, 19, 24, ring spanners 9, 10, 12, 14, 17, 19, 22, 27, 36, socket wrenches 10, 14, 19, cut pliers, 2 screw drivers, hex. allen plug wrench SW 5, sliding caliper, feeler gauge, plastic mallet, puller screw 5030, pin wrench Matra 513, drive shaft holding tool Matra 508, pin wrench Matra 338/1, puller Matra 299a, toolkit driftpin, timing light.

Figure 1

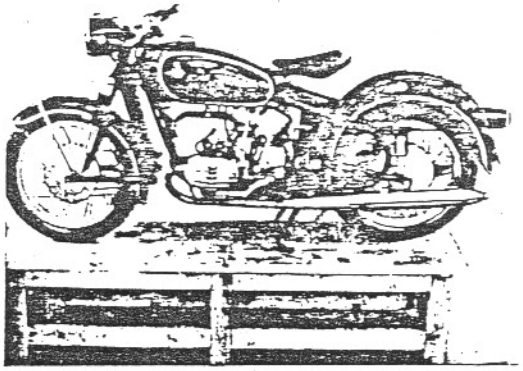


1

D1 = Removing and Installing Rear Wheel

1. Place the motorcycle on its stand upon the mounting table 5043.

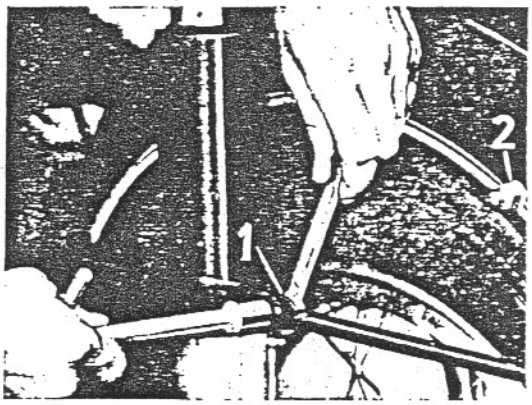
Figure 2



2

2. Remove mudguard brace bolts (1) SW 14 on frame and mudguard connecting bolts (2) SW 14 and swing the end of the rear mudguard up.

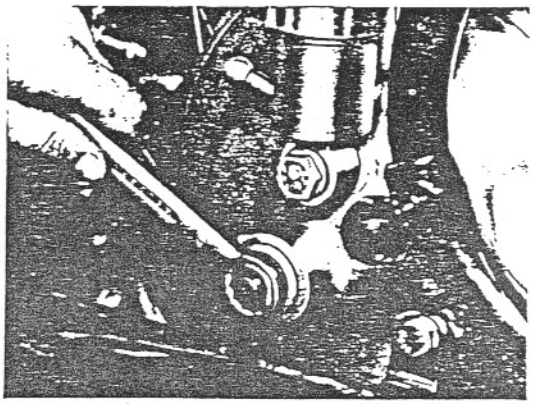
Figure 3



3

3. With the SW 22 socket wrench, loosen axle spindle nut on the drive side and remove it together with its washer.

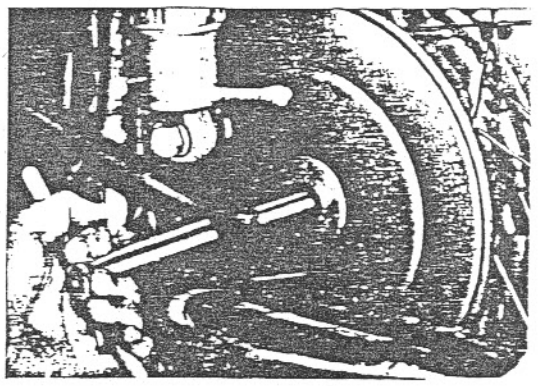
Figure 4



4

4. Loosen SW 17 nut (3) of clamping bolt on the left swinging arm, and, using driftpin (of toolkit), withdraw axle spindle.

Figure 5



5

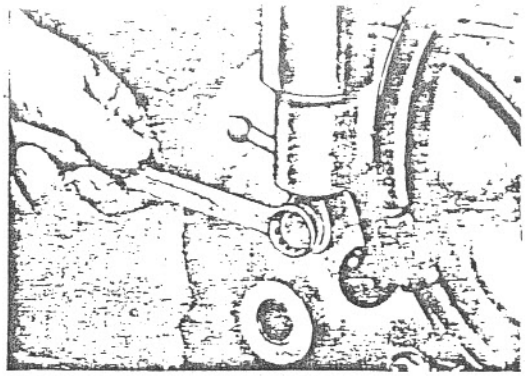
Caution! Before installing axle spindle, clean it well and grease lightly. Rotate it, while inserting, to prevent binding. After tightening of axle spindle nut, press the mudguard repeatedly down to actuate the springing. Then only, tighten the clamping bolt (3).

5. Remove wheel.

D 2 a = Removing and Installing Final Drive

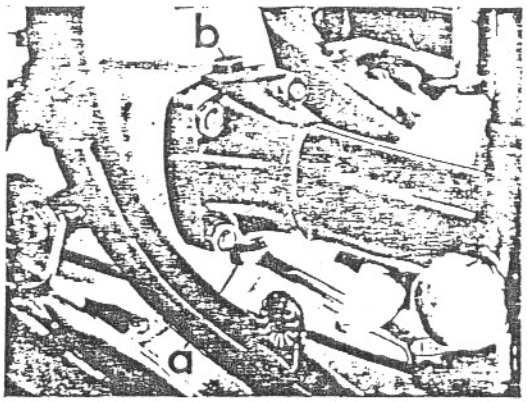
(Road Wheel removed)

1. Loosen shock absorber mounting screw SW 19 at right, and remove it together with the washers.
Figure 6



6

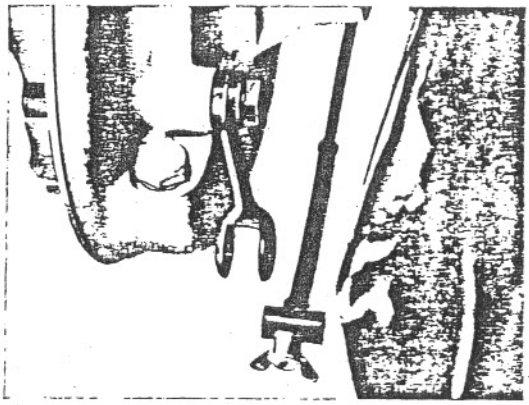
2. Unscrew plug SW 14 (a) to drain oil of right swinging arm. To facilitate this, remove filler plug SW 14 (b).
Figure 7



7

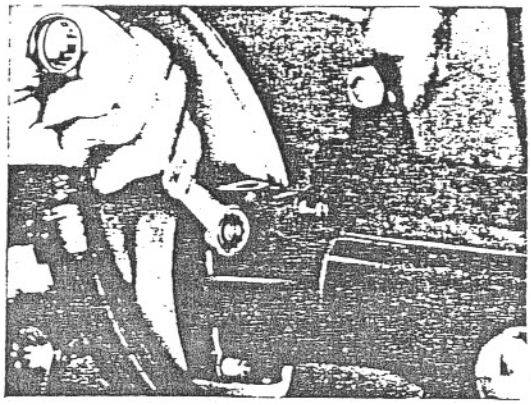
Caution! After reinstallation, fill-in 9 cu.in. of SAE 40 engine oil through filler hole (b).

3. Unscrew wing nut on brake linkage remove brake rod from lever pin, lift hollow pin out of lever, install it on the brake rod and fasten with the wing nut. **Figure 8**



8

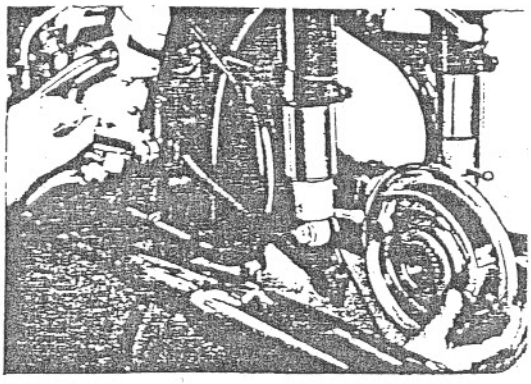
4. Remove SW 14 nuts from the four right-hand swing arm mounting studs.
Figure 9



9

5. Remove final drive from the right swinging arm.

Caution! When connecting final drive to swinging arm, engage a transmission gear and with the kickstarter turn universal shaft until the gear coupling meshes. **Figure 10**

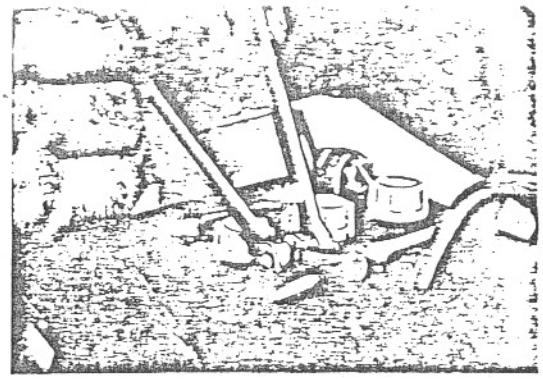


10

D 2 b = Removing and Installing Rear Swinging Arm

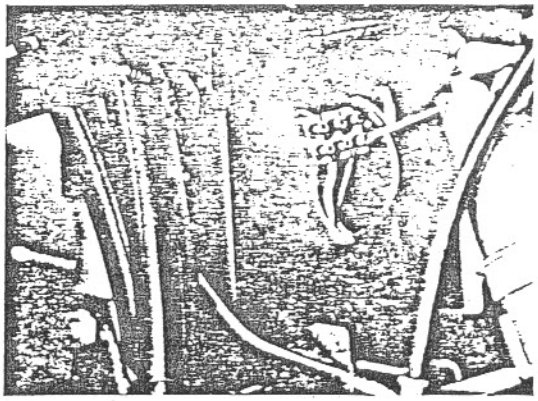
(Final Drive removed)

1. Unhook rubber strap of battery, remove battery cover, disconnect cables and remove battery together with moss rubber pad. Figure 11



11

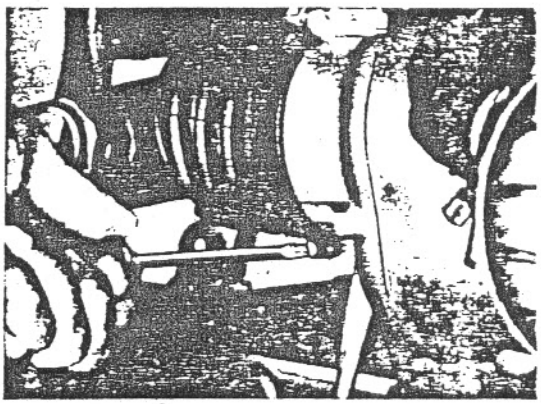
2. From terminal block in center of battery carrying plate, disconnect red cable right, white cable central and black cable left (viewed in driving direction). Figure 12



12

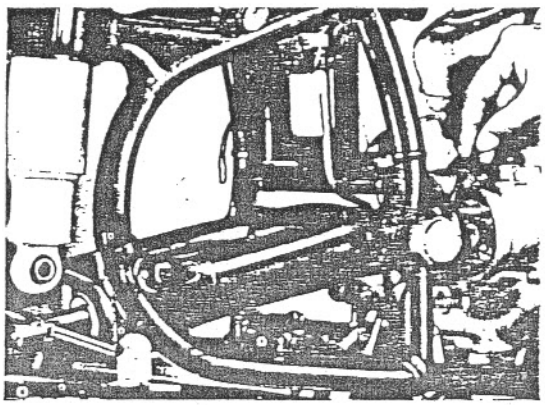
3. Unscrew lower mudguard clamp screw SW 14, the two upper mudguard clamp screws SW 10 on frame fixture and the four screws SW 10 mm., two on each side, from the brackets welded to the spring holders. Remove mudguard.

4. Disconnect rubber sleeve between transmission and swinging arm on transmission side and push it back as far as possible. Figure 13



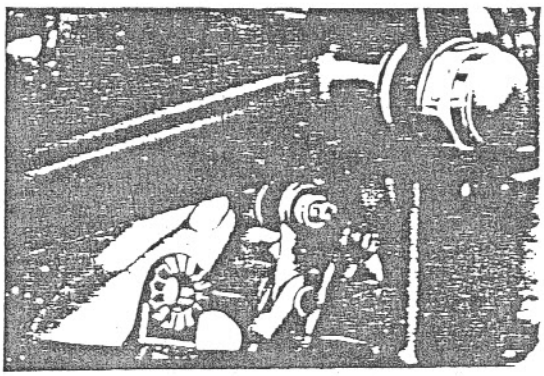
13

5. Using a 6 mm. cranked. Allen head wrench remove the four connecting screws from universal joint, holding drive shaft with Matra tool 508 for this purpose. Figure 14



14

6. Disconnect bearing of foot brake bellcrank lever from right swinging arm. For this end, remove cotter pin and castellated nut SW 14, remove bolt, take off washer and bushing out of lever. Figure 15



15

7. Remove pivot bearings of rear swinging arm, left and right: Unscrew acorn nuts SW 36 mm. **Figure 16**

Loosen locknuts SW 27 of bearing pins and unscrew bearing pins with pin wrench Matra 513. **Figure 17**

Caution! Install bearing pins in a way that on both sides the same distance (a) is obtained between swinging arm hub and frame. The universal shaft should then be centrally positioned in the swinging arm tube, so as to prevent it from striking on as the springing moves up and down. If necessary, the distances "a" may slightly differently be adjusted. **Figure 18**

Then still tighten 1/8 turn one bearing pin screwed into stop position in order to obtain the necessary bearing tension. Lock bearing pin on either side by counterscrewing and tighten the acorn nuts. The taper roller bearings must on no account have any play, the tension, however, should on the other hand not be excessive.

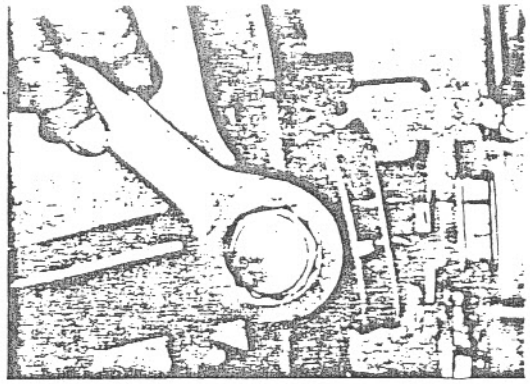
8. Remove spring leg mounting screw, left, together with its washer after loosening the retaining nut. The rear swinging fork is now ready for removal. **Figure 19**

9. Remove swinging arm rubber seal rings with spacer bushing and taper roller bearing inner race with roller cage on both sides. Do not remove roller bearing outer races except in case of damages. **Figure 20**

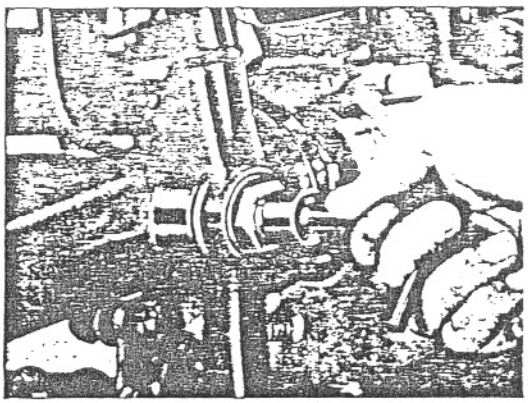
Caution! When assembling, clean and properly grease the taper roller bearings.

10. Remove universal shaft from swinging arm only if necessary. For this unscrew nut SW 22 by inserting the Matra tool 508 into the internally-splined coupler gear and removing this gear with puller Matra 299a. (See page 102.)

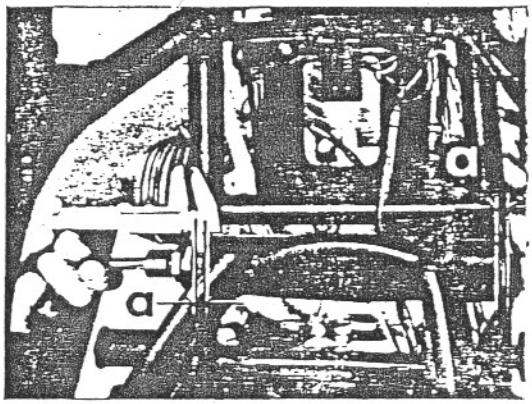
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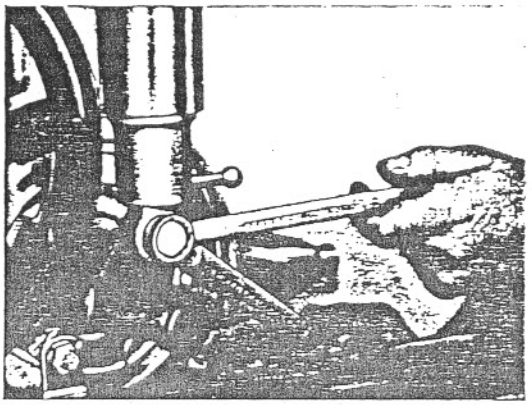
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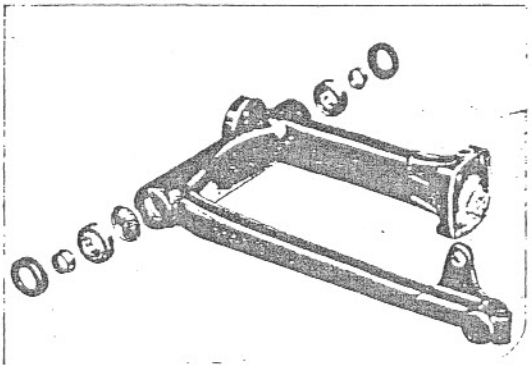
18



19



20



D 3 a = Removing and Installing Transmission

(Rear Swinging Arm removed, Battery disconnected)

1. After lifting rubber plug and loosening threaded pin, remove neutral indicator cable (1) and disconnect ground (earth) strap (2) from left-hand cover securing screw SW 10 mm. on bottom of transmission.

2. Detach control cable (3) from clutch lever and remove return spring between lever and housing. Figure 21

Lift out support bushing for control cable on right bottom end of transmission housing.

3. After loosening wire locked fastening screw SW 9 remove speedometer drive. Figure 22

4. Detach intake tubes first from the carburetors (eventually loosen carburetor mounting screws) and thereupon remove them from the transmission housing. Figure 23

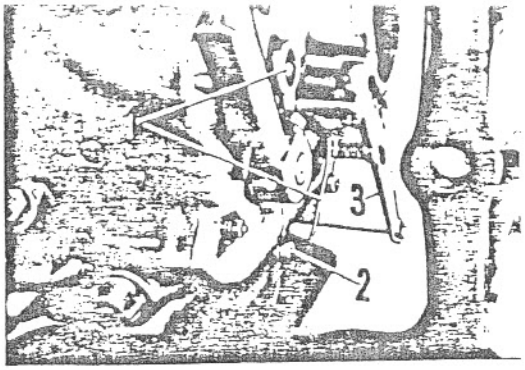
5. Remove air filter from transmission housing and remove it. Figure 24

6. Unscrew the four stud nuts SW 14 fastening transmission to engine and remove lower hexagon-headed bolt SW 14 at right by pushing it out in forward direction. Pull transmission off engine to the rear and lift it to the left out of the frame. Figure 25

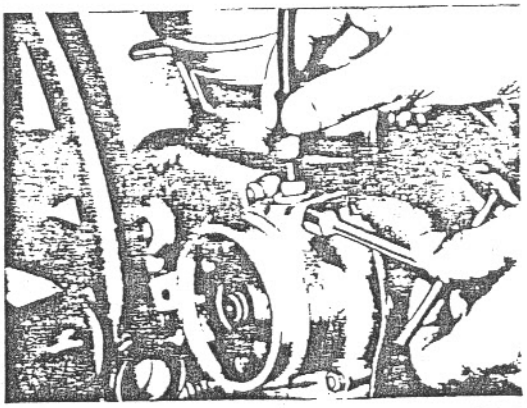
D 3 b = Removing and Installing Transmission with installed Final Drive

If the rear swinging fork has not been removed, the engine and transmission block may then, after detaching engine mounts on top and bottom, pushed ahead as far as to allow the transmission to be removed as described under 1 to 6.

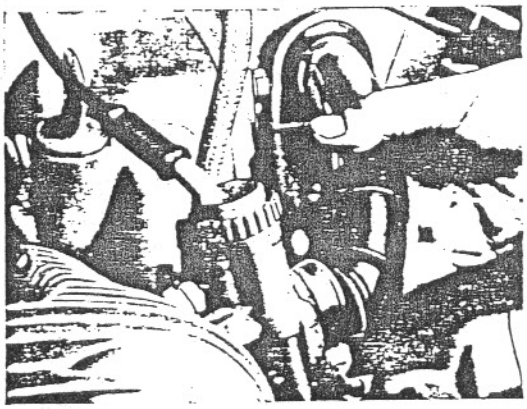
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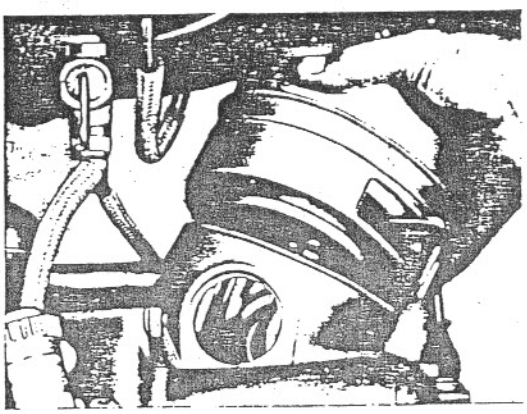
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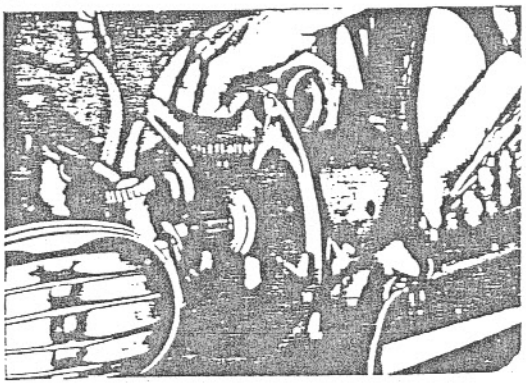
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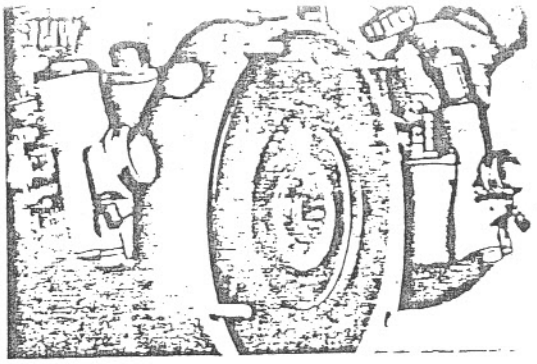
25



D 4 = Removing and Installing Engine

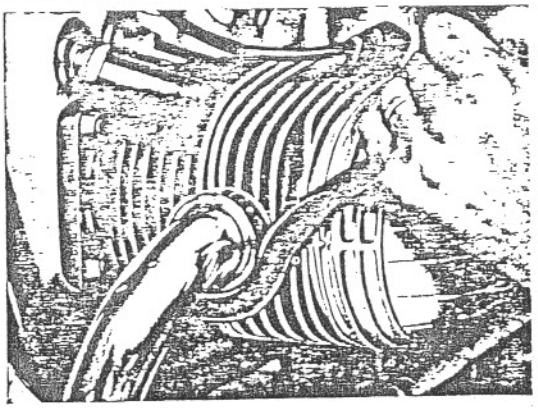
(Transmission removed)

1. Unscrew carburetor cover assembly and remove same with control cable and throttle slide from the carburetors. Figure 26



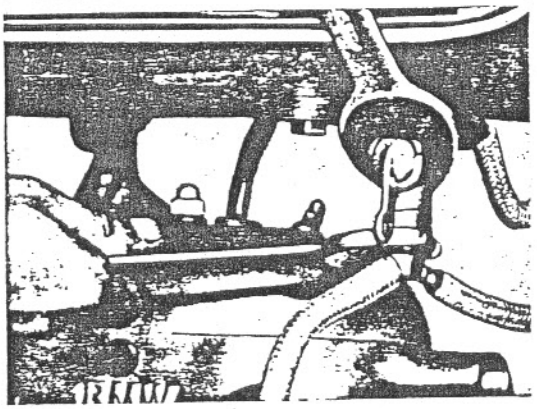
26

2. Using 49 mm. dia. pin wrench Matra 338/1 and commercial-type 60 mm. dia. wrench with pin of approx. 4.5 mm. dia. respectively, for R 50 S and R 69 S, loosen exhaust pipe connecting nuts on the cylinder heads. Figure 27



27

Unscrew SW 19 nuts on rear engine mounting rod, tap in rod first at the left, then at the right, detach exhaust pipe fastening clips and foot rests, loosen rear exhaust pipe mounting and remove the complete exhaust system.

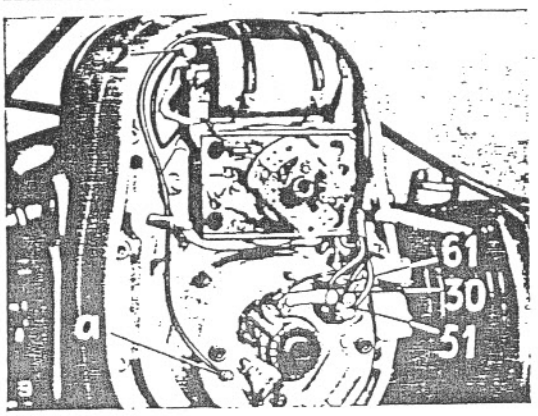


28

3. Close fuel shut-off and disconnect fuel lines on SW 24 suel shut-off. Figure 28

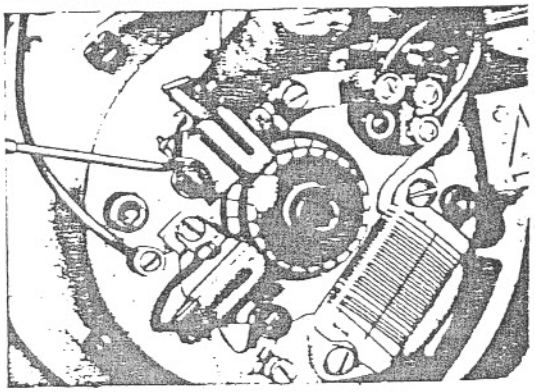
4. Remove front end cover from timing cover after loosening the two hexagon nuts SW 14.

5. From generator disconnect:
Black cable from terminal 30, red cable from terminal 51 and brown cable from ground terminal (a) as well as the black-red cable from ignition coil terminal 2. Figure 29



29

Lift brush springs off the brushes, pull these slightly out and jam them laterally with the springs. Figure 30



30

6. Unscrew the two allen head SW 5 screws securing generator body and remove the latter, taking care not to lose centering washer to engine housing, if any fitted. (See Fig. 31.)

Caution! On some timing covers three M 6 threaded holes are provided for special purposes, of which the one running into the breather

passage must always be plugged with a M 6×10 screw and an aluminium seal washer. **Figure 31**

7. Remove SW 6 allen head armature mounting screw and press armature off crankshaft by screwing in puller screw 5030. **Figure 32**

Put armature into generator body and keep the whole, wrapped into clean paper, in a proper place.

8. Remove upper cover from engine housing and pull wiring harness out of engine housing. **Figure 33**

9. Detach upper engine mounting from frame. Place a box under engine oil sump, then tap out lower engine mounting rods, first the rear one and thereafter the front bolt upon removing SW 19 nuts. Remove spacer bushings at the left between frame eyes and engine housing. **Figure 34**

10. Tilt engine carefully rearward, raise it with its clutch side and moving it to the right lift it out of the frame. Take care to avoid automatic advance unit of ignition magneto touching the lower frame tube! **Figure 35**

Caution! Having installed the engine carry out the following operations:

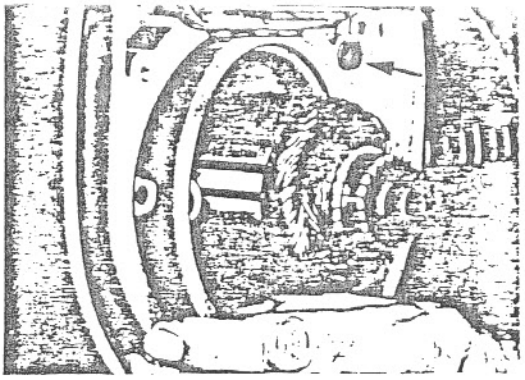
1. Check ignition timing adjustment by means of timing light (see page 86).

2. Adjust carburetor control cables with closed throttle slides to .02" cable play (9 mm. wrench), check idling speed and synchronize both cylinders (see page 88).

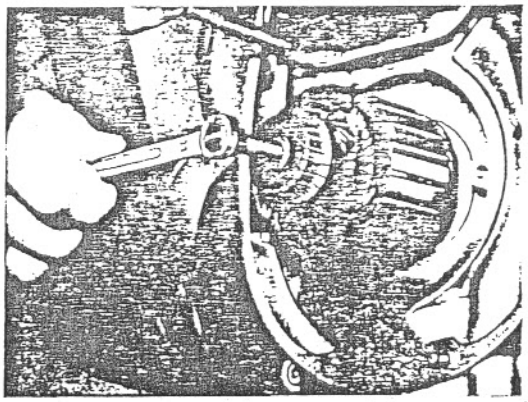
3. Adjust clutch control cable to .16 to .20" play on handlebar clutch lever by means of the knurled nut.

4. Perform a trial ride and thereafter check valve clearance and, if necessary, adjust to specified values (with SW 11 and SW 12 wrenches).

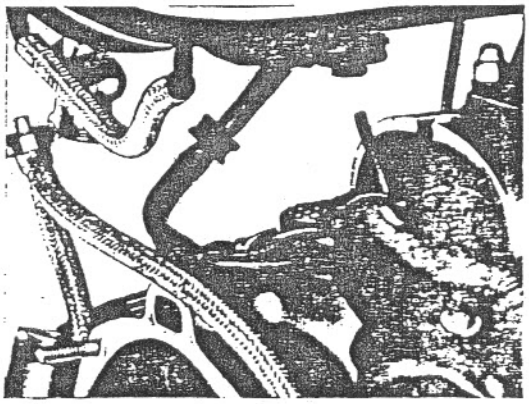
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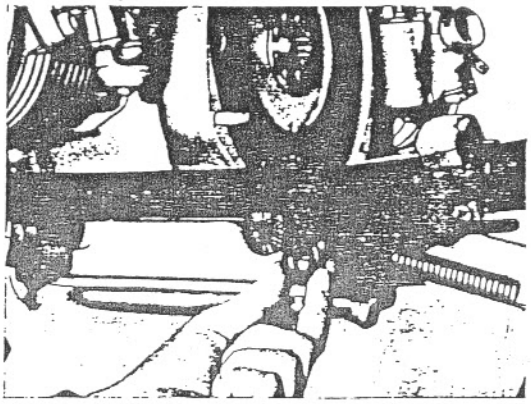
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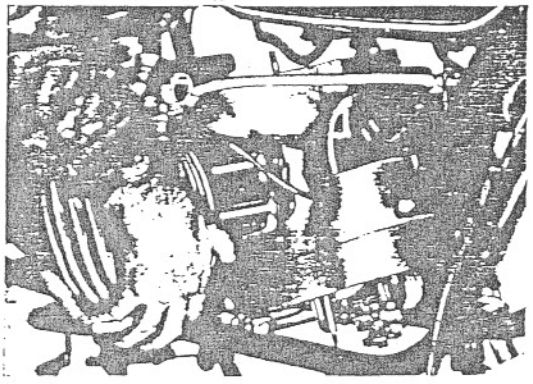
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34



35



M = Engine

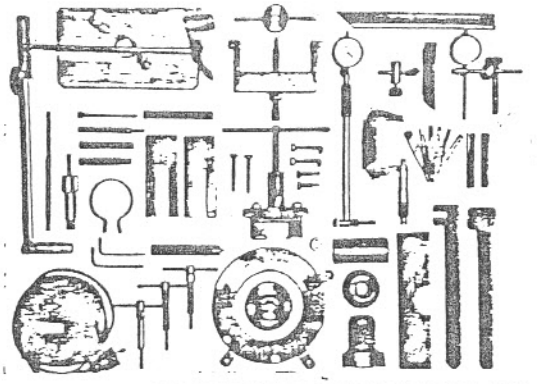
Tools:

Matra special tools No. 292, 311, 355a, 368, 499, 529, 530a, 534, 535, 536, 540, 348747/6, 7809 M, 190D/14 mm.; see page 36 and 38.

