REPAIR MANUAL
for the MZ MOTOR-CYCLES
ES 175/2 and ES 250/2

Edition 1969

VEB MOTORADWERK ZSCHOPAU · DDR

Repair Manual

for the

MZ MOTOR-CYCLES

ES 175/2 and ES 250/2

With 162 illustrations

and 26 drawings of special tools

Edition 1969

VEB MOTORRADWERK ZSCHOPAU

The motor-cycles types ES 175/2 and ES 250/2 are manufactured by VEB Motorradwerk Zschopau

This Repair Manual has been compiled by a group of authors in the employ of VEB Motorradwerk Zschopau

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KG 3/34/69

Preface

We hold lengthy comments on MZ motor-cycles to be unnecessary. In the high latitudes of Finland, in the parching heat of Africa, under the most different operating conditions these motor-cycles run to the satisfaction of their owners.

To ensure that the vehicles remain in perfect working oder and reiiable in service after a long period of operation, involving a certain amount of wear, we issue this Repair Manual to give the necessary instructions to or MZ workshops at home and abroad.

Repair work is a matter of confidence in several respects:

Reliability and high workmanship of the mechanics; the safety of the driver depends on them.

Finding the actual cause of the trouble; this ensures that no material is wasted and labour costs are restricted to a minimum.

From these items result: no retouching work, short times of inoperation and low repair costs.

To ensure this, we describe not only the work to be performed by the fitter or mechanic (the necessary skill presumed), but also the symptoms of various faults and their possible causes.

A good workmanship in repairs largely depends on the use of the special tools and means recommended by MZ. We should like to underline that especially self-service workshops and amateur constructors should bear this in mind to avoid considerable additional expenditure of labour and material due to false optimism.

For workshops contracted for servicing MZ-products, the special tools are available from the MZ Spare Sales Department – whereas, for amateur constructors, there is the only possibility of making them, using the sketches given in the Appendix.

We hope, this Reference Book offers the required information to the staffs of the workshops contracted for servicing our products at home and abroad, and to the friends of MZ motor-cycles throughout the world; and we wish good success to each and all.

VEB MOTORRADWERK ZSCHOPAU

Service Dept.

Table of Contents

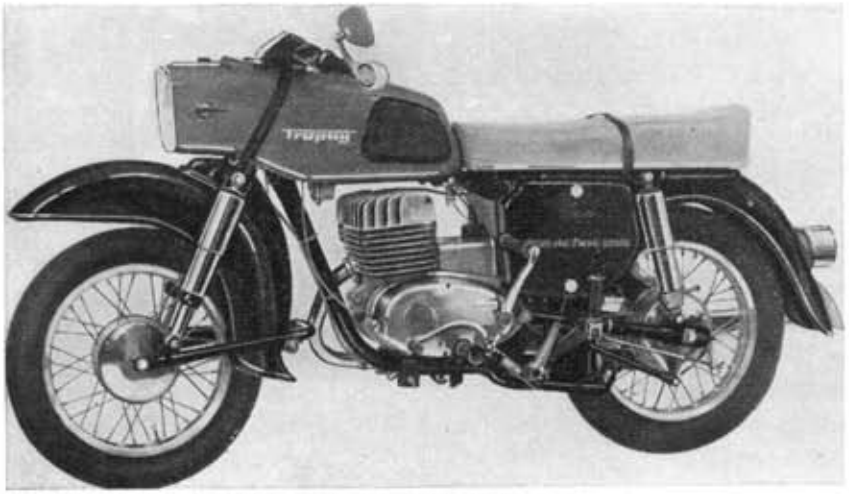


Fig. 1. ES 175/2 – ES 250/2 (de Luxe) with dual seat

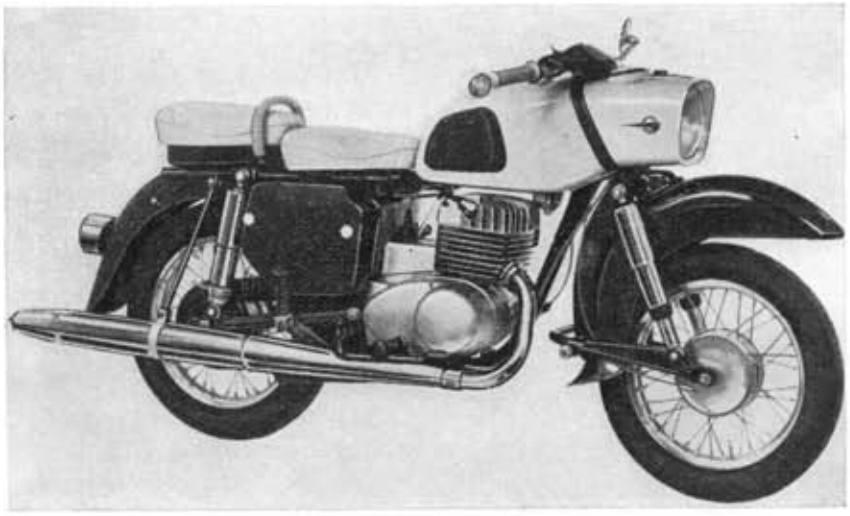


Fig. 2. ES 175/2 – ES 250/2 with separate seats

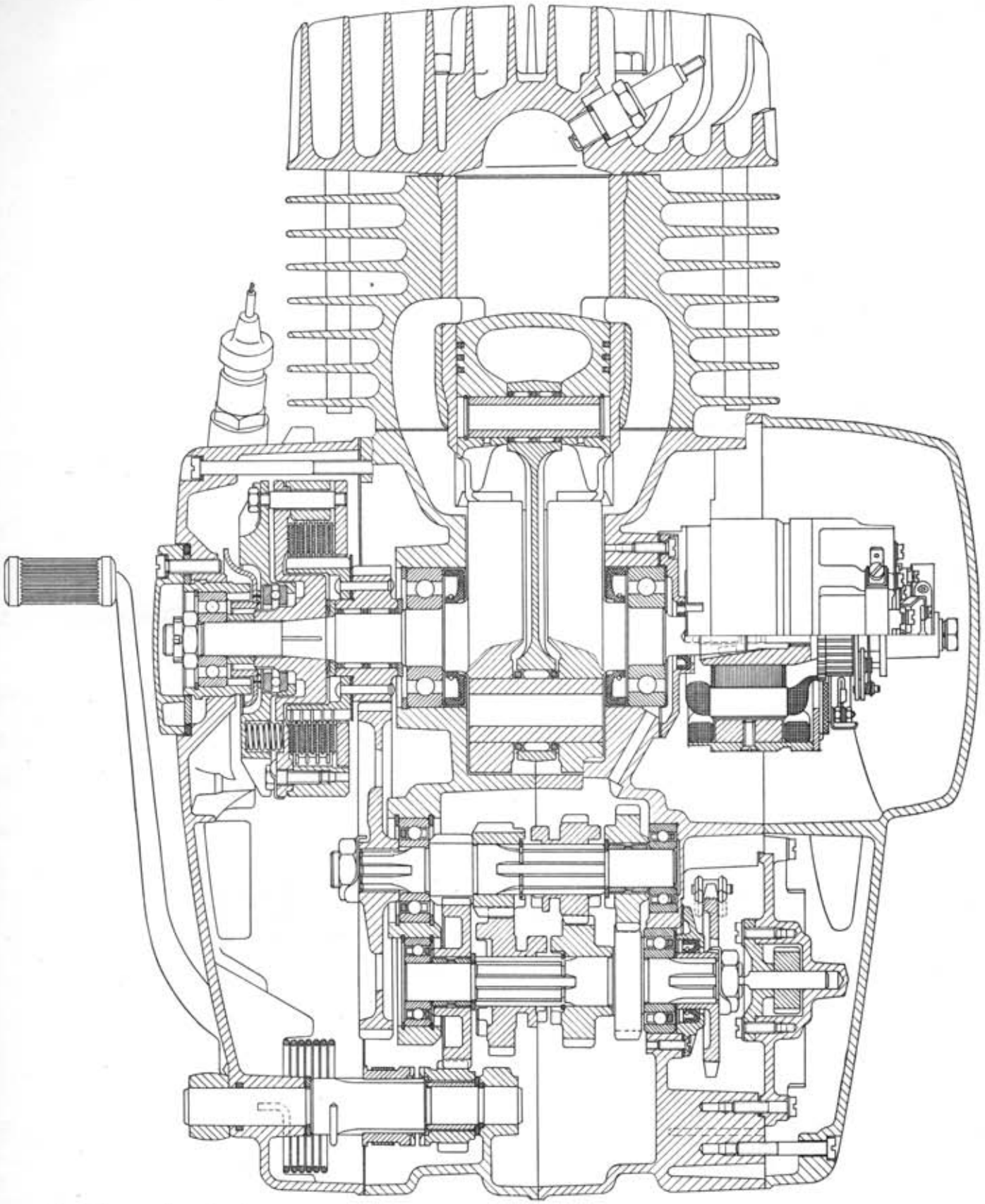


Fig. 3. Cross section of engine

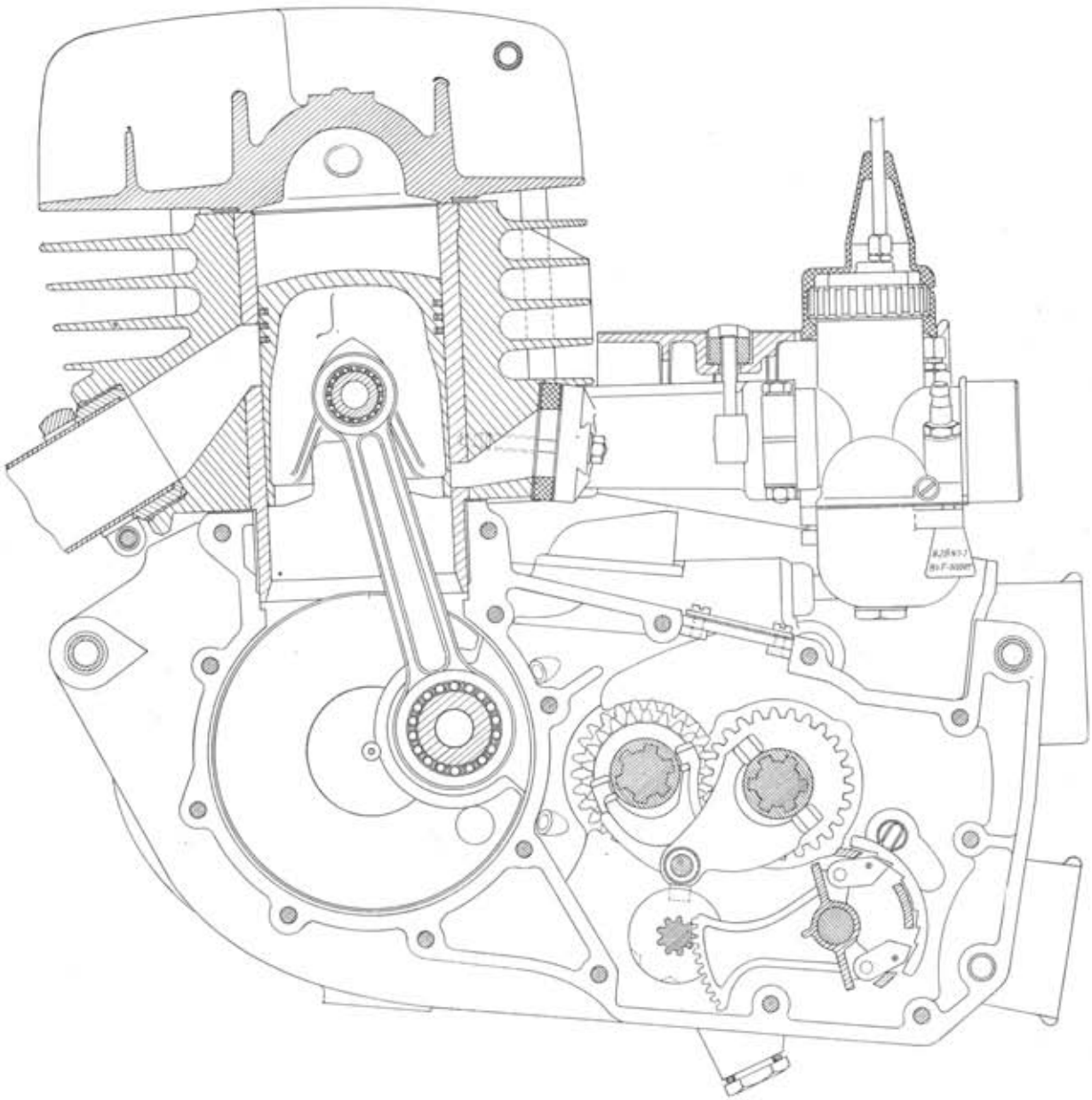


Fig. 4. Longitudinal section of engine

1. Technical Data

1.1. Engine

	ES 175/2	ES 250/2
Cycle	two stroke (reverse scavenging)	two stroke (reverse scavenging)
Cooling system	air-cooled (relative wind)	air-cooled (relative wind)
Number of cylinders	1	1
Stroke/bore (in mm)	65/58	65/69
Swept volume	172 cm^3	243 cm^3
Ratio of compression	(ε) 9 : 1	8.5 : 1
Compression volume of cylinder head (when assembled)	21 $\pm$ 0.5 cm^3	33 + 1 cm^3
Maximum output at	5,200 to 5,500 rpm 13.5 DIN h.p. = 9.9 kW or 15.0 SAE h.p.	5,000 to 5,300 r.p.m. 17.5 DIN h.p. = 12.9 kW or 19.5 SAE h.p.
Maximum torque	1.85 kg-m at 5,000 to 5,100 rpm	2.5 kg-m at 4,500 to 4,700 rpm
Lubrication	petroil lubrication 33 : 1 with special two-stroke motor oil	
Connecting-rod bearings	cage-type needle bearings for big end (K 28 × 35 × 20) and gudgeon pin (KK 18 × 22 × 24 F)	
Crankshaft main bearings	2 bearings 6305 c 003 f (silent) 1 bearing 6302	
Lubrication of main bearings	by gear lubricant	
Piston	with 2 rings upper ring chromium-plated	with 3 rings upper ring chromium-plated
Weight of pistons complete with rings, gudgeon-pin and locking devices	240 $^{+5}$ g	360 $^{+5}$ g
Cylinder (broad-finned)	liner of special grey-cast iron with cylinder metal cast around	
Timing in terms of crank angles		
Inlet	140°	140°
Transfer	113°	113°
Exhaust	165°	160°

1.2. Carburetter

Type	BVF 26 N 1-1	BVF 28 N 1-1
Transfer port	26 mm	28 mm
Main jet	100	107
Needle jet	65	67
Partial-load needle No.	K 2 with 5 notches	K 3 with 5 notches
Needle position from top	3rd to 4th notch[1]) (4th for running-in)	3rd to 4th notch[1]) (4th for running-in)
Starting jet	90	100
Slow-running jet	35	40
Float-needle valve	18	18
Slow-running air screw	1 1/2 to 2 1/2 rev. open	2 to 3 rev. open
Transfer bore-hole	1.5 mm	1.5 mm
Idling bore-hole	0.8 mm	0.8 mm

1.3. Electrical Equipment

Ignition	battery ignition	battery ignition
Ignition timing	3.0 mm B.T.D.C. with the flyweights fully flown out = 22° 15′ crank angle	3.0 mm B.T.D.C. with the flyweights fully flown out = 22° 15′ crank angle

[1]) Besides the driving habit, the sparking-plug appearance is decisive for the adjustment

	ES 175/2	ES 250/2
Contact breaker points gap	0.3 mm	0.3 mm
Sparking-plug	Isolator M 14/260	Isolator M 14/260
Electrode gap	0.6 mm	0.6 mm
Dynamo	direct current, 6 V 60 W, short-time operation 90 W	
Charging control light (red)	in speedometer	
Regulator	RSC 60/6, under the left-hand enclosure	
Battery	6 V, 12 Ah (lead storage battery, flat type)	
Ignition coil	6 V, under the left-hand enclosure	
Headlamp	fixed – lamp opening 170 mm asymmetric passing beam	
Dimmer switch	at left-hand handle bar	
Combined stop, tail and number-plate lamp	stop light contact at rear brake spanner	
Flashing-light indicators	at the two handle-bar ends (switch at right-hand handle bar)	
Flasher unit	in headlamp shell	
Horn	below fuel tank	
By-pass light signal	actuated by push-button arranged below dimmer switch	
Electric bulbs		
Bilux twin-filament bulbs	6 V, 45/40 W, asymmetric passing beam	
Parking light	6 V, 4 W, cap BA 9 s	
Stop light	6 V, 18 W, cap S 8,5	
Tail light	6 V, 5 W, cap S 8	
Flashing light	6 V, 18 W, cap S 8,5	
Charging control light	6 V, 1.2 W	
Idling indicating light	6 V, 1.2 W	
Speedometer illumination	6 V, 1.2 W	