Tools made on drawings: No. 5003, 5014, 5021, 5030, 5034, 5035, 5036, 5038/1, 5039, 5041, 5048, 5104, 5108, 5117, 5119, 5127, 5128, 5129, 5145; see page 40 and 42.

Cylinder measuring dial gauge, micrometer caliper, feeler gauge, dial gauge, test equipment for setting and readjusting ignition timing, allen head wrenches 5 and 6 mm. and tools from local jobbers. **Figure 36**

36



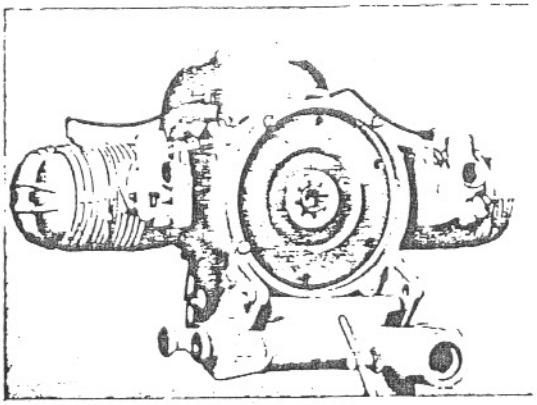
M1 = Removing Cylinder Head, Repairing and Reinstalling

(Engine removed)

1. Removing and Installing Cylinder Heads

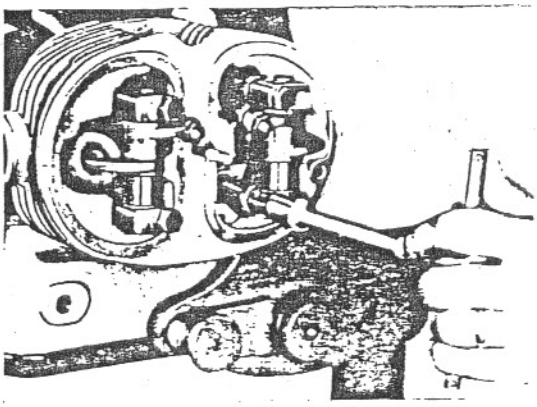
Place engine upon support stand V 5014 and fasten by screws. **Figure 37**

37



Remove SW 14 retaining nuts of cover brackets by means of SW 14 socket wrench and the two SW 10 nuts between second and third cylinder head fin on each head. Remove cover brackets and nuts together with the rocker covers and gaskets. **Figure 38**

38



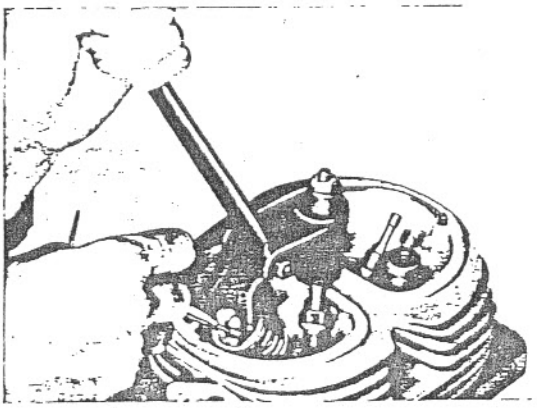
Remove rocker shaft support brackets with rocker arms, push rods and cylinder head.

Caution! When refitting, insure that the gasket between cylinder and head is in good condition and tighten cylinderhead mounting screws with a torque wrench to 25 ft./lbs.
When installing rocker covers, make certain that the gaskets are completely dry.

2. Removing and Installing Valves, including Inspection.

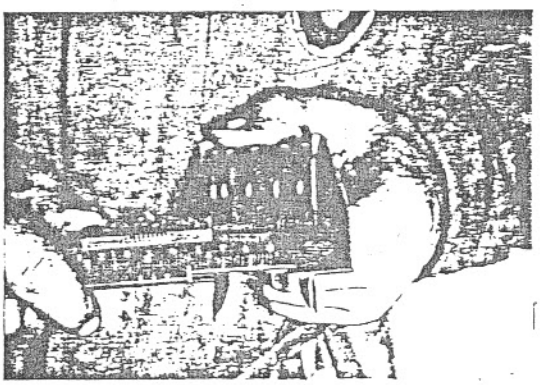
Install cylinder head on fixture 5034. With the valve lifter making part of this fixture compress valve springs and remove valve locks, using magnetic needle or a scriber, from the spring sleeve. Remove spring sleeve, valve springs and retainer, and after lifting from the fixture, the valves. **Figure 39**

39



Inspection: Check cylinder heads for cracks and proper sealing surfaces, tightness of valve guides and valve seats, valve wear in guides, rocker arms for proper running surfaces and freedom from cracks, and valve springs for specified length and pressure (see Tolerances and Fits page 30). **Figure 40**

40



Caution! When installing valve springs, make sure that the closed coils are toward the cylinder head.

3. Replacing Valve Guides:
Grind off old guides top down to snap ring. **Figure 41**

Remove snap ring, heat cylinder to 356 to 428° F. and with drift punch 5127 or 5128 tap valve guides inwards. **Figure 42**

Press new valve guides equipped with snap ring into heated cylinder head (interference fit .0012"–.002", eventually use 0.1 mm. oversize guides and reface them to the specified size). Ream cooled down valve guides with valve guide reamer 7K7 and 8H7, respectively, see Tolerances and Fits, page 28. **Figure 43**

4. **Replacing Valve Seats:**
Valve seat rings which have become too small owing to repeated re-milling operations must be replaced. In case the necessary tools and the experience are not available it is recommendable to use replacement cylinder heads.

If the overhauling is done in your workshop, use the Hunger valve seat cutting tool to machine off the valve seat ring without damaging the stock of cylinder head round the bore. Heat cylinder head to 430 to 500° F., and insert the new valve seat ring (see Tolerances and Fits).

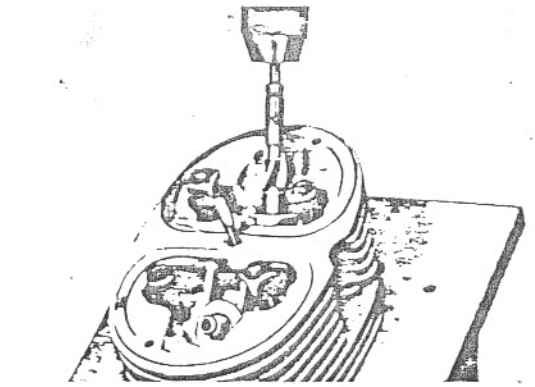
5. **Refacing Valve Seats:**
Reface the valve seat rings in cylinder head with the Hunger valve seat cutting tool. Reconditioning angle 45° +30'.

Figure 44

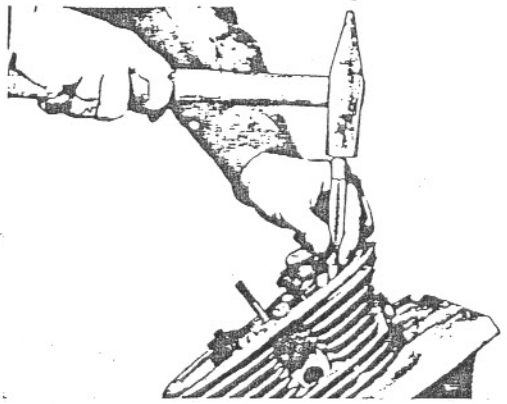
Valve seat width 1.5 mm. (.06") for intake valve, 2 mm. (.08") for exhaust valve, on R 50 S and R 69 S 1.5 mm. for both intake and exhaust valves, the seat angle being 45°. Chamfering towards combustion chamber 15°. Chamfering toward intake and exhaust ports–if necessary–should be a 75° angle. The contact surface on the valve face should be adjacent to valve head max. diameter.

Reface the valves, if necessary, to a 45° –30' angle by using a valve refacing machine, the edge (margin) of the valve head should not exceed 1 mm. (.04"). **Figure 45**
Reground valve heads and valve seats reconditioned with the Hunger tool do not need any further grinding with fine grinding compound after assembling. It is however advisable to test tightness by filling gasoline into the valve chamber. To eventually grind the valves with a compound use valve holders Matra 368 and 540, respectively.

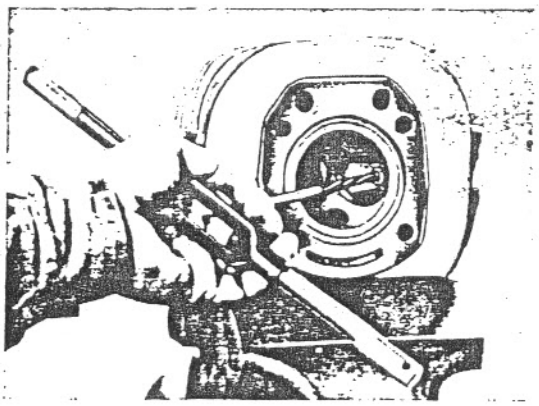
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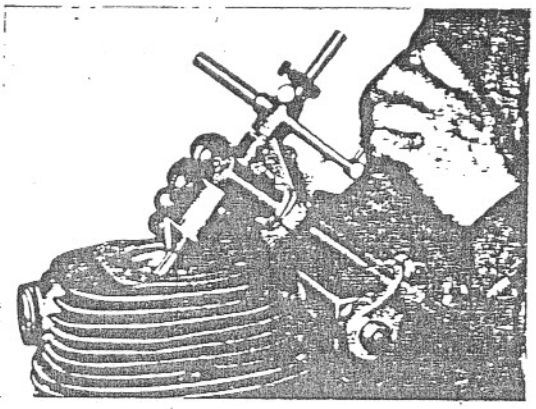
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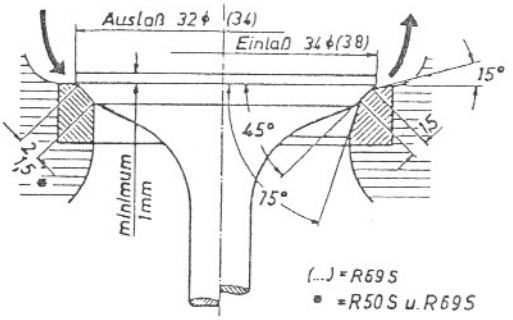
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44



45



M 2 = Removing and Installing Cylinders and Pistons, Checking and Reconditioning

It is recommendable to check the ignition timing before removing cylinders or the generator if this check has not been performed already at the beginning. This way possible already existing faults may be located and taken in account on the further tests. For this check spark timing adjustment without altering the breaker gap (proceeding as described on page 84 under point 3a).

1. Removing and Installing Cylinders and Pistons

Loosen four retaining nuts SW 14 on each cylinder, remove cylinders with upper and lower gaskets and install connecting rod protecting wood tools 5035 on engine housing cylinder flange. Remove piston pin snap ring (retainer) by inserting a drawing point through the transverse groove. **Figure 46**

Press pin out of piston by means of a commercial-type remover. If necessary heat piston and tap out pin with drift punch 5129. **Figure 47**

Caution! Before fitting pistons to connecting rods check whether the piston pins are parallel to cylinder flange seating surfaces on engine housing. For this turn engine 90° in support stand. Slide piston pin into connecting rod eye, place two prisms 5036 of equal thickness upon the housing surface, and rotate crankshaft until piston pin touches the prisms very slightly. **Figure 48**

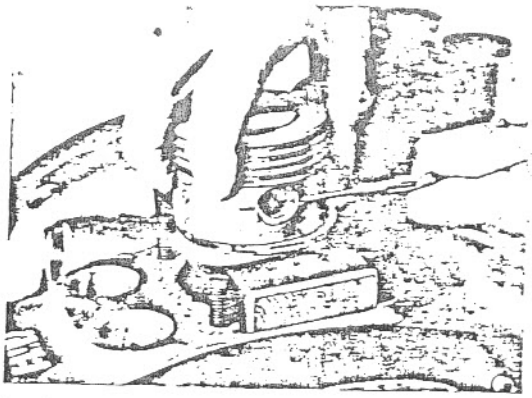
The two piston pin ends must then evenly seat on the prisms. Whenever possible, this check should be made with the connecting rod in true vertical position. With the connecting rod in inclined position this check will also indicate an eventual twist of the connecting rod.

If necessary, straighten slightly bent connecting rod carefully by means of the Connecting Rod Aligner Tools 5021 or with a suitable arbour inserted through the connecting rod eye. **Figure 49**

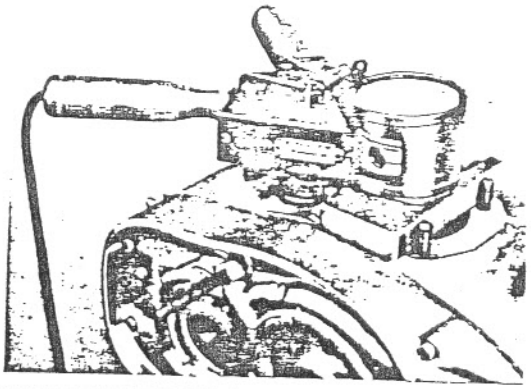
To fit piston pins heat pistons. Install the piston with the mark "vorn" (front) so the arrow points forward.
Install snap ring with one end so into the groove that the wire runs over the whole removal slot and finish inserting the ring into the groove by using an appropriate wood stick. **Figure 50**

To install the cylinder oil piston and piston rings, space the ring gaps equally round the piston circumference and slip the well oiled piston into the cylinder, through use of Piston Ring Compressor 5003.

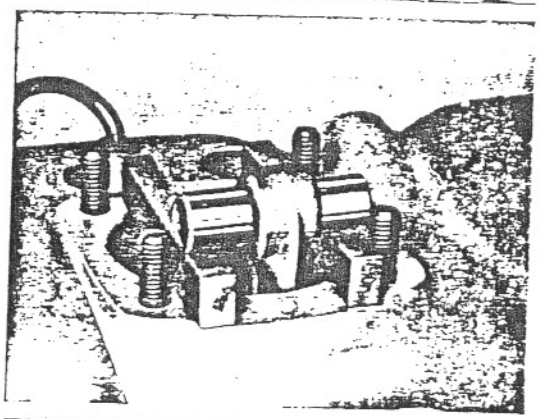
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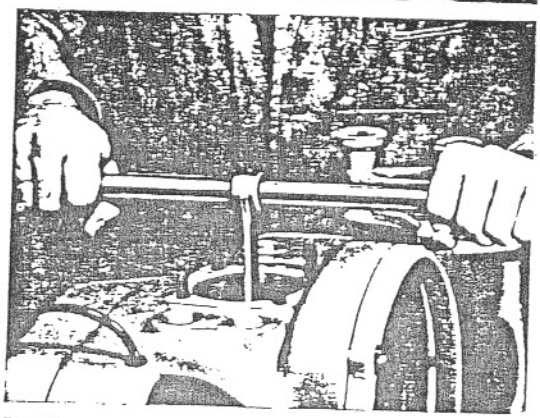
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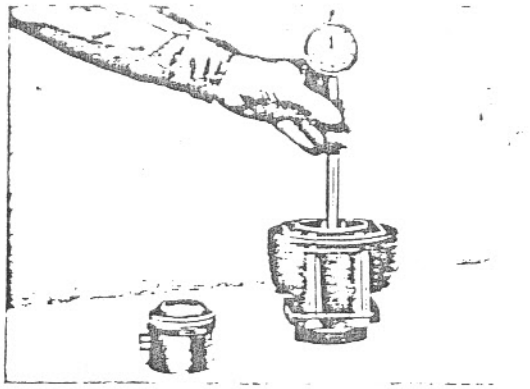


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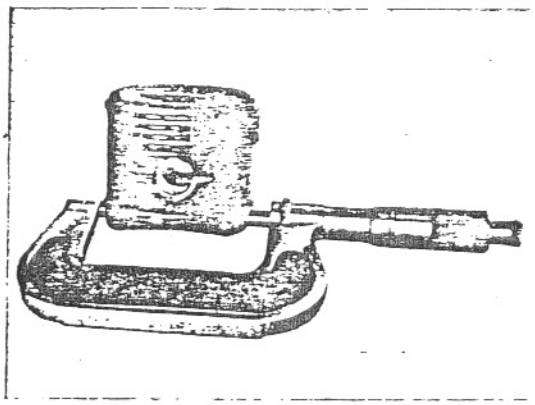


2. Checking and Reconditioning

Measure the diameter of each cylinder bore, taking the reading on three points: Approx. 0.4" below the top edge, at the middle and near the bottom edge with the cylinder measuring gauge placed parallel to piston pin and at a room temperature of approx. 70° F. Then repeat three measurements with the gauge placed at right angles to the piston pin. For the taper of cylinder bore refer to Tolerances and Fits, page 25.
Figure 51

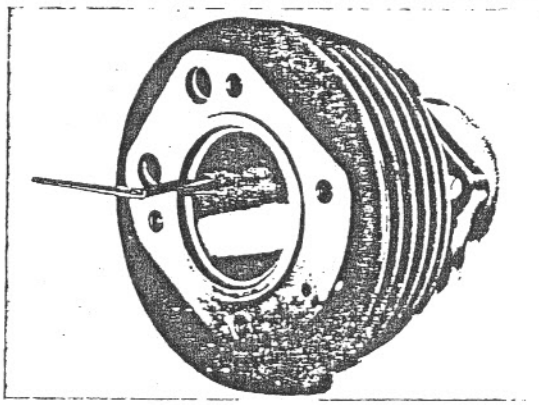

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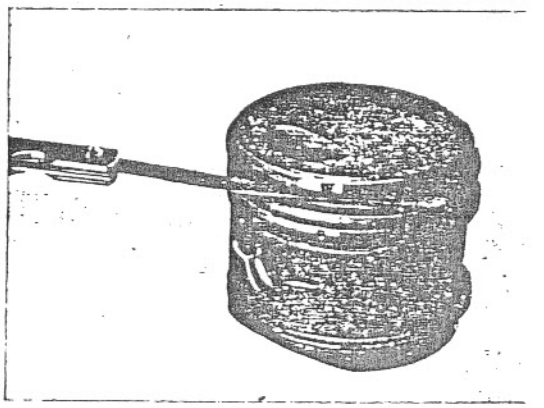
Measure the piston diameter at the bottom end of the skirt crosswise to the piston pin axis. **Figure 52**


52

The manufacture diameter achieved in the lower part of the cylinder bore, approx. at the height of the cylinder flange, serves to determine the clearance between piston and cylinder wall. Manufacturing differences from standard size are stamped in the side of the cylinder flange, in hundredths of a millimeter without the nominal specification. In the case of plus tolerances without + sign (the number 3 for instance stands for +0.03 mm.), and in case of minus tolerances, e.g. –3 (for –0.03 mm.), with the–sign.

The piston diameter is stamped in the piston head, e.g. 67.97. For piston to cylinder wall clearance, piston ring gap and side clearances and piston pin fits refer to Tolerances and Fits, page 25.
Figure 53 and 54


53

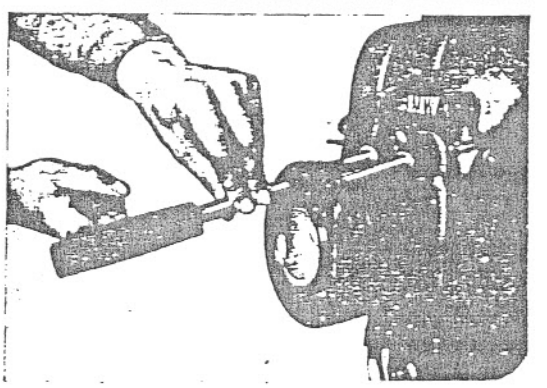

54

The cylinders may be reground to two oversize diameters:
R 50 and R 50 S: 68.50 mm. and 69.00 mm., R 60 and R 69 S: 72.50 mm. and 73.00 mm.

Mark reground specifications instead of the factory data on the cylinder foot.

Caution! To slip cylinders over pistons, insert oiled piston und piston rings with Piston Ring Compressor 5003.

Whenever the pushrod protecting tubes have evidenced a leakage, they may with the resetting tool Matra 530a be tapped further down in order to obtain the proper fit of the rubber seals. **Figure 55**


55

W 3 = Removing and installing Ignition Magneto

1. Remove allen head mounting screw (a) SW 6 for centrifugal advance unit and magneto rotor, grasp advance unit carefully on breaker cam and remove it.

2. Disconnect the two high-tension cables from ignition coil terminals (b). Unscrew the two retaining nuts (c) SW 10 and remove them with washers. Care to keep watches away from magneto rotor to avoid magnetization. **Figure 56**

3. Remove magneto rotor from camshaft by means of puller screw 5030. **Figure 57**

Slip magneto rotor into magneto body and wrap the whole into clean cloths or paper for protection.

Caution! For reinstallation

1. move flywheel until its "S" mark (symbol for "Spätzündung" = retarded ignition) is in line with the reference mark on engine housing (inspection hole), see figure 60, left.

2. Install cleaned magneto rotor (one drop of oil on oil seal and oil seal contact surface, cone clean and dry) with mark upward onto the camshaft without fastening it.

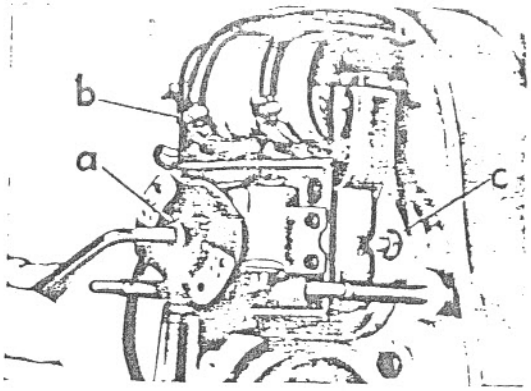
3. Install magneto body onto timing cover casting and fasten it with mounting screws in center of oblong holes. **Figure 58**
Knead breaker cam felt with Bosch grease Ft 1 v 4.

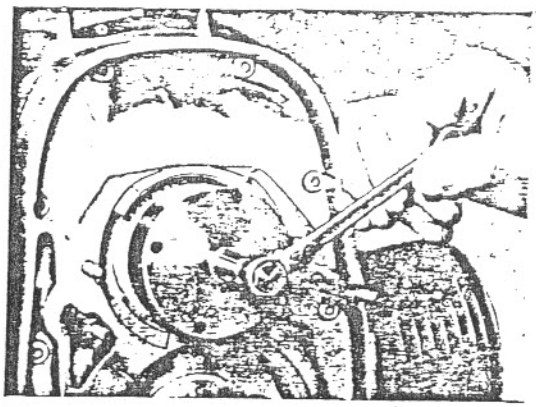
4. Lubricate the cleaned automatic advance unit with a trace of Bosch grease Ft v 30 into bore, install the unit onto likewise greased rotor shaft with nose in groove and fasten slightly by hand with the central mounting screw. **Figure 59**

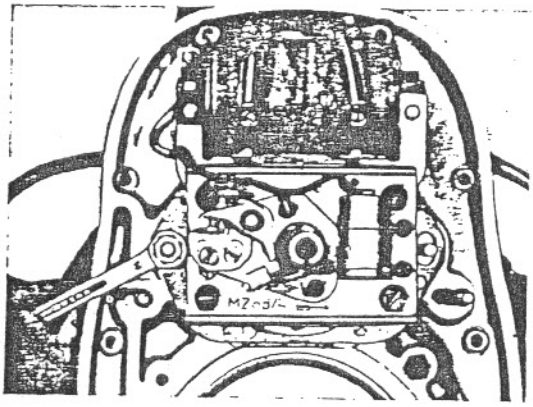
5. Rotate magneto rotor with automatic advance unit while holding flywheel until marks of rotor (a) and magneto body front plate (b) are lined up. **Figure 60, right**

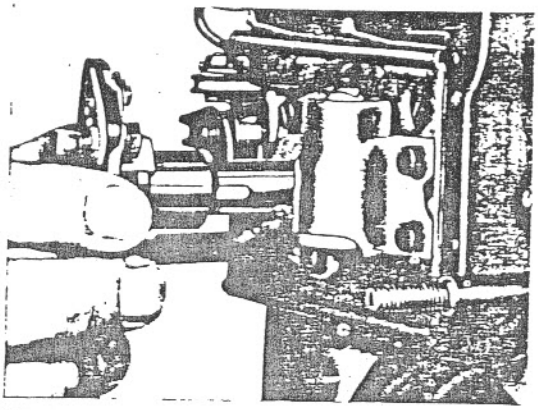
In this position tighten central mounting screw with torque wrench to 14.5 ft./lbs.
For final ignition timing adjustment refer to page 84.

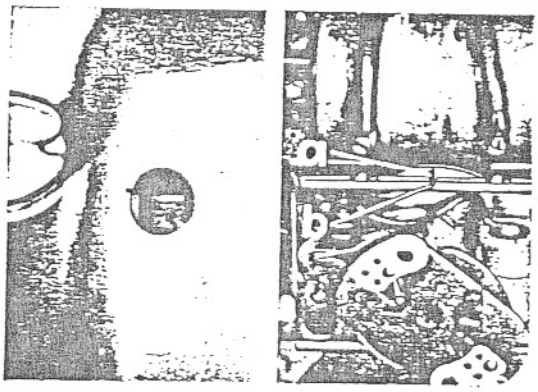
6. Check if advance springs readily return governor weights from

56


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60


their outer position, the breaker cam has a longitudinal play of .008"–.024" and is easy to rotate. Magneto rotor cone max. allowable out-of-round .0008".

Eventually check taper fit of rotor and camshaft for possible binding spots and eliminate them by polishing with pumice stone paste, and if necessary carefully apply a slight dressing blow, with plastic mallet on cone of installed rotor.

M 4 = Removing and Installing Camshaft and Timing Gears

1. Remove oil drain plug from engine housing (on R 50 S and R 69 S drain plug with magnet) and allow oil to drain off.
2. Remove the 12 allen head screws SW 5 securing timing cover casting to engine housing. Install puller tool Matra 499 or 536 with the two pertaining collar screws over crankshaft cone, screw it onto the timing cover and remove the latter from the crankshaft by turning the puller spindle. **Figure 61**
3. Remove snap ring from camshaft gear and remove breather valve plate with pressure spring. **Figure 62**

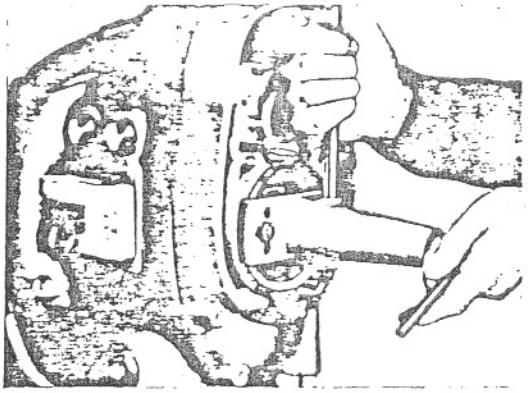
Caution! When refitting check the breather plate for axial smoothness and oil its sliding surface liberally.

4. Remove the four cylindrical screws fastening camshaft bearing bush, inserting the screw driver through timing gear holes. **Figure 63**
5. Install puller tool Matra 355a on engine housing, screw spindle with 8 mm. thread into camshaft end and remove camshaft with gear and bearing by means of SW 22 nut. **Figure 64**

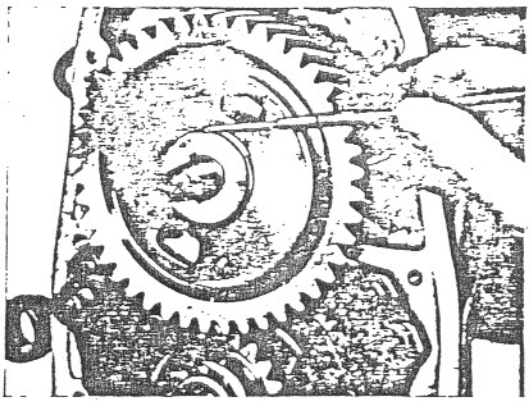
Remove camshaft gear only when the ball bearing or the gear itself have to be replacement, then remove snap ring in ball bearing bushing and press ball bearing out of bushing. **Figure 65**

Caution! To install camshaft, heat engine housing and fit its gear so to crankshaft gear that the marks on both gears line up.

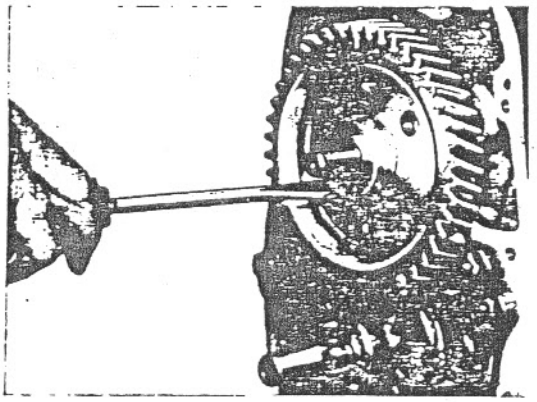
61



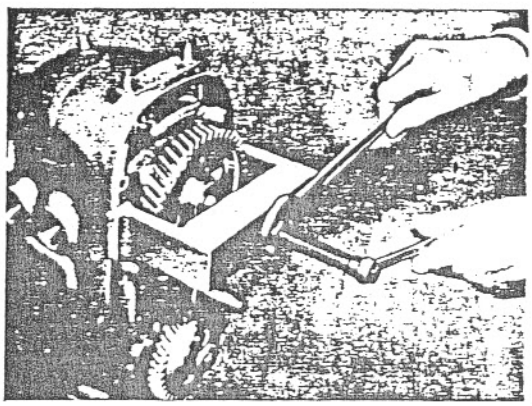
62



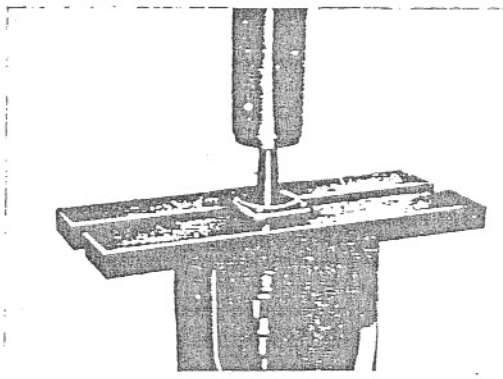
63



64



65



6. Removing and installing oil pump drive gear:

Bend locking plate of retaining nut back and remove **SW 14 nut with left-hand thread.** **Figure 66**

Remove drive gear from cone of pump gear shaft, giving the large gear for this a slight dab with a plastic mallet.

7. Remove ball bearing from crankshaft, using two screw drivers or a commercial-type puller. **Figure 67**

Caution! To install the ball bearing, heat it to approx. 175° F. and press it quickly into place through use of pressure bush 5039, on no account apply axial blows against the crankshaft!