1.4. Gearbox

Gear-shift system	foot-operated (rack, segment, cam barrel)	
Number of speeds	4	
Gear ratios		
1st speed	2.77 : 1 = 13 : 36 teeth	
2nd speed	1.63 : 1 = 19 : 31 teeth	
2nd speed	1.8 : 1 = 15 : 27 teeth (from engine No. 4 512 291 and engine No. 4 623 112)	
3rd speed	1.23 : 1 = 22 : 27 teeth	
4th speed	0.92 : 1 = 25 : 23 teeth	
Bearings on driving shaft	6204 (20 × 47 × 14) and 6203 (17 × 40 × 12)	
Bearings on driven shaft	6203 (17 × 40 × 12) and 6204 (20 × 47 × 14)	
Idling indicating light	electric indicator lamp (green) in speedometer	

1.5. Transmission

Clutch	on left tailshaft, in oil bath, 5 friction disks with cork parts	
Transmission engine/gear	2.43 : 1	
by helical gears	28 : 68 teeth	
Transmission gear/rear wheel	2.65 : 1 = 17 : 45 teeth	2.14 : 1 = 21 : 45 teeth
by roller chain	12.7 × 7.75 × 8.51 mm ($^1/_2 \times {}^5/_{16}$ inch)	
	116 links	118 links (with side-car: 2.65 : 1 = 17 : 45 teeth)

1.6. Basic Structure (Chassis)

Frame	continuous single-tube frame, welded. Steering head brazed. Induction air through frame tube, elastic engine suspension in silent blocks	
Steering angle	63°	
Castor	105 mm	
Castor with side-car	65	

	ES 175/2	ES 250/2
Suspension system	long swinging arms at front and rear	
front	suspension units with hydraulic damping, shock course 142 mm	
rear	suspension units with hydraulic damping with hand adjustment for load, shock course 115 mm	
Wheels	wire spokes, non-offset	
Rim size		
front	1.85 B × 16	
rear	2.15 B × 16	
Tyres		
front	3.25 – 16 (or 3.00 – 16)	
rear	3.50 – 16	
Tyre inflation pressure (in atm. excess pressure over atmosphere)		
front	1.4 atm.	1.4 atm.
rear	1.9 atm. solo	1.9 atm. solo
rear	2.1 atm. with pillion rider	2.1 atm. with pillion rider and for side-car, 2.6 atm. with full team
Brakes	full hub brakes, 160 mm diameter 30 mm shoe width	

1.7. Dimensions and Weights

Wheel base	1,325 mm	
Length	2,090 mm	
Width with mirror	862 mm	
Height	1,060 mm	
Ground clearance, loaded	170 mm	
Weight, unloaded	155 kg	156 kg
Carrying capacity	165 kg	164 kg
Permissible total weight	320 kg	320 kg

1.8. Capacities

Gear	750 cm^3 of gear oil GL 60 (additive-type) for summer and winter. (SAE 40 in foreign countries)
Fuel tank	about 16 litres of fuel-oil mixture, mixing ratio 33 : 1
Including reserve of	about 1.5 litres
Suspension units	
front	80 cm^3 each
rear	80 cm^3 each, shock absorber oil "Globo" viscosity 1.65 to 1.92 °E at 50 °C = 8 to 11 c/St/50 °C
	In foreign countries only use branded shock absorber fluid of the same viscosity!

1.9. Maximum Speed

	about 110 km/h	about 120 km/h

The maximum speed is determined uder the following conditions:
For the test run, the motor-cycle must be run in, otherwise a distance of at least 3,000 km must have been covered. The vehicle is to be operated on a plane, dry concrete raod or rough asphalt road which is in good repair. Gradients, rising or falling, of up to 0.5 per cent are permissible. The wind velocity should be not more than 3 m/s. The test distance must be covered twice, i.e. there and back without interruption. The rider assumes a sporting posture and his suit should fit tightly.

1.10. Deceleration

7.1 m/s² on a skid-proof concrete raod (autobahn). With practically new tyres and careful actuation of both brakes, the following braking distances are ensured:

at 30 km/h	4.9 m
at 60 km/h	19.4 m
at 99 km/h	44.0 m.

These values do not include the rider's reaction time. The **chassis No.** is attached to the rear right-hand frame extension for mounting the rear mudguard. **The engine No.** is marked on the right-hand side of the engine block.

We reserve the right to modify or deviate from the Published Specifications without notice in the interest of technical progress.

1.11. Diagrams

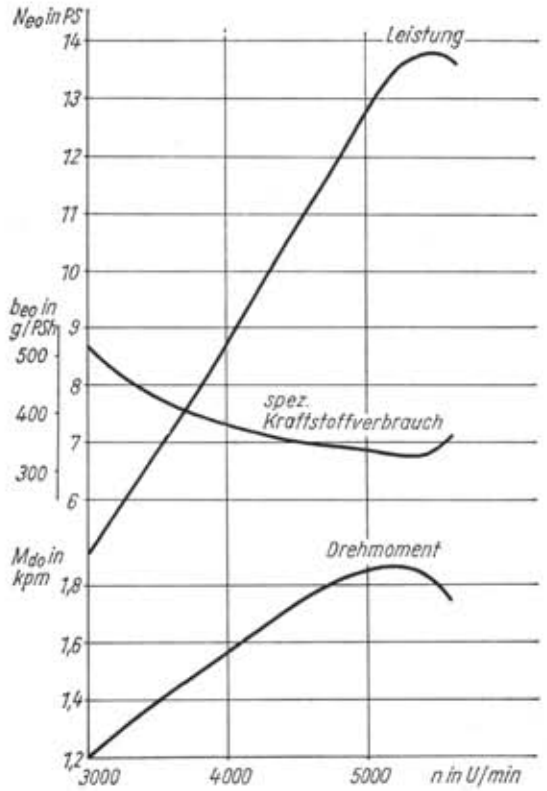


Fig. 5. Performance, specific fuel consumption and torque of the ES 175/2

Leistung — Performance
spez. Kraftstoffbedarf — specific fuel consumption
Drehmoment — torque

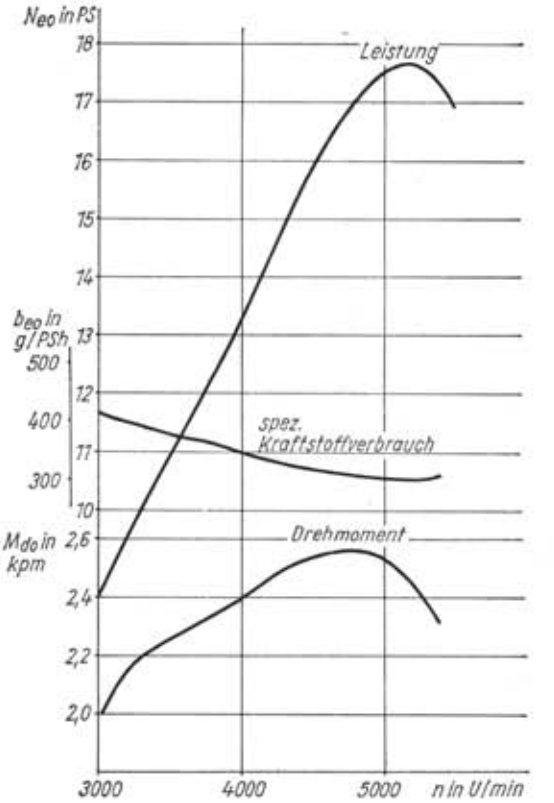


Fig. 6. Performance, specific fuel consumption and torque of the ES 250/2

Leistung — Performance
spez. Kraftstoffbedarf — specific fuel consumption
Drehmoment — torque

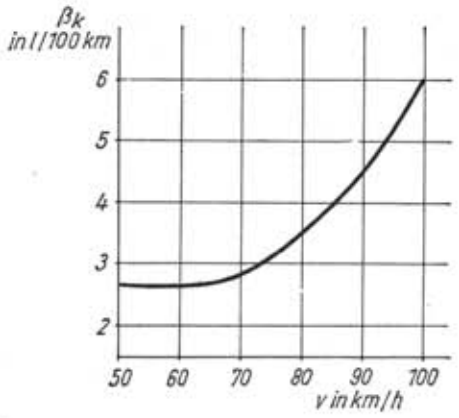


Fig. 7. Traffic fuel consumption of the ES 175/2 at 4th speed

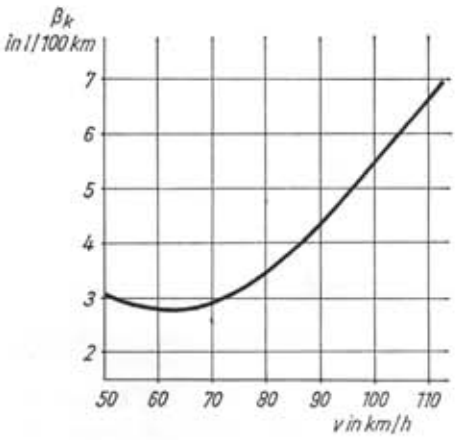


Fig. 8. Traffic fuel consumption of the ES 250/2 at 4th speed

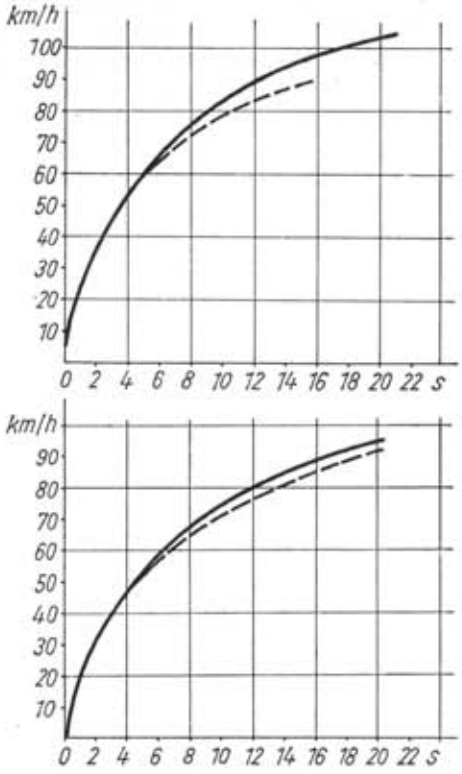


Fig. 9. Acceleration of the ES 175/2 and ES 250/2

2. Fuel, Lubricants and Fluids

2.1. Fuel

According to the design of the engine, a petrol of 79 octane, namely "VK Normal", should be used for both motor-cycle types.
In foreign countries, the use of a fuel with a similar octane rating should be used. If fuels with a high octane number are used, a too rich mixture may be brought about. This can be neutralised by setting the partial load (jet) needle lower.

2.2. Motor Oil

The two connecting-rod bearings, cylinder liner and piston are lubricated by the simple and reliable system of petroil lubrication. Tests conducted by us over a period of may years have shown that it is recommendable to use exclusively

Hyzet two-stroke motor oil

for the engine at home. This additive-type oil reduces the rate of mechanical wear and the deposition of products of combustion.
Customers of MZ abroad are recommended to use exclusively special two-stroke motor oils (such as Zwo-Ta-Mix, Shell 2 T, Castrol 2 T or similar brands).
If, in foreign countries, only non-additive type motor oils (i.e. straight mineral oils) are available, the engine must not be run with additive-type motor oils for any intermediate period. These special motor oils contain active substances (the so-called additives) which, among other effects, keep the deposition of products of combustion very low. If additive-type and straight motor oils are run alternately, the deposits of products of combustion from mineral oils are dissolved and cause premature wear of the components of the crank assembly because of the abrasive effect produced by the dissolved deposits.

2.2.1. Mixing Ratio

The mixing ratio is 33 : 1 in any case, that is to say, during and after the running-in period. In any case, 10 litres of petrol are mixed with 0.33 litres of two-stroke oil.

In foreign countries:

1 Imperial gallon (4.54 litres) of petrol are mixed with 0.23 Imperial pints of two-stroke oil.
1 U.S. gallon (3.78 litres) of petrol are mixed with 0.23 U.S. pints of two-stroke oil.
(See conversion table on page 88.)

If non-additive type of motor oil (mineral oil) is only available, a mixture in the ratio of 25 : 1 must be prepared. This is equal to 10 litres of petrol and 0.4 litres of oil or a proportion of oil of 4 per cent.

2.3. Lubricants for Transmission System

For gearbox and primary drive, a capacity of 0.75 litres (750 cm^3) of gear oil grade GL 60 are required.

Viscosity: 7 to 9 °E/50 °C = 53 to 68 cSt,
this roughly equals SAE 80 EP.

Strictly observe the specified quantity of oil, otherwise the clutch will act as "eddy-current brake". The excessive supply of oil will be pressed through the vent holes in the filler plug and will contaminate the engine block.

For foreign countries:

If gear oil of the above-mentioned viscosity is not available, use straight motor oil SAE 40 (mineral oil) as gear lubricant.

For lubricating the secondary chain, also use GL 60 gear oil.
The 6005 bearing in the rear-wheel drive (damping member) is lubricated with "Ceritol" anti-friction bearing grease; this also applies to steering and wheel bearings.

2.4. Lubricants for Chassis

All lubricating points of the chassis (including speedometer drive) must be lubricated with GL 60 gear oil by means of a grease gun.
Any chassis grease is absolutely unsuitable – e.g. for the bearing pins of the swinging arms – because the lubricating ducts will be clogged by resinified grease after a short time of operation.
Only the steering and wheel bearings and the brake spanners are provided with anti-friction bearing grease "Ceritol" k 5 or k 3.
Drop point 145 to 155 °C. Temperature limits of application: – 25 to + 95 °C.

For foreign countries:

In the place of GL 60 gear oil, a motor oil resembling SAE 30 to 40 may be used. In the place of Ceritol k 5 anti-friction bearing grease, an acid-free anti-friction bearing grease (drop point over 150 °C and freezing point at – 30 °C) can be used.
Cup grease (stauffer grease) is absolutely unsuited!

2.5. Shock Absorber Fluid

All shock absorbers are filled with 80 cm^3 of "Globo" shock absorber oil.
Viscosity: 1.65 to 1.92 °E/50 °C = 8 to 11 cSt/50 °C.

For foreign countries:

If "Globo" shock absorber oil is not available another proprietary product can be used, provided it has the same viscosity.
If the value is higher, the suspension units will return too slowly to the end position. In the case of shocks, the springing action becomes harder and harder. If the value is lower, the return energy of the compression springs in the suspension units is not properly taken up, this means that the shock absorbers become useless – the vehicle is said to "float".

3. Disassembling the Engine

Note: SW = Width over flats; for example, "SW 17" means widt over flats 17 mm.

3.1. Removing the Engine from the Chassis

Remove the dynamo cover and withdraw the four slip-on type connectors from the dynamo. If the identification colours of the various cables are not clearly discernible, it is advisable, especially for amateur constructors, to mark the lines by means of paper slips. This will save the time for measuring them when reassembling and will protect the governor which, otherwise, may become charred.
Remove the retaining screw of the armature (1) and then the two screws (2) of the pole casing (3). Then pull the pole casing a short distance outward and loosen the cam carrier (4) by slightly moving it to and fro – do not use undue force to remove it.

The armature must only be removed by means of puller 02-MW 39-4. Other means, e.g. a jaw-type extractor, will squeeze the segments or damage the winding. Remove the fitting key (flat key) and remove the chain lock. Speedometer (1) to be removed.

Loosen the screw for the rear shock absorber brace and the clamping screw at the front of the cylinder – and then the central support, and remove the complete exhaust assembly.
To remove the carburetter, slacken back the two clamping screws at the induction pipe connection (1) and the clamping ring at the induction rubber tube.
Loosen the nuts of the cylinder head crosswise and step by step, because the calinder head can also be distorted when it is being removed.
Unhook the spring of the prop stand (2) by means of a wire loop, unscrew the two engine retaining screws (3) and loosen the nuts of the front silent blocks (4). After disconnecting the clutch cable control (see Fig. 84), the engine can be removed from the basic structure.

At this stage is disassembling, the front silent blocks (A) can be changed.
For this purpose, the rear engine retaining screws should not be lossened.

Note: The lugs at the silent blocks must match with the recesses of the engine holder plates, otherwise the engine mounting is subject to impermissible initial stress.