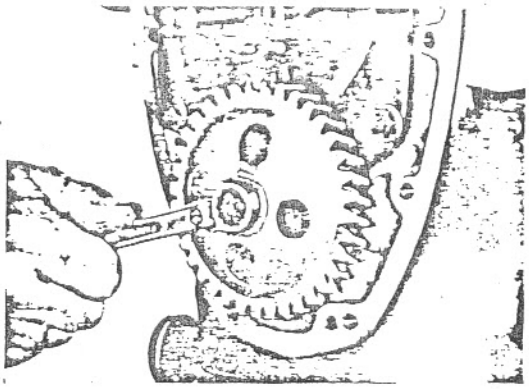
Seize the gear by means of the puller claws of remover tool Matra 499 and remove it from the crankshaft. **Figure 68**

Caution! On eventual replacements of the timing gear set pay attention to the mark on top of engine housing beside the contact face (for instance +2 or –3) which is determinant for the choice of the size of the new timing gear set.

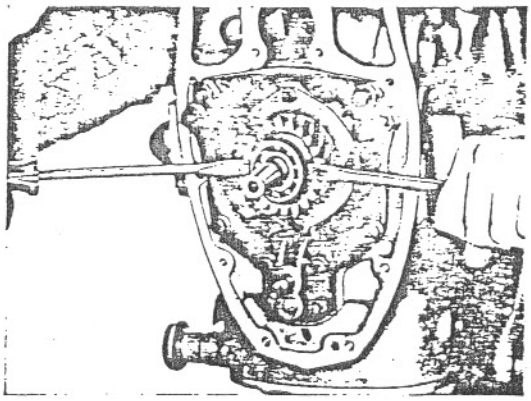
To install the crankshaft gear, heat same to 300° F., grease crankshaft cone with tallow, install guiding bush 5040 on crankshaft cone and slip heated gear with sleeve (a) and pressure bush (b) 5038 quickly onto crankshaft. **Figure 69**

Apply pressure bush (b) 5038 on gear, screw spindle (d) of tool Matra 355a into crankshaft and finish pressing into place by means of lever nut (c) Matra 535. **Figure 70**

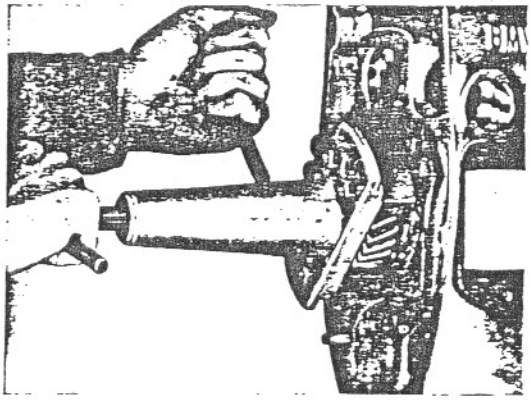
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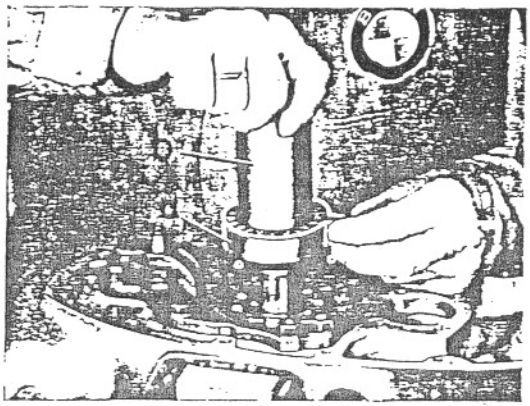
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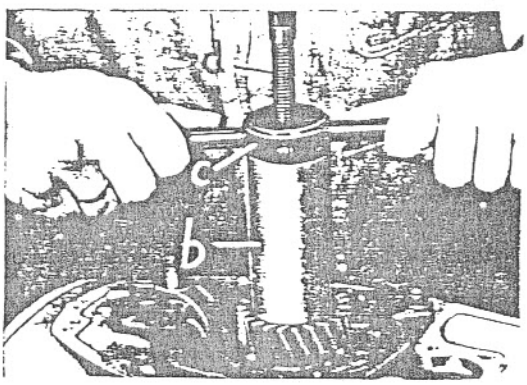
68



69

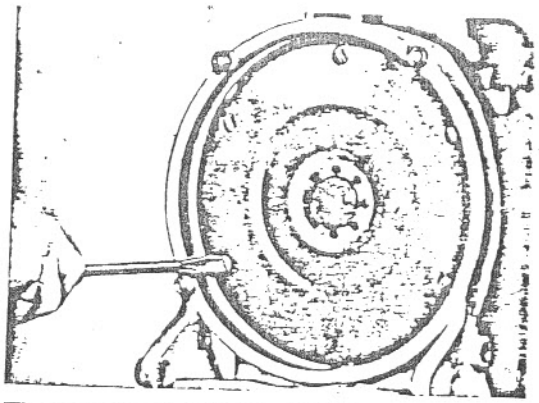


70



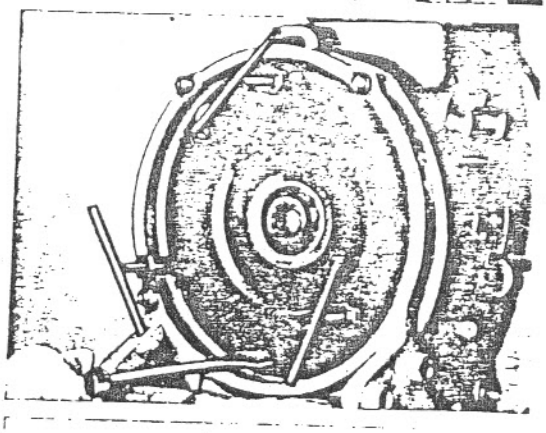
M 5 = Removing and Installing Clutch Unit

1. Remove every second fastening screw on pressure ring with a screw driver, and in their place install three clamping screws Matra 534 and screw their nut fully down onto the pressure ring. **Figure 71**



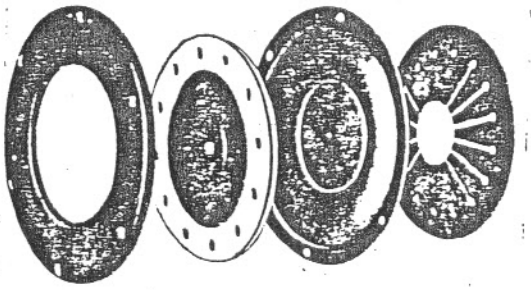
71

Remove other three fastening screws and evenly loosen the three clamping screw nuts until spring in completely released. **Figure 72**



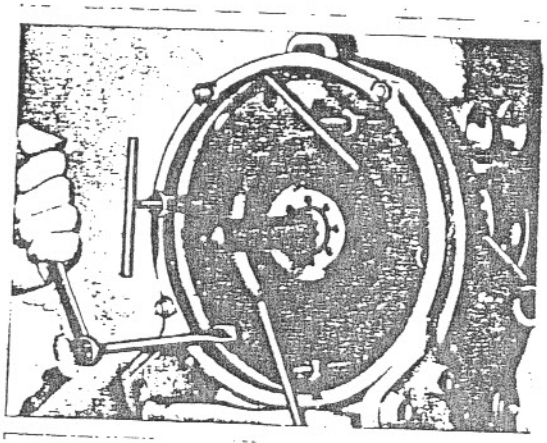
72

Remove pressure ring, pressure plate with diaphragm, clutch plate and disk spring. **Figure 73**



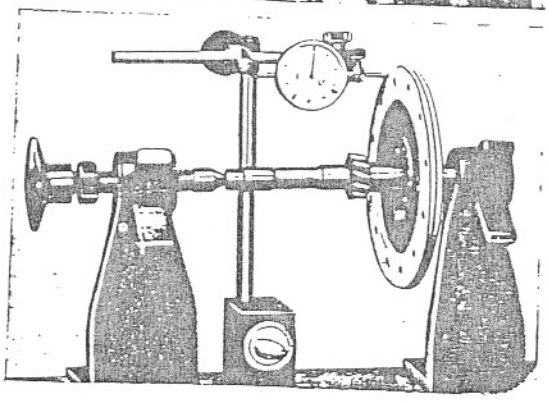
73

Caution! When installing clutch unit, use aligning tool Matra 529 for centering of clutch plate. **Figure 74**



74

2. **Inspection and reconditioning:** Check clutch plate for wear and torsion and disk spring for tension in installed condition. For this, refer to Tolerances and Fits. Check lateral runout of clutch plate, max. allowable runout .02". **Figure 75**



75

Caution!
Adjust eventual new clutch plate with a close sliding fit upon the splines of the transmission primary shaft.

M 6 = Removing and Installing Flywheel

1. Install locking fixture for flywheel, Matra 292, on transmission connecting studs, then connect the fixture to flywheel by means of three M 8×1×28 mm. hex-head screws.

Release tab washer of flywheel and remove flywheel mounting screw SW 36 together with the tab washer.

2. Install Matra 311 puller with 2 screws 20 mm. long on the flywheel and remove. **Figure 76**

Eventually apply a slight dab on the puller screw.

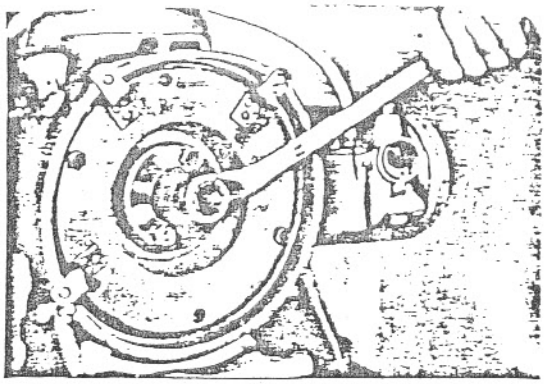
Caution! When reinstalling, check clearance between top flat of woodruff key and key groove of flywheel with feeler gauge. **Figure 77**

Tighten flywheel mounting screw by means of torque wrench to 123 ft./lbs. **Figure 78**

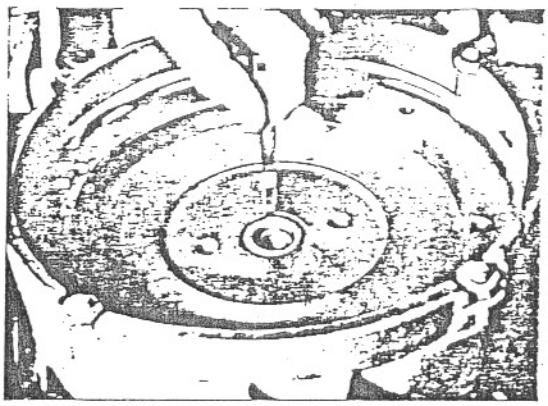
Prior to this, bend lock washer slightly up so it may thereafter easily be seized for definite bending. **Figure 79**

Check flywheel for runout with gauge 5104. Max. allowable runout .004". **Figure 80**

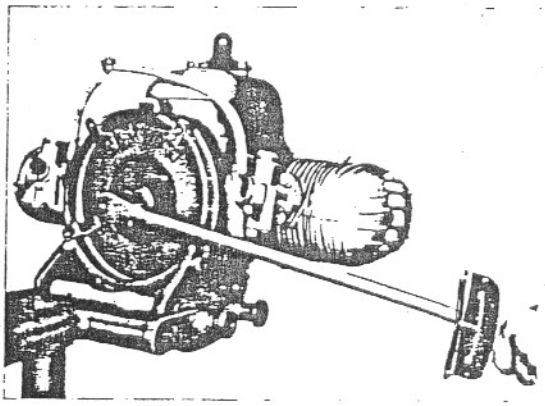
76



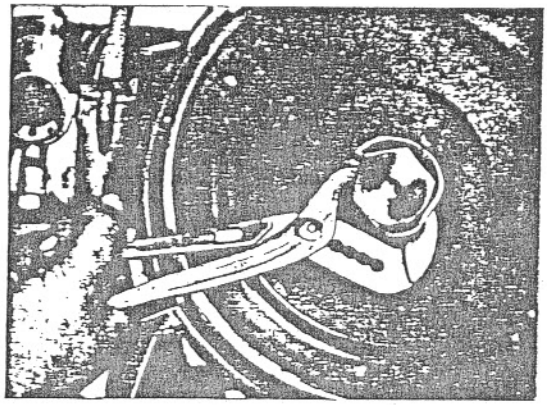
77



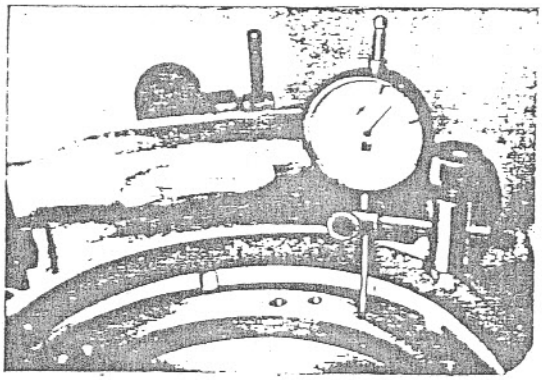
78



79

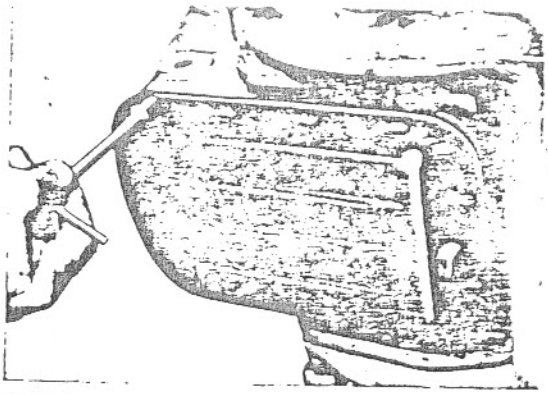


80



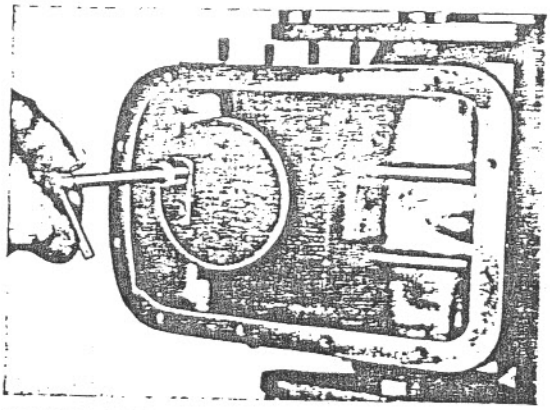
M 7 = Removing and Installing Oil Sump and Oil Strainer

1. Drain engine oil. Remove mounting screws SW 10 with flat washers by means of socket wrench. Remove oil pan with gasket. **Figure 81**



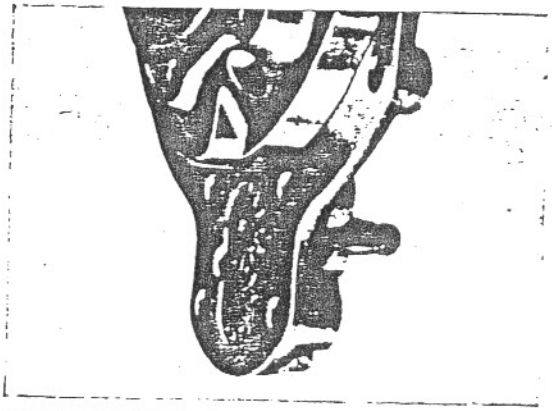
81

2. Bend back locking plate on oil strainer fastening screws, remove screws SW 10 with oil strainer and gasket. **Figure 82**



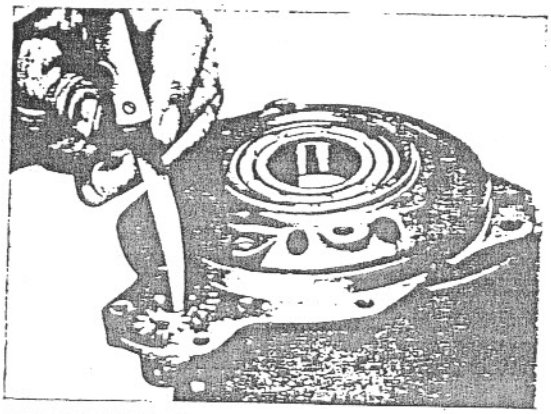
82

Caution! Before reinstalling oil strainer, wash it throughly in gasoline (solvent).



83

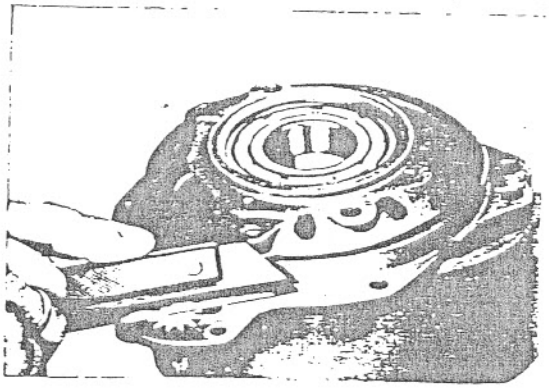
3. For removal of oil pump gears refer to M 8. **Figure 83**



84

4. **Inspection:**
Before reinstalling, wash oil strainer thoroughly in gasoline and install it with wire mesh side downward and secure with the locking plate.

Measure backlash (.0012" to .002") between oil pump gears with feeler gauge. **Figure 84**

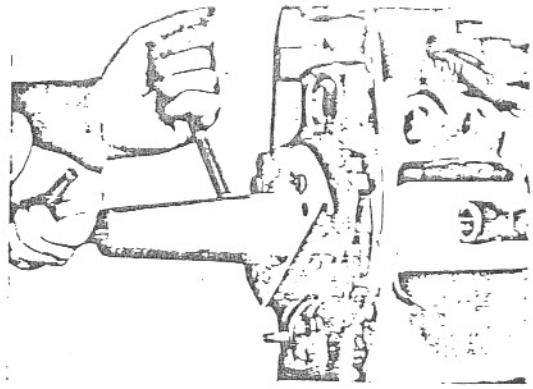


85

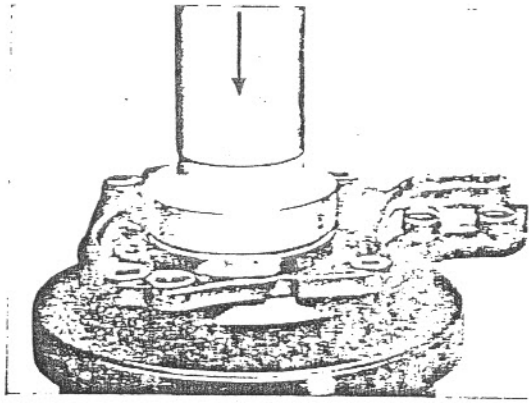
Measure side play of gears in bearing cover plate (.0004" to .0016") with straight edge. **Figure 85**

M 8 = Removing and Installing Crankshaft with Connecting Rods

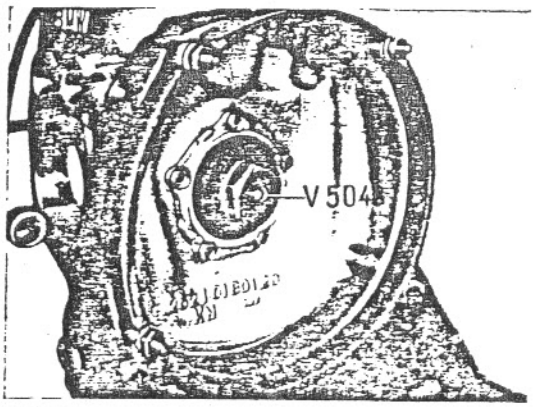
1. Remove front bearing cover plate. For this, remove 8 fastening screws SW 10 (four longer screws below on oil pump portion) with spring washers, install puller Matra 499/1 with two screws Matra 499/5 (M 8×72) onto the two threaded holes in bearing cover and pull same off together with the ball bearing through use of spindle. **Figure 86**


86

Put the bearing cover away and remove oil pump gears. Remove spacer ring from crankshaft. Only if necessary press ball bearing out of cover plate, after removal of bearing flange, and press the new ball bearing into the seat. **Figure 87**

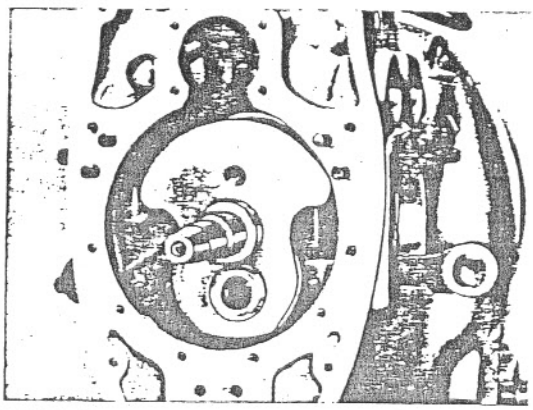

87

2. Removal of crankshaft:
Unscrew front oil slinger mounting screw and remove oil slinger.
Heat engine housing to approx. 180°F.
On R 50 S and R 69 S, after removing oil seal, spring washer and covering washer, fasten removing and installing ring 5048 with flywheel mounting screw onto rear journal spherical roller bearing. **Figure 88**

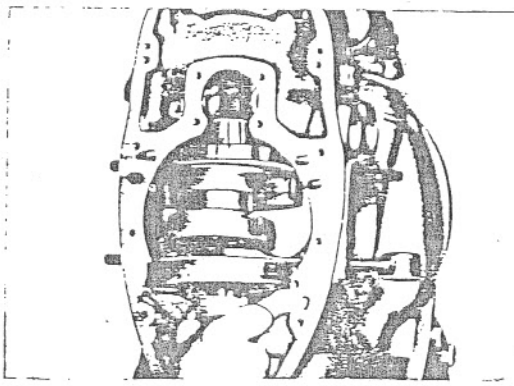


88

The crankshaft may then be pulled out of the rear bearing seat.
On R 50 S and R 69 S remove the guide ring 5048 after spherical roller bearing has become free.
Grasp crankshaft, front crankweb up, on front journal end. **Figure 89**


89

Tilt journal end throughly downward and lift crankshaft with its rear end through the recess below the camshaft bearing hole out of engine housing. **Figure 90**


90

3. **Checks:**
Max. out-of-round of crankshaft (.0008") on journal end, crankshaft being placed on "Vee" blocks at the front and rear main bearing journals. Connecting rod big end bearing without noticeable play. In case of faults it is recommended to use replacement crankshafts with connecting rods. **Figure 91**

4. Installation of crankshaft:
Heat engine housing to approx. 180° F. Install crankshaft, oil retainer

plate with cupped portion on rear ball bearing and connecting rods in correct position for left front and right rear cylinder, with rear crankshaft end upward, reversely to removal, completely into the rear bearing seat.
On R 50 S and R 69 S, after inserting crankshaft into the engine housing, fasten guide ring 5048 with flywheel mounting screw firmly to the spherical roller bearing (without oil retainer plate).
Install oil slinger plate snugly onto front crankweb, fasten with flat head screw and secure the latter with a notch impact applied by means of a screw driver. **Figure 92**

Install spacer ring with chamfering towards oil slinger on crankshaft journal. **Figure 93**

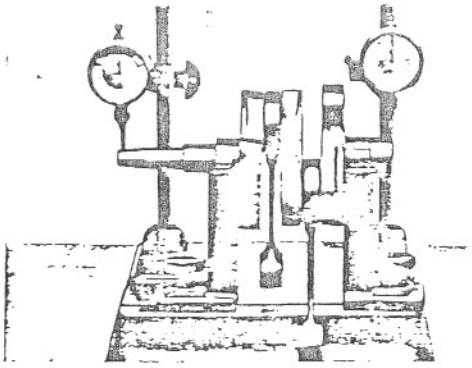
While engine housing is still warm, slip front bearing cover plate onto crankshaft journal, making sure that the oil pump gear with cone seats in the upper bearing hole.
Install spindle of puller Matra 355a (a) with lever nut Matra 535 (b) and pressure bushing 5038/1 (c) onto ball bearing in bearing cover. Screw the spindle into the crankshaft thread, and with lever nut pull bearing cover onto crankshaft until the cover plate nearly touches the engine housing. Thereafter install 4 long mounting screws below on oil pump portion, 2 short screws above them and 4 nuts on the mounting studs (all with spring washers) and press the cover evenly into contact against the crankcase by tightening screws and nuts.

Only then continue tightening the lever nut of the tool and this way pull the crankshaft forward onto contact on ball bearing inner race.
Caution! This final forward pulling of the crankshaft is important and must on the "S" engines (with rear journal spherical roller bearing) always be achieved with the guide ring 5048 screwed on. **Figure 94**

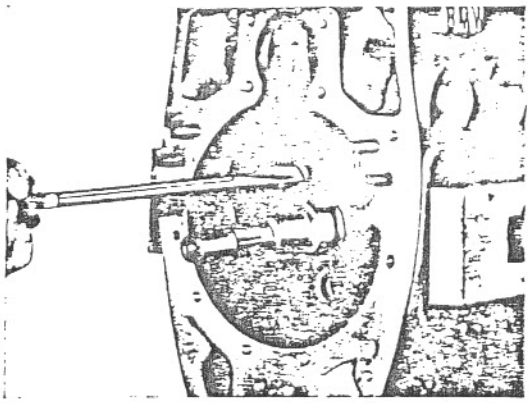
On R 50 S and R 69 S the guide ring may then be removed, the oil retaining washer with the deep cup-shaped side installed toward inner race of rear bearing, and the oil seal pressed into place so as to permit approx. 1 mm. (.04") of seal to protrude from the casting surface (drift tool 5108). **Figure 95**

For installation of flywheel refer to M 6.

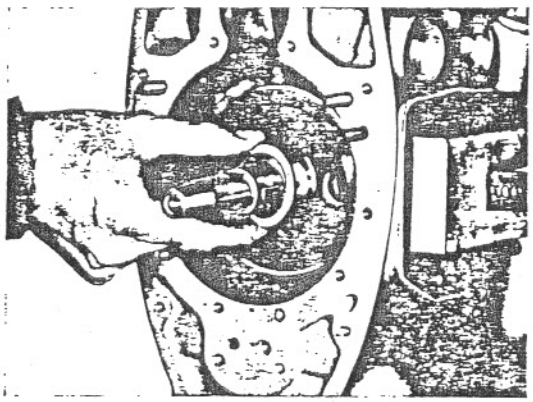
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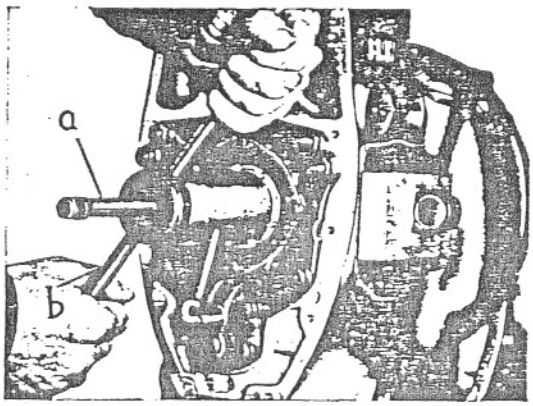
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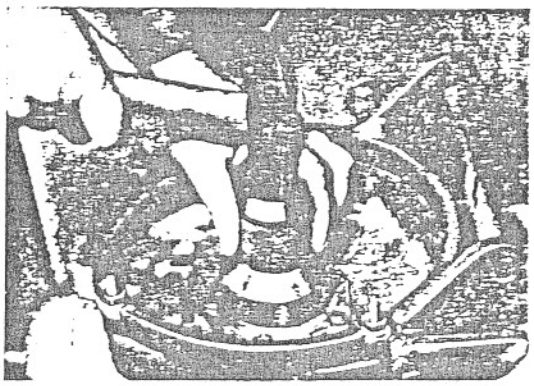
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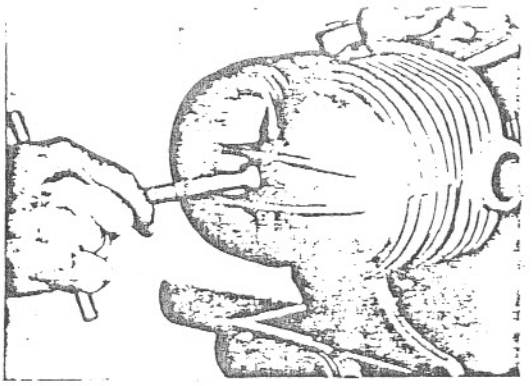
94



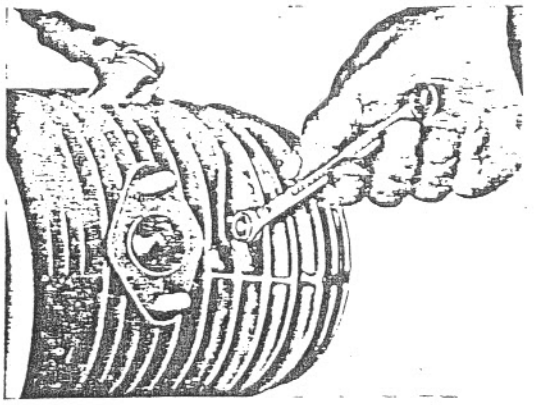
95



1. On the two rocker covers remove the central retaining nut SW 14 together with the corrugated washer.
Figure 96


96

On each cylinder head remove the two opposite nuts SW 10 and corrugated washers between the second and the fourth cylinder head fin.
Figure 97

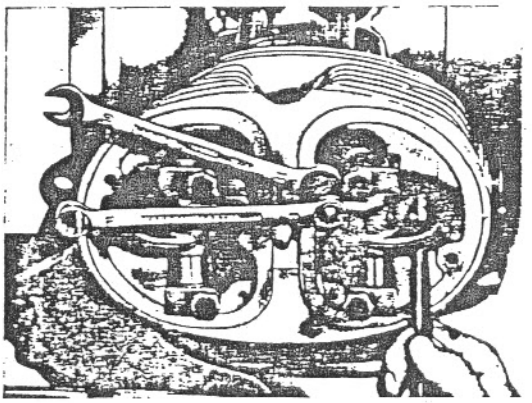

97

Remove rocker covers after having placed a tin box under each cylinder head to collect the oil dropping from rocker chamber.

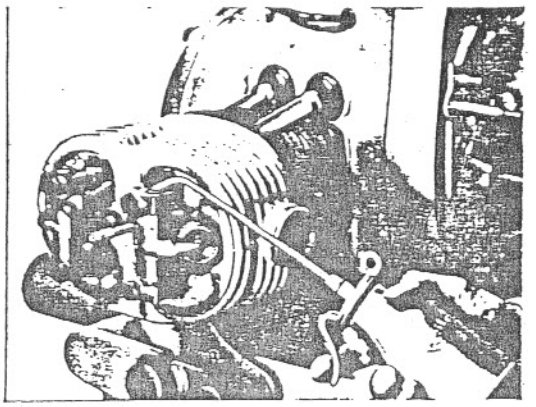
2. Remove spark plug adapters, unscrew spark plugs.

3. Rotate the engine until the piston of the cylinder to be adjusted is at the top dead center on the compression stroke, when the flywheel "OT" mark lines up with the with the references line in the inspection hole: Both valves are then closed, and the valves of the opposite cylinder head are in overlapping position.