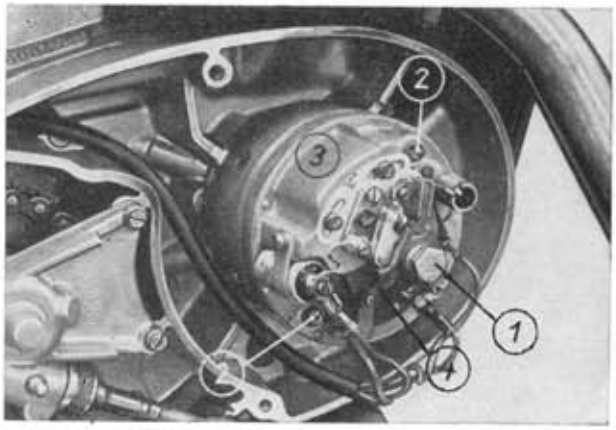


Fig. 10

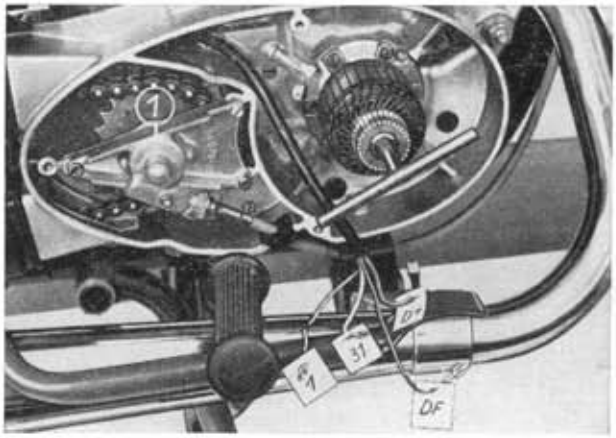


Fig. 11

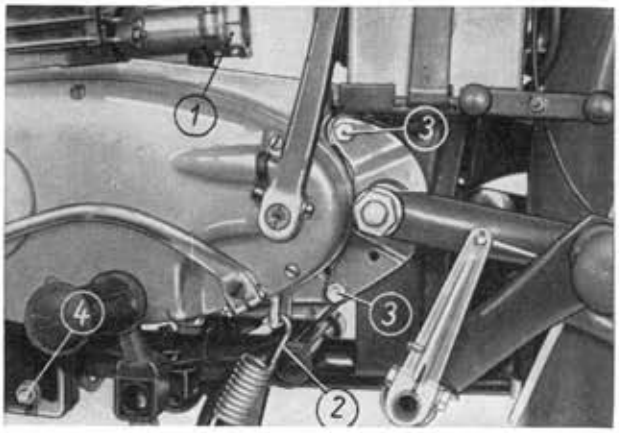


Fig. 12

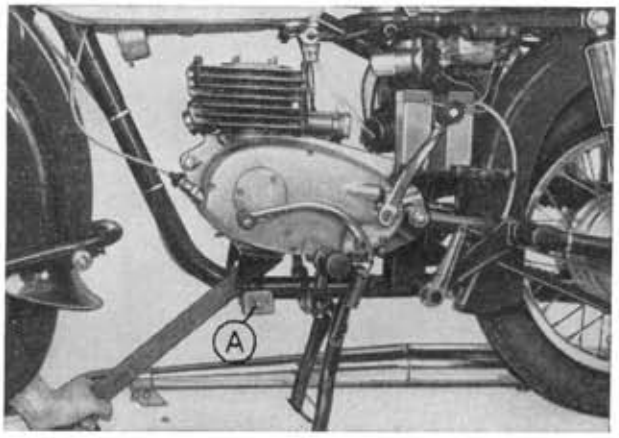


Fig. 13

3.2. Disassembling the Engine

The engine is placed in the assembly device 05-MV 197-0 to be disassembled. Prior to this, the front housing screw M 10 × 75 must be removed.

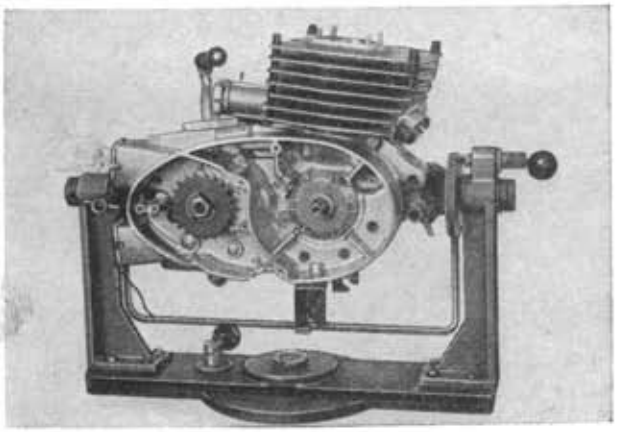


Fig 14

Loosen the screw (SW 24) at the gearbox sprocket, for this purpose, insert the holder-up 05-MW 45-3.

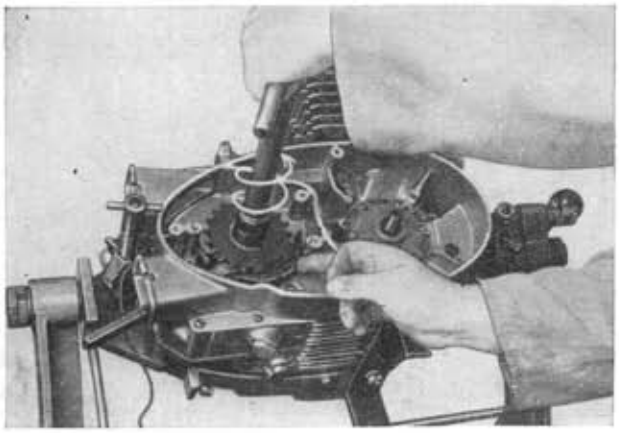


Fig. 15

Pull off the gearbox sprocket wheel with the help of the 05-MV 45-3 device. This puller is also intended for removing the 68-teeth drive gear.

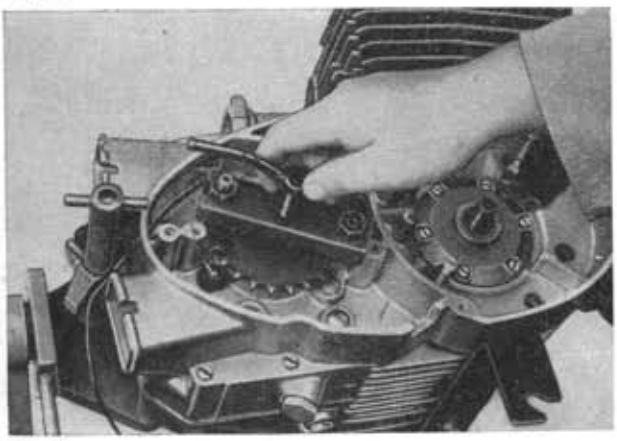


Fig. 16

Remove the foot control lever (the kick-starter remains in place), unscrew the three screws for the cover and remove the cover together with the adjusting plate (1). Take care not to damage the rubber sealing ring and copper rings.
Remove the engine supporting strap (2). Remove the cotter pin from the castle nut at the tail shaft and loosen the nut by a blow against the box spanner or socket wrench (right-hand thread).
By applying slight blows to the lugs (3) at the cover, the cover is released. For this purpose, use a rubber or plastic mallet. It should be noted that this operation bears on the transition fit of the clutch supporting bearing 6302 on the tail shaft.

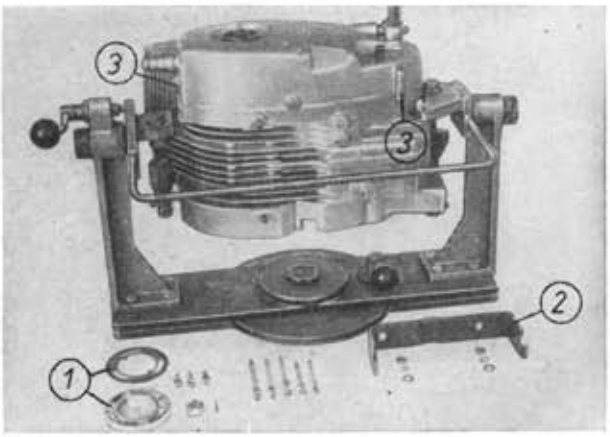


Fig. 17

Pull off the clutch, using tool 05-MW 20-4.

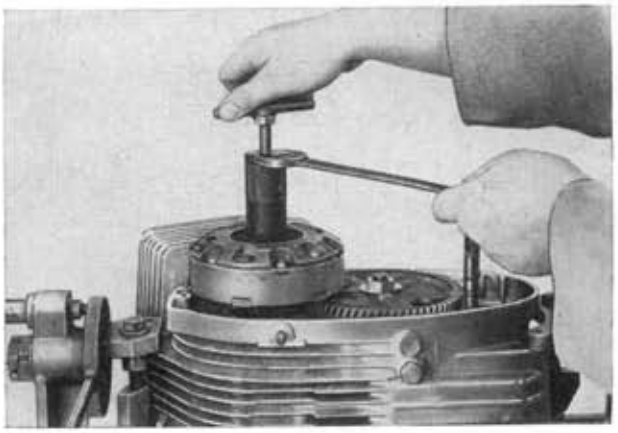


Fig. 18

Remove the driving gear with 28 teeth with the clutch dog.
Take care not to damage the needle bearing.
Apply the holder-up 05-MW 15-3 to the driving gear with 68 teeth and loosen the nut (SW 24).

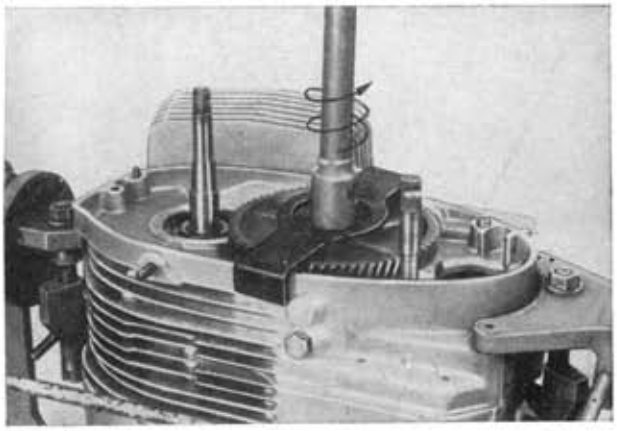


Fig. 19

Extract driving gear with the help of puller 05- MW 45-3.

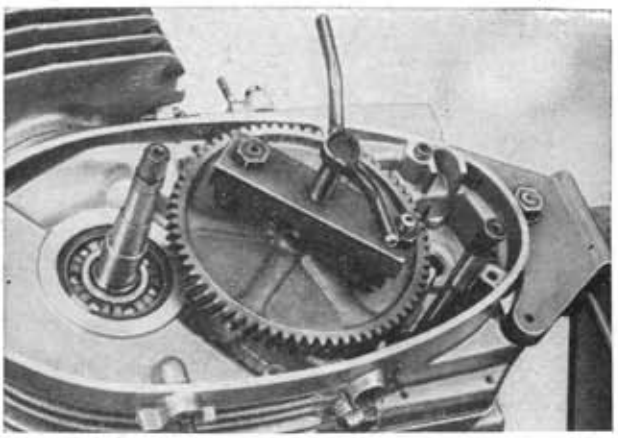


Fig. 20

Take the cylinder off. Remove the gudgeon-pin circlips and push the gudgeon pin out of its seat with the help of driver 05-MW 190-3. Take care to see to it that the mushroom head of the thrust spindle contacts the centre of the gudgeon pin, otherwise the needle bearing will be rendered useless. Do not beat the gudgeon pin out of its seat, because this usually leads to damage to the needle bearing. If the bearing is treated with care, it will have a long service life.
In order to re-use the needle bearing, wrap it in a clean piece of cloth or paper. If needles have fallen out, a new bearing must be replaced.

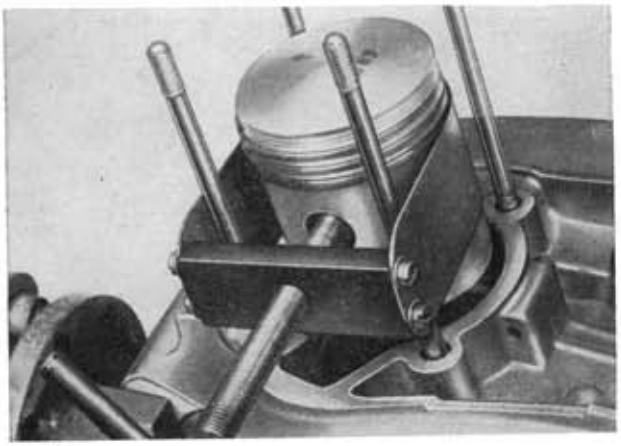


Fig. 21

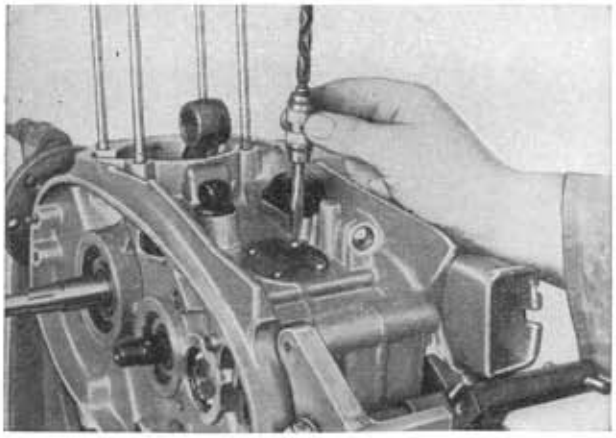


Fig. 22

Remove the cover of the gear inspection hole.

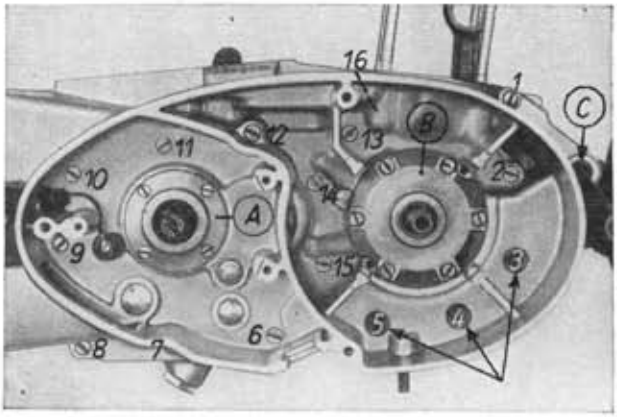


Fig. 23

Remove the sealing caps from the driven shaft (A) and dynamo bearing (B). Drive out the fitting sleeve (C). Loosen all of the 15 casing screws – three of them you will find below the rubber plug (arrows). At the upper part of the casing, remove a nut (SW 10) with corrugated washer from the 16th screwed connection.

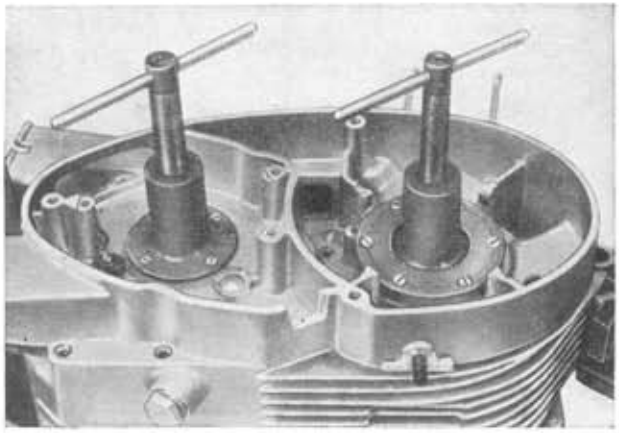


Fig. 24

Take the right-hand half of the casing off:
For this purpose, apply dismantling screw 05-MV 70-2 and backing ring (having the same No.) to the tail shaft and dismantling screw 05-MV 71-2 to the driven shaft.
Tighten the spindles of the two dismantling devices uniformly and at the same time.
These two devices must be used in any case. Casings damaged by beating or pressing have to be subjected to time-consuming refinishing operations to make them tight.

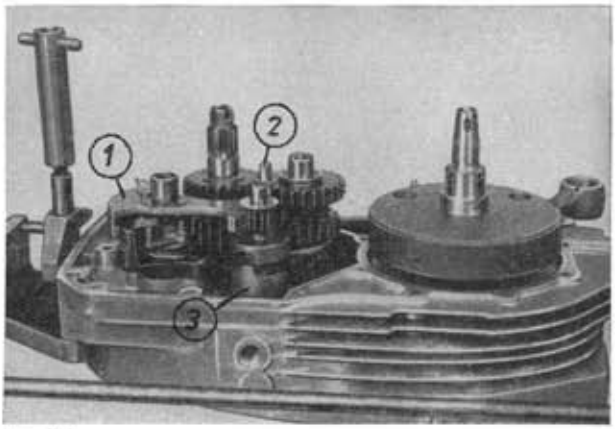


Fig. 25

Unscrew the gear detention screw (older models have two of them). Take care not to lose the ball. Remove the toothed gear-shifting quadrant (1) together with the complete gear-shifting mechanism and the guide pin (2). Then, the two shift forks and the cam barrel (3) can be taken off.
Use a mallet of plastics to drive out driving and driven shafts (applying blows alternately).

To drive out the crankshaft, screw the device No. 05-MV 69-2 in place. Insert the dismantling screw 05-MV 70-2 into the prismatic guide. This screw has already been used for taking off the casing (see Fig. 24).

Do not beat out the crankshaft by means of a hammer, because shafts maltreated in this way will not be accepted by reconditioning shops.

All ball bearings in the left-hand half of the casing are locked by circlips (see Fig. 3).