4. Measure valve clearance for intake .006", for exhaust .008" and adjust as necessary. For this loosen SW 12 locknut and turn the SW 11 adjusting screw until the correct play is felt when the feeler gauge is inserted between rocker arm and valve stem. Tighten the locknut and check the clearance once again.
Figure 98

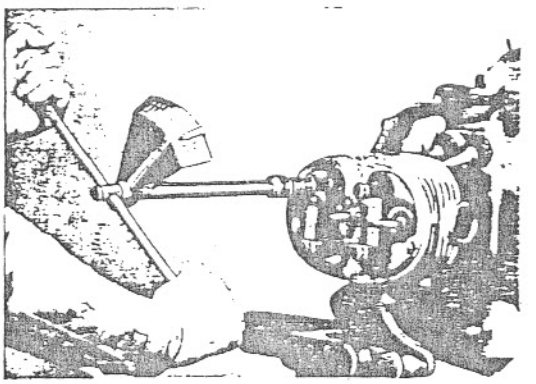

98

Rotate crankshaft 360° and adjust valve clearances on opposite cylinder in the same way. Before installing the rocker covers fill rocker shafts with oil, check gasket and wipe dry the sealing surfaces. **Figure 99**


99

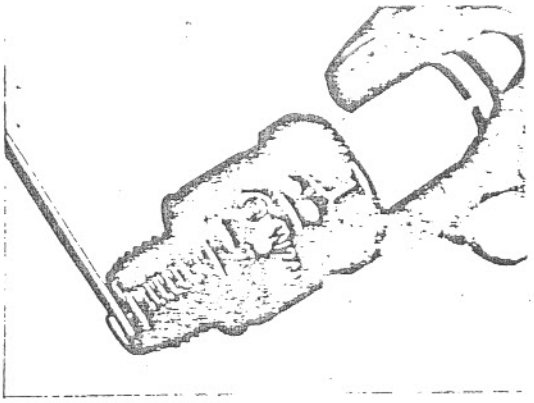
Caution! On overhauled engines, after the first 300 miles and with engine cold,

1. tighten cylinder head mounting screws SW 14 with torque wrench to 25 ft./lbs. and thereafter.
Figure 100

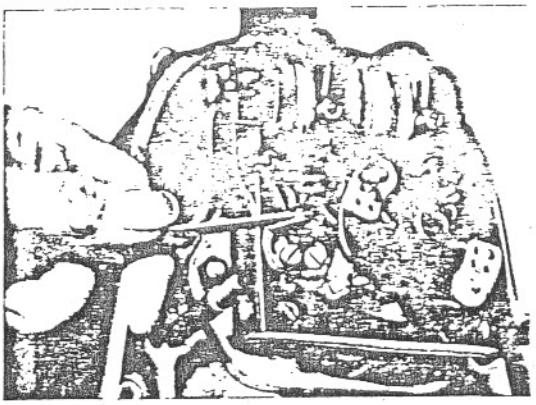

100

2. check and adjust valve clearances.

1. Check spark plug electrode gap and, if necessary, adjust to .024".
Figure 101

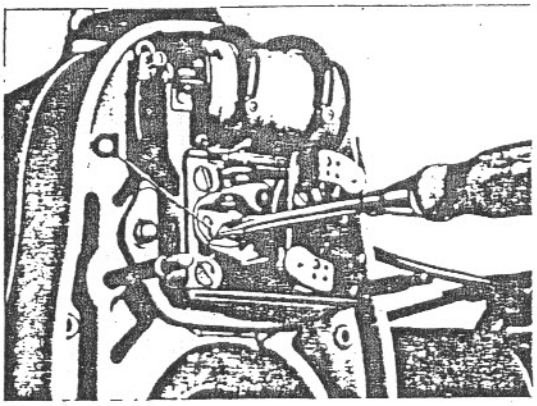

101

2. Inspect breaker contact points on magneto for wear and, if necessary, dress them with a fine-cut contact file or replace points.
Adjust the point opening with feeler gauge to a clearance of .016".
Figure 102


102

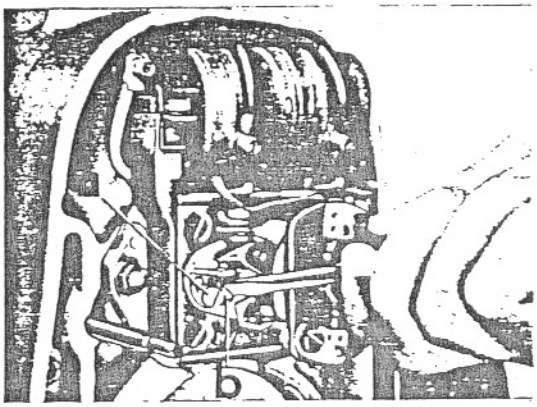
For this loosen lock screw (a) on stationary point plate,
Figure 103

and turn eccentric screw (b) until the specified gap (.016") is obtained.
Figure 104


103

Retighten contact support lock screw (a).

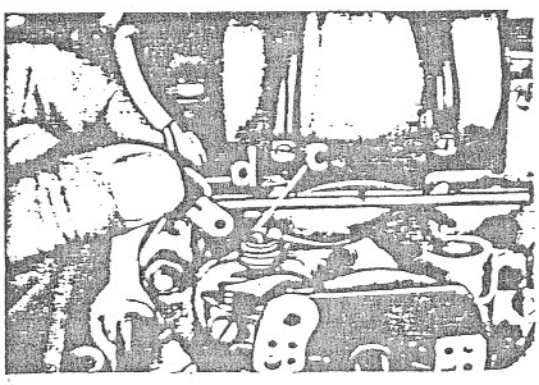
3. a) **Ignition timing adjustment on stopped engine with test lamp or with vibrator device.**
Disconnect cable (d) to ignition coil from terminal (c) in order to protect ignition magneto from external currents.
Figure 105



104

Connect one cable of light tester to ground and other cable to terminal (c).
Figure 106

When the mark "S" on the flywheel is directly in line with the reference line in the inspection hole of engine housing, that is when initial timing at 9° before T.D.C. takes place, the test lamp should then by very slightly moving flywheel for and aft light up and go out, respectively, or the vibrator respond.
If not, readjust ignition timing by loosening the two SW 10 magneto retaining nuts and rotating the magneto body within the oblong holes for the mounting studs.



105

moving the magneto body clockwise (magneto viewed from the operator) advances the ignition, moving it counterclockwise retards the spark.

Figure 107

b) The ignition timing adjustment should, whenever possible, be rechecked by means of a timing light. To do this, connect the timing light (c) with its two cables (d) and (e) between spark plug (a) and high-tension cable (b), in accordance with the manufacturer's instruction. Hold timing light in front of inspection hole (f) in engine housing in a rectangular position to the engine axis. **Figure 108**

When engine idles at a speed of about 500 to 750 r.p.m., the flywheel mark "S" for initial timing at 9° before T.D.C. should apposite the housing reference line (f) in the inspection hole appear as a shining line (R).
If this shining line appears more upward, the ignition is too advanced (F), and when it appears below the middle the spark timing is too retarded (S).

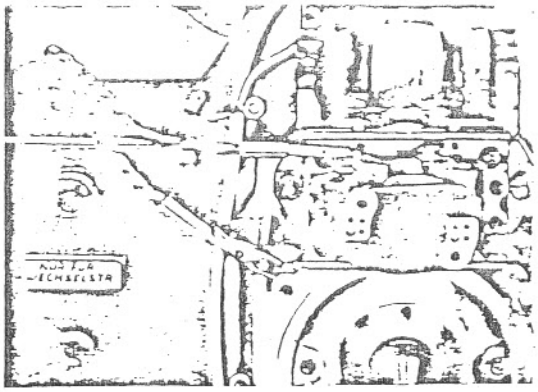
Figure 109

As the engine speed increases, the shining line disappears upward (beginning of advance shift at approx. 1200 r.p.m.) and as the engine speed is further increased to approx. 5800 r.p.m., the flywheel mark "F" (max. advance at 39° before T.D.C. appears from below in the inspection hole and travels onto the housing reference line (fully advanced position).
When the ignition timing functions properly, the shining line must shift up and down as the engine speed is increased or lowered, otherwise the automatic advance unit must immediately be corrected. Check side play and running clearance of cam body on rotor shaft as well as free movement of governor weights and if not correct replace advance unit.
When measuring the left and right cylinder, the difference in the firing spark setting must not be more than ± 2 degrees. If this is not the case, check the cone seat of automatic advance unit for correct condition, smoothen out eventual binding spots by means of pumice stone paste. (Also see M 3/6.)

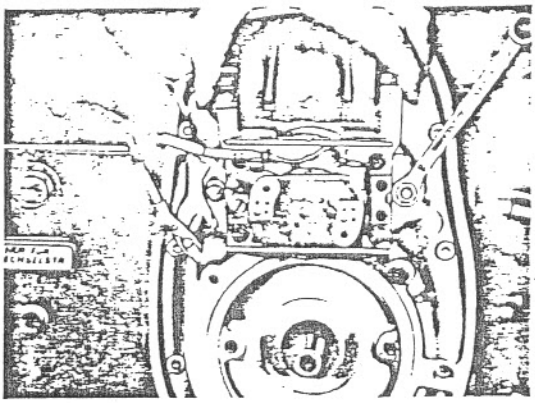
4. Check safety spark gap (g) 10 to 11 mm. between high-tension cable terminals on ignition coil and the sheet metal tips on ground, and adjust if necessary.

Figure 110

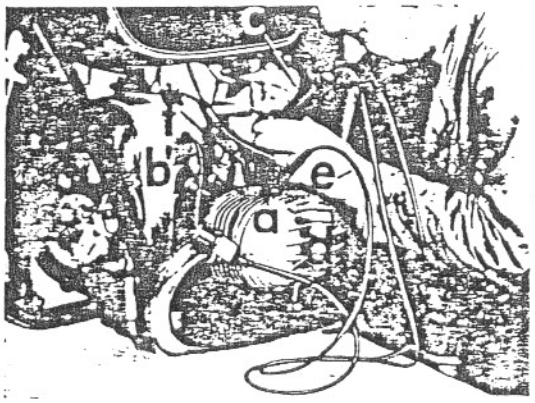
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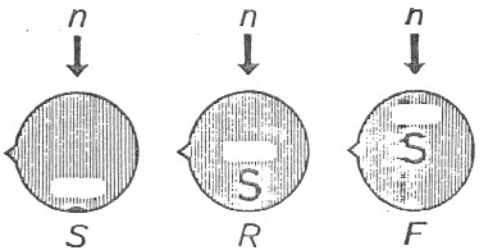
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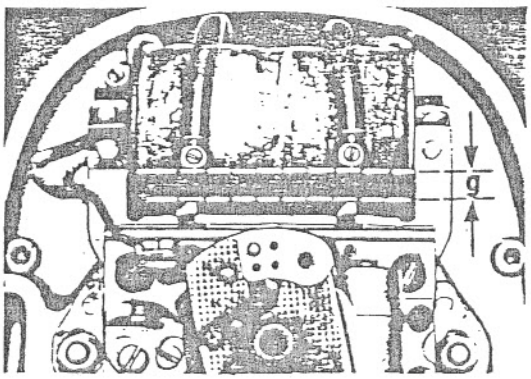
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109



110



M11 = Cleaning Carburetors and Intake Air Filter, Adjusting of Idling Speed

1. Hold fuel shut-off with SW 24 open-ended wrench and unscrew SW 24 pipe union by rotating it counter-clockwise. (The pipe union has a right-hand thread on the shut-off side and a left-hand thread on bottom side.) Remove filter screen from the hose fitting and clean. Take care that packing ring is not lost!

Figure 111

2. Disconnect intake air filter from transmission housing and remove the filter. Clean the filter element (a), when necessary by tapping out the dust, and replace it at least every 8,000 miles.

Caution! When installing the air filter, remember the locating pin and care for a correct fit.

Upon removal of upper engine housing cover, lift out the filter screen (b), clean it in gasoline and wet with oil.

Figure 112

3. For removal and cleaning of the carburetor unscrew the knurled ring on top and pull throttle slide upward out. For removal of the float and jets see illustration:
1. Intake port, 2. Feed for idling mixture, 3. Idling jet, 4. Plug, 5. Control cable with return spring, 6. Jet needle holder, 7. Throttle slide, 8. Air intake pipe, 9. Compensating air feed, 10. Jet needle, 11. Needle jet, 12. Main jet, 13. Plug, 14. Priming button, 15. Float bowl, 16. Float, 17. Damper ring, 18. Hose fitting, 19. Idling mixture adjusting screw, 20. Throttle valve stop screw.

Figure 113

4. Air-blast all passages and jets and reassemble parts properly cleaned and provided with new gaskets.
For preliminary adjustment screw the idling mixture adjusting screw fully in and then screw it out one and a half turns.

5. To adjust the idling speed turn twist grip to idling stop position and adjust throttle cables on both carburetors for a play of .02".

Figure 114

Start engine, then remove spark plug adapter from right-hand cylinder and adjust left-hand carburetor:
Turning idling mixture adjusting screw (a) to the right enrichens the mixture, and screwing to the left weakens it. At the same time adjust on throttle slide limit screw (b) for the best idling speed. Clockwise rotation increases idling speed, and counterclockwise turning decreases it.

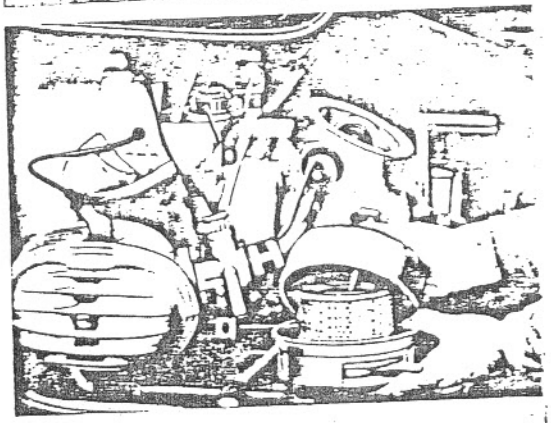
Figure 115

Thereafter remove spark plug adapter from left-hand cylinder and adjust right-hand carburetor in the same manner.
Check even change-over to fast idling speed by alternately removing spark plug adapters from right and left cylinder and resetting cable adjuster on the slower side. Do not forget to tighten locknuts!

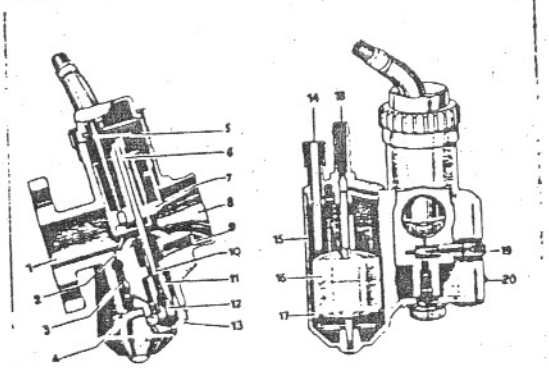
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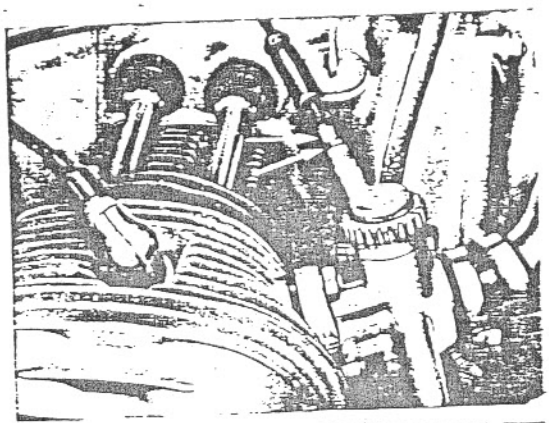
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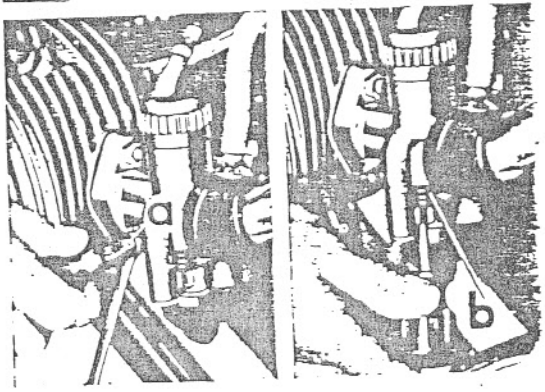
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114



115



Tools:
Special tools Matra No. 297/1a and /2a, 319/1 and /2 and /3, 494/2a and /3, 500, 501, 503, 504; refer to page 37 and 39.
Tools on drawing No. 5014 or 5017, 5061, 5065, 5095, 5097; see page 41 and 43.
Torque wrench, plastic mallet, check mirror, straight pliers for outward eared snap rings, angled pliers for outward eared snap rings, depth gauge, punch, 2 screw drivers, ring wrenches SW 8/9, 14/15, 17/19, socket wrench SW 10, allen head wrench SW 6. Figure 116

G 1 = Removing and Installing Coupling Flange of output shaft

1. Install the transmission into repair stand 5014 or into transmission support 5017 clamped into a vise.
Figure 117

2. Drain transmission oil.
3. Loosen fastening clip of rubber boot on transmission rear end, remove clip and rubber boot.
4. Remove cotter pin and retaining pin of clutch lever and the lever itself.

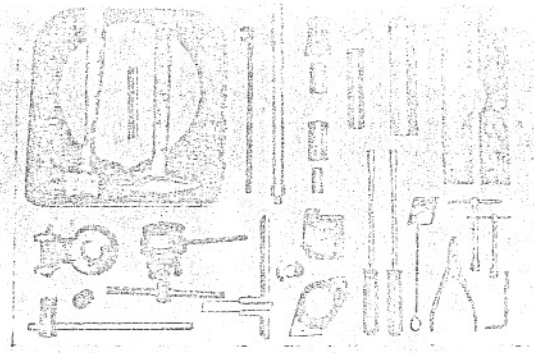
5. Install Matra 500 fixture on coupling flange and unscrew the grooved nut by means of Matra 494/2a socket wrench.
Figure 118

Caution! When assembling tighten grooved nut with socket wrench supplement Matra 494/3 for torque wrench and Matra 500 fixture from 85 to 110 ft./lbs. torque.
Figure 119

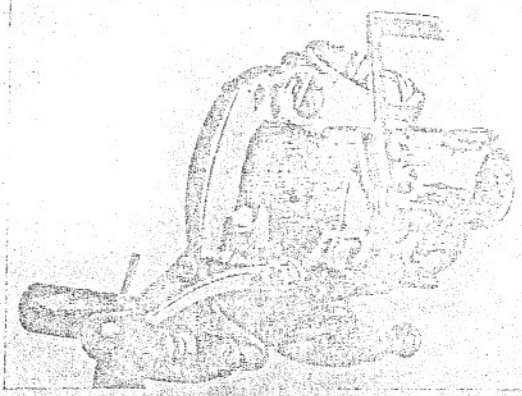
6. Fasten Matra 501 puller tool with four pertaining screws on the coupling flange and press off the latter. If necessary direct a slight dab against the puller spindle head.
Figure 120

7. Remove bushing for speedometer worm gear only if there is need: Unscrew SW 9 fastening screw, pry out the bushing with the levering effect of two screw drivers set against the bushing flange edge, at left and right, and remove worm gear.
8. Remove oil seal for output shaft, when found in worn condition, and with a suitable driver install the new one with sealing lip rearward into the housing cover, permitting approx. 1 mm. of seal to protrude from the cover surface.

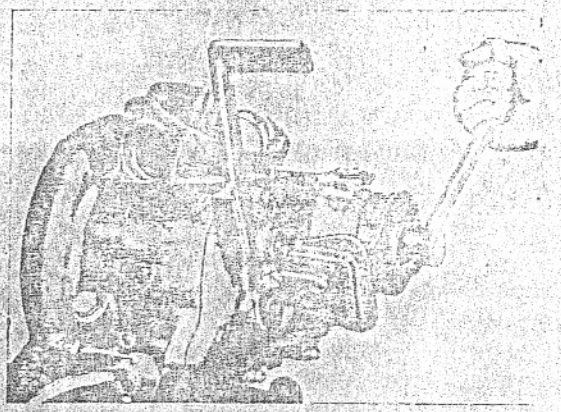
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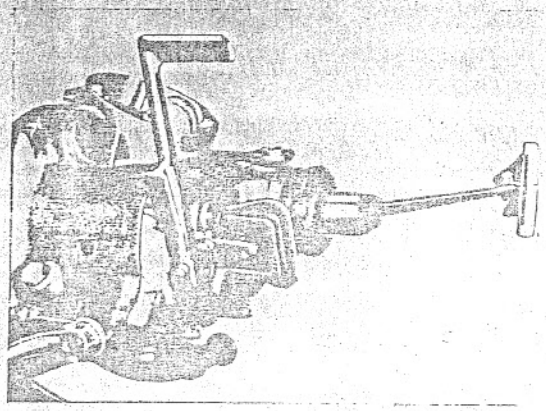
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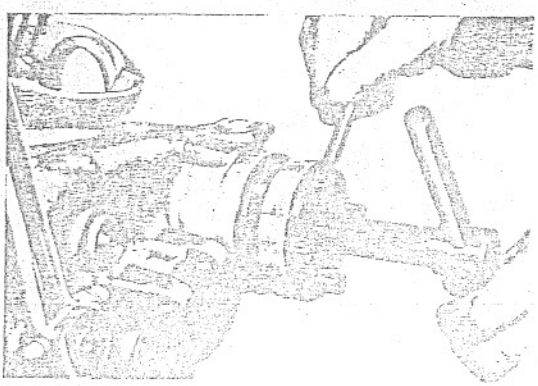
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119



120



G 2 = Removing and Installing Transmission Shafts

1. From clutch throw-out rod, remove thrust piece with seal ring, ball cage, thrust plate and thrust rod with felt ring.

2. Remove seven transmission cover retaining nuts SW 10 together with their washers.

Figure 121

3. Heat transmission to approx. 180° F., press kickstart crank slightly down and tap off the transmission cover with a hard wood stick applied against the overhanging noses provided for this end. Simultaneously, tap back ball bearing of primary shaft by means of a driver tool in forks.

Figure 122

Remove shims for adjusting end play of shafts from the cover.

4. Remove the two allenhead screws for shifting fork retaining plate, together with their washers.

Fig. 123

Mark mating shifting forks and bushings, remove bushings and retaining plate.

5. Remove the three transmission shafts together with the shifting forks from still warm housing. If necessary give plastic mallet dabs against the housing to release the shafts from their bearing seats. Exercise care to get out the shifting forks away from any obstructions. Remove oil retainer plate from bottom of primary shaft ball bearing seat in housing.

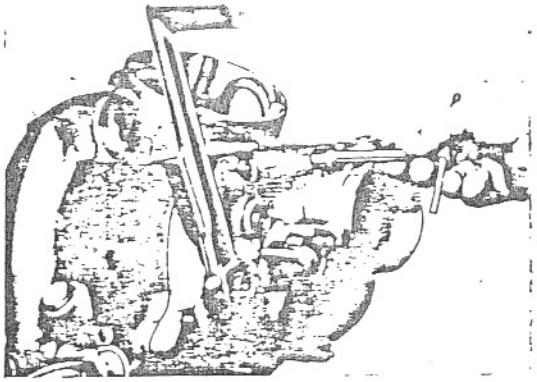
Figure 124

Caution! To install the transmission shafts, heat housing to 180–210° F. Whenever output shaft and/or speed gear coupling disks, shifting forks, cam plate have been replaced, the position of the shifting forks must be adjusted again. To do this, tap output shaft fully into housing and support free end by means of Matra 504 setting fixturo screwed to housing. Foot shift mechanism must be in the housing to allow the Matra 503 shifting wrench to be installed onto the double-edged boss SW 16 of the shifting sector. First install the lower shifting fork and then the upper one, and check each shifting fork individually.
With the inspection mirror (a) examine whether the shifting fork in the various rest positions (neutral as well as lower fork in third and fourth, and upper fork in 1st and 2nd) keeps the coupling disk equidistant from the dogs of the neighboring speed gears, at right and left.

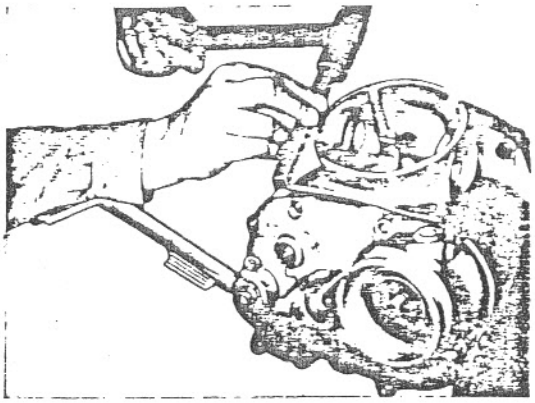
Figure 125

If not, remove the fork in question and bend both ends into the required position.
Moreover check each shifting fork for ease of function and wether its two operating ends simultaneously actuate on the coupling disk without causing same to bind on the output shaft.

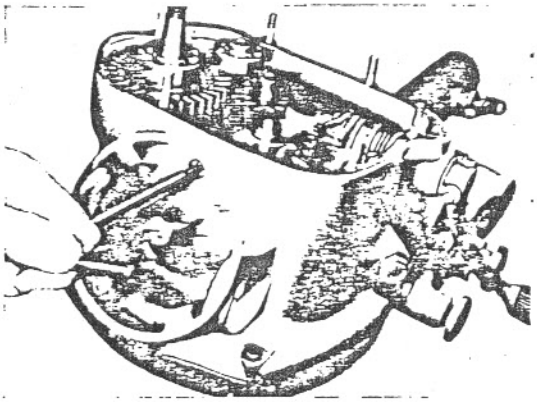
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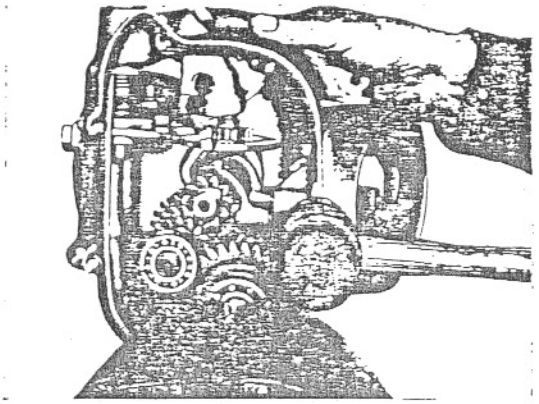
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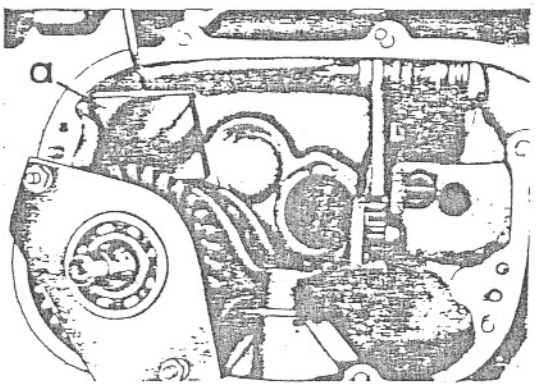
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124



125



If not, rotate shifting fork bushing 180 and tighten in this position, or redress accessible shifting fork end with adjusting tool 5065.
For this give shifting fork end first a pressure load and then a pull load, while each time shifting through with the shifting wrench, and then bend the fork ends into that direction which allowed the easier shifting.
To definitely install the shafts, first install primary shaft with replacer sleeve Matra 297/1a for oil seal protection, into the housing and with driver bushing 5095 applied against **ball bearing outer race** finish tapping into place.

Figure 126

On no account tap against the upper shaft end when installing the primary shaft, otherwise the proper fit of the Then install oil retainer plate into shaft in the housing is not insured. ball bearing bore of output shaft, range intermediary shaft and output shaft with shifting forks into the housing and mesh the gears.

Figure 127

Tap both shafts together into the bearing seats, applying installing drifts against ball bearing inner races. Use care to avoid bending of shifting forks.

Figure 128

To measure the end play of the transmission shafts, install new gasket on transmission housing.
Support output shaft with Matra 504 fixture and, using a depth gauge, measure distance from ball bearing to mating surface of housing. Then measure distance from housing cover mating surface to bottom of ball bearing seat in cover and compensate difference with shims of appropriate thickness until an end play of .008" (0.2 mm.) is obtained. It will be convenient to stick the shims with some grease to the bottom of bearing seat in the transmission cover.

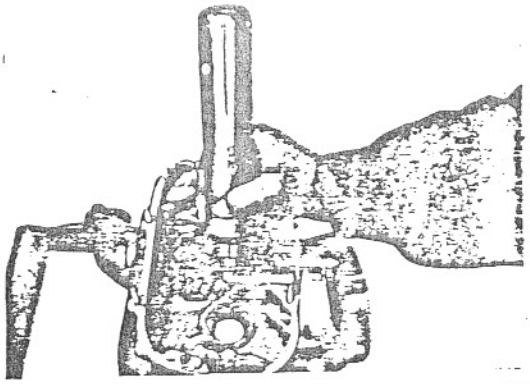
Figure 129

The measuring for the intermediary shaft is to be done in exactly the same way. This end play should be .008" to .016" (0.2–0.4 mm.).
In order to facilitate the measuring on the primary shaft, install the exactly 20 mm. high gauge bushing 5061 onto tightened washer on shaft end and measure for an end play of .008" (0.2 mm.). Stick the determined cup-shaped shim with grease onto the inner race of the ball bearing, which is already installed into the transmission cover.

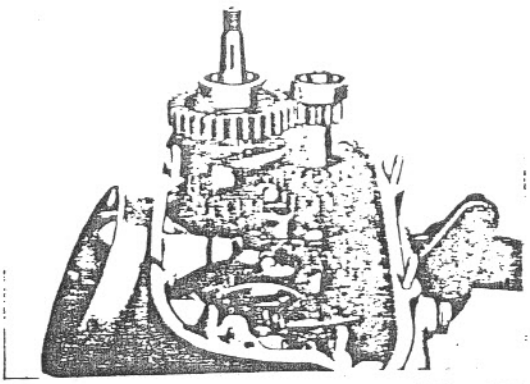
Figure 130

Heat transmission housing cover for installation to 180–210° F. Press kickstarter crank slightly down and mesh segment gear with kickstarter gear on primary shaft.

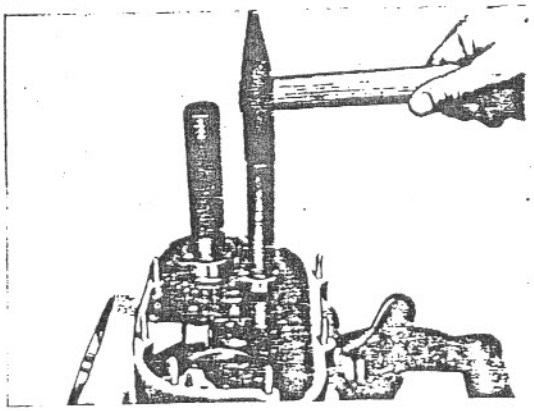
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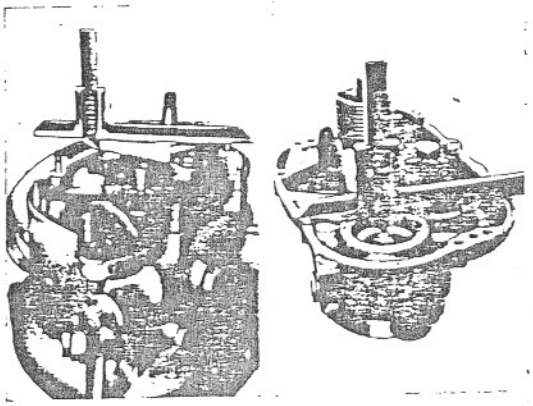
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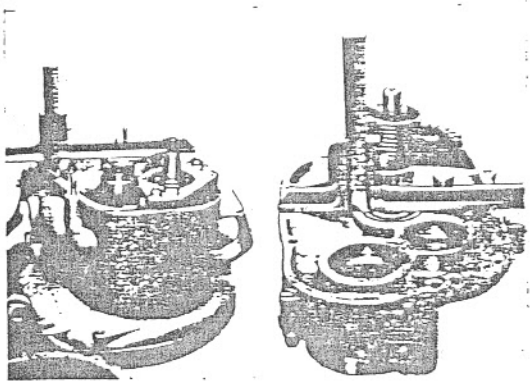
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129



130



G 3 = Removing and Installing Foot Gear Shifting Mechanism

1. Remove cam plate retaining snap ring and cam plate itself.
   Ratchet plate return spring is now free for removal.
2. Lift out snap rings retaining sector gear and ratchet plate, respectively, and remove these parts. **Figure 131**
3. Tap cotter screw out of foot shift lever upon unscrewing the retaining nut, and remove lever and spacer between lever and housing.
4. Remove interlocking lever with spacer bushing, interlock holder with steel spring ring, spacer washer and return spring inward.