Bear in mind that they have to be taken out by means of pointed pliers, prior to driving the bearings out of their seats.

All engine parts must be cleaned carefully to ensure a successful trouble shooting. Note that not only those parts which may cause any operational trouble should be checked, but all parts subject to wear should be carefully inspected and measured. This is the only way to save the costs of a second repair after a short operating time.

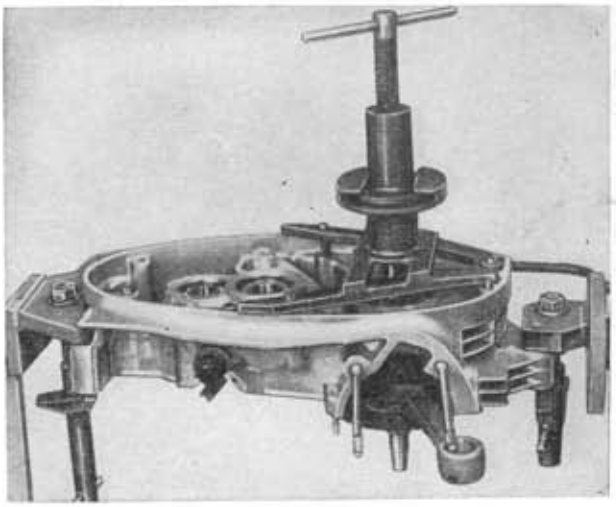


Fig. 26

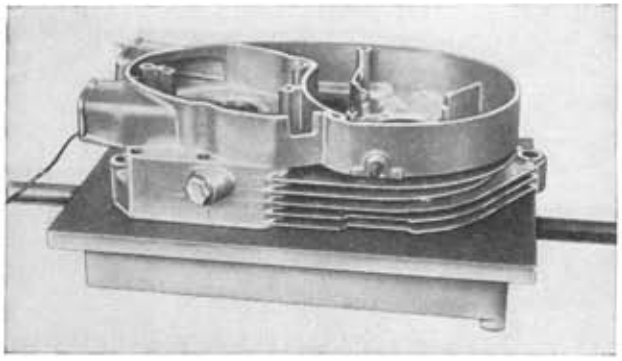


Fig. 27

4. Assembling the Engine

The sealing faces of the two halves of the casing, of the clutch cover and of the cylinder head are carefully cleaned and then checked on a surface plate. If necessary they are spot-ground. For this purpose, a fine-grained sheet of emery cloth is placed between surface plate and the part to be treated.

All faces must be perfectly plane, that is to say, any scratch or remains of sealing material must be removed. Then, and only then, the engine will become perfectly tight.

If a surface plate is not available, the table of a machine tool, e.g. that of a column-type drilling machine, will do good service.

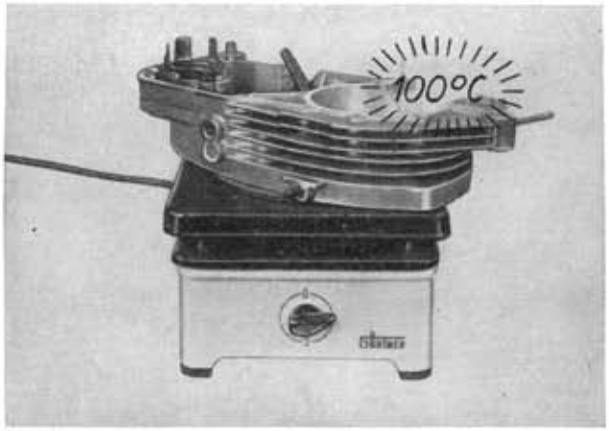


Fig. 28

The next thing to do is to insert the circlip 65 × 1.8 for the crankshaft bearing and the two lock rings (50 × 1.75 and 42 × 1.0) for the bearings of driving shaft and driven shaft. Then heat the casing half to a temperature of about 100 °C on an electric cooking plate. This is necessary to facilitate the insertion of all ball bearings, especially to prevent them from being tilted because in this way the bearing seats would be damaged.

Do not use a welding torch for heating. By locally overheating portions of the casing, the casing can be distorted.

4.1. Crankshaft

While the temperature of the casing slowly rises, the bearings to be mounted are placed so as to be ready at hand, together with the appropriate drifts. The checked gear-shift mechanism and the crankshaft must also be ready at hand.

This job can be compared with a surgical operation, any motion of the hand must be in keeping with the requirements and perfect cleanliness is imperative.

For the crankshaft main bearing, only use special bearings denoted by "c 003 f" (silent).

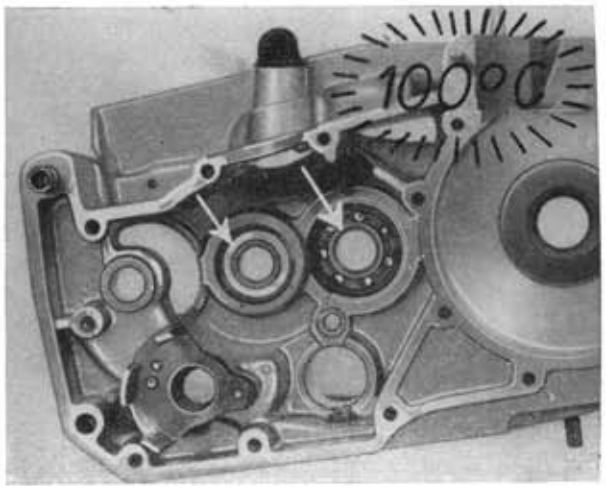


Fig. 29

Sequence of assembling operations:

Crankshaft bearing 6305 to be mounted by means of drift 05-MW 92-4

Crankshaft seal ring to be mounted by means of drift 05-MW-91-4

Bearing on driven shaft 6204 to be mounted by means of drift 05-MW 106-4

Bearing on driving shaft 6203 to be mounted by means of drift 05-MW 106-4

When mounting the gearbox bearings, take care that alternately the open side of the cage and the closed side of the cage (arrows) pont inwards. Fit the inner circlips.

For the crankshaft, only use green (petrol-proof) seal rings.

It should be noted that the crankshafts of the ···/2 models can only be used for the specific model, that is to say, the shaft of the ES 250/2 cannot be used for the ES 175/2 (and vice versa). Therefore, observe the marking (in a circle).
The date of manufacture is marked on the side of the crank disc of the short tail end.

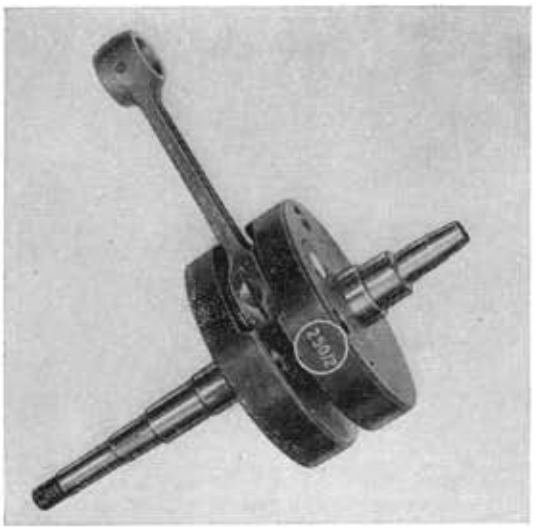


Fig. 30

Any crankshaft, no matter whether it is reconditioned or new, must be checked that it is not out of true. It may have been distorted during transportation (or a fall). When fitting a crankshaft in this condition, any engine repair would be useless, because a severely vibrating engine cannot produce the specified output. Further, there are difficulties when timing the ignition.
The maximum permissible amount for the crankshaft to be out of true is 0.03 mm at all measuring points.
If there is no test arrangement for true-running tests available, tests can be carried out between the centres of a lathe.

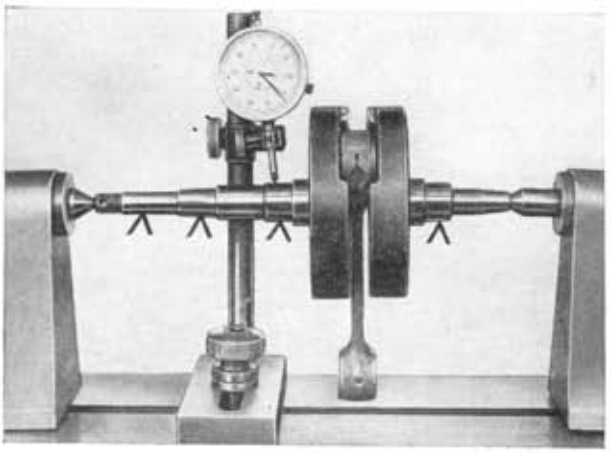


Fig. 31

The **radial play** of the cage-type needle bearing in the connecting rod must be within the limits of

0.015 to 0.030 mm

with the assembly in new condition.
The **maximum permissible wear** is of the order of 0.05 mm.

Axial clearance:

(1) between crank disc and needle bearing from 0.50 to max. 0.80 mm
(2) between crank disc and big-end bush from 2.10 to max. 2.50 mm

The connecting rod is guided by the small-end bush, that is why the axial clearance can be a little larger at the other end.
See also Fig. 65.

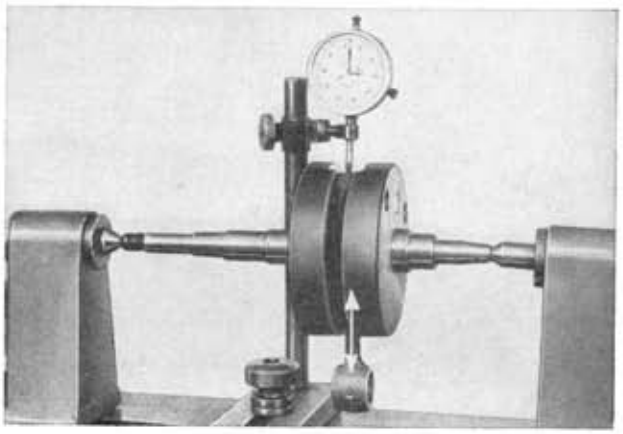


Fig. 32

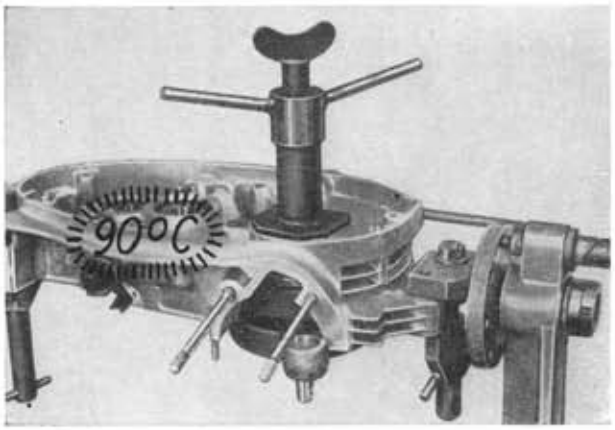


Fig. 33

Meanwhile, the temperature of the ball bearings fitted in cold condition has risen due to the heat transferred from the hot crankcase. It is advisable, to reheat the assembly. In this condition, the crankshaft can be pushed through the bearing up to the collar. If this should fail, use the upper part of the clutch setting device 05-MV 150-2 (for dismantling the clutch) and apply it together with a suitable piece of tube to draw the shaft up to the collar. On no account beat on the crankshaft. Prior to this operation, slightly oil the tail shaft.

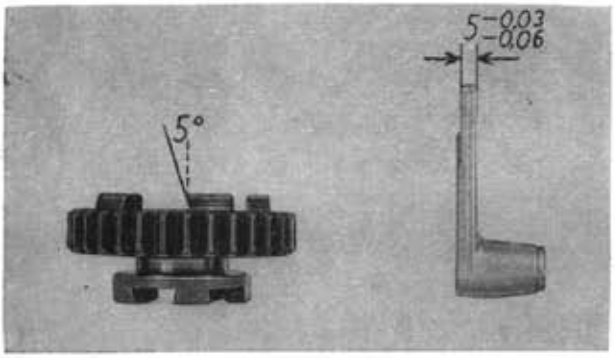


Fig. 34

4.2. Gearbox

Check all dogs of the shift gears for wear. The 5° undercut must bear for three quarters, otherwise this part and the mating gear must be replaced. Under load, the undercut retains the gears in mesh, but not the indexing detent.
The wear limit of the two selector forks is of the order of 0.4 mm.
Parts that show a blue colour must be replaced by new ones.
For the 2nd speed only use the gears 15/27 (1.8 : 1) (better setting, lesser shifting noise).

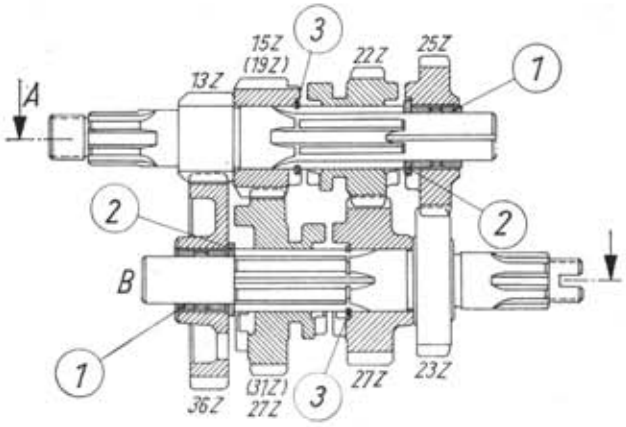


Fig. 35

Sectional view of the gearing:
The two "floating" sleeves (1) must be free to rotate easily in the gears and on the shafts.
If the sleeves and the check washers (2) show signs of heavy wear or seizing, symptoms that may occur after a longer period of operation, then these parts have to be replaced by new ones.
When assembling, take care that the two circlips (3) fit tightly. A circlip that is fitted loosely will be worn rapidly during operation and, eventually, jump out of the groove. As a consequence, two speeds are engaged – this means the gearbox is blocked.
(A) Driving shaft
(B) Driven shaft.

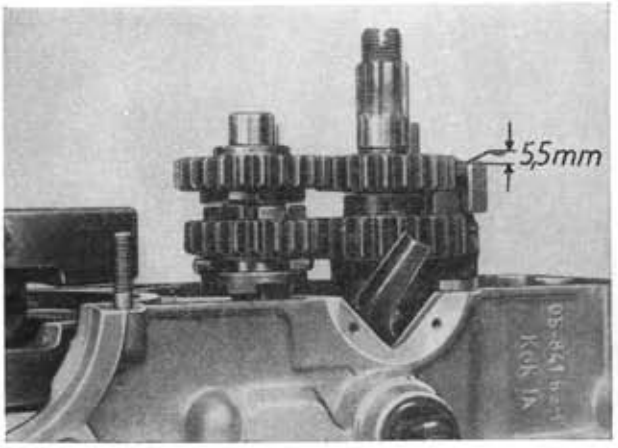


Fig. 36

Heat transferred from the heated casing caused the temperature of the gearbox bearings to rise. Now, use a mallet of plastic material and drive the complete assembly of driving and driven shafts – see Fig. 35 – in place until they contact the bearing collar; take care to apply slight blows only. Perhaps the floating sleeve of the driven shaft will be jammed axially during this operation; however, this is of no consequence at this stage of assembling – the whole assembly will be aligned after fitting the right-hand half of the casing. The contact for the idling indicator must be checked for proper gap and adjusted by bending, if required.

The next thing to do is to fit the two selector forks and to push the pivot pin in place, inserting an 8 × 13 × 1.5. washer. Then, the selector cylinder with cams is inserted into the pins of the selector forks and pressed down. If this cannot be performed easily, once more lift the pivot pin as required.
(The gear assembly in the accompanying illustration is shown from the bottom side to exhibit the selector forks.)

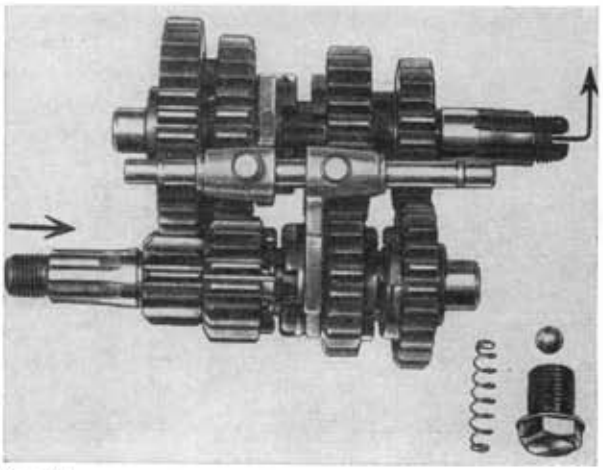


Fig. 37

Screw the indexing detent screw into the casing; the ball engages with the V-groove in the cam cylinder. It should be noted that only the specific compression spring with rolled up ends has to be used, otherwise the ball will jam.
Then check that the dogs properly mesh in all four gears; for this purpose use the profiled socket wrench No. 02-MW 60-3 and turn the selector cam cylinder. If one shift gear is in mesh under pressure, the pertaining selector fork must be readjusted in order that it does not turn blue in colour due to continuous friction.