Caution! When assembling, install parts on interlocking lever in the following order: Spacer bushing, upon it the steel spring ring with the two interlock holders so inserted that the cranked ends pointing to the interlocking lever jam the two stop pins of interlock pawl in parallel position, thereafter the spacer washer and finally interlock lever return spring with curved ends toward interlocking lever.
Figure 132

Install the whole into housing, so that return spring ends jam pilot pin in housing crosswise.
Install foot shift lever with appropriate spacer washer onto housing (.004" of play).
Slip sector gear with interlock gear onto interlocking lever shaft. The two points of the interlock pawl, left and right, must then be equidistant to gear sector outer diameter. If necessary, adjust by rebending the ends of return spring.
Figure 133

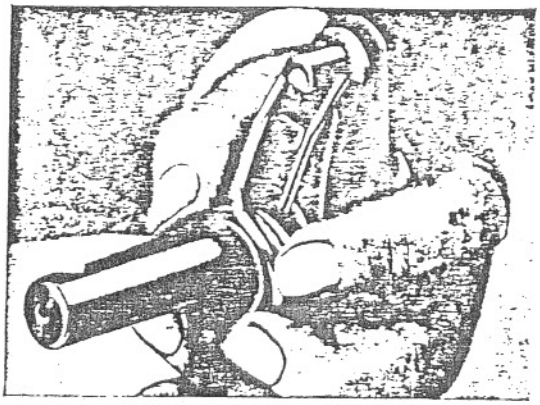
Install ratchet plate onto sector gear, secure with snap ring and fit snap ring to secure sector gear on interlocking lever shaft.
Install ratchet plate return spring on pin in housing, press ratchet plate upon it and slip cam plate so on axle that the second tooth of the sector gear (viewed from open housing) is exactly in line with the mark on cam plate gear.
Figure 134

The backlash (a) between ratchet plate and detent notches on cam plate, which is determined by the two stop screws limiting the rotation of the interlocking lever, should in the two shifting directions be approx. 2 mm. (.08") for each gear from 1st to 4th. If necessary, adjust stop screws by inserting washers of appropriate thickness. Figure 135

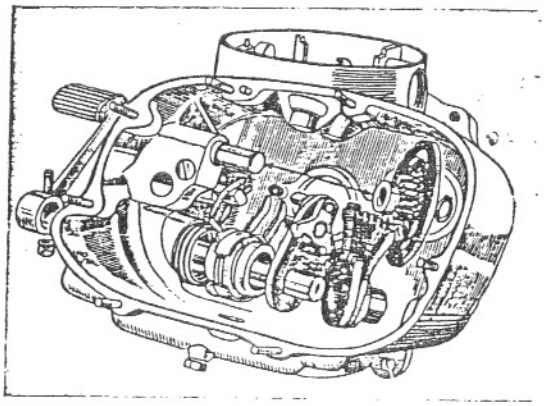
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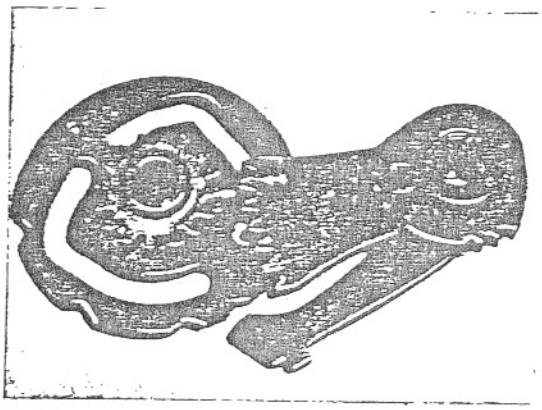
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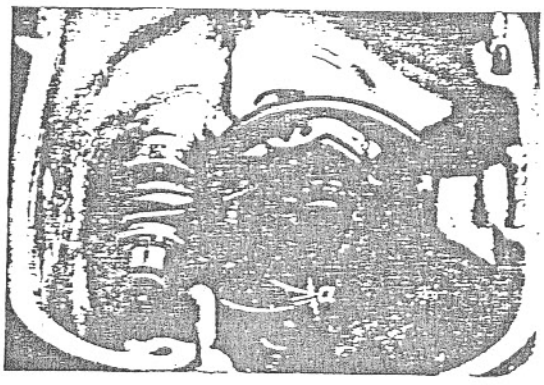
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134



135



G 4 = Disassembling and Assembling Primary Shaft

1. Press off tightened washer (a) on rear end of shaft and kickstarter gear. Remove washer, pressure spring and kickstarter gear.

Figure 136

2. Compress torsion damper spring (f) by means of Matra 319/2 tool and a press and list snap ring (s) out of its groove. Remove kickstarter ratchet, torsion damper spring, coupling and drive gear.

Figure 137

3. If necessary, press off ball bearing with sealing bushing and flat washer.

Caution! When assembling the torsion damper, slip on drive gear (z), coupling (d), torsion damper spring (f), ratchet (m) and tapered sleeve Matra 319/3 with cylindrical end ahead.
Install snap ring (s) on cone and with Matra 319/2 tool in vise or under a press, compress the torsion damper until the snap ring snaps into its groove.

Figure 138

G 5 = Disassembling and Assembling Output Shaft

1. Remove woodruff key for coupling flange from shaft.

Figure 139

Under first speed gear (33 teeth), insert two-piece plate (p), place same upon cylinder (c) and press off speed gear with thrust washer and ball bearing by means of a suitable press.

Figure 140

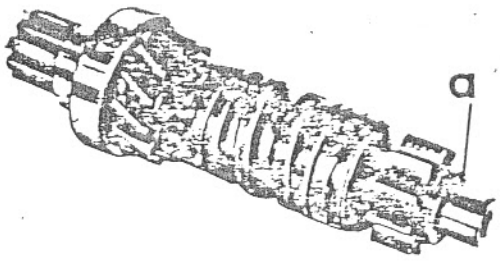
Remove bushing for 1st speed gear, thrust washer and 1st to 2nd clutch sleeve.

2. Remove snap ring for 2nd speed gear with thrust washer and 2nd and 3rd speed gears.

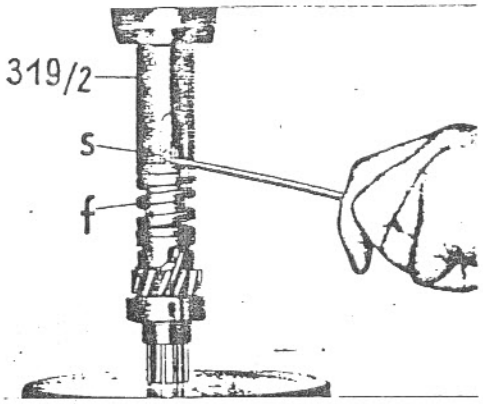
Figure 141

3. Lift snap ring for ball bearing 6303 out of front shaft end, and with a suitable arbour press out the shaft so third to fourth clutch sleeve with thrust washer, bushing, 4th speed gear spacer washer and ball bearing will become free.

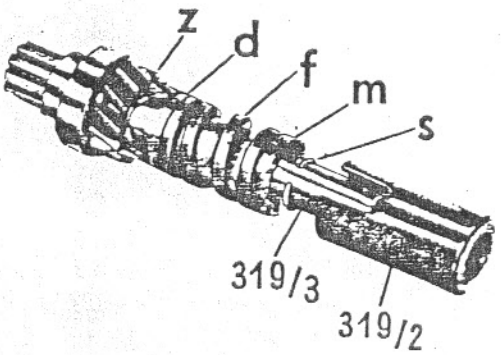
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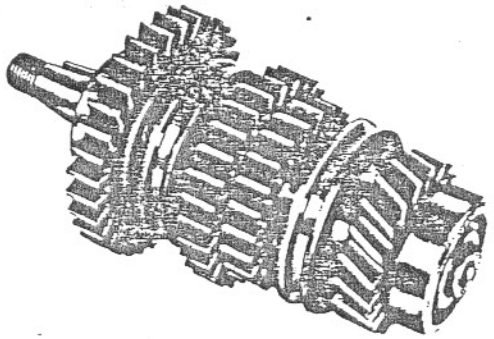
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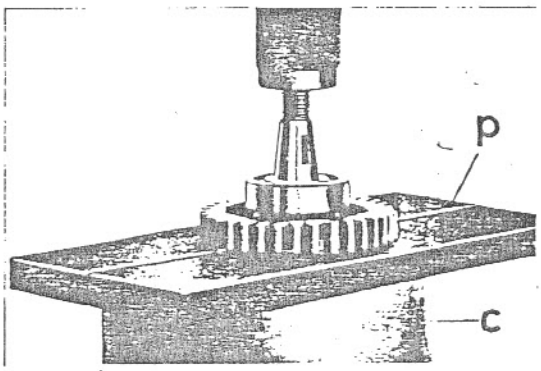
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139



140



G 6 = Removing and Installing Kickstarter

Remove retaining nut of cotter screw and washer and washer from kick-starter crank. Tap out the cotter screw and pull off crank, press segment gear and spring out of cover.
Remove idler gear retaining snap ring and idler gear itself.

Caution! Whenever the spring has been removed from the segment gear, it should, when being installed, with the offstanding end be supported upon the segment gear, and tightened on the inward bent end by means of a screw driver until it may with flat pliers be inserted into the mounting hole in segment gear hub.

Figure 142

When refitting the segment gear into the transmission cover, use flat pliers to insert offstanding spring end into the mounting hole provided in the cover.

Figure 143

G 7 = Removing and Installing Speedometer Drive Take-Off

Remove SW 9 locking screw, lift out bushing with the levering effect of two screw drivers, and pull out worm gear.

Figure 144

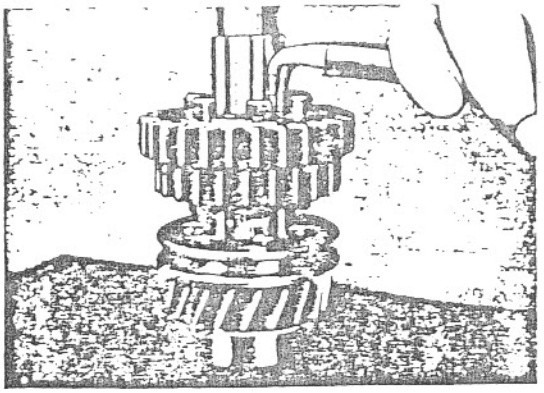
G 8 = Removing and Installing Neutral Indicator Contact

Remove contact shaft SW 10 retaining nut, star washer, flat washer, spring and, if necessary, the insulating washer. Since the contact shaft and the insulating bushing are always fitted with a sealing compound, replacement parts should be installed in the same manner. Check and if necessary adjust the position of the contact spring with the 5097 gauge.

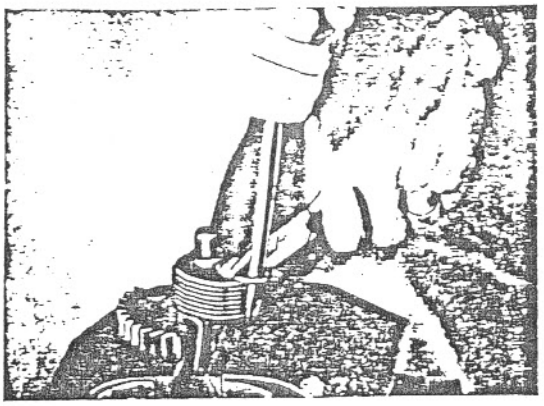
Figure 145

After installing cover, check with the gears in neutral position whether a light tester interpolated into circuit connected to neutral indicator terminal and to ground lights, and goes out when transmission is shifted into a gear. If necessary, redress contact spring.

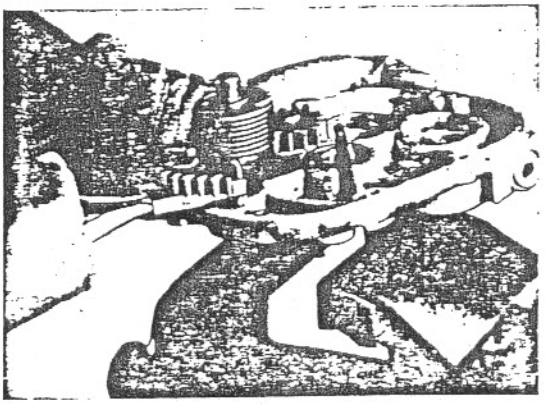
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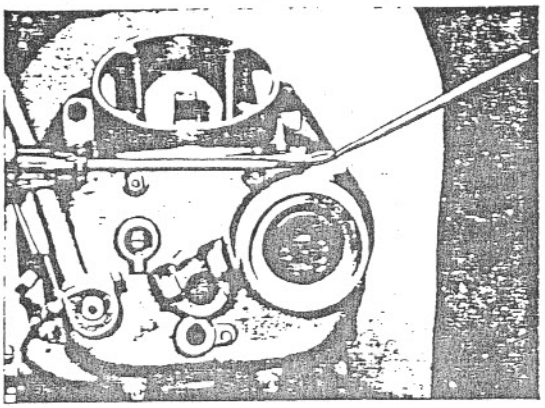
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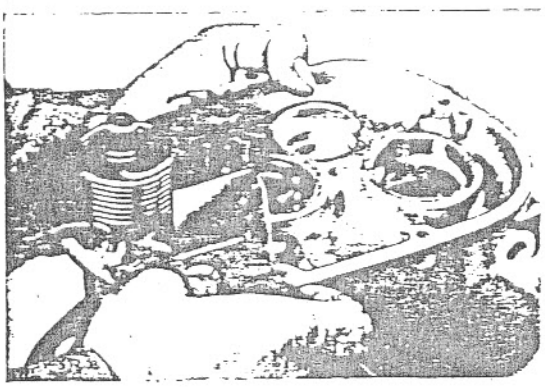
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144



145



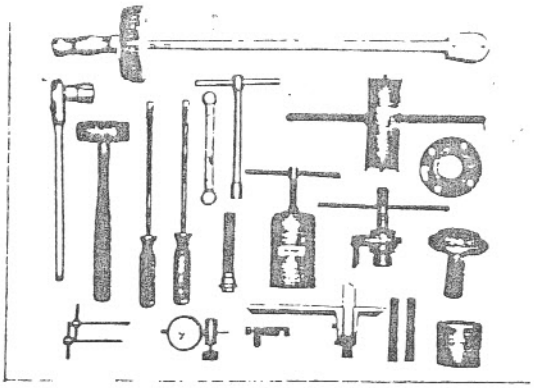
H = Disassembling, Reconditioning and Assembling Final Drive

(Final Drive and Swinging Arm removed, oil drained)

Tools:

Puller tool Matra 299a, two clamping screws Matra 357a, installing sleeve Matra 505, double-grooved wrench Matra 506a, fixture Matra 507, T-handle wrench with fixture Matra 508, installing sleeve Matra 509, installing drift Matra 511, dial gauge with measuring tool 5042, torque wrench, ratchet wrench with socket coupling SW 22, plastic mallet, 2 screw driver, 1 ring wrench SW 17, socket wrench SW 14, depth gouge, two measuring prisms.

Figure 146

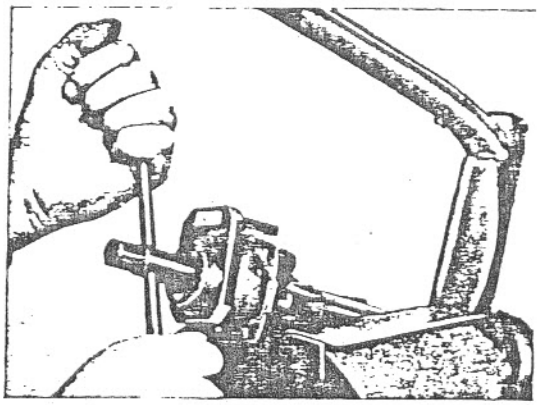


146

H1 = Removing Drive Shaft from Swinging Arm and Installing

1. Clamp rear swinging arm into vise equipped with soft metal jaws. Insert Matra 508 fixture with toothing into internal splining of cup on drive shaft end and with the pertaining T-handle wrench unscrew the nut off the shaft, and remove nut and washer.

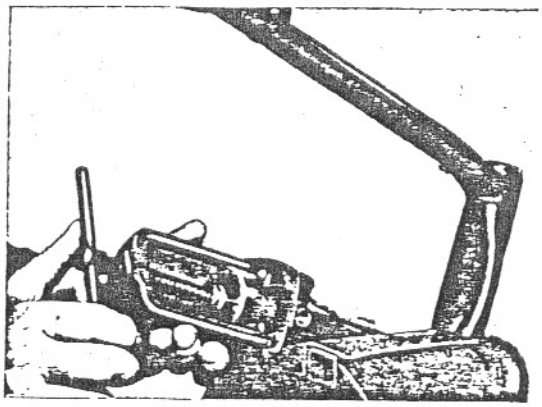
Figure 147



147

2. With Matra 299a puller seize drive shaft cup, insert suitable extension drift between thrust spindle and drive shaft and press off drive shaft cup in this way. Remove drive shaft cup and drive shaft itself.

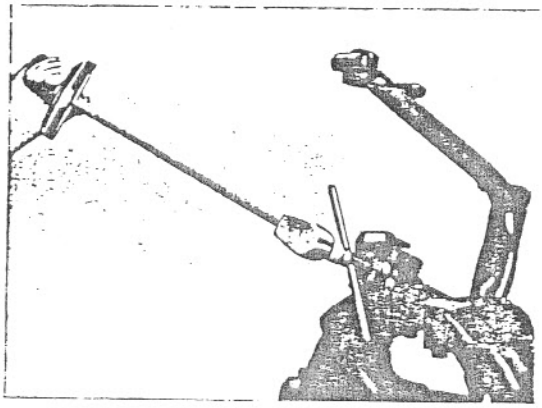
Figure 148



148

Caution! When reassembling, check whether the drive shaft is of the type **with** key groove and key or of the type **without** key groove and key. Universal shaft cups with key groove must **only** be installed on drive shafts with key groove and key and must be tightened with a torque of from 94 to 108 ft./lbs. on the nut.
Universal drive cups without key groove may be fitted ondrive shafts with or without key groove. The retaining nut should then be tightened from 108 to 123 ft./lbs. torque.

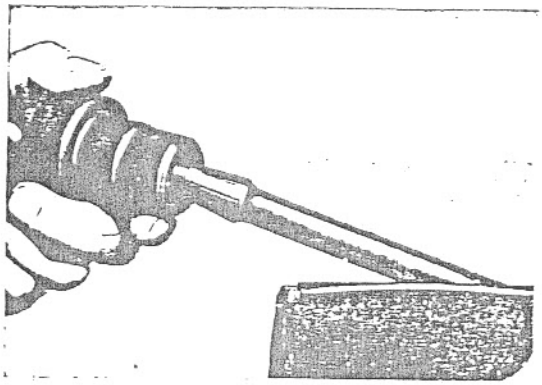
Figure 149



149

Whenever the drive shaft or the drive shaft cup is replaced, the cones must in any case be lapped in with a fine grade of grinding compound. Under all circumstances clean inner and outer cone with trichlor-ethylene (do not use gasoline) before installing the drive shaft cup.

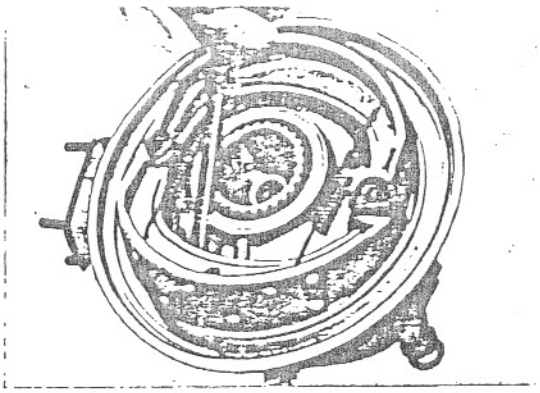
Figure 150



150

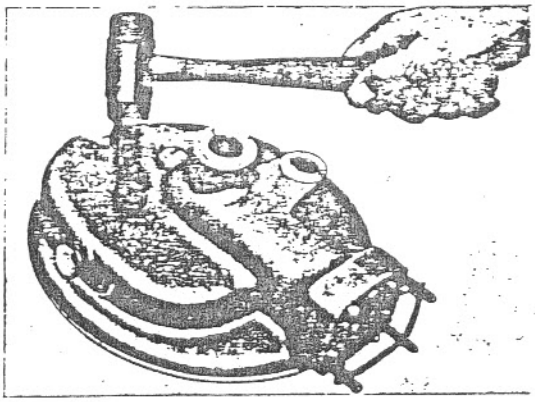
H 2 = Disassembling, Reconditioning and Assembling Final Drive

1. Mark rear wheel brake shoes with housing. First pry the brake shoe which rests on the flattened collar washer of the brake cam, off the housing by means of a screw driver, and remove the two brake shoes.
Figure 151



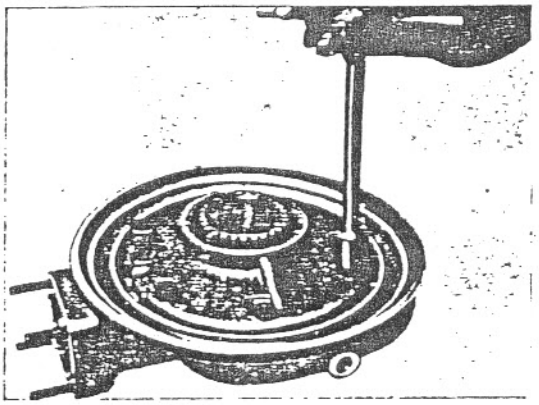
151

2. Unscrew brake lever retaining nut SW 17 and remove together with the star washer. Tap out brake cam.
Figure 152



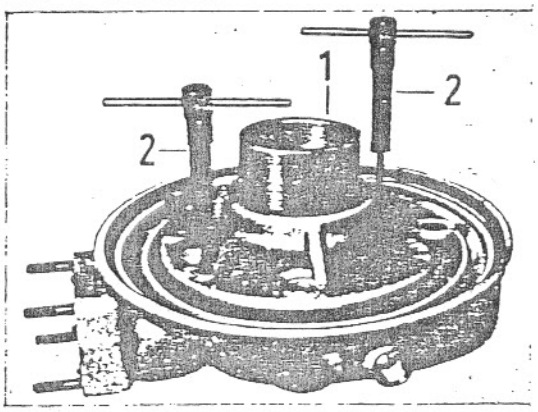
152

3. Remove final drive housing cover. For this unscrew 6 SW 14 retaining nuts with their corrugated washers.
Figure 153



153

To protect the oil seal, slide Matra 505 installing sleeve (1) completely over the splining on ring gear hub, then install the two Matra 357a clamping screws (2) into the two diametrically opposed M 6 threads in housing cover, and press off the cover by means of these screws. Remove cover and ring gear with needle bearing inner race and shim.
Figure 154

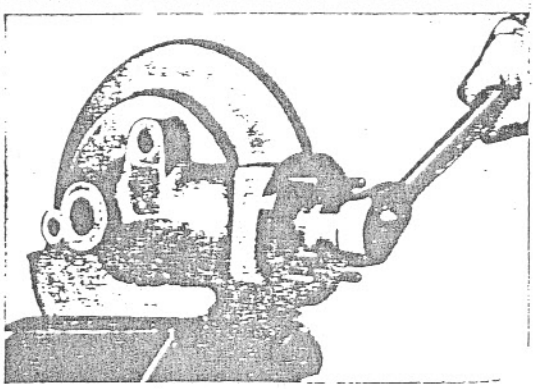


154

When the ball bearing remains in the housing, heat the cover and tap it against a wood block to throw out the bearing, and remove the shim behind the bearing. Whenever the needle bearing in final drive housing needs replacement, heat housing to 180° F., remove outer race and pull inner race off ring gear hub. When replacing seal rings, remind fitting position of the sealing lip and use Matra 509 installing sleeve for installing oil seal into housing and Matra 511 driver tool to fit seal into cover.

Caution! To install the housing cover, heat same to approx. 180° F.

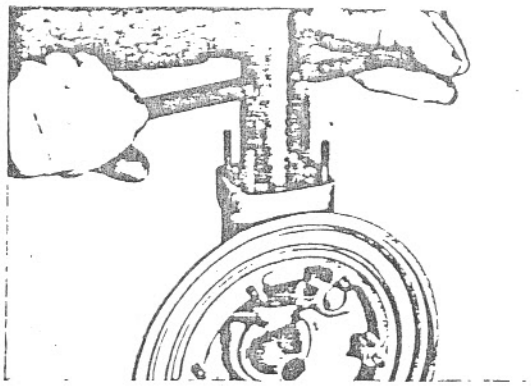
4. Release locking washer of drive pinion retaining nut. Install Matra 507 fixture on coupler gear and mounting studs for swinging arm, and unscrew nut off drive pinion by means of SW 22 socket wrench. Remove nut, locking washer and coupler gear.
Figure 155



155

5. Unscrew threaded ring with oil seal with Matra 506a double-grooved wrench and remove threaded ring and spacer washer on ball bearing inner race.

Figure 156

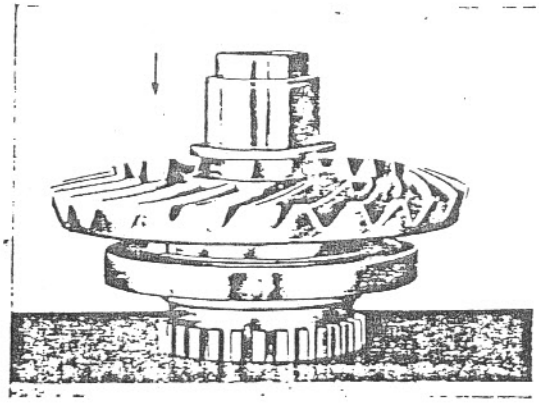


156

Heat final drive housing to approx. 180° F., then remove drive pinion with ball bearing, shims behind ball bearing outer race and bearing needles from outer race remaining in housing.

Caution! Whenever the ball bearing upon the pinion needs replacement, install the bearing with opening for balls ahead, viewed in driving direction. To replace the ball bearing upon the ring gear, when necessary, tap the bearing evenly out with a shoft-metal drift by inserting some through the ring gear holes provided ad hoc.

Figure 157

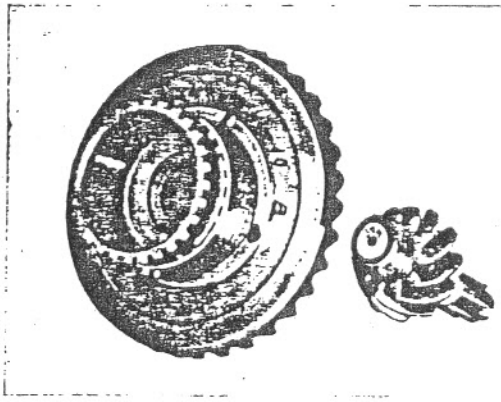


157

6. **Replacement of pinion and ring gear**

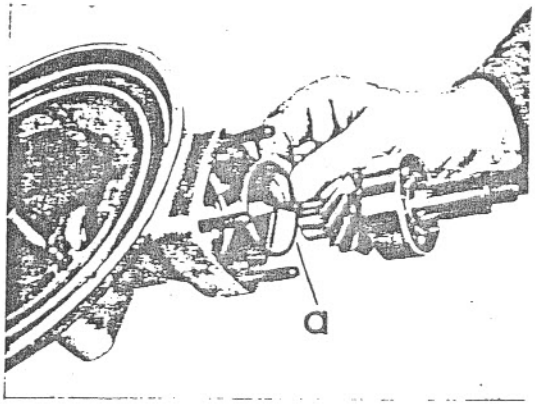
Drive pinions and ring gears are machined in pairs and cannot be replaced separately. The specification on the ring gear, for instance 314–10, means with the first number the identification of the gear set, with the second number + or – 10 the deviation from the pinion standard position measurement in hundreths of a millimeter.

Figure 158



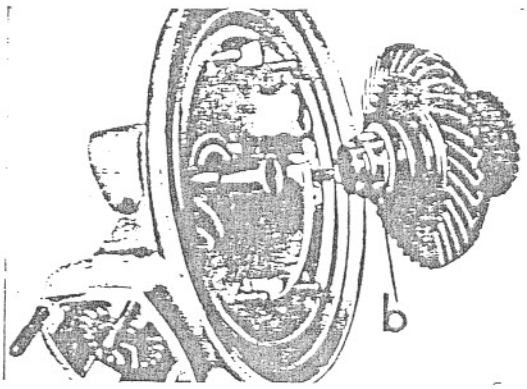
158

The standard position measurement is 74.5 ± .05 mm., measured from ball bearing shoulder on pinion to ring gear axis.
If for instance a + 10 gear set was installed and the new pinion is a + 30 item, first an additional shim (a) with a thickness of 30 – 10 = .20 mm. is to be inserted between ball bearing outer race and bearing seat in the housing. **Figure 159**



159

For backlash adjustment, a bronze shim of appropriate thickness (b) should be inserted between needle bearing inner and outer race upon the ring gear hub. **Figure 160**



160

7. Measure the backlash between the gears on ring outer diameter with measuring tool 5042. Backlash should be from .15 to .20 mm. (.006–.008 in.).
Figure 161

Gear tooth contact pattern check. For this, check drive pattern with Paris blue for Klingelnberg toothing. Correct tooth contact pattern is well centered on the drive flank of the pinion, but may be slightly toward the heel. **Figure 162**

If tooth contact pattern on pinion drive flank is at the heel, then increase pinion to ring gear axis distance by inserting thicker shims and correct backlash by inserting a thinner bronze shim between needle bearing inner and outer race on ring gear. **Figure 163a**

If tooth contact pattern is at the toe, reduce pinion to ring gear axis distance by thinner shim on ball bearing outer race and correct backlash by inserting a thicker bronze shim into the needle bearing.
Figure 163b

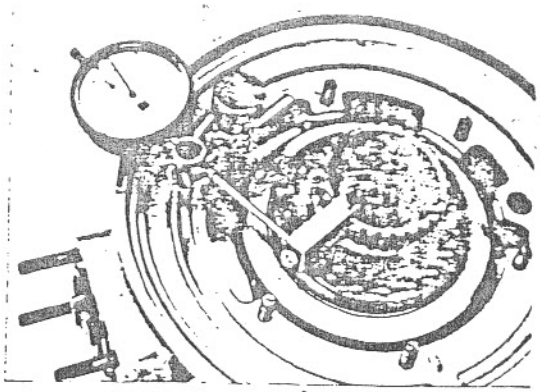
Finally check tooth contact pattern again. Because of the interference fit of the bearing always heat the housing for removal and installation of the pinion.

8. **Adjusting side play of ring gear.** With depth gauge and an eventually required intermediate piece measure the distance (a) from ball bearing seat to cover mating surface.
Figure 164

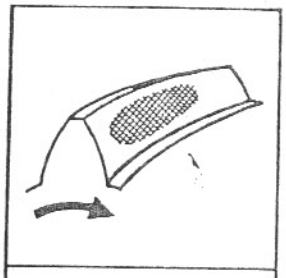
On final drive housing, with gasket on mating surface, measure the distance (b) from ball bearing on ring gear to gasket on mating surface. **Figure 165**

The required side play of .05 mm. (.002") is obtained by inserting shims of appropriate thickness between ball bearing und bearing seat in cover. The required shim thickness then equals the difference of distance (a) less distance (b) less .05 mm. (.002") side play. This play is slightly reduced by the compression of the gasket, care should be taken, however, that ring gear is not under pressure.