Fig. 38

Check at the gearchange member (with selector cylinder) that the gearchange pedal return spring (1) and the ratchet spring (2) show the required spring tension after 50,000 km of operation. In case of doubt, provide with new parts.
Check the points of wear on the ratchets (arrows).

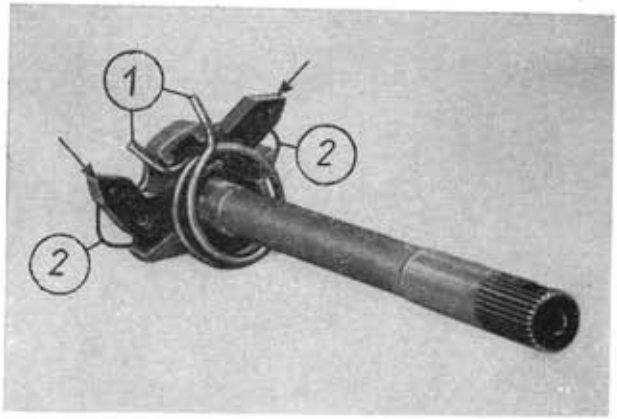


Fig. 39

4.3. Adjustment of Gearchange Mechanism

One tooth of the selector cylinder is chamfered. One root between two adjacent teeth at the gearchange quadrant (A) is marked by a punch mark. Both markings, the chamfer and the punch mark, must coincide.
(The punch mark is indicated by a chalk line.)
Place the right-hand half of the casing for trial in place to check the axial clearance of the selector cylinder (with check washer). Maximum permissible clearance 0.2 mm.

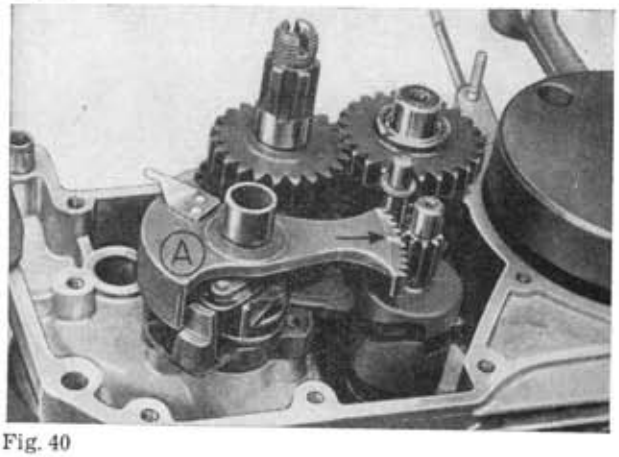


Fig. 40

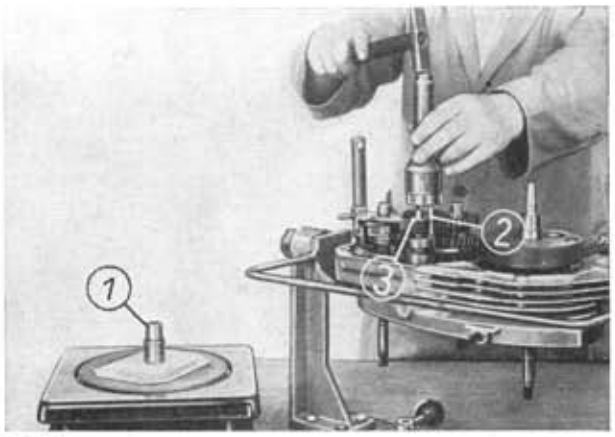


Fig. 41

Place the inner races of the two gearbox bearings on a mushroom-type heater (1) and heat them to about 70 °C. Use an asbestos plate to prevent heat transfer to the bearing outer race.
The bearings are fitted in place until they properly contact their seat by slightly tapping them, using the drift No. 05-MW 106-4.
Heavy blows must not be applied, they will damage the ball bearings, therefore, do not assemble them in a cold state.
Place the 8 × 13 × 1.5 washer on the pivot pin (2) and the check washer 10 × 24 × 1.5 on the selector cylinder (3). If shims were found in this assembly when dismantling (size 0.2 mm), then refit them.
Slightly oil all shafts and ends.

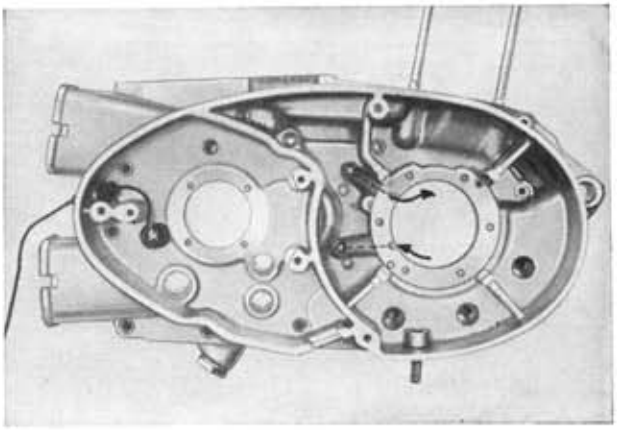


Fig. 42

4.4. Mounting the Right-hand Half of the Casing

The crankshaft bearing at the side of the dynamo is provided with gear lubricant through the marked holes.
When cleaning the engine parts, take care that these two oil pipes are not clogged.

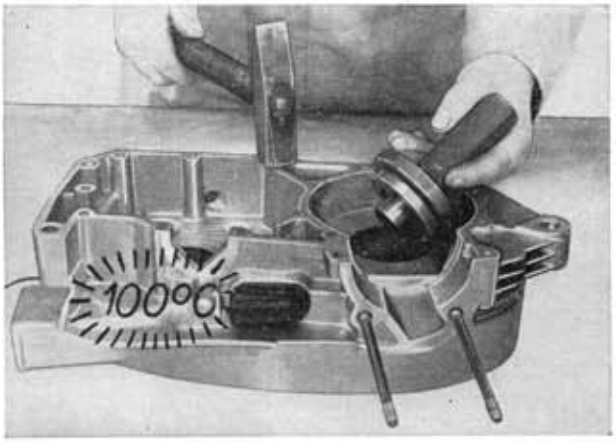


Fig. 43

The next thing to do is to fit the 30 × 62 × 10 radial seal ring into the right-hand casing half, which is heated to a temperature of about 100 °C, in such a way that the sealing lip points outward (see also Fig. 3). Use the 05-MW 91-4 drift for this purpose. The collar on this drift ensures that the ring is not driven in too far. If the ring is driven in too far, it will be pressed back when fitting the 6305 bearing so that the ring will rub on the crank disk. Please, be quick to ensure that the temperature of the casing is sufficiently high for the next operations.

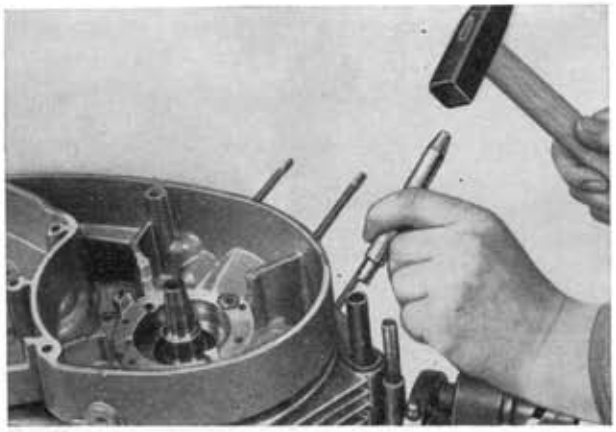


Fig. 44

Apply a film of sealing compound uniformly to the sealing face of the casing (take care not to clog the tapped holes). Place the casing on the assembly and drive it down so that it contacts the assembly close by the gearbox bearings, using a mallet of plastic material. Use a mandrel with collar to drive the fitting sleeve in place, at the front of the casing, so that both halves of the casing are properly alinged.

This operation must be carried out quickly and with every care. The reason for this is demonstrated in the following illustrations.
The inner race of the 6305 bearing must be heated by means of the heating mushroom (or a heated mandrel) in order that the heated inner race easily slides on the cold tail shaft and the cold bearing outer race in the heated casing.
For this operation, drift No. 05-MW 92-4 is to be used. The face of this drift is provided with a lug whose size corresponds with the diameter of the inner race of the bearing. With this, the bearing is prevented from being displaced axially (Fig. 46).

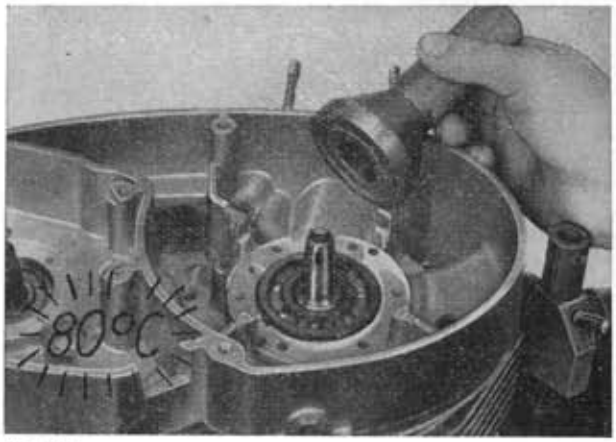


Fig. 45

In this case, the drift was not used for fitting, but a piece of pipe was used to beat on the outer race. As a consequence, the crankshaft is under axial pressure because the bearing was driven in too far (without feel). The inner race presses the slightly elastic crankshaft back. Consequently, the radial play (lubricating film!) of the left-hand bearing is removed, too. The balls no longer bear radially, but run towards the sides – producing a whining sound until they become useless due to premature wear.

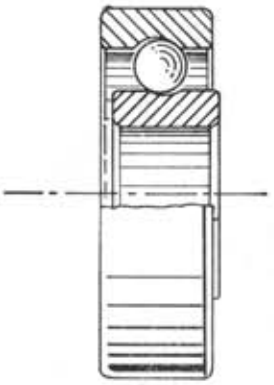


Fig. 46

If the pressure applied for beating the bearing in place is higher, the crankshaft will be compressed laterally. As a consequence, it is out of true and useless for the following reasons:

1. The contact breaker will no longer lift at the specified instant or the range of adjustment of the contact-braker base plate becomes insufficient.
2. The crankshaft running out of true induces intense vibrations in the engine so that the guaranteed performance cannot be achieved. The elastic engine suspension cannot neutralise this fault. Quite on the contrary – since the chassis no longer acts as a "vibration damper", the consequences will be still severer.

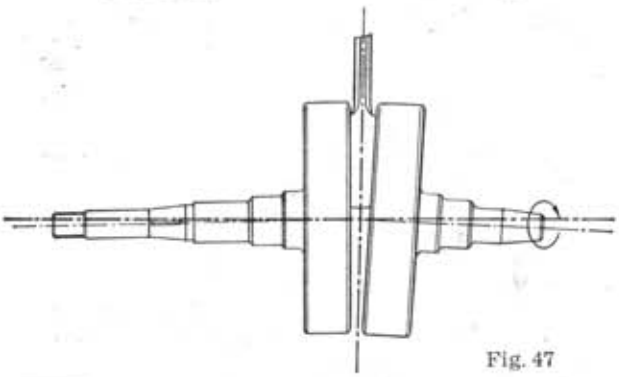


Fig. 47

If a bearing is driven in place with undue force, with the casing in a cold state and the inner race not heated, there is the risk of tilting the outer race so that it fails to fit axially parallel.
Such a casing is useless, because even a properly fitted bearing would again be tilted due to the damaged seat. (To demonstrate this clearly, the three sketches are somewhat exaggerated.)

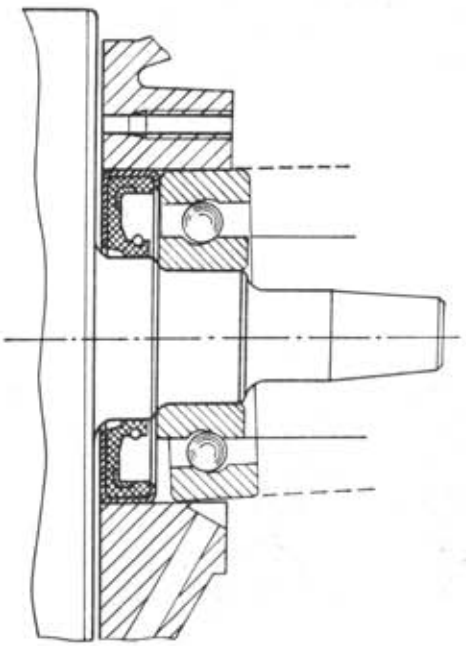


Fig. 48

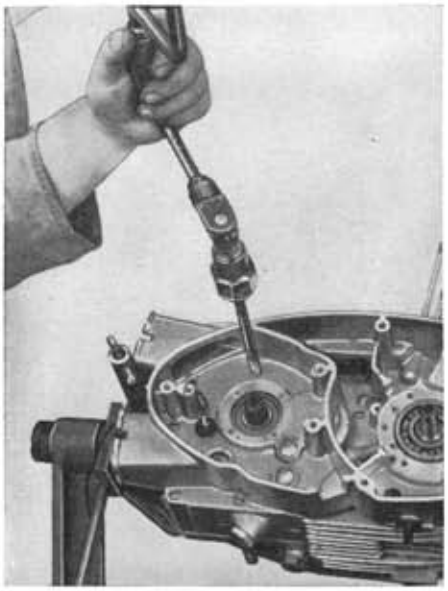


Fig. 49

Tighten the 15 casing screws by means of a properly fitting screwdriver (using a breast drill, if possible). Do not omit the nut SW 10 (see Fig. 23).
Observe the correct sequence:
Start in the centre of the casing, tighten alternately on the right and left and crosswise.
Operate quickly so that the temperature of the casing is still high enough for the next operation.

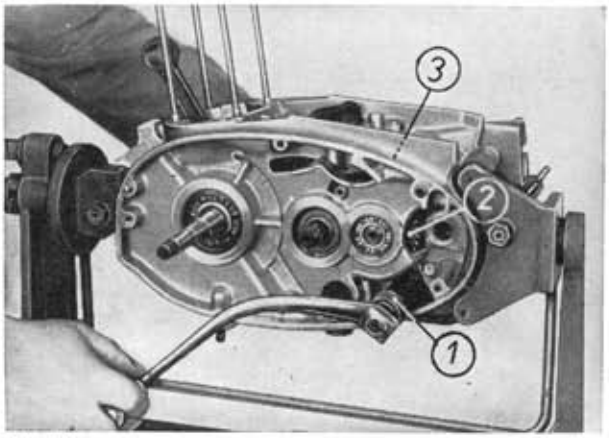


Fig. 50

Put the guide sleeve (1) 05-MV 49-4 and the selector lever on the selector shaft. Turn the gear shafts and shift all speeds by way of trial.
At the opening in the casing (2) for the starter gear, check that the sleeve in the gear of the 1st speed (window gear) shows the specified axial clearance of 0.2 mm.
Check the fourth gear through the inspection hole (3). The sleeve must also have an axial clearance of 0.2 mm.
The required axial clearance is obtained by tapping the driven or driving shaft (using a copper or brass mandrel). In the case of the driving shaft, the shaft must be tapped back in place via the inner race of the bearing. Take note of Fig. 35.

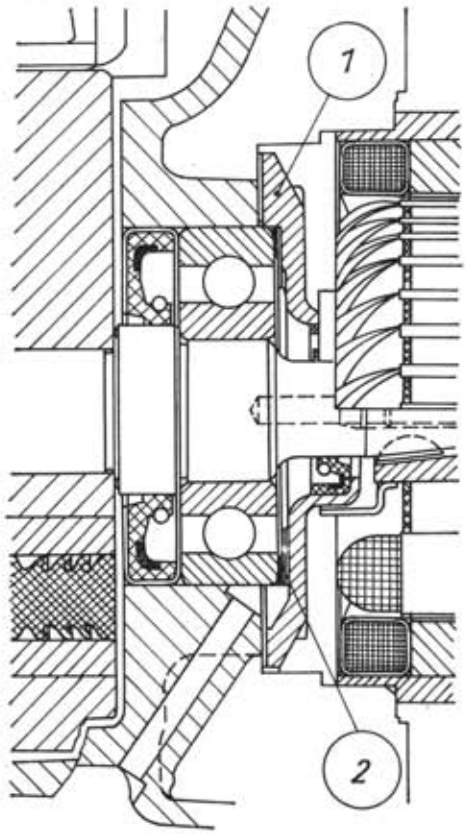


Fig. 51

Check the 17 × 30 × 7 radial seal ring in the sealing cap (1) and clean the sealing faces; if required, smoothen by means of emery cloth. Using a depth gauge or slide rule, determine the distance between bearing outer race and sealing cap and establish an exial clearance of 0.2 mm with the help of shims (2). The thickness of the paper packing must be taken into account.
Proceed in the same way with the sealing cap on the driven shaft.
Tighten the two sealing caps properly and uniformly.
From the 2nd quarter of 1969, the tailshaft at the dynamo side will be increased in diameter from 17 to 20 mm. When fitting this crankshaft, a radial seal ring of 20 × 30 × 7 and a sealing cap with an opening of 20 mm have to be used or the latter must be bored to 20.2 mm.