161

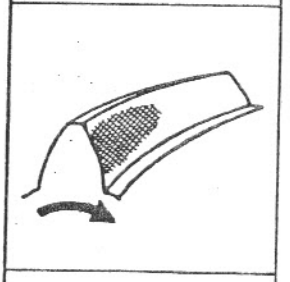


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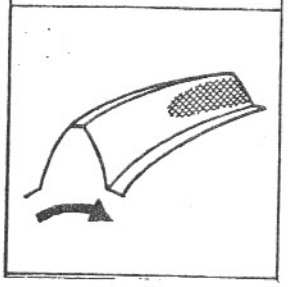
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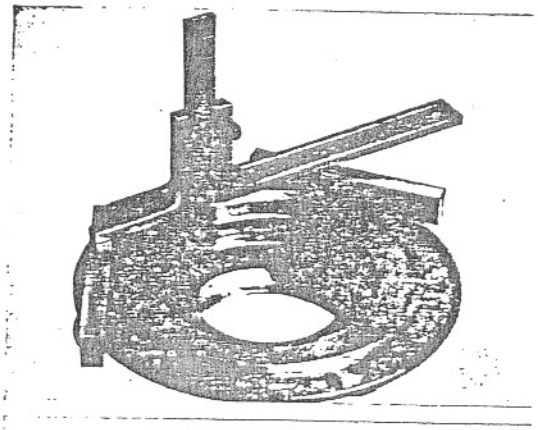
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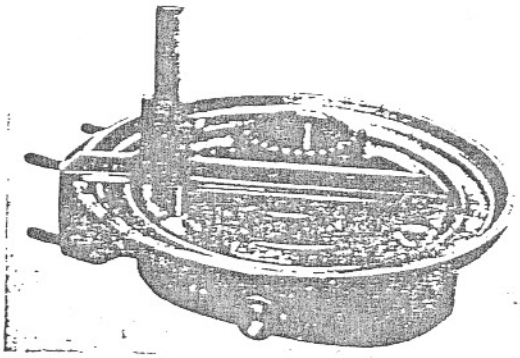


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164



165



B = Brakes and Road Wheels
(Wheels removed)

Tools:

Pin wrench Matra 517, spoke fitting gauge 5050/3 or /5, drift 5078, installing sleeve 5080, wheel balancing stand 5106, spoke tightener, centering stand, spacer bushing 120 mm. long for checking wheel bearings on axle spindle, piece of chalk. **Figure 166**

B1 = Removing Wheel Bearings, Re-Packing with Grease and Installing

1. Clamp Matra 517 pin wrench into vise. Install wheel so on pin wrench that the sealing cover fits onto the pins of the wrench. Screw out the sealing cover by rotating the wheel. **Figure 167**

   Remove bearing sealing cover with inserted felt ring retainer and spacer bushing with additional felt ring, wheel hub plate and corrugated washer. From the hub, remove taper roller bearing inner race (cone) with cage, spacer washer and inner spacer bushing.

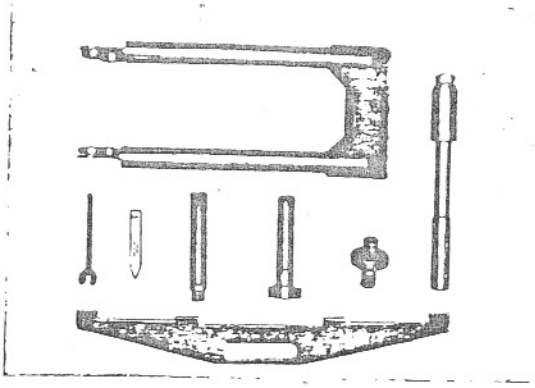
2. Apply 5078 drift on brake side upon spacer bushing and tap left taper roller bearing outer race, outer spacer bushing, taper roller bearing from brake side and right-hand spacer bushing out of hub. **Figure 168**

Caution! Before reinstalling bearings into the hub, check them for freedom from play. To do this, clamp rear wheel axle spindle with soft-metal jaws into vise and install the complete bearing set consisting of left taper roller bearing, spacer washer, inner spacer bushing, outer spacer bushing and right taper roller bearing upon the axle spindle. **Figure 169**

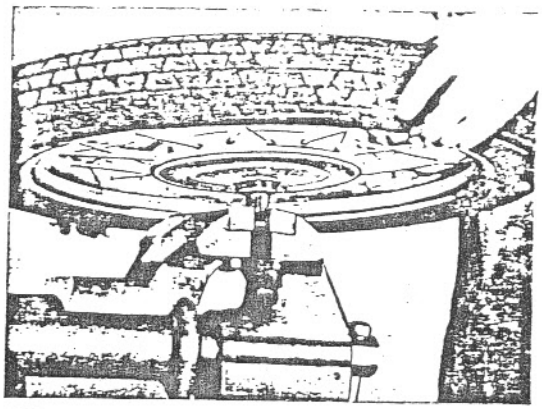
Thereupon install y drift tube of about 30 mm. O. D., 20.1 mm. I. D. and 120 mm. length with washer and nut. Compress bearing assembly by tightening the nut. The bearing is properly adjusted when the outer spacer bushing between the two taper roller bearing outer races may, without any side play, with moderate pressure be displaced within the diameteral play. Ohterwise retouch the spacing washer or install a new one. **Figure 170**

To install taper roller bearing outer races into the hub, use special installing sleeve 5080. All road wheel bearings are equal with the exception that an intermediate bushing is provided for the thinner front wheel axle spindle. This should be held in mind when interchanging wheels. Pack cleaned bearing with about .70 ounces of Shell Retinax A grease.

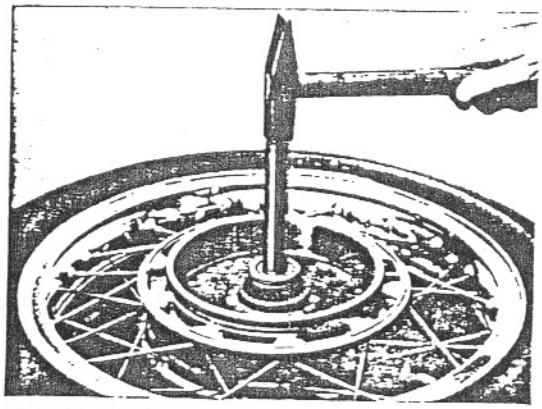
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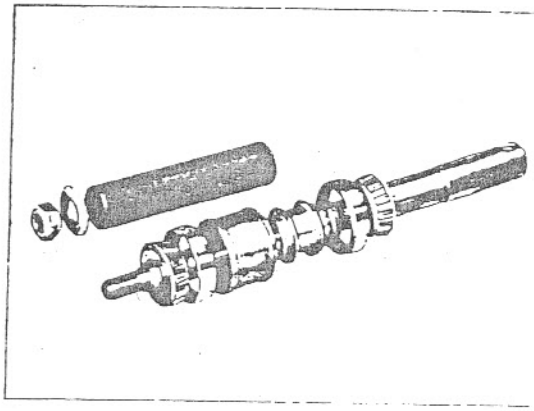
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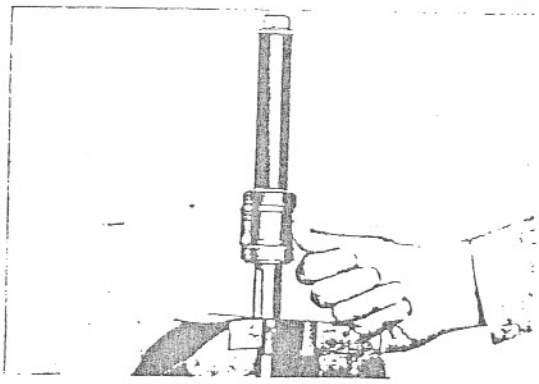
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169



170



B 2 = Brake Shoe Relining

When brake linings are so badly worn that the copper rivets will bear shortly, new linings must be riveted on. Brake drums found to be scored, rough or untrue owing to fitting of new spokes or excessive tightening of the spoke retaining nipples, must be carefully re-machined on a drum lathe.
In its rest position, the brake lever must point rearward so when shifted into full braking position it stands a right angles to the brake cable. **Figure 171**

B 3 = Fitting Wheel Spokes

The motorcycles R 50, R 50 S, R 60 and R 69 S provided for "solo" use are equipped with 2.15 B × 18 light metal rims which require the spoke fitting gauge 5050/5.
On motorcycles supplied as sidecar machines, front wheel, sidecar wheel and spare wheel are equipped with 2.15 B × 18 steel rims, which also require the 5050/3 spoke fitting gauge. The rear wheels of the sidecar machines possess 2.75 C × 18 steel rims which should be installed with the spoke fitting gauge 5050/3.

1. Place wheel hub with bearing, drum side down upon a bench. Slip one pair of spokes crossing at the hub and provided with washers through the hub spoke holes, which however are not situated at the same height! **Figure 172**

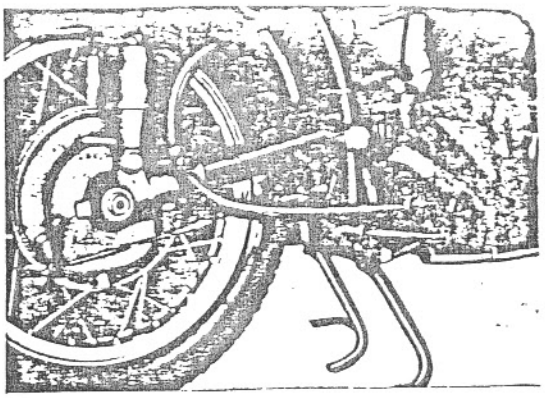
   Place the rim so into position that the pressed in nipple holding holes point exactly into the direction of the spokes inserted into the hub. The higher situated spoke must then meet the higher nipple hole on the rim, and the lower situated spoke the corresponding lower nipple hole of rim, otherwise the rim should be turned over. The other spoke pairs are fitted in exactly the same manner and fastened with nipples. **Figure 173**

2. Tighten nipples evenly, setting rim to hub distance with spoke fitting gauge 5050/5 or 5050/3 applied on brake drum side. **Figure 174**

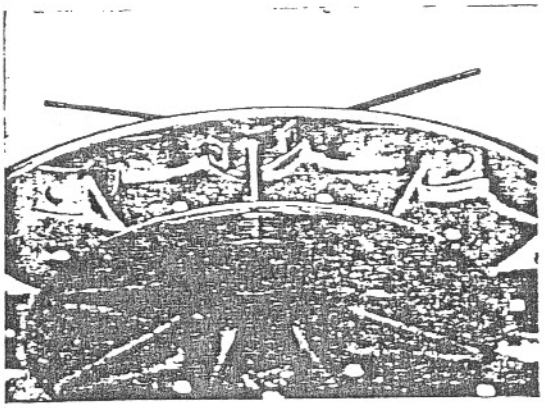
   Max. allowable diameteral runout 1 mm. (.04"), max. lateral runout .2 mm. (.008"), measured on rim bead. **Figure 175**

Caution! Grind down protruding spoke ends in order to prevent a puncture of the inner tube. Retighten the wheels after the first 1,200 miles All road wheels of the models R 50 S and R 69 S must be rebalanced after tire installation (fixture 5106). (Max. unbalance 9 grams on inner rim diameter.)
In the case of the R 50 and R 60 models the rebalancing of the road wheels is strongly recommended.

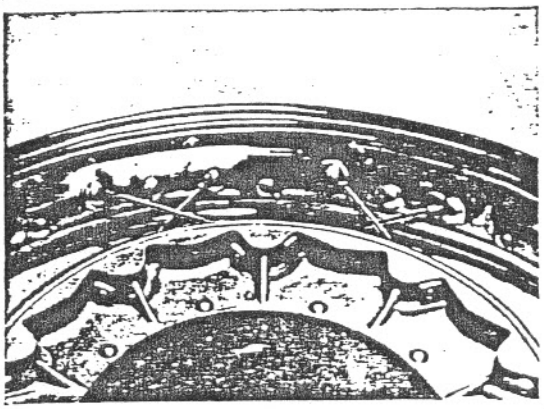
171



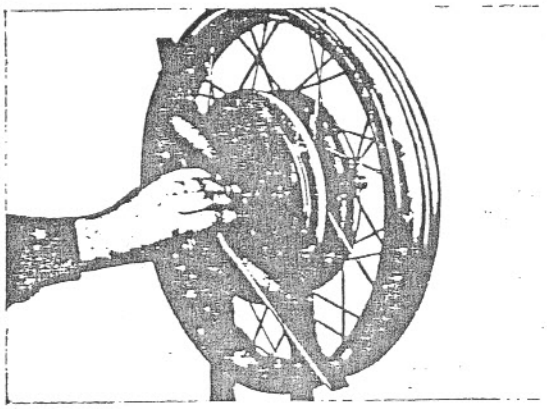
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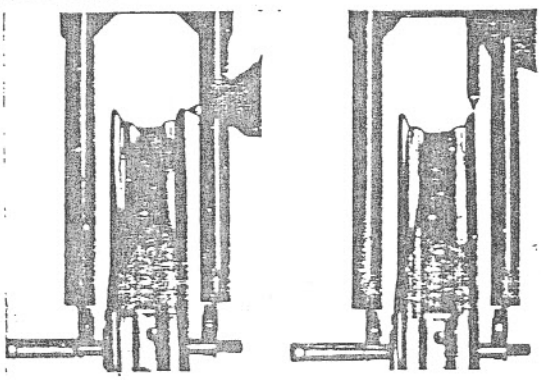
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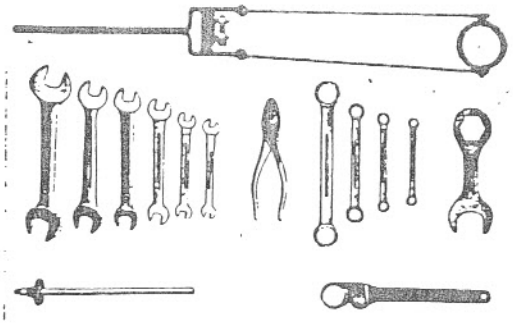
175



L = Steering and Spring Legs
(Road Wheel removed)

Tools:

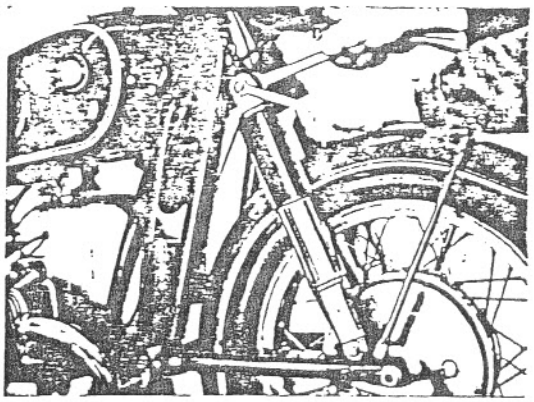
Pin wrench Matra 286, installing drift Matra 519, fixture 5094, open-ended wrench SW 24, SW 19, SW 17, SW 14, SW 10, SW 9, cut pliers, ring spanner SW 24, 17, 14, 10, toolkit wrench SW 36/41, Dowidat clamping wrench 31 mm.
Figure 176



176

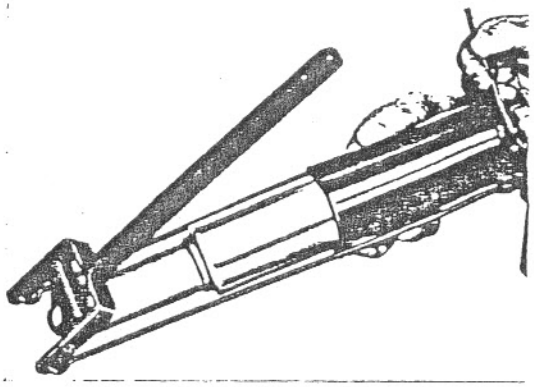
L1 = Removing and Installing Spring Legs

1. Set the motorcycle on its stand and block it up at the frame under the engine.
2. Remove SW 17 nuts from mounting bolts on fork and swinging arm, push bolts out and remove them with their washers; remove front spring leg.
Figure 177



177

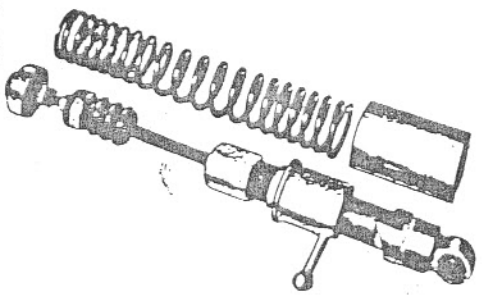
Upon the spring tube of the suspension unit, install pull plate of spring fitting fixture 5094 (made on drawing). Clamp upper spring leg connecting into vise, insert pin through fixture lever and lower spring leg eye. Turn over lever until it is stopped as the spring leg is compressed. With SW 9 open-ended wrench applied on flat of damper rod unscrew this out of upper spring leg eye.
Figure 178



178

Removal of rear spring legs: Place spring adjusting lever into "solo" driving position and with swinging arm down loosen spring leg mounts on top (Matra 286 pin wrench and SW 17 ring spanner with screw driver) and bottom, and remove spring legs downward. **Figure 179**

3. To remove damper, clamp lower spring leg eye into vise.
Remove upper damper protecting cap and unscrew shock absorber with Dowidat No. 31–10 clamping wrench, applied on top. **Figure 180**

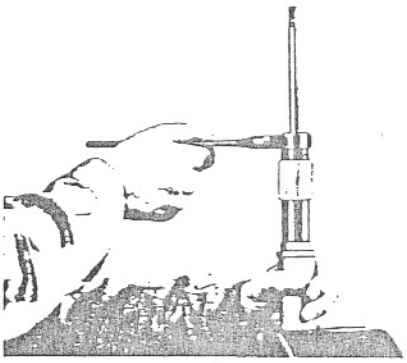


179

Never reserve the shock absorber in a horizontal position, but stock it in an upright position.

4. Press rubber bushings off spring leg eyes only when required.

Caution! Before refitting check spring length and tension (see page 35). Pulling the shock absorber must require much more force than compressing it, but the rod should evenly slide into both directions.



180

Caution! Fully compressed shock absorbers must not be given a higher

load than 500 grams, as otherwise inner damages would result.
If pulling and compression require the same low force or if there are jerking motions the shock absorber is leaky and requires replacement. When installing, fit spring legs for solo vehicles into upper locations, and sidecar motorcycle spring legs into the lower locations on the fork.

L2 = Removing and Installing Front Swinging Arm

(Road Wheel and Shock Absorbers removed)

1. Remove front fender (mudguard).
2. Unscrew SW 24 acorn nut on the left side, screw Matra 519 pilot pin into swinging arm pivot bolt, and pull out or tap out altogether. **Figure 181**

Remove swinging arm, taking care not to lose any of the shims inserted at left and right.

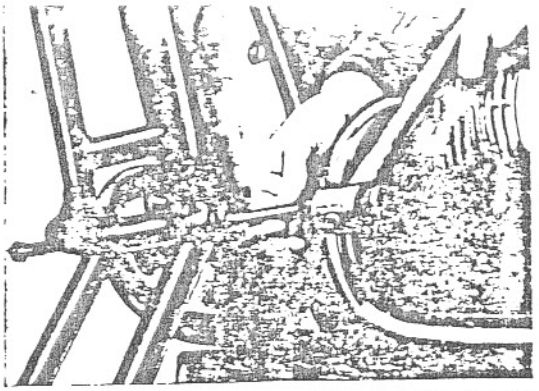
3. With finger remove bearing seal ring, thrust bushing and taper roller bearing inner race with roller cage, left and right. Remove taper roller bearing outer race only when damaged by means of a commercial type internal puller and when such a tool is not available tap race out with a drift applied on the opposite side. In the latter case the bottom covering washer must also be replaced because of the damages experienced on removal of the damages experienced on removal of the bearing. Do not mix up any taper roller bearing races and/or rollers against others. **Figure 182**

Caution! When assembling, pack taper roller bearings with Shell Retinax A grease. To insert the swinging arm pivot bolt, screw pilot pin Matra 519 into the inner thread of the bolt and knurled nut of pilot pin into the thread of the fork. When being installed, the swinging arm bearing should only have a 0.1 mm. (.004") side play, otherwise insert thicker shims. **Figure 183**

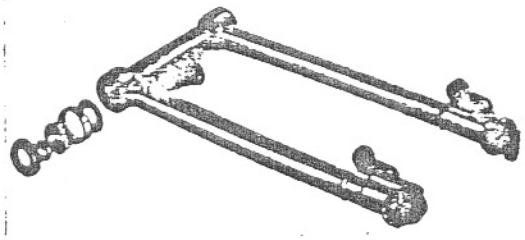
Screw swinging arm pivot bolt into the fork and unscrew knurled nut off fork as swinging arm bolt thread turns into position. **Figure 184**

Tighten swinging arm pivot bolt and acorn nut so far that, with the front wheel removed, the pivoted fork sinks about 50° slowly down under its own weight. **Figure 185**

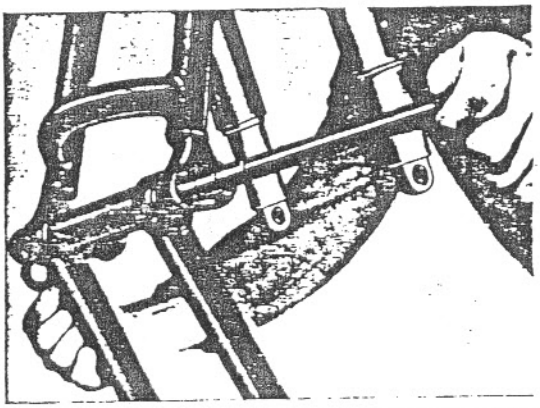
181



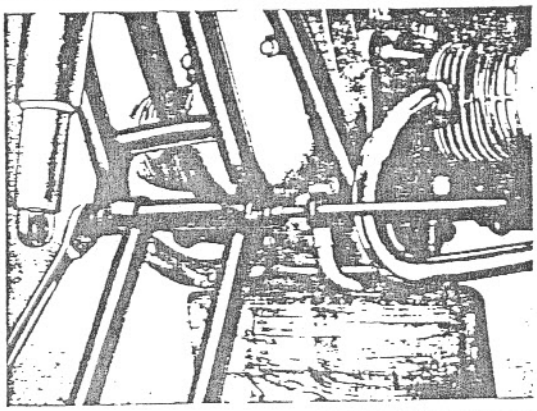
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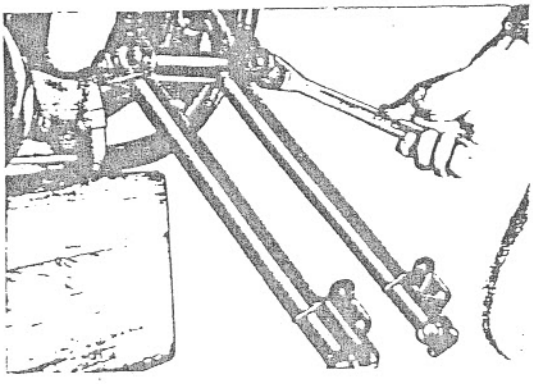
183



184



185



L 3 = Removing and Installing Front Fork

1. **Removing and Refitting Steering Damper:**
a) On R 50 and R 60 remove friction steering damper. For this, remove the cotter pin from bottom end of steering damper rod. Unscrew damper rod on lock knob above and remove pressure plate below as well as lock cap and lock washer on top. **Figure 186**

Unscrew SW 14 nut from SW 19 clamping screw, and remove steering damper friction and anchor plate with spring washer, flat washers and rubber rings. **Figure 187**

b) On R 50 S and R 69 S remove lock knob and disconnect coupling lever assembly from fork and piston rod. Refer to L 4.

2. **Removing and Refitting Headlamp:**
Disconnect dimmer switch at left, and blinker switch at right handlebar grip from handlebar tube by removing lower fastening screw with a screw driver. **Figure 188**

Pull wiring harness somewhat out of headlamp shell.
Remove SW 14 headlamp mounting screws, taking care not to lose any of the rubber washers. Leave headlamp attached on the wiring harness. Proceed carefully to avoid damaging the headlamp.

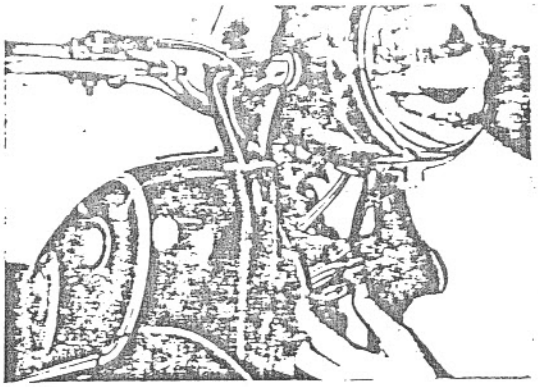
3. **Lifting off Handlebars with Upper Fork Guide:**
Remove steering column locking nut SW 36 and the two SW 19 fork holding nuts on top plate. Cocer fuel tank with a clean cloth, lift off handlebars and place same upon the fuel tank.

4. **Removing Front Fork from Frame:**
Remove spacing shim over lower nut and unscrew lower nut SW 41, using care not to lose any of the bearing balls in lower race. Remove fork from frame and remove upper dust cover and outer ball bearing race with balls. **Figure 189**

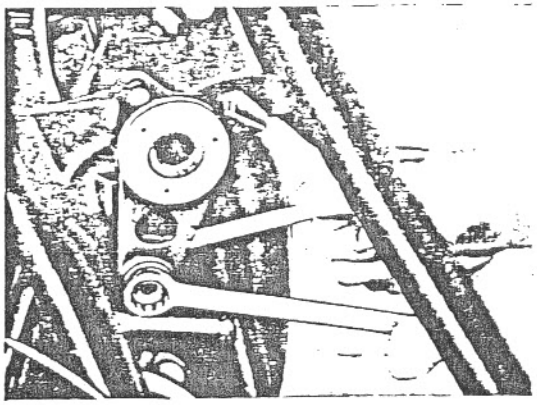
Caution! When reassembling, stick with grease 23 balls into each ball-race. **Figure 190**

Having installed the fork, adjust steering head by tightening head race adjuster nut SW 41 below and steering column locknut SW 36 above until all play is removed, but the fork is still free to rotate on the head races. The headlamp must be readjusted thereafter (see "Electrical Equipment").

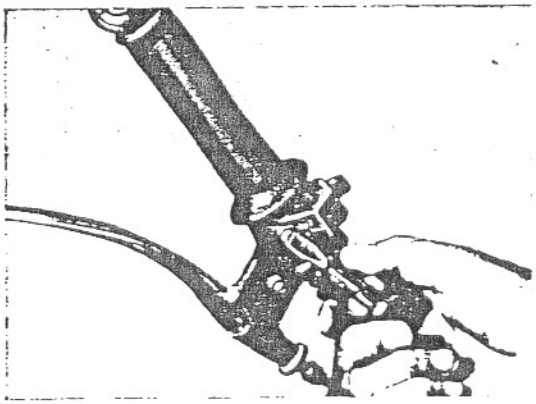
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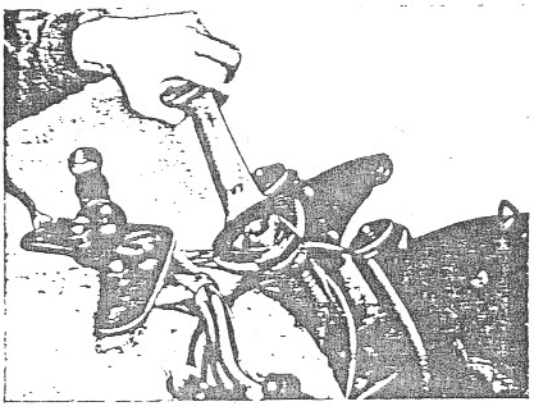
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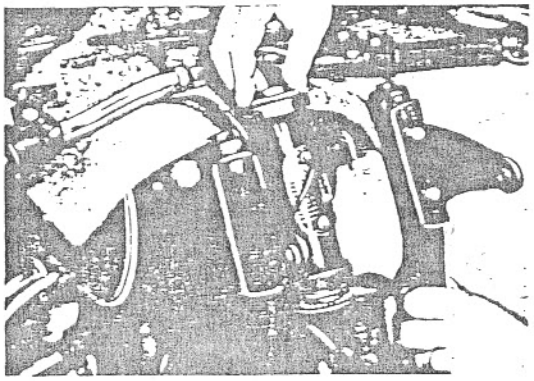
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189



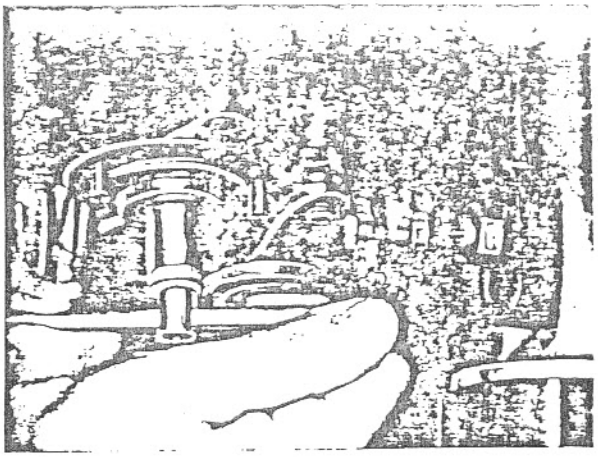
190



L4 = Removing and Installing Hydraulic Steering Damper

1. Removing complete toggle lever coupling: With thin-walled socket wrench unscrew SW 12 nut with lock-washer from bottom of steering head and pull lock knob upward out.

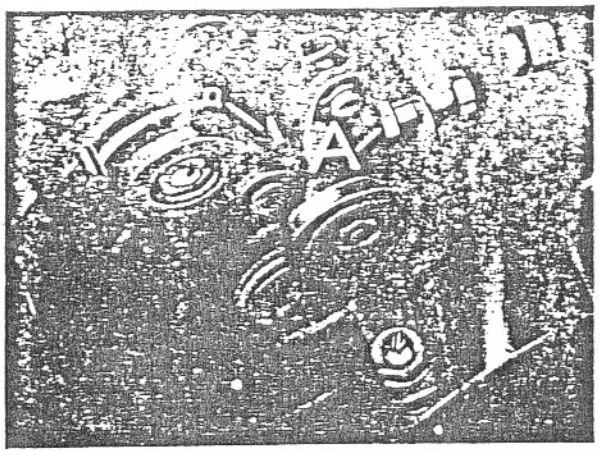
Figure 191



191

Caution! The SW 14 nut on the lock knob rod must on assembling be so adjusted with the counter nut that the corrugated washer beneath the steering head is as much compressed as to still allow easy rotation of the lock knob after having tightened the SW 12 nut below with lock washer. Having installed the toggle lever coupling visually inspect new lock knob rod for length so as to avoid touching the coupling lever. The limit screw (A), which governs the point at which the toggle lever engages, must be so adjusted that the lever arm makes contact just after the detent is clearly felt. Moreover a tension sleeve (a) is provided in the fork yoke to secure damper engagement.

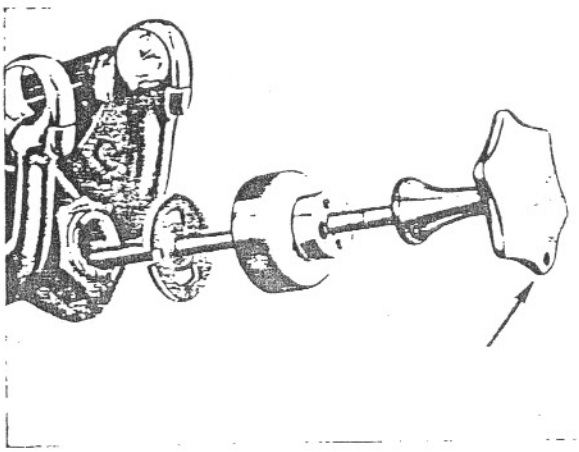
Figure 192



192

In the disengaged position the lock knob is retained by two spring-loaded detent balls in the perforated plate on top of steering head and additionally by a tension sleeve in the fork yoke. The red dot on the knob must then point to the rear.

Figure 193



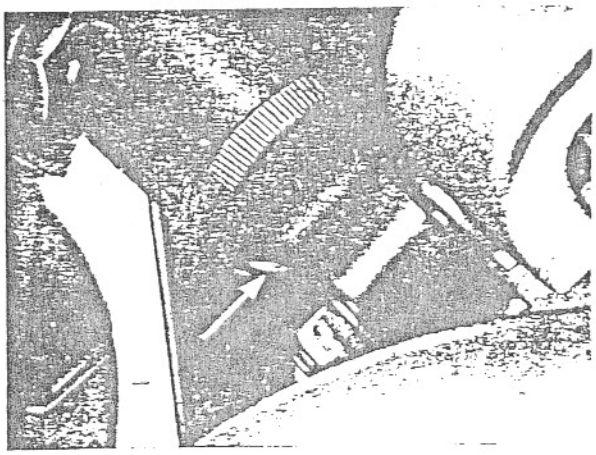
193

2. Remove lock washer from pin of fork yoke. Unscrew self-locking nut SW 14 (recently castellated nut with cotter pin) with washer of piston rod from toggle lever while holding the piston rod by means of screwdriver inserted into the slot in piston rod. When removing the toggle lever coupling use care not to lose the second washer behind the toggle lever and the corrugated washer below the steering head.

3. Disconnect rear coupling of hydraulic steering damper and remove complete cylinder. The fastening clamp on upper frame tube should if possible not be loosened, as otherwise the damper position must be readjusted after installation.

Caution! The hydraulic cylinder must always be so installed that the notch mark on rear face of cylinder constitutes the bottommost point.

Figure 194



194

Check hydraulic cylinder in installed position (notch mark) for even resistance to pull and pressure motion, but when doing this restrain from pulling or pressing piston by force into the final stop positions (precision test only by means of testing

machine, see manufacturer's specification contained in "Tolerances and Fits". Never disassemble defective cylinder, but replace the complete unit.

4. **Position of Installed Hydraulic Cylinder**

Whenever essential parts are replaced, such as frame, fork, toggle lever coupling or when the rear fastening clamp is loosened, the hydraulic cylinder must be readjusted in order to insure that the damper rod in the final positions with handlebars fully turned to right and left does not touch cylinder faces inside and that the cylinder itself is sufficiently distant from the fork prongs.

All parts connected, damper knob in engaged position, piston rod separated from toggle lever, fastening clamp on upper frame tube in loose state.

a) Pull piston rod carefully out until piston stops in hydraulic cylinder and measure length "a" to adapter of threaded pin—approx. 62 mm. (2.44").

b) Slip piston rod carefully completely in onto stop in cylinder and pull out to length "b" = approx. 6 to 9 mm. (.24"–.36").

c) Turn fork completely to left and attach piston rod in oblong hole of toggle lever (washer, toggle lever, washer and new SW 14 self-locking nut each time), slightly displacing for this the fastening clamp on frame tube as required without altering the position of the piston rod in cylinder. **Figure 195**

Eventually turn fastening clamp somewhat or slip piston rod in oblong hole upward, so the hydraulic cylinder does not touch the fork prong. **Figure 196**

Tighten fastening clamp.

d) Turn fork fully to right. The length of the now pulled out piston rod must be less than that measured at "a", pulled out to stop, and should be approx. 2.28". **Figure 197, left**

Move damper knob into the engaged position, forks remains turned to right stop position. The hydraulic cylinder must, neither in this position, touch the fork prong.

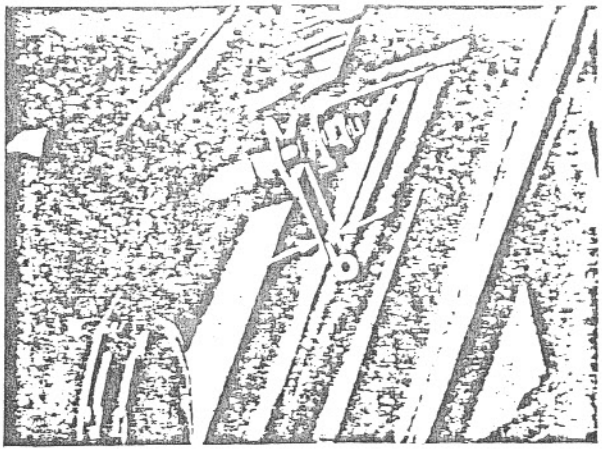
Figure 197, right

After an eventually necessary readjustment repeat check as outlined under "a" to "d".

Definitely tighten SW 14 self-locking nut or castellated nut with washer on piston rod, while holding piston rod by means of screw driver inserted into slot of piston rod; tighten castellated nut up to cotter pin hole and install new cotter pin.

Figure 198

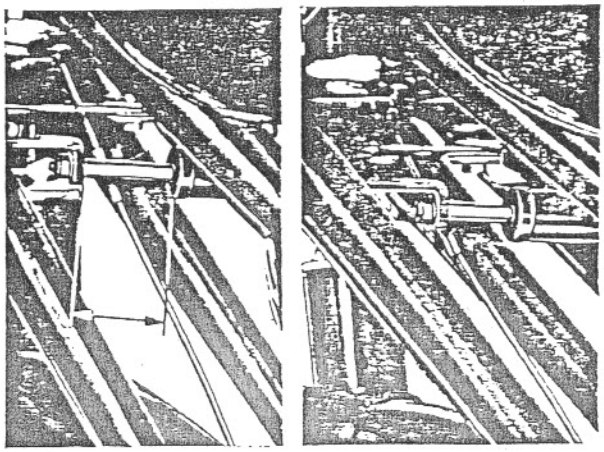
195



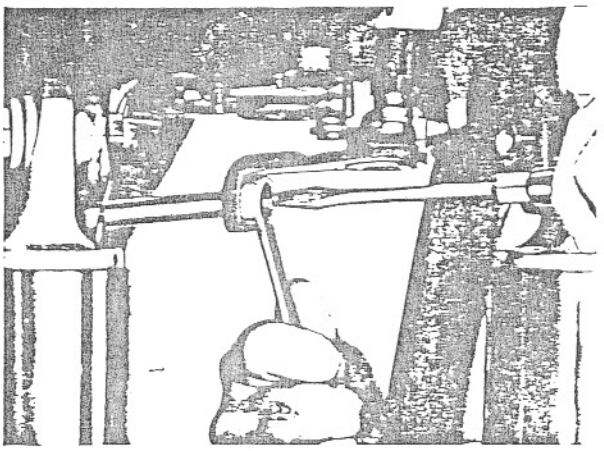
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197



198



E = Electrical Equipment

Description

The electrical equipment consists of the generator, the magneto assembly, the battery, the lighting equipment, the horn, the blinker lights, the neutral indicator and the charging indicator.

The Generator (Bosch LJ/CGE 60/6/1700 R 5) is a shunt-type dynamo driven from the engine crankshaft, with built-in voltage regulator for a rated tension of 6 volts. Its rated output of 60 watts is produced at an engine speed of 1,700 r.p.m. and the peak output of 90 watts at 2,100 r.p.m.
The rated output therefore is obtained at the following speeds (m.p.h.):

Models	1st	2nd	3rd	4th
R 50, R 60, R 69 Solo	9	14	20	25.5
R 50 S Solo	8	12.5	17	22
R 60 with sidecar	5.6	10	14	19

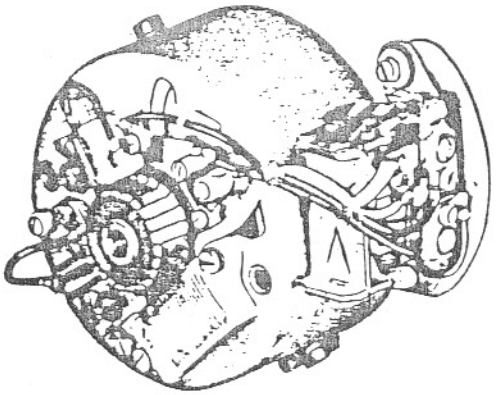


Bild - Fig. 199: Lichtmaschine - Dynamo - Generator - Dínamo

Ignition System

The engines have magneto ignition with automatic timing control, the magneto being driven directly from the camshaft at half engine speed.

The magneto assembly of the two-cylinder motorcycle is completely independent of the rest of the electrical system. It guarantees a powerful spark even at high engine speeds and has proved especially reliable. The constituent parts of the magneto are: a permanent magnet which is integral with the camshaft and serves as rotor; the fixed stator which comprises the laminated steel core with the ignition coil and the safety gap; the contact breaker and the automatic advance unit. The firing point is 9° before T.D.C.

The timing range amounts to 30° of crankshaft, so a max. advance of 39° ± 2° before T.D.C. is obtained.

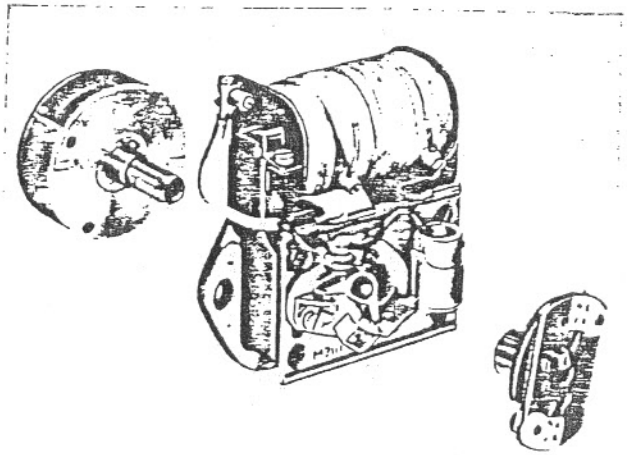


Bild - Fig. 200: Magnetzünder - Magnéto d'allumage - Ignition magneto - Magneto de encendido

The Battery has a rated tension of 6 volts and a capacity of 8 ampere-hours. When the engine is turned off or idling, the battery provides the electric power as the generator supplies current only from 1.700 r.p.m. upward. At normal driving speeds the battery is charged by the generator and is then an electric power consuming unit. The battery contains electrolyte with specific gravity (state of charge) of 1.28 (tropics 1.23), the level should be approx. 6 mm (.24") above the plates, and should only be completed with distilled water.

The Lighting Equipment

The headlamp LE MTA 160/2 (48/3) with double-filament bulb 6 V, 35/35 watts and electric dimmer switch on handlebars, parking light, charge and neutral indicators of 6 V/2 W each, and speedometer light 6 V/1.2 W is rubber-mounted on the front fork. It also incorporates the ignition and light switch, the red window for charge indicator light, the green window for neutral indicator light, the speedometer and the flasher unit, if installed (optional item).

2 The generator should about every 6,000 miles be cleaned by wiping off deposits of carbon dust with a clean, petrol-moistened linen cloth. Replace worn brushes with new genuine brushes. The brushes must slide easily in their holders and brush springs should exert a pressure of .7 to .9 lbs. in order to press the brushes against the commutator.
Check commutator for clean, smooth and grease-free surface, eventually cleanse with a petrol-dampened cloth or, if worn, have it reconditioned in a special workshop. Check commutator for runout. Max. allowable runout, measured after fitting armature to crankshaft, .04 mm. (.0016").
Instead of the earlier Bosch F-type **regulator** the Bosch Z-type regulator (RS'ZA) is now used, both being single-field, double-contact voltage regulators. The Z-type regulator, however, possesses two armatures, one for voltage regulator and one for cut-out relay. Never try to readjust by bending springs on the regulator, but entrust it to a Bosch service station for inspection and replacement of worn parts.

3. Ignition Magneto

Ignition coil and condenser require no maintenance. In particular cases they should be replaced.
The breaker points should always be clean and dry. Cleanse them by inserting a clean, smooth and grease-free tin strip, approximately as thick as a postcard, between them and moving to and fro. Reface burned contact points with a contact file or replace.
The contact breaker gap is .4 mm. (.16").
The contact breaker arm must move freely on the axle. Periodically rub a trace of Bosch Ft 1 V 4 grease (eventually heat resisting grease) into the lubricating felt of the cam, using care to avoid getting grease on contacts. The governor weights of the automatic advance unit must freely turn on their fulcrum pins and easily be returned by their springs.

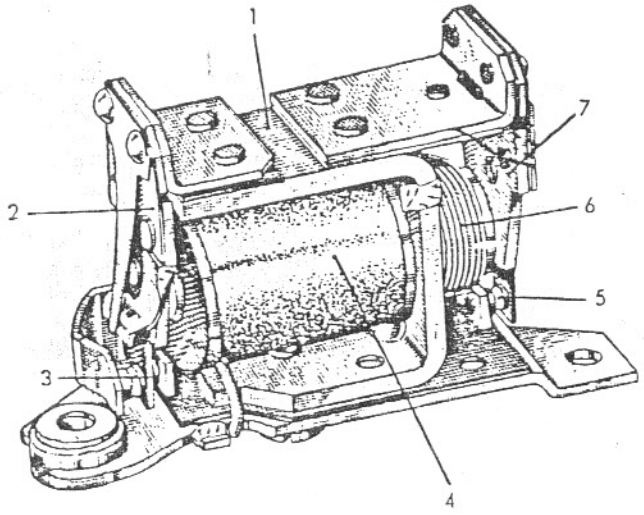
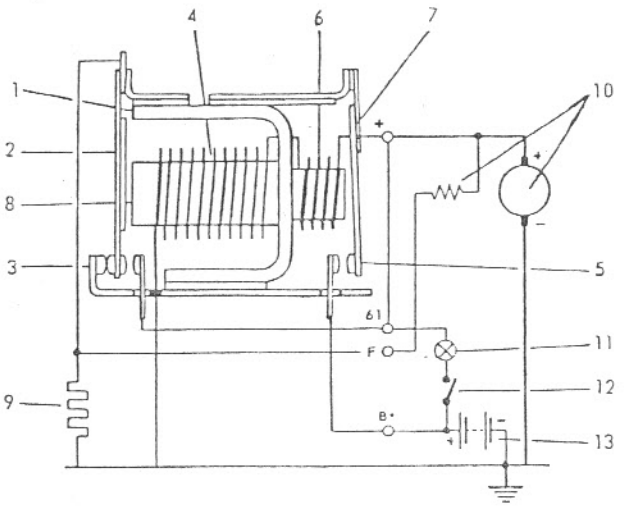


Bild – Fig. 201: Bosch-Reglerschalter RS/ZA
Régulateur de tension Bosch RS/ZA
Bosch RS/ZA voltage regulator
Regulador de voltaje Bosch RS/ZA

1. Magnetbügel
   Etrier de l'aimant
   Magnet "U" bow
   Arco del imán
2. Regleranker
   Induit du régulateur
   Regulator armature
   Inducido del regulador
3. Reglerkontakte
   Contacts du régulateur
   Regulator contact points
   Contactos del regulador
4. Spannungswicklung
   Bobine de tension
   Voltage regulator coil
   Devanado de voltaje
5. Schalterkontakte
   Contacts de l'interrupteur
   Circuit breaker points
   Contactos del interruptor
6. Stromwicklung
   Bobine d'intensité
   Current regulator coil
   Devanado de amperaje
7. Schalteranker
   Induit de l'interrupteur
   Circuit breaker armature
   Inducido del interruptor

Bild – Fig. 202: Schaltschema des Z-Reglers
Schéma des connexions du régulateur Z
Wiring diagram of Z regulator
Circuito eléctrico del regulador Z

8. Magnetkern
   Noyau de l'aimant
   Magnet core
   Cuerpo del imán
9. Regelwiderstand
   Résistance du régulateur
   Regulator resistance
   Resistencia del regulador
10. Lichtmaschine
    Dynamo
    Generator
    Dinamo
11. Ladekontrollampe
    Lampe de contrôle de charge
    Charge indicator lamp
    Luz indicadora de la descarga
12. Zündschalter
    Commutateur d'allumage
    Ignition switch
    Conmutador del encendido
13. Batterie
    Batterie
    Battery
    Bateria



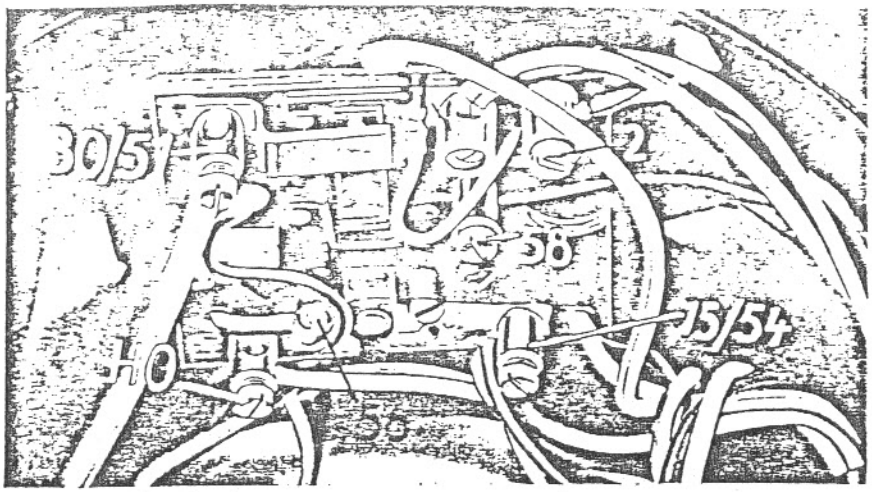


Bild – Fig. 203
Zündschloß
Commutateur d'allumage
Ignition switch
Conmutador del encendido

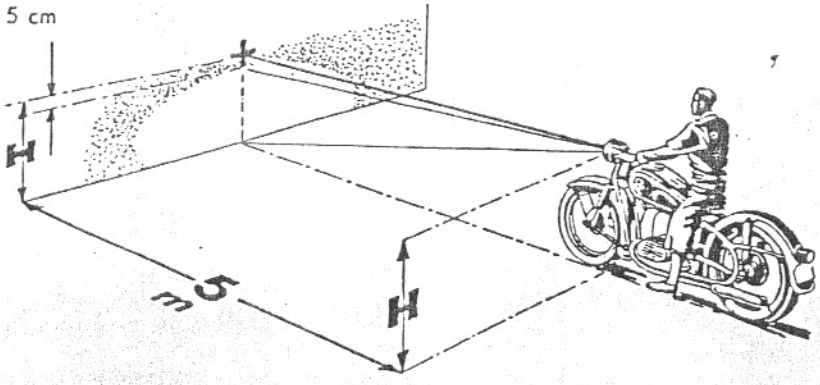


Bild – Fig. 204:
Scheinwerfer einstellen
Réglage du phare
Headlamp adjustment
Ajuste del faro

5. **Lampen im Scheinwerfer:**

Biluxlampe	6 V, 35/35 W
Standlicht	6 V, 2 W
Tacholicht	6 V, 1,2 W
Ladelicht	6 V, 2 W
Leerlauflicht	6 V, 2 W

5. **Lampes dans le phare :**

Lampe bilux	6 V, 35/35 W
Lampe de position	6 V, 2 W
Lampe de compteur	6 V, 1,2 W
Témoin de charge	6 V, 2 W
Témoin de point-mort	6 V, 2 W

4. Headlamp. On this unit inspect above all the contacts in the switch box for any signs of corrosion and clean carefully. Check leads in headlamp for chafing marks and correct connections. The ignition switch should be greased periodically to prevent water leak-in, using care to avoid getting grease on contacts or bulbs.

The headlamp setting for high and low beam is of vital importance and must therefore be readjusted after any overhaul.

For this purpose, a cross should be drawn on a light-colored wall at the same height as the center of the headlamp. The motorcycle should stand on its wheels about 5½ yards (5 meters) from the wall and be loaded by a rider. Switch on the high beam and set the headlamp so that the reference cross is in the middle of the beam on the wall. Switch to low beam; the upper edge of the illuminated area should be about two inches (5 cm.) below the reference cross, adjust as required.

If the motorcycle is to be operated with a sidecar, this adjustment should be carried out with the sidecar occupied.

Bild – Fig. 205:

Scheinwerfereinsatz abgenommen

Ensemble réflecteur déposé

Reflector unit removed

Conjunto del reflector quitado

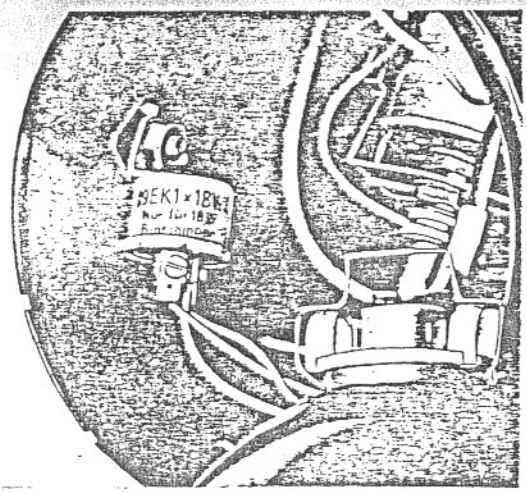


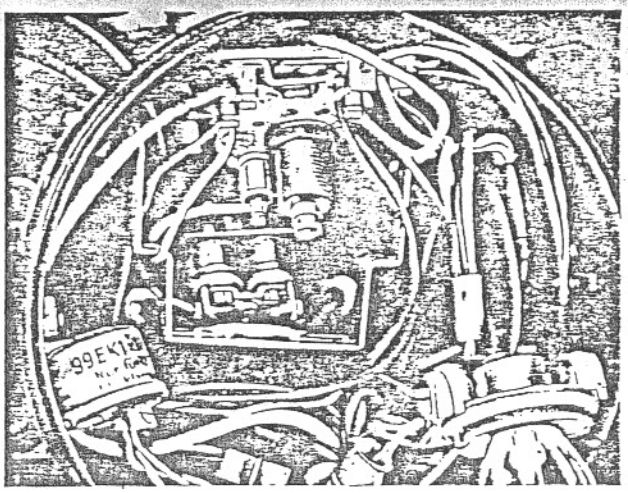
Bild – Fig. 206:

Bilux-Lampe mit Halter abgenommen; Tachometerspirale und Tachometer abgebaut zum Auswechseln der Lampen in den Kontrolleuchten.

Lampe bilux avec douille enlevée ; transmission flexible et boîtier du compteur déposées pour le remplacement des lampes de contrôle.

Bilux lamp with socket removed; speedometer drive shaft and body removed for replacement of indicator lamps.

Bombilla Bilux con portalámparas sacada; transmisión y caja del velocímetro quitadas para la sustitución de las bombillas en las luces de control.



5. Lamps in headlamp:

Bilux lamp (twin-filament)	6 V, 35/35 W
Parking light	6 V, 2 W
Speedometer illumination	6 V, 1.2 W
Charging indicator	6 V, 2 W
Neutral indicator	6 V, 2 W

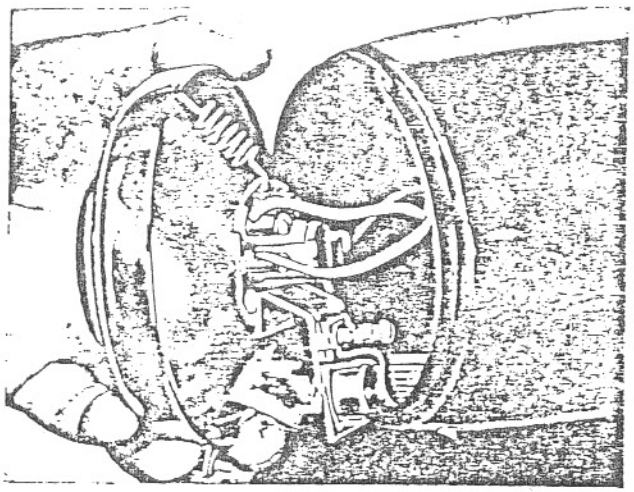


Bild – Fig. 207

Schluß- und Bremsleuchte, Lampen wechseln. Schluß- und Bremslicht Zweifadenlampe 6 V, 5/18 W, Kennzeichenbeleuchtung Kugellampe 6 V, 5 W.

Remplacement de la lampe arrière et stop 6 V, 5/18 W et de la lampe d'éclairage de plaque 6 V, 5 W.

Replacing tail and stop lamp. Tail-stop light twin-filament bulb, 6 V, 5/18 W. License plate illumination round-bulb lamp, 6 V, 5 W.

Sustituir las lámparas de posición trasera y de freno. Luz de posición y de freno: lámpara de dos filamentos 6 V, 5/18 W. Luz de la matrícula: lámpara esférica 6 V, 5 W.

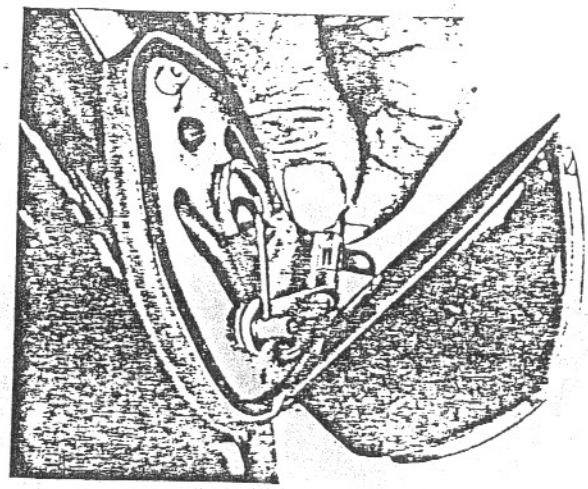


Bild – Fig. 208

Seitenwagenleuchte, Lampe 6 V/3 W wechseln.

Remplacement de la lampe de position side-car, 6 V, 3 W.

Replacing sidecar lamp, 6 V/3 W bulb.

Sustituir la luz del sidecar, lámpara de 6 V/3 W.

6 Blinker Light installed in the headlamp. The bulb is removed by unfastening the cover screws) and pressing back on the cover plug screw. If necessary unscrew the cover plug from the blinker light-bulb for example, file and lubricate the throttle twist grips are necessary:

1. Remove the cover plug, and the bulb.

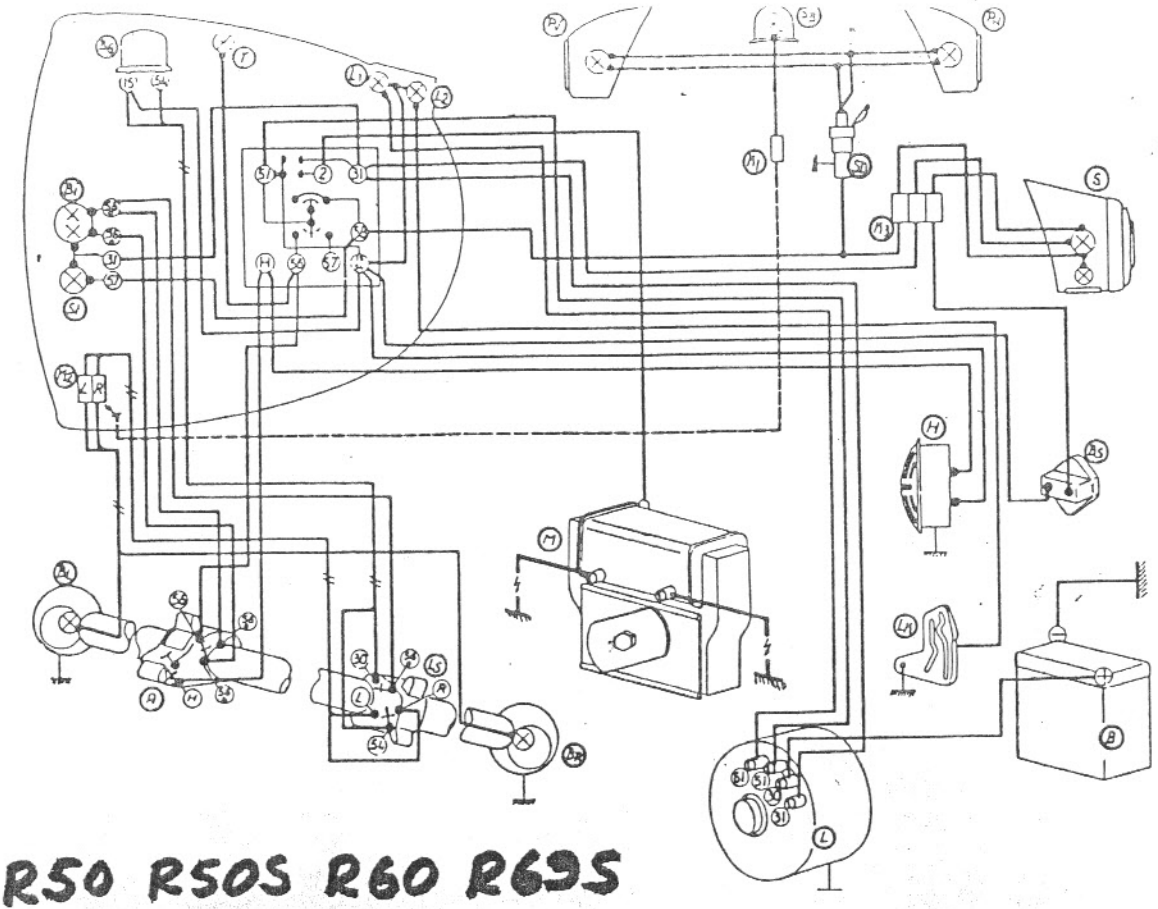
2. Pull the insulating sleeve on the bulb, together with the spring, out of the end of the handle bar. Disconnect the wiring by releasing the screw terminal.

3. Using a screwdriver (note: do NOT screw out), the handle of the screwdriver
(Also see Fi

7. **Spark Plugs.** For R 50 and R 60 Bosch: W 240 T 1 or Beru 240/14. For R 50 S and R 69 S for running-in period: Bosch W 240 T 1 or Beru 240/14; afterwards: Bosch W 260 T 1 or Beru 260/14. Electrode gap .024" (.6 mm.). Clean spark plugs, when necessary, in a sand-blast type cleaner and correct electrode gap. Badly burned plugs should be replaced. Replace spark plugs in any way at least every 11,000 miles (18,000 km).

8. **Wiring Harness and Leads**

Inspect the various wires for proper insulation and connections. The covering hoses and rubber sleeves should be in correct condition. Leads with blank spots must be replaced. No insulation tape should be used, except in cases of emergency. Be sure the HT-ignition cables are absolutely well insulated and the rubber sleeves so slipped over as to insure a water tight connection to the spark plug adapters.



R50 R50S R60 R69S

Bild – Fig. 209 Stromlaufplan – Schéma des connections – Wiring Diagram – Esquema de conexiones eléctricas

List of Wires

Colour	sq.mm.	from	to
black-violet	.75	15 headlamp	stop light switch
brown	1.5	31 headlamp	31 generator
blue	.75	charging indicator light	61 generator
black-red	1.5	2 headlamp	2 ignition magneto
red	2.5	30/51 headlamp	51 generator
black	1.5	15 headlamp	horn
black	1.5	H headlamp	horn
black	.75	58 headlamp	3-pole terminal
brown	.75	31 headlamp	3-pole terminal
black	1.5	30 generator	battery +
black-violet	.75	wire connector	stop light switch
black	.75	headlamp, neutral indicator	transmission, neutral indicator contact
black	1.5	battery –	transmission, ground
black	.75	3-pole terminal	sidecar jack (socket)
black	3×.75	3-pole terminal	tail light
Blinker-System:			
black	.75	2-pole terminal in headlamp	blinker light LH
blue	.75	2-pole terminal in headlamp	blinker light RH
red	1.0	ignition switch, terminal 15	blinker unit, terminal 15
blue	.75	blinker switch RH	2-pole terminal in headlamp
black	.75	blinker switch LH	2-pole terminal in headlamp
green	.75	blinker switch 54	blinker unit, terminal 54
grey	.75	blinker switch 56a	bilux lamp, terminal 56a
red	.75	blinker switch 30	blinker unit, terminal 15

The 3-pole terminal is situated on battery carrier, at rear.