4.5. Straightening the Connecting Rod

Due to improper transport, or when the gudgeon pin was driven out of a reused crankshaft, the connecting rod may have become distorted or twisted. With the connecting rod in this condition, the needle bearing of the connecting rod would fail after a short period of operation.
For this reason, the small-end boss must be checked and aligned, if required.
The gap between mandrel and ruler indicates whether crankshaft and gudgeon pin are axially parallel (twist).

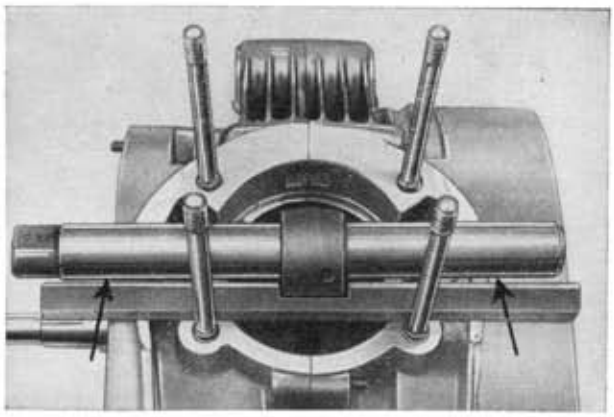


Fig. 52

This is the way to check that the connecting rod is positioned at the correct angle.
When the engine has been operated for some time, the wear pattern of the piston will show whether the connecting rod is out of the perpendicular or not.
The No. of mandrel and ruler for testing is 05-ML 24-3.
If the ruler with 15, 18 or 20-mm mandrel is already at hand, the 22-mm mandrel can be purchased alone.

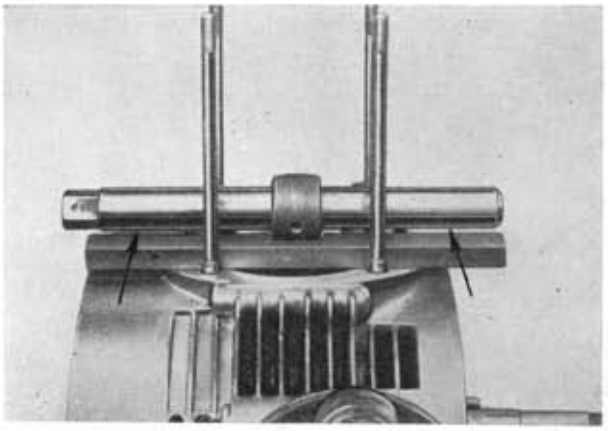


Fig. 53

Always support the connecting rod when straightening. Do not try to press the whole connecting rod into the proper position, it will return to its initial position.
Place the cover of the inspection hole on the casing and screw it in place.

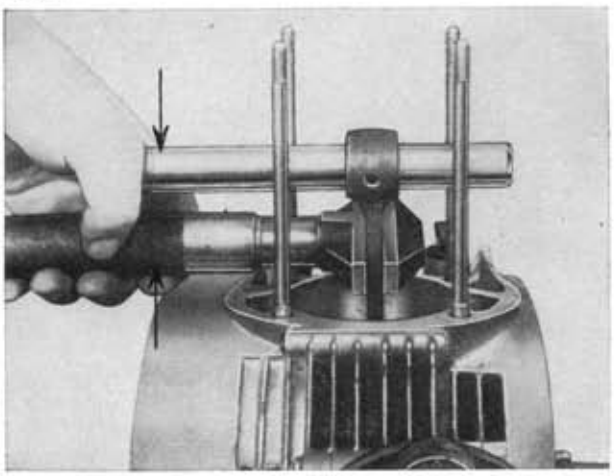


Fig. 54

4.6. Mounting Piston and Cylinder

To prevent any foreign particles from getting into the crankcase, the next job to do is to mount piston and cylinder. The markings on the piston head have the following meanings:

a) Arrow – when the piston is mounted, the arrow must point in the direction of the exhaust port.
b) 68.97 – this is the "nominal size" of the piston, that is to say, it is 68.97 mm in diameter. Matched with a cylinder marked "+ 1", a fitting clearance of 0.04 mm is obtained.

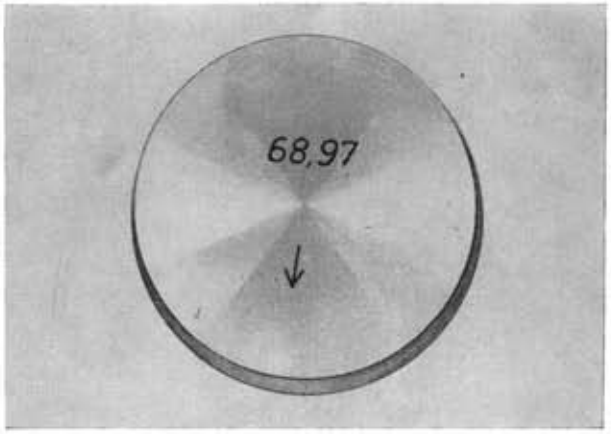


Fig. 55

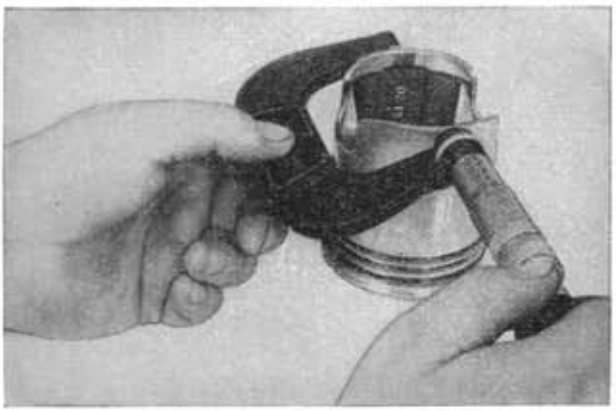


Fig. 56

The "nominal size" is measured at the lower edge of the piston skirt. The piston skirt is conical, the ring section has the smallest diameter.

	Fitting Clearance (Piston/Cylinder)	Wear Value (maximum)
ES 175/2	0.04 mm	0.10 mm
ES 250/2	0.04 mm	0.10 mm.

Oversizes of pistons for each model:

3 oversizes – each by 0.25 mm thicker than the previous one. More than 2 mm must not be removed in reboring the cylinder, otherwise the cylinder liner may be deformed.

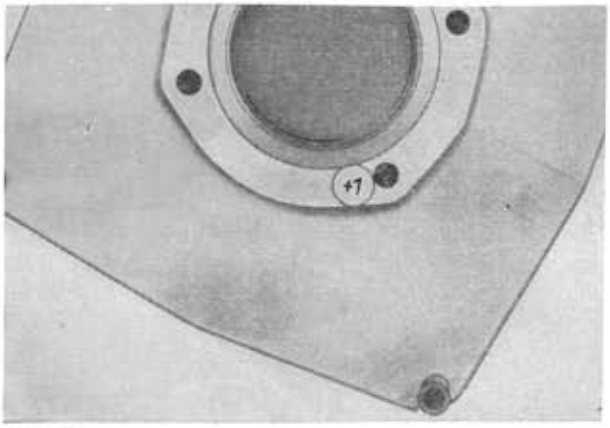


Fig. 57

Within the circle, the marking of the cylinder:

0 = full size (58.00 or 69.00 mm)
+ 1 = 0.01 mm over full size
+ 2 = 0.02 mm over full size.

Pay attention to the example of mating shown in Fig. 55 (paragraph b).

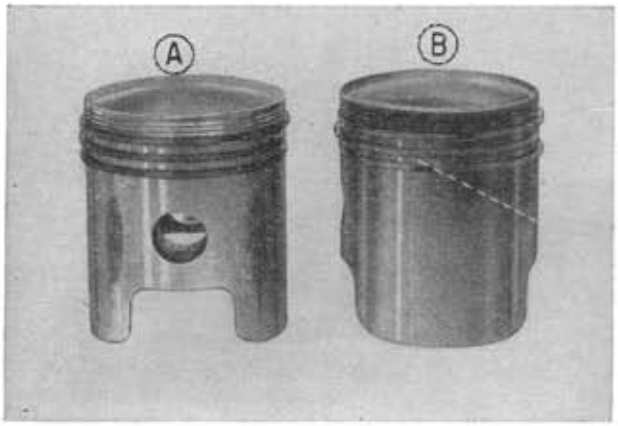


Fig. 58

Wear patterns of pistons:

(A) This piston was caused to jam because the fit of the gudgeon pin in the small-end boss was too tight.
The portions that have jammed are retouched by means of a corundum file. Wetten the file with a fueloil mixture. On no account use emery paper.

(B) Wear pattern after 18,000 km. The angular position of the connecting rod is correct; the slight shade on the right (dotted) was caused by the fact that the connecting rod is guided at the top at the gudgeon pin. This wear pattern is normal.

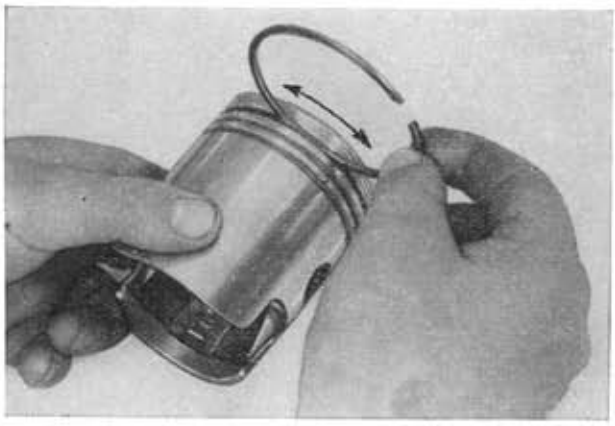


Fig. 59

If a used piston is re-used, the piston rings must be checked that they are free to move easily in the grooves. Particular attention should be paid to the upper ring, because it is subjected to the highest temperature. In the event of abnormal operating temperature, due to improper carburetter tuning or ignition timing, this ring may be distorted. This is indicated by a corrugated contact face.

When removing the piston rings, the following must be taken into consideration:

Each ring must be placed in that groove in which it was originally fitted and run in (even not overturned).

Width of piston ring groove	Wear value
$2\ ^{+0.06}_{+0.03}$ mm	2.10 mm

Piston rings whose vertical play is excessive fail to produce a properly gas-tight seal and emit a "whining" sound. If the locking pins for the piston rings have worked loose, the piston is useless.

Whenever possible, the piston rings should not be removed. If this has to be done, however, use the piston ring pliers No. 05-MW 141-4 together with the appropriate expander, size 58 or 69 mm (see sketch for making special tools). The expander must be used, otherwise the ring would not only be distorted into an ellipse, but also be no longer plane (because of the rectangular section). Consequently, the ring would jam in the groove.

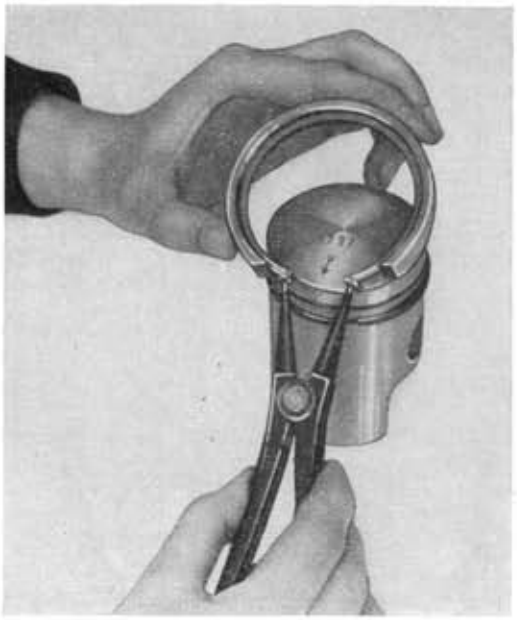


Fig. 60

To clean the grooves, use a sharpened piece of an old piston ring. When using a scraper or screwdriver, the grooves would be widened.
Loose scale-like deposits on the piston head are removed by means of a wire brush. The firmly adhering layer is left, because it protects the piston from uncalled-for heat absorption.
The same applies to deposits on the ring section and piston skirt.

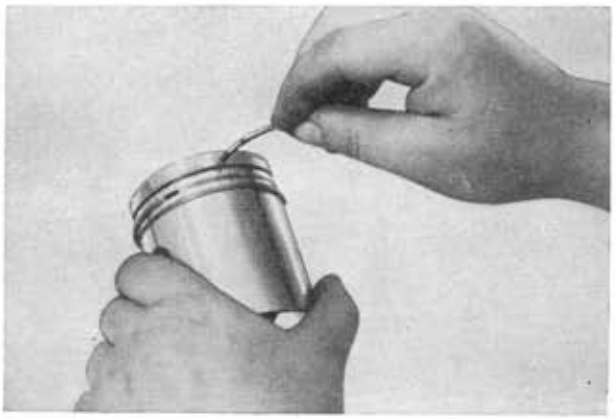


Fig. 61

Piston-ring gap

in new condition: 0.2 mm
wear value: 1.6 mm.

If the piston-ring gap is too small, the rings will stick; as a consequence, friction will increase and the wear rate, too. The view that, by fitting a set of new piston rings, the performance of an engine that has run for a long period will be improved, is wrong. In accordance with the engine performance, the cylinder bore has become more or less oval, whereas new rings are perfectly cylindrical. Consequently, exhaust gases escape, the ring temperature will rise, and the rings are distorted and may jam.

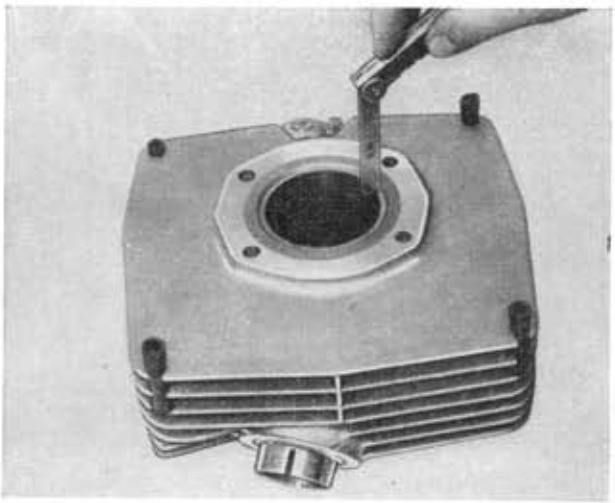


Fig. 62

Fig. 63

Althoug cylinder bore and piston skirt are superfinished, their finished size is subject to tolerances. The allowance is 0.01 mm

$(+4\ \mu m)$ $(-6\ \mu m)$ } for each part.

In order to avoid the coincidence of the upper limit of the piston with the lower limit of the cylinder (and vice versa), both parts must be measured and mated according to the specified fitting clearance of 0.04 mm. Otherwise it may happen that the fitting clearance is 0.03 mm or 0.05 mm, as the case may be, though the parts are properly marked. The wear value is related to the values measured in the upper and lower quarters of the cylinder liner (Fig. 56).

In the centre between the ports, the rate of wear naturally is a little higher.

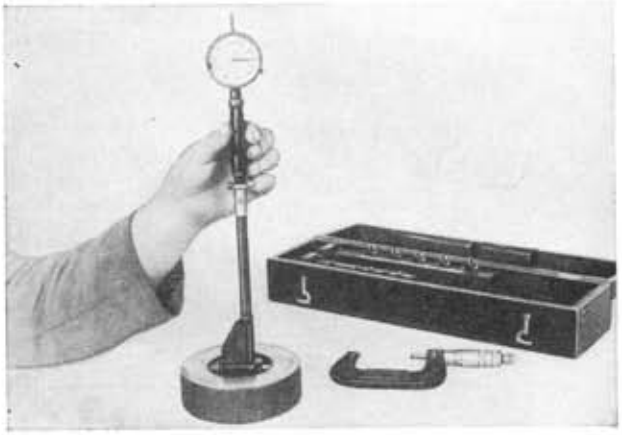


Fig. 64

To avoid measuring errors, the internal measuring instrument must be exactly set to the specified basic size of 58.00 or 69.00 mm by means of a gauge ring (or, as a makeshift, a micrometer).

Allowances on the gauge ring (marking by inspection) must be taken into consideration.

The needle bearing of the gudgeon pin must be almost free from play (2 to maximum 4 μm), though it must not jam perceptibly. To produce this fit, a range of needle bearings with the following allowances is available:

1 bearing with a medium allowance less 1 μm
2 bearings with a medium allowance less 3 μm
2 bearings with a medium allowance less 5 μm
2 bearings with a medium allowance less 7 μm
1 bearing with a medium allowance less 9 μm.