Key to wiring diagram

A = Dimmer switch
B = Battery
BG = Flasher unit
Bi = Double-filament bulb
BL = Left blinker
BR = Right blinker
BS = Stop light switch
H = Horn
K1 = Cable connector (1-pole)
K2 = Cable connector (2-pole)
K3 = Cable connector (3-pole)
L = Generator (dynamo)
L1 = Charge indicator
L2 = Neutral indicator
LK = Neutral indicator contact
LS = Blinker and headlight flasher switch
M = Magneto
PH = Rear side light Sidecar
PV = Front side light Sidecar
S = Stop, tail and license plate light
SB = Blinker Sidecar
SD = Electrical jack (socket)
St = Parking light
T = Speedometer light

For sidecar operation, connect the wire, which is shown dotted in the schematic, to cable jonction K2 in place of the conductor from right-hand blinker light (BR).

Typical Failures, their Causes and Correction

Before performing a checking procedure on the electrical system, disconnect the negative battery cable, except in cases where it will be absolutely necessary to keep the battery in the circuit for a particular test.

1. Ignition Failures

If engine will not start or stalls when running and fuel supply and carburetors function properly the ignition system should then be checked. To do this, proceed on each cylinder as follows: Remove spark plug, pull ignition cable out of spark plug adapter, hold cable at a distance of about .2" (5 mm) from a cylinder fin and crank engine. Sparks must then flash from cable to cylinder fin; if this is the case, the failure resides in the spark plug. If no sparks flash from cable end to ground, the failure may be due to one of the following causes:

Possible causes	Remedies
a) Ignition key does not engage properly. Movable contact spring in switch box fails to come away from ground contact.	If the failure is not located in the switch box, disconnect cable from terminal 2 of magneto in case of need. But remember that in this case the engine cannot be switched off with the ignition key.
b) Cable between terminal 2 in switch box and terminal 2 of magneto is grounded.	Replace cable, in case of emergency disconnect cable from terminal 2 of magneto as described under a).
c) Ignition cable defective or grounded.	Replace ignition cable.
d) Breaker points dirty, oxidized or burned.	Clean both points with contact file. Thereafter check breaker gap. This should not exceed .016".
e) Heavy contact firing or badly burned contacts due to defective condenser.	Replace condenser (cannot be repaired) and smoothen contacts with contact file or replace. Adjust breaker gap as specified under d).
f) Breaker arm binds.	Clean bearing bushing and pin of breaker arm and lubricate with Bosch Ft 1 v4 grease.
g) Breaker arm fails to come away from cam. Rubbing block on breaker arm is worn.	Replace breaker arm and adjust breaker gap as specified under d).
h) Safety spark gap on ignition magneto too small.	Aajust gap to 10–11 mm. (.4" to .44").
i) Ignition coil open circuited to external metal part.	Replace ignition coil. Only in case of need insulate ignition coil by coating it with shellac. Likewise coat parts adjacent to ignition coil, to which the spark jumps, with shellac.
k) Ignition coil defective.	Replace (cannot be repaired).
l) Automatic advance unit inoperative.	Clean shaft and cam hole and lubricate with Bosch Ft v 30 grease. Check governor weights and springs and grease them.
m) If ignition misses only at high engine speeds, this failure may be due to lead deposits on spark plug insulator.	Permanent use of leaded fuels will cause lead deposits on insulator of spark plug. With spark plug cold, this deposit is non-conducting, but becomes conducting with spark plug hot (over 930 deg. F.). Best remedy: Replace plugs.
or breaker arm spring is slightly distorted, so breaker arm rubs with its bushing on the support or on the lockwasher and becomes inoperative.	Dress breaker arm spring into parallel position to the generator.

2. Generator Failures

Never try to perform adjustments by turning the lacquer sealed hexagon nut or bending the contact springs of the regulator as this would invalidize the manufacturer's warranty. Adjustments of this kind should therefore only be carried out in a Bosch service station.

Provisional Generator Test

Switch on full lighting, actuate horn.
As horn is actuated the lighting intensity should only drop slightly. Otherwise the battery must be recharged from a charging equipment.
Install fully charged battery, accelerate engine up to approx. 2,500 r.p.m., switch on full lighting and disconnect negative battery cable. While negative cable is removed the brightness of the lighting should slightly increase, and diminish when touching the negative pole with the cable.
If the lighting reacts contrarily, the generator output is insufficient and an accurate test should then be performed with a generator tester, whenever possible in a Bosch service station.

Causes of Generator Failures and their Correction

Possible causes	Remedies
a) The charge indicator lamp will not go out.	
Brushes do not rest upon the commutator or jam in their holders,	Dress brush springs, replace worn brushes. Free up jammed brushes in their holders.
or commutator greasy or oily	Clean commutator with petrol-dampened cloth, scrape out slots between commutator segments with piece of wood.
or regulator contacts dirty	Clean contacts by inserting and moving to and fro a thin and proper tin strip between them. On no account file these contacts.
or armature winding defective.	Replace armature.
b) Charge indicator lamp glows dimly when driving (a very slight glowing, particularly with lighting switched on is without significance and will disappear as the battery is properly charged).	
Otherwise: Battery discharged or defective	Charge battery with a charging equipment or replace.
or improper cable connections	Retighten terminal clamping screws on generator, headlamp and battery, clean ground connection on battery.
or improper contacts of cut-out relay of voltage regulator	Disconnect battery and clean contacts by moving to and fro a thin and proper tin strip between them. Under no circumstances file these contacts.
c) Charge indicator lamp lights very brightly and burns out or battery boils over, this coinciding with frequent burning out of bulbs.	
Cut-out relay inoperative due to foreign material, particularly iron chips, in air gap between armature and coil or on cut-out contact	Remove foreign material with a piece of stiff and smooth carton.
or cut-out relay inoperative because of improper ground connections	Slightly loosen fastening screw of cut-out relay, which retains the ground connection, and retighten.
or cut-out relay contacts badly burned, insufficient point spring tension, battery connected incorrectly (Positive pole to ground, generator polarity reversed).	Replace regulator. After installing the new regulator polarize the generator by causing a momentary connection between terminals 51 and 61 on regulator by means of a jumper wire. In no case should current be supplied to F (DF).
d) Charge indicator light flashes at regular intervals, probably due to a short circuit in electric leads.	First switch off lighting, i.e. ignition key inserted in central position. If failure is still evident, check wires: generator 51 to headlamp 51, headlamp 15/54 to neutral indicator light and horn for short circuit. If no failure was found there, switch on parking light, check leads to tail light and sidecar and thereafter lead to parking light and headlamp. If after this checking the cause of the failure is not yet evident, switch on the headlamp and check wires to Bilux lamp and the Bilux lamp itself.
e) Headlamp flickering or going out temporarily. Wire broken or loose connection,	Locate failure by pressing or slightly pulling on the various wires. Replace defective wire, tighten loose terminals.
or battery defective.	Broken plates can easily be detected by slightly pulling and pressing on battery poles, replace battery.

The before mentioned checking procedures for ignition system and generator are suggested for emergency cases when special testing equipment is not available.

1. No-Load Regulating Voltage

Start engine and speed up to approx. 2,000 r.p.m. Disconnect ground lead from the battery. Connect a voltmeter between terminal D+61 of voltage regulator and ground. Increase engine speed, noting voltage setting, until voltage remains constant. This value (7.2 to 7.9 V) represents the no-load regulating voltage and the start to the generator characteristic.

When the hand on the voltmeter vibrates during this test or performs heavy kicks, this can be due to the following faults: Generator brushes too short, dirty or sticking. Brush spring tension insufficient, commutator in out-of-round condition, defective armature windings, damaged voltage regulator. Be sure the ground leads are securely connected and the contact on terminal D+61 of the voltage regulator is in order, because otherwise the field coils are likely to burn.

If the specified no-load regulating voltage is not obtained, the battery receives insufficient charging current. If the test values exceed the specified value, the battery is overcharged.

2. Cut-in Voltage

(This test should best be left to a Bosch service shop.)

The current and voltage regulator assembly possesses an electromagnetically controlled circuit breaker (cut-out relay) which closes the charging circuit when the generator is charging. Testing the cut-in voltage is extremely important and starts with engine idling.

To do this, disconnect the ground lead from the battery, and connect voltmeter, as described above, to terminal D+61 of the voltage regulator and to ground. Disconnect the lead from terminal 30/51 of the regulator, and connect an ammeter between this terminal and the disconnected lead.

Increase engine speed slowly from the idling rate, noting the settings of the two instruments. On the moment the hand on the ammeter performs a kick, take the reading of the cut-in voltage on the voltmeter (6.4 to 7.1 V).

If the cut-in voltage is too low, reverse current flows, from the cut-in moment on, from the battery back to the circuit until a satisfactory generator voltage is attained, so that the battery will too rapidly be discharged. If the cut-in voltage is too high, the regulator contacts may be damaged by the extremely violent rush of the cut-in current.

This test is made because the load voltage of the generator is regulated pursuant to an inclined characteristic. For this purpose connect a voltmeter and a variable resistance (incorporated in Bosch testing equipment) from terminal 30/51 of voltage regulator to ground.

Operate engine at medium speed and adjust the variable resistance to generator watt value (60 watts). The voltmeter setting must then correspond to the specified generator load regulating voltage (6.5 to 7.4), if generator and regulator function correctly.

If a testing equipment is not available, connect for an emergency check as many electrical accessories as required to obtain the specified amperage reading (11.5 Amps.), when the voltmeter must show the correct regulating voltage.

If generator load regulating voltage is too high, the generator is overcharged and may burn and the carbon brushes do not attain a satisfactory service life. If the regulating voltage is too low, the generator fails to deliver its maximum output and battery charge is insufficient.

4. Reverse Current

Connect testing instruments as when testing cut-in voltage. The ammeter, however, should be of the center zero type so as to allow readings in both current directions. The circuit breaker which on reaching the cut-in voltage connects the generator to the circuit, must at lower speeds open this circuit, so as to avoid current flowing from battery to generator. The breaker points open when a predetermined reverse current flows from battery via generator to ground.

To check the reverse current start with medium engine speeds and slowly reduce engine speed until a charging current decrease to zero is noted on the ammeter. When further reducing engine speed (if necessary reduce idling rate), the hand on the ammeter moves accordingly to the other scale side (reverse current). When the reverse current attains a value of from 2 to 7.5 amps. the circuit breaker must open the points and the hand on the ammeter rush back to zero.

When performing this test take in mind that the indicated reverse current values have been determined with the battery in half-discharged condition. A fully charged battery delivers slightly higher values, a discharged one lower values. When reverse current amperage is too high, the circuit breaker points tend to stick and the reverse current flow after engine stopping may burn the generator or the battery may be discharged.

Testing Armature (Removed from Generator)

1. Test for Ground

Test for grounded armature with a tester, for instance Bosch EFAW 85.
Place one probe on the commutator, one probe on armature lamination. Insulation against ground is in order if test lamp does NOT light.

2. Test for Short in Winding

Can only be detected with precision testing instruments or with a sound detector. Armature winding is not shorted if the sound detector intercepts no noise.

3. Open Circuit in Winding

Commutator evidences badly burned sports on the various segments.

Testing Field Coils in Removed Generator Frame

Connect plus pole of a 6-volt battery via an ammeter to terminal 61 of the frame, connect battery minus pole to ground on frame. Field coils are in order if ammeter indicates 2.7 amps. and if a piece of soft iron (screwdriver) used for touching the poles is attracted to each of the four pole shoes with the same force.

1. Resistance

is in order if ammeter slightly recedes as regulator armature is depressed. It is defective if ammeter does not more indicate any current.

2. Grounded Coil

Ammeter setting is esentially more than 2.7 amps. or becomes essentially more by pressing down the regulator armature.

3. Short Circuit in Field Winding

Ammeter setting slightly more than 2.7 amps.

4. Open Circuit in one of the Field Coils

Ammeter indicates current only when regulator armature is pressed down, so far resistance coil is not defective, too. A generator with defective field coils should be left to a Bosch service station for replacement.

Subsequent Mounting of BMW "Special" Sidecar

The subsequent modification of a solo motorcycle to accommodate a sidecar involves a number of technical changes which in every case should be reserved for a special BMW garage.

Figure 210

1. Exchange the "solo" pinion and ring gear set in rear axle drive against another with the "sidecar" ratio 4.33:1. Hereby remove the earlier teeth numbers on bevel drive housing and stamp in the new ones: 26/6.

   Figure 211

2. Exchange the transmission against another witn sidecar ratio (only for R 50 and R 60).

3. Install modified speedometer with ratio for sidecar operation.

4. Equip the front and rear suspension with springs for sidecar operation (see page 35).

   Set the swinging arm bearing of the front fork into the forward location on the fork.

   Figure 212

   and the front wheel upper suspension mounting into the lower position on the fork.

   Figure 213

5. Exchange brake lever without stop screw on rear wheel against brake lever with stop screw and install it into the same position on the brake cam.
   Screw in the stop screw on this brake lever untila noticeable braking effect is obtained, then reverse stop screw, until wheel just runs freely, and tighten lock nut.

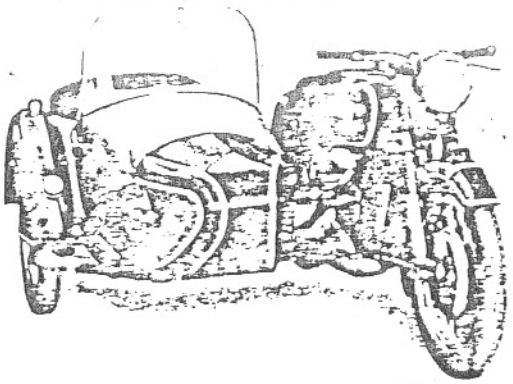
   Figure 214

6. It is adviceable to exchange the 25.6" solo handlebar against a 28" sidecar handlebar. In this case install also the longer control cables for sidecar operation.

7. Exchange the wheels with light-metal rims for solo operation against wheels with steel rims:
   front wheel 2.15 B × 18 with 3.50–18 tires, rear wheel 2.75 C × 18 with 4.00–18 tires.

8. Replace the front engine mounting bolt by the ball pin to be supplied by BMW. For this, it is necessary to remove the bushing fitted into the right-hand frame eye. Instead of the normal SW 19 retaining nut a cas-

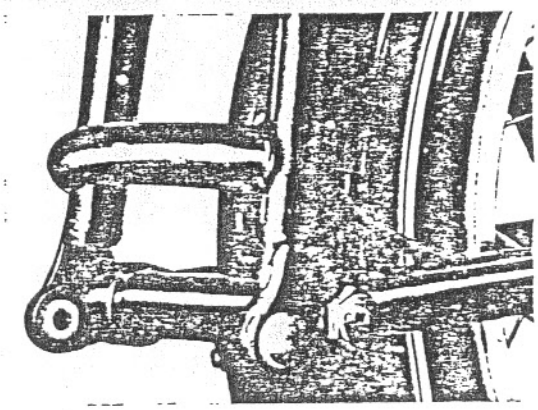
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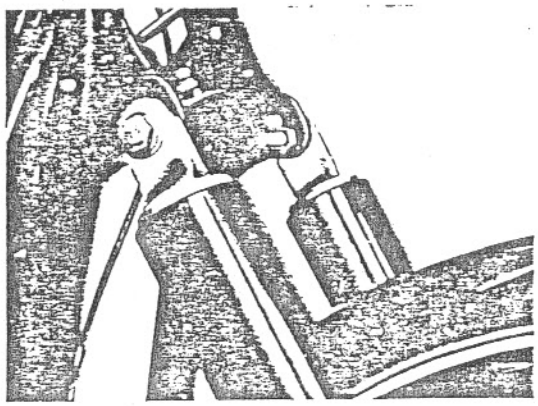
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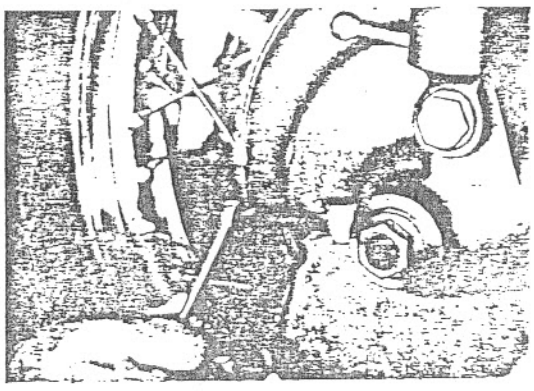
212



213



214



slotted nut is provided for the ball pin, which must be secured with a cotter pin after tightening.

Figure 215

Further install the two eye bolts to be supplied by BMW for the connection of the sidecar braces, into the provided eyes on right frame tube, at front and at rear. On the eyes, remove the finish pain from contact surfaces for the eye bolts, and after adjusting the braces tighten the eye bolt nuts with 54 ft./lbs. torque.

Figure 216

9. 9. Screw the brake rod sufficiently far into SW 14 threaded sleeve on pull cylinder piston rod. Remove solo brake rod and on its place connect the clevis of the brake pull cylinder with the existing pin at front, the new brake rod with washer, return spring and lockwasher to brake lever at rear. The flattened side of the brake rod and the notch in the hollow pin of the new brake lever must point upward. Screw on the wing nut until any longitudinal linkage play is eliminated. While doing this, the piston in the pull cylinder should not be drawn off its rest position. Thereafter tighten locknuts on the threaded bushing fitted to the rod. Be sure that the brake cylinder does not touch the frame.

Figure 217

10. 10. To mount the sidecar, set the motorcycle on its stand, block up the sidecar and swing sidecar fender (mudguard) back after having loosened the retaining nuts at front.

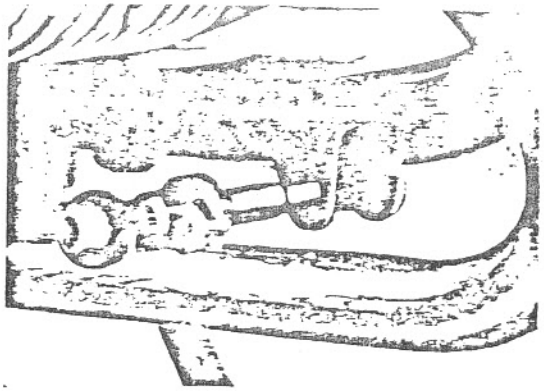
Important!
Before installing the sidecar wheel polish axle stub with emery and grease it slightly. Slip sidecar wheel into position, using care to prevent wheel hub touching the brake plate. If necessary insert a spacing washer. Install wheel hub speed cap and tap it tight with a plastic mallet. After removal of the two rubber plugs from the brake plate the serrated nuts for brake adjustment will become accessible through the plug holes and may then be rotated by means of a screwdriver. Rotate these adjuster nuts, one after the other, until the associated brake shoe begins to drag, thereafter reverse adjuster nuts until wheel just turns freely.

Figures 218/219

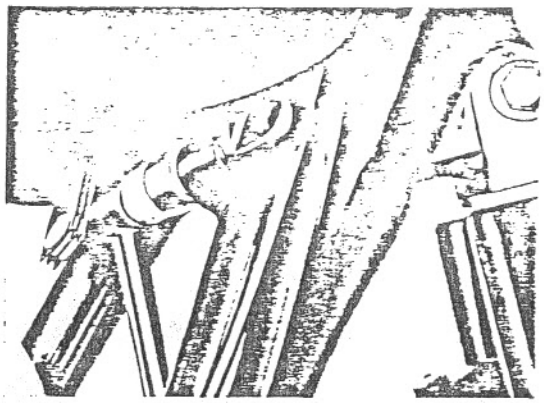
Connect sidecar below.
Rock the motorcycle repeatedly sidewise in order to insure a perfect seat of the ball joints.

11. 11. Adjusting toe-in: Place the motorcycle into upright position. Position

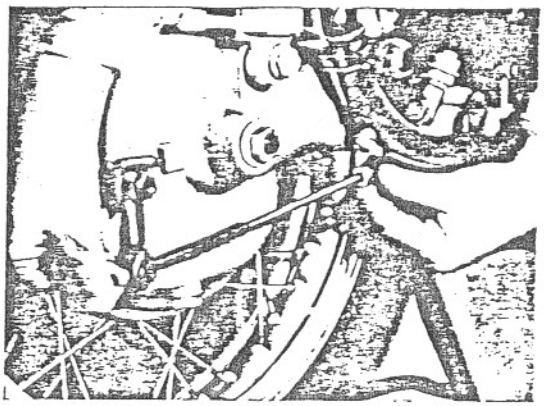
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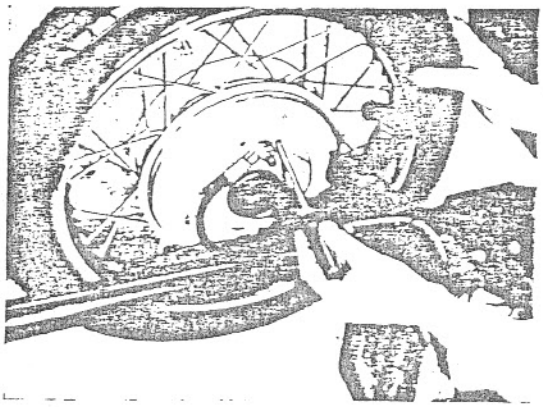
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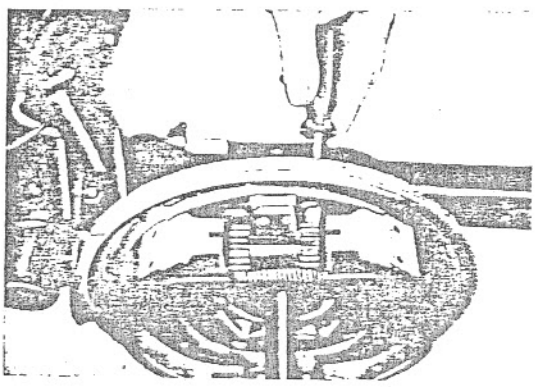
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218



219



a measuring staff along outside of sidecar wheel and place a second measuring staff along outside of front and rear wheel of motorcycle. Measure the distance between both measuring staffs on end of front and rear wheel of motorcycle. The distance (a) in the rear must be from 1.2" to 1.6" more than the distance (b) in the front. Figure 220

If necessary correct by displacing in or outward the coupling arm in the rear cross tube after loosening the clamping screws.

Figure 221

The longitudinal runner of the sidecar frame should then be approx. 10 mm. (.4") lower at the rear than at the front; for this twist coupling arm as required, before tightening the clamping screws.

12. Adjust upper rear sidecar brace to motorcycle so that the motorcycle stands in upright position, i.e. without camber, and with SW 19 connecting screw fasten clevis head of sidecar brace onto the eye bolts of the motorcycle. Likewise connect front sidecar brace, but make sure that it is tension-free; when the sidecar and motorcycle are occupied, the camber (difference C–D) at the rear wheel, measured on the rim beads, should amount to approximately 3/8" to 7/16" (10 mm.).

Figure 222

Remove protection boots from brake hose and pull cylinder and connect the hose.

Caution! Whenever the brake line is disconnected, the protection boots should be reinstalled. As the connections of the brake line are equipped with check valves, it will normally not be necessary to bleed the hydraulic line again.

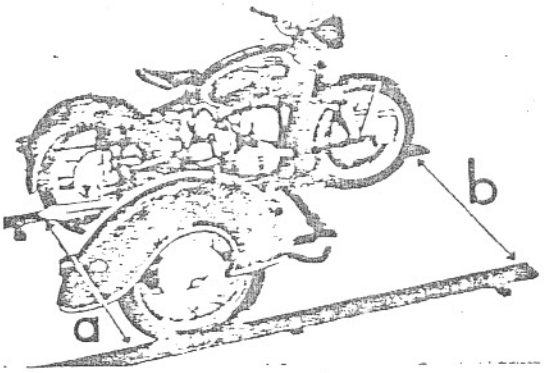
13. To fill up or to bleed the hydraulic brake unscrew the filler plug on the pull cylinder. Place a jar under the pull cylinder and remove rubber cap brom bleeder valve on wheel cylinder. From a brake fluid pressure tank, connect a hose to bleeder valve, loosen bleeder valve one turn and pump ATE blue brake fluid through the hydraulic line until fluid runs out of the pull cylinder in a solid stream without air bubbles. The fluid level of the pull cylinder must always be at 1 cm. (.4") over cylinder bushing. Retighten bleeder valve, reinstall rubber cap and tighten pull cylinder filler plug.
Actuate brake lever and check brake lines for leaks.

Figure 223

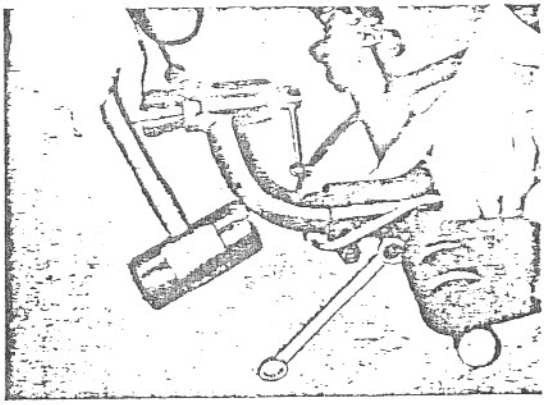
14. The braking action on the sidecar wheel, relative to that on the rear wheel, may be reduced or completely cut out by screwing in knurled nut (a) at the hydraulic brake cylinder.

Figure 224

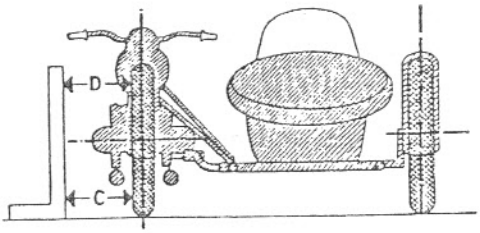
220



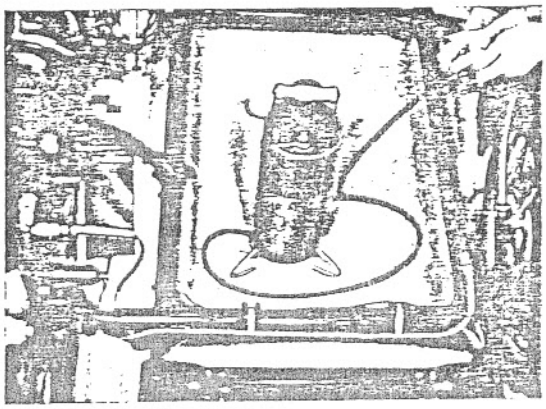
221



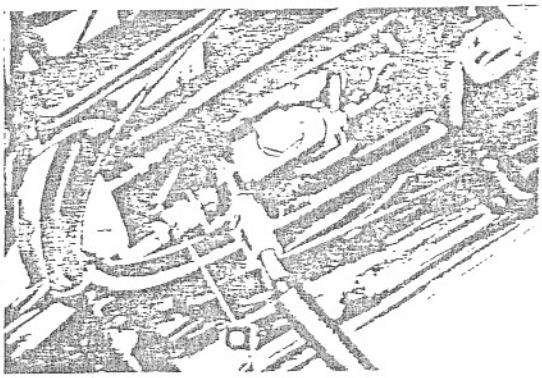
222



223



224



This is the case it the pressure spring (13) is fully compressed by the knurled nut "a" or (10) respectively. (coils contact each other) and thus the pull rod (i.e. also the piston rod in the main cylinder) is firmly connected to the main cylinder, so hydraulic pressure cannot be exercised when the brake is actuated.

Figure 225

The sidecar brake should take hold after the rear wheel brake has already begun to grip.
In general, the total braking action of the front and rear wheel brakes of the motorcycle should be so proportioned to that of the sidecar that the vehicle always tracks well, irrespective of the load, when the brakes are applied.
When the brake hose connection had to be repeatedly disconnected from the pull cylinder during removal of sidecar, it is recommended to bleed the hydraulic system again. With correctly adjusted brake shoes and system properly bled the piston in the pull cylinder will travel approx. from 4 to 5 mm. until the sidecar brake begins to grip.

15. Remove blinker light from right handlebar end (if installed) (see page 135), disconnect lead from terminal K 2 (R) of blinker unit in headlamp and on its place connect the new lead for the blinker light upon the sidecar fender (mudguard). Seal opening in handlebar end with a suitable plug.

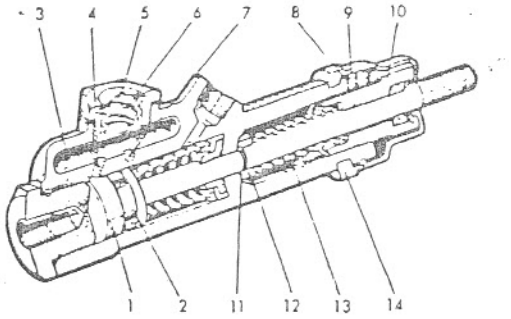
Figure 226

16. The electric jack (socket) for connection of the sidecar lighting is situated under the seat on the cross tube of the frame. The jack is energized as the light on the headlamp is switched on.

Figure 227

When disconnecting and reconnecting the sidecar camber adjustment is not required so far the connections have not been altered.
On the bumper bar for the rebound limit of the sidecar wheel an eyelet is provided, onto the upper end of which a shock absorber may be installed.
The lower eye of this shock absorber is then to be connected to the swinging arm in wheel axle center.

225



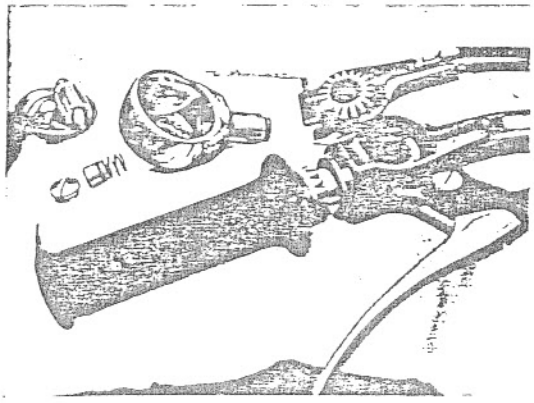
1. Kolben mit Kolbenstange
2. Kolbenmanschette
3. Ausgleichbehälter
4. Nachlaufbohrung
5. Luftbohrung im Deckel
6. Faltenbalg
7. Ausgleichbohrung
8. Arretierkugel
9. Federring
10. Stellschraube
11. Sprengring
12. Überwurfring
13. Druckfeder
14. Gummimanschette

1. Piston avec tige de piston
2. Coupelle caoutchouc du piston
3. Réservoir de compensation
4. Trou de retour
5. Trou de ventilation dans le couvercle
6. Soufflet cache-poussière
7. Trou d'égalisation
8. Bille d'arrêt
9. Rondelle Grower
10. Vis de réglage
11. Jonc d'arrêt
12. Anneau de raccord
13. Ressort de rappel du piston
14. Anneau de retenue

1. Piston with push rod
2. Primary cup
3. Brake fluid container
4. Feed port
5. Vent hole in cover
6. Rubber bellows
7. Compensating port
8. Detent ball
9. Spring washer
10. Set screw
11. Snap ring
12. Union ring
13. Return spring
14. Secondary cup

1. Embolo con biela
2. Guarnición primaria
3. Depósito de líquido de frenos
4. Orificio de alimentación
5. Orificio de ventilación en la tapa
6. Fuelle de goma
7. Orificio de compensación
8. Bola de detención
9. Anillo elástico
10. Tornillo regulador
11. Arandela de seguridad
12. Anillo de unión
13. Resorte retroceso
14. Guarnición secundaria

226



227