Since workshops normally are not provided with the necessary means for measuring these dimensions, fitting takes a certain touch (see above).
This set of eight items is available from MZ Spare Parts Service.
In contrast with the descriptions regarding designs with small-end bushes, the connecting rods mounted in gudgeon pins supported in needle bearings is axially guided in the piston. Compensation is possible by a larger axial clearance at the big-end boss.

That is why only specific –/2-model pistons can be used.

(1) Axial clearance needle cage – cam disk
(2) Axial clearance con rod – cam disk

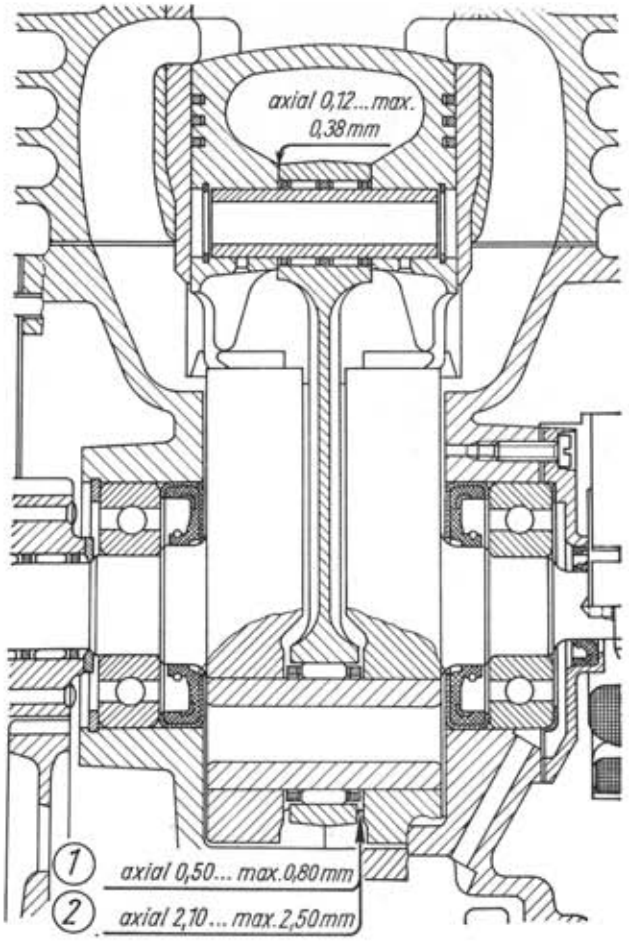


Fig. 65
axial axially

Gudgeon pin $18\ ^{+\ 0.0025}_{-\ 0.0050}$	Small-end boss = $22\ ^{+\ 0.007}_{-\ 0.016}$											
	Marking yellow + 0.007 to + 0.004		Marking black + 0.003 to 0		Marking green – 0.001 to – 0.004		Marking white – 0.005 to – 0.008		Marking blue – 0.009 to – 0.012		Marking brown – 0.013 to – 0.016	
Marking Tolerance in μm	Needle-Allowance in μm	Radial Play in μm	Needle-Allowance in μm	Radial Play in μm	Needle-Allowance in μm	Radial Play in μm	Needle-Allowance in μm	Radial Play in μm	Needle-Allowance in μm	Radial Play in μm	Needle-Allowance in μm	Radial Play in μm
green + 2.5 0	0 – 2	1,5 to 11	– 2 – 4	1,5 to 11	– 4 – 6	1,5 to 11	– 6 – 8	1,5 to 11				
white 0 – 2.5	0 – 2	4 to 13,5	– 4 – 2	4 to 13,5	– 4 – 6	4 to 13,5	– 6 – 8	4 to 13,5	– 8 – 10	4 to 13,5		
black – 2.5 – 5.0			0 – 2	2.5 to 12	– 2 – 4	2.5 to 12	– 4 – 6	2.5 to 12	– 6 – 8	4 to 12	– 8 – 10	2.5 to 12

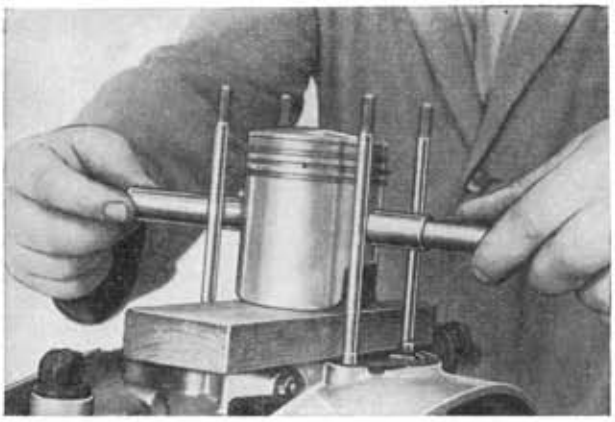


Fig. 66

Piston and guide mandrel No. 05-MW 19-4 are heated to a temperature between 40 and 50 °C, then the selected needle bearing is oiled and fitted. Place the piston on the support No. 05-MW 16-4 and adjust it with the tapered end of the guide mandrel.

Take care that the arrow on the piston head points in the direction of the exhaust.

Then quickly push the cold gudgeon pin in place – if it fails to slip through to the final position, do not apply blows, but use the device No. 05-MV 190-3 to push the pin in place.

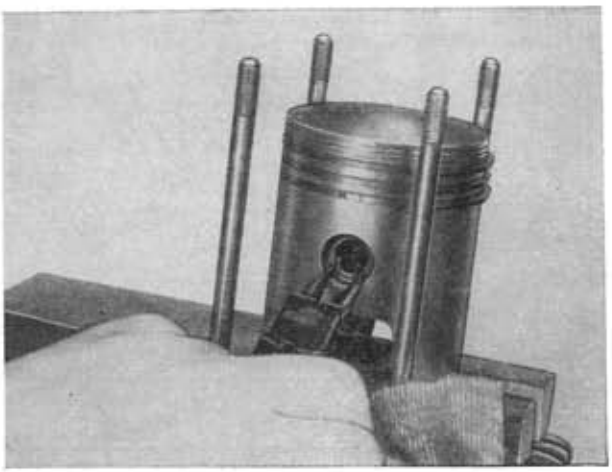


Fig. 67

The locking rings are fitted in such a way that the eyes point upwards or downwards, but not sidewards. Take special care to see that they properly fit in the grooves.

Always use new locking rings.

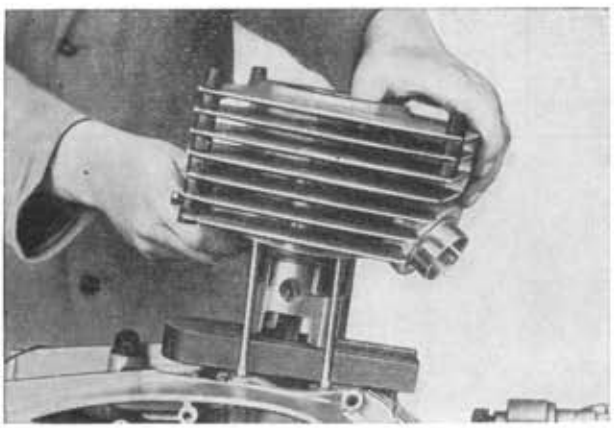


Fig. 68

To protect the cylinder-foot gasket from damage, stick it to the cylinder by means of two dots of grease. Then apply a thin film of motor oil to the cylinder liner and mount the cylinder. Take care that the piston rings have the correct position, i.e. the piston-ring gap must be above the locking pins. Do not use undue force to press the cylinder down, but press the rings into the groove one after the other so that they can be pressed further into the grooves by the chamfer of the liner. Carefully observe the locking pins to prevent broken rings.

All MZ-engines (except racing engines with rotary inlet valve) have a "symmetric" timing diagram. Related to the inlet (140°) this means that the piston edge releases the inlet port 70° **before** T.D.C. and closes 70° **after** T.D.C.

Timing in terms of crank angles:

	ES 175/2	ES 250/2
Inlet	140°	140°
Transfer	113°	113°
Exhaust	165°	160°

OT	TDC
UT	BDC
Aö	Exhaust port opens
As	Exhaust port closes
Eö	Inlet opens
Es	Inlet closes
Üö	Transfer port opens
Üs	Transfer port closes

A makeshift dial with graduation is available from any stationer.
For use in workshops, the dial should be riveted on sheet metal to reinforce it.

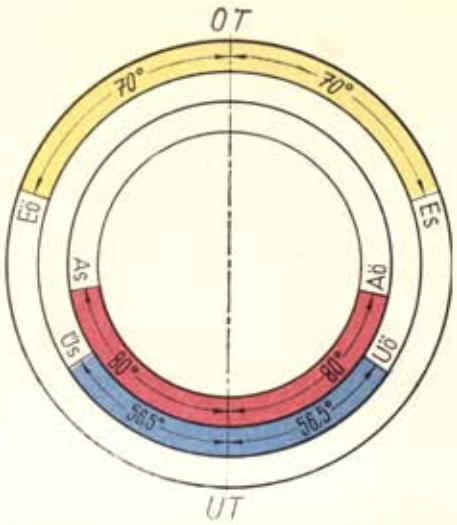


Fig. 69

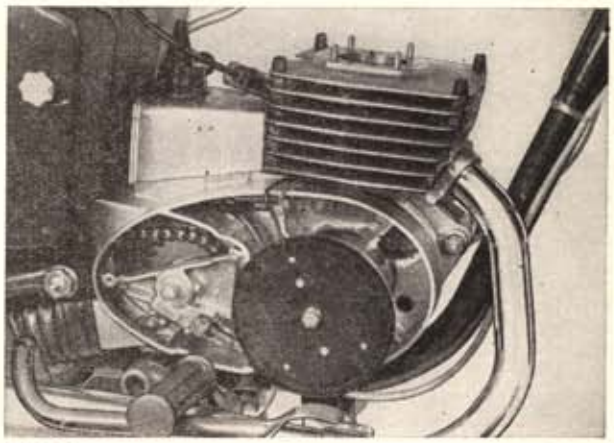


Fig. 70

Since, meanwhile, the casing has cooled down to ambient temperature, all 15 screws and the nut of the tie-bolt at the cylinder neck are re-tightened.
To ensure a good heat transfer between cylinder and head, **no gasket** is provided. Therefore, the sealing faces of the head (in any case) and of the cylinder must be checked on a surface plate and spot-ground, if necessary.
The four supporting corners of the sealing faces may be recessed for not more than 0.1 to 0.15 mm.


Fig. 71

Untight cylinder heads are almost exclusively due to the wrong way of tightening the fastening screws. Tightening must be done "crosswise", that is to say, in the sequence 1 — 3 — 4 — 2. Do not screw home the screw in one continuous operation, but in steps. At the final stage, use a torque of 5 kg-m.
The combustion chamber with the cylinder head in place has a cubic capacity of (free from carbonaceous oil deposits)

ES 175/2 21 ± 0.5 (27) cm^3
ES 250/2 $33 + 1$ (40) cm^3.

Flushing oil is filled into the chamber up to the inner edge of the hole for the plug, using a graduated vessel.
The values in brackets refer to the dismounted cylinder head with the sparking-plug screwed in place. For metering out by litres, use fuel mixture. Place a piece of a glass pane on top; more or less big air bubbles will show whether the combustion chamber is actually full or not.

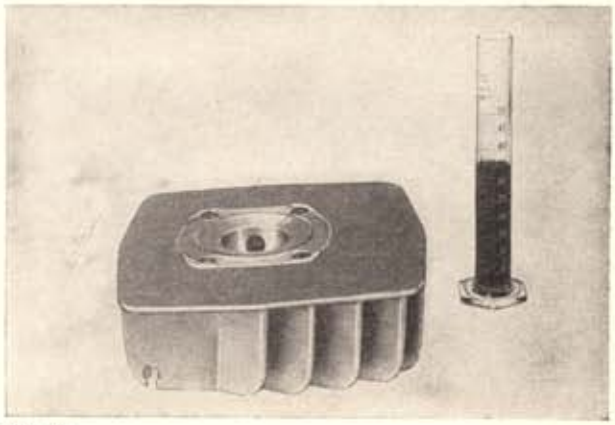


Fig. 72

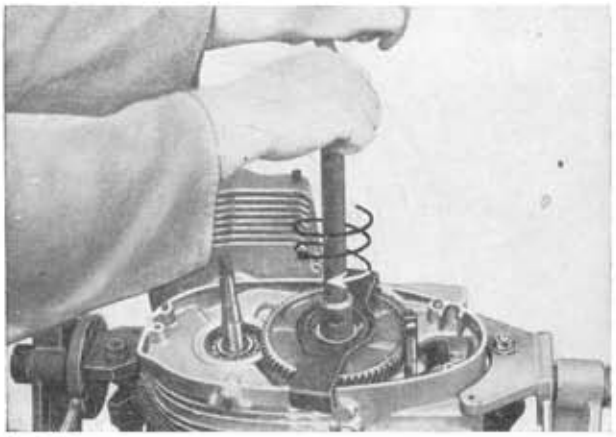


Fig. 73

4.7. Clutch and Primary Drive

At first, the driving gear with 68 teeth is fitted. Apply pressure by hand or tap slightly until the hub profile is engaged.
On no account apply hammer blows to the sprocket – this would remove the axial clearance of the "floating" bearing sleeve.
Apply the holder-up No. 05-MW 15-3, fit the lock plat and tighten the nut (and thus the gear) by means of a socket wrench properly.
Fold up the lock plate.

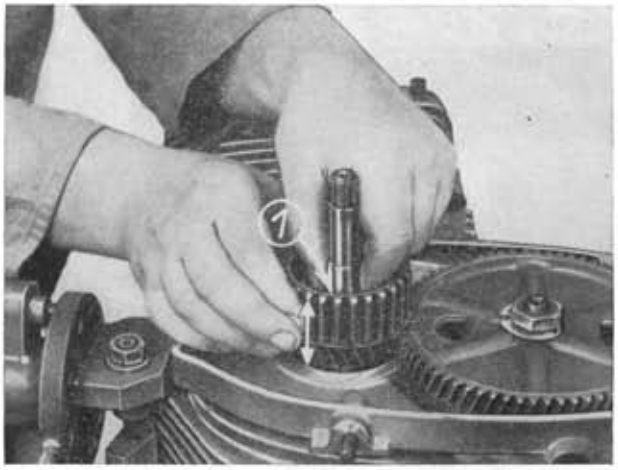


Fig. 74

An abnormal noise, ocurring after a longer period of operation, which fades away when the clutch lever is actuated, is caused by an excessive axial play between the drive pinion with 28 teeth and the clutch drive gear. These two spur gears are thus allowed to move axially when the load is changed; this is due to their helical gearing.
Permissible axial clearance 0.05 mm to maximum 0.1 mm. The clearance should not be less, otherwise the 28-teeth drive pinion will be laterally jammed – consequently, the clutch fails to separate the engine from the gearbox. It may also happen that the clutch body slides on the crankshaft cone.
For testing, the measuring points must be free from oil. The spacing washer 19 × 34 × 3 (1) should be put on top as upper limit of the measuring range and then be pressed down.

Fig. 75

The measuring device described as special tool No. 05-ML 13-4 should be made and used by those who do not wish to rely on their feel. For the dimensions see sketch included in the Appendix.
A clutch body can be modified easily; this will not be very time-consuming.
For measuring, a washer 19 × 34 × 3 must also be put on top as upper limit. However, a notch must be provided through the side to allow the measuring pin to pass through.

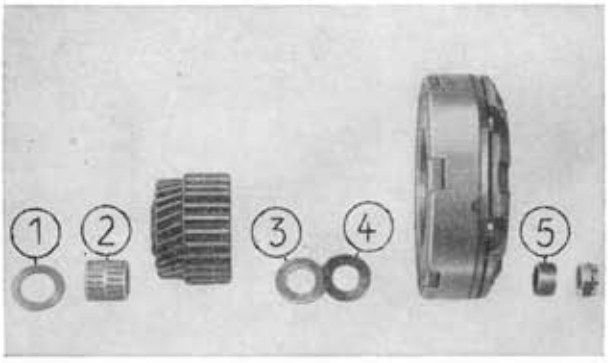


Fig. 76

The drive parts are mounted in the following order:

(1) Check plate 22 × 34
It is available in three thicknesses:
1.9 mm, 1.95 mm, 2.0 mm
The measured axial clearance is reduced or increased to the permissible value of anything between 0.05 mm to maximum 0.1 mm by placing the required check plate.
(2) Two-row needle bearing 22 × 26 × 26
The wear will be so insignificant that it is scarcely measurable. The bearing clearance can be corrected by replacing the drive gear (within upper and lower tolerance limits).
(3) Spacing washer 19 × 34 × 3
(4) Spring washer 19 × 34 × 1
(5) Spacing sleeve, 11 mm long.

If the radial play of the clutch driver exceeds 0.3 mm, the frictional facing disks must be replaced (noise).
If the disks have already indented the driver, the clutch performance will be impaired due to the fluted indentations in the splined profile.
The clutch thrust bearing (30 × 47 × 11) in the pressure flange is dimensioned in such a way that wear will scarcely occur, even after a long period of operation.
When checking the **backlash of the gears** of the primary drive, the radial play of the bearings on crankshaft and driving shaft have to be taken into account. If these bearings are worn, the sum of three bearing clearances will result in a high backlash of teeth. In this case, it is useless to replace the pair of spur gears without new bearings.
A simple but reliable method: A strip of lead foil (or hammered out lead wire) is placed in the nip between the gears and drawn in up to two or three teeth. The impression obtained in this way is measured at the level of the pitch circle (centre of the teeth) by means of a micrometer.
The limit of wear is 0.25 mm.

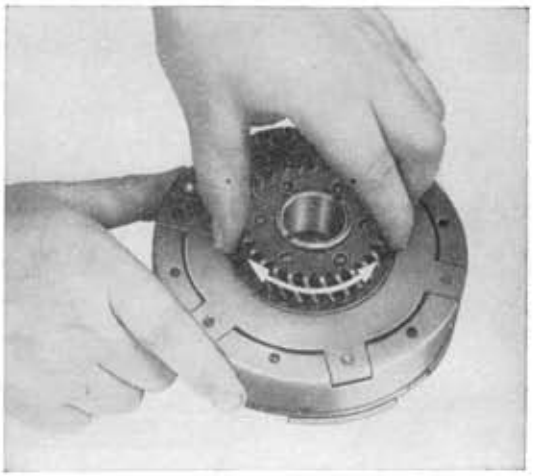


Fig. 77

Clutch tensioning device 05-MV 150-2. When tightening the tommy nut, the clutch pressure flange is released and the nuts of the spacing bolts and the hexagon head screws can be removed.
The complete clutch is balanced. Therefore, pay attention to the three markings when reassembling. Carefully lock screws and nuts – only use new locking plates.
Please, take notice of the illustration – in order to centre the disks, the clutch driver must be placed at the bottom.

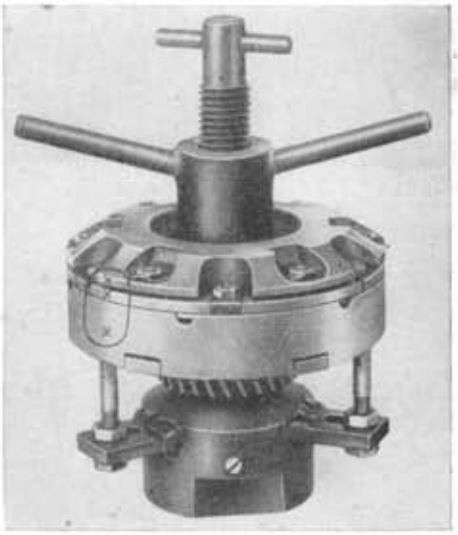


Fig. 78

(1) Frictional facing disk new: 3.0 ± 0.1 mm
Wear value: – 0.3 mm
(2) Steel disk: 1.5 – 0.1 mm
If its colour has turned blue of if it is no longer plane, replace it.
(3) Pressure springs:
Length, slack 28.3 ± 0.6 mm
Pressure, normal (P_n) 13.5 kp
at fitting length of 17.0 mm.

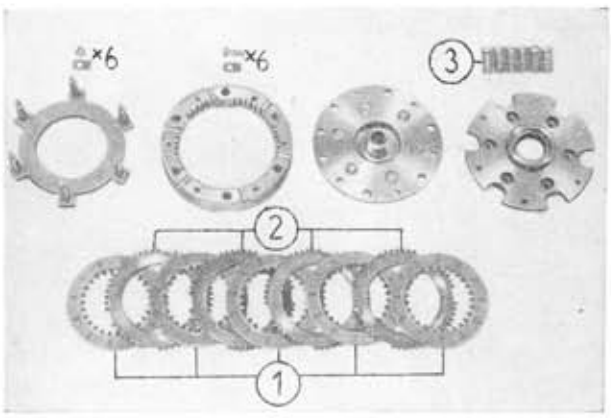


Fig. 79

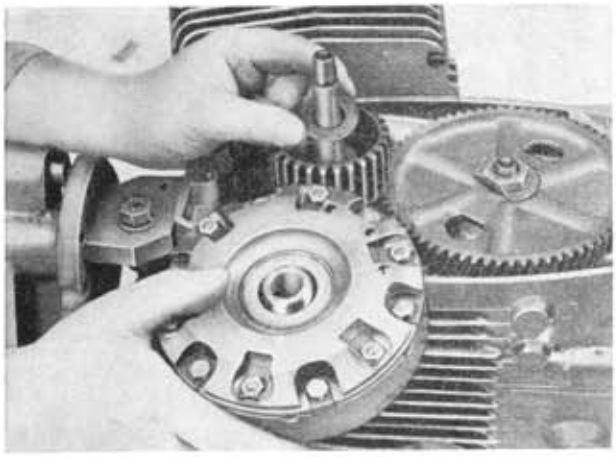


Fig. 80

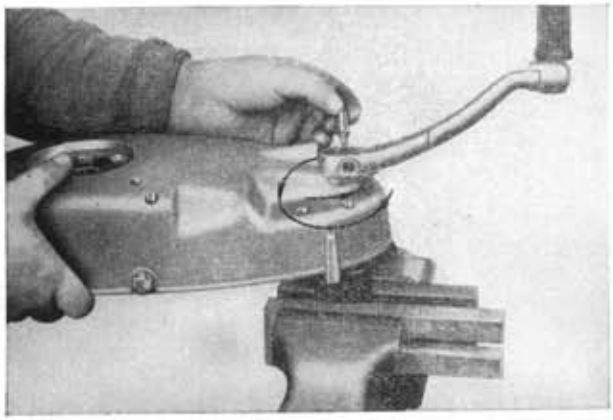


Fig. 81

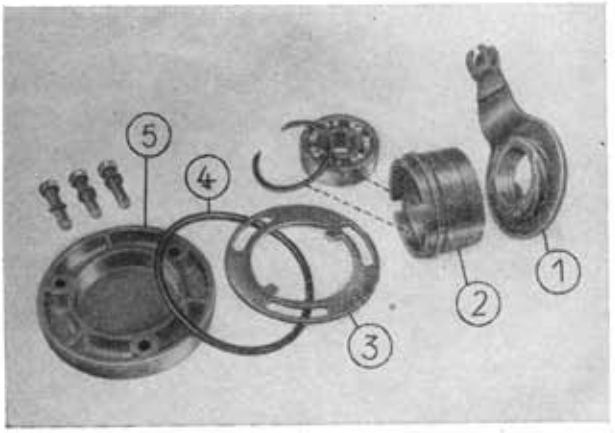


Fig. 82

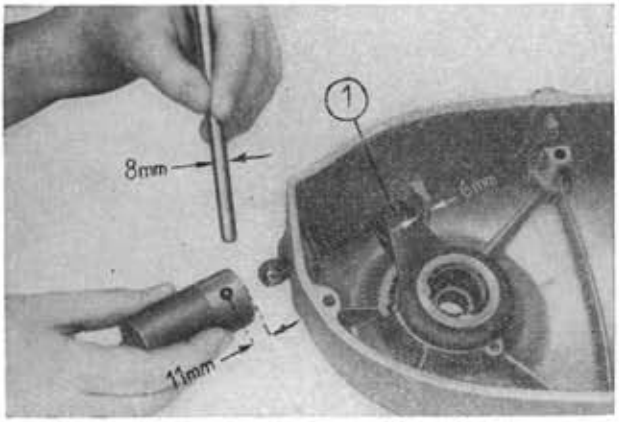


Fig. 83

Sequence of assembling operations see Fig. 76. To ensure that the clutch positively fits on the crankshaft cone, take care to see that the two cones are in good condition. Clean the two cones (free from oil), slip on the clutch and tighten with the help of a suitable piece of piece and the castle nut (7 kg-m).

After loosening the nut, the clutch must adhere to the crankshaft end, notwithstanding the pressure of the inserted spring washer.

If this is not the case, remove the check washer and the drive gear, apply a thin film of finishing compound to the crankshaft cone and re-grind the clutch, turning it in either direction, until the cone bears on the whole surface.

Carefully cover the assembly to prevent abrasive material from getting into the bearings.

After grinding, the axial clearance must be re-adjusted.

To tension the kickstarter spring, the previously assembled starter shaft (see also Fig. 3) is clamped in a vice between two copper jaws or wood insertions.

Sequence of assembling operations:

Check the annular seal ring in the bore-hole in the casing. Put the check washer on the starter shaft, slip the spring on the shaft and push the folded up end of the spring into the hole in the shaft.

Push the folded down end of the spring into the clutch cover, put the cover on the starter shaft and clamp the latter in a vice.

Mount the kickstarter, turn the clutch cover through roughly one and a quarter of a revolution anticlockwise, and drive in the tapered screw from top and tighten it.

To change the 6302 bearing, remove the outer circlip.

When the bearing bush is dismantled, press it from inward towards the outside because of the collar.

If the **clutch** fails to work free from jerks, check the flat thread of pressure lever and bearing bush. Burr, drag marks or sharp edges must be removed with the help of an emery stick.

Parts for clutch actuation (from inside to outside):

(1) Pressure lever
(2) Bearing bush with bearing 6302
(3) Adjusting plate
(4) Annular rubber seal ring
(5) Cap with screws and seal rings.

Bearing bush, pressure lever and adjusting plate must be adjusted before the cover is mounted. Use a piece of pipe, suitable for the plane surface of the cover, as an aid. Push a mandrel through the pipe and nipple eye and tap the adjusting plate until the pipe is stopped and a distance of 6 mm is left between pressure lever (1) and rib.

Within this range, the wear on frictional facing and disks caused by road operation can be compesated by the rapid adjusting device at the clutch hand control lever.

This shows how the clutch cable control is fitted. Pay attention to the condition (leak-proof) of the seal ring (arrow). Place rubber cape and cable control holder (1) on the cable control – fit the nipple. Screw in the holder – put on the plug-in nipple (2) and thus lock the rubber cap.
Wipe the sealing faces of the clutch housing, place the cover gasket on the housing (without leak-proofing material) and check that the spacing sleeve is in place.
Fit the clutch cover and force it down by applying slight blows with a mallet of plastics. Care must be taken because of the 6302 bearing.
Uniformly and crosswise tighten the cover screws (starting in the centre).

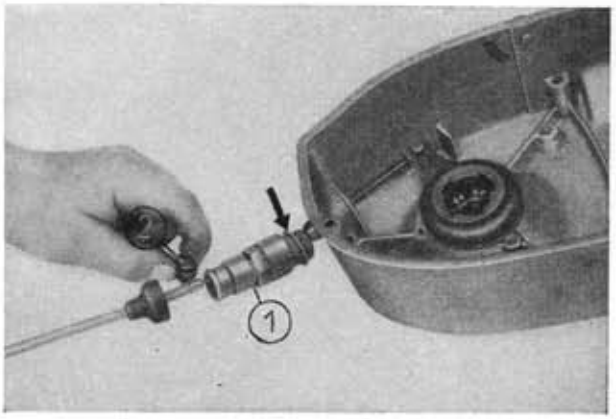


Fig. 84

Fasten the castle nut (SW 22) and tighten it with about 7 kg-m. For holding up, put the 22-m checking mandrel into the small-end boss or, if the cylinder is already mounted, apply the holder-up No. 05-MW 45-3 to the gearbox sprocket and engage the first speed. Always use a new properly fitting cotter pin and fold over the two ends by means of a pair of pliers so that the pin cannot work loose.
Pieces of a broken cotter pin can block the primary drive!
Insert adjusting plate and sealing ring. Screw the protective cap in place and make sure the three sealing rings are in perfect condition (see Fig. 82).

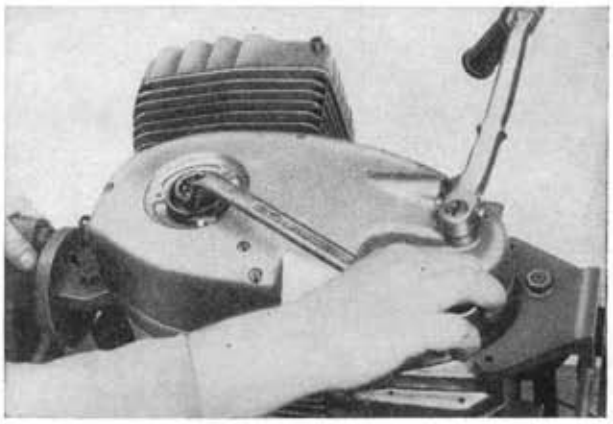


Fig. 85

Mount the gearbox sprocket and fasten the nut (SW 22), applying the holder-up 05-MW 45-3. Fit the lock plate.
The fourth speed is a cruising or high gear. In chiefly mountainous regions or for drivers who **do not take full advantage of the speeds,** the standard gearbox sprocket of the ES 250/2 with 21 teeth should be replaced by the gearbox sprocket with 20 teeth of the ES 250/1.

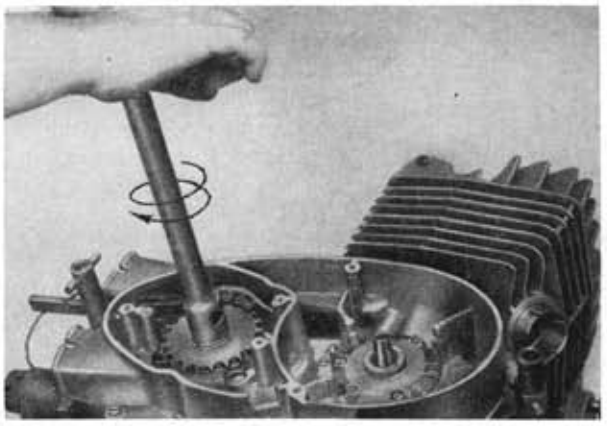


Fig. 86

When the engine is completely assembled, immediately fill up with gear lubricant, otherwise this may be forgotten.

At home: 750 cm^3 of GL 60 gear oil
viscosity: 7 to 9 °E/50 °C = 53 to 68 cSt,
this roughly equals SAE 80 EP

Abroad: If there is no gear oil of the same characteristics available, use straight motor oil SAE 40 (mineral oil).

Measure the oil quantity exactly. "A little more" may be the cause for falling short of the maximum speed by 10 km/h. In this case, the clutch will act as an "eddy-current brake".
The equalise compressed air, the vent hole (arrow) in the plug.
If oil leaks out, check whether too much has been filled in or fuel is in the gearbox (smelling test). Cause: sealing ring on crankshaft leaky.

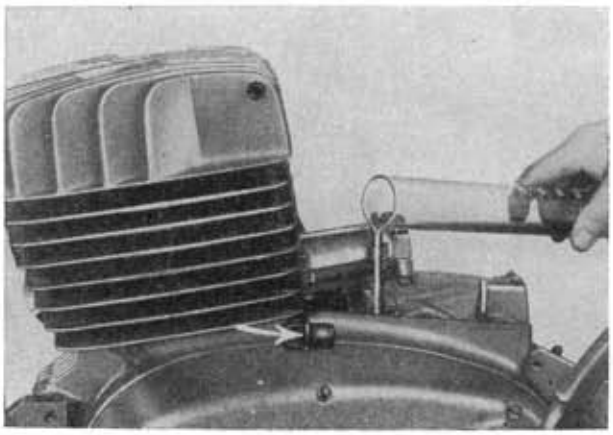


Fig. 87

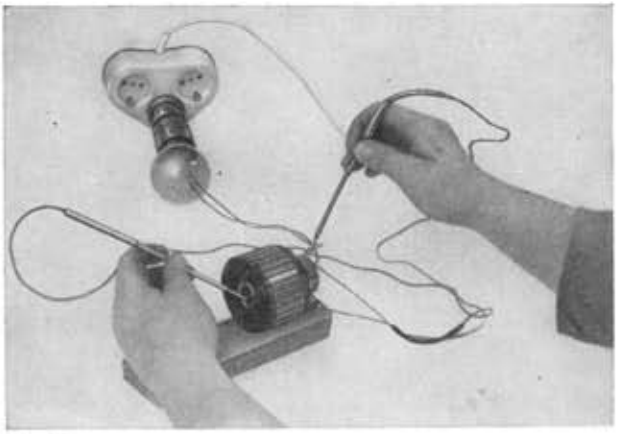


Fig. 88

5. Elektrical Equipment

The purpose of checking the electrical equipment is the exact location of a trouble, the part which actually is defective. Repairs should exclusively be done by IKA Service Workshops (in order to obtain the benefit of the guarantee).

5.1. Checking the Dynamo

Checking the Armature for Accidental Ground

The test voltage should be anything between 60 and 75 V; if the necessary care is taken, 220 V (mains voltage) are permissible. In any case use a properly insulated support.

Interconnect a test lamp and test one commutator segment after the other by means of the test point.

If the lamp fails to flash up, the insulations of armature and commutator are in order. When the lamp shows a dark-red light, a slight ground leakage is given; when the lamp shines bright, a severe ground leakage is given so that the armature must be repaired.

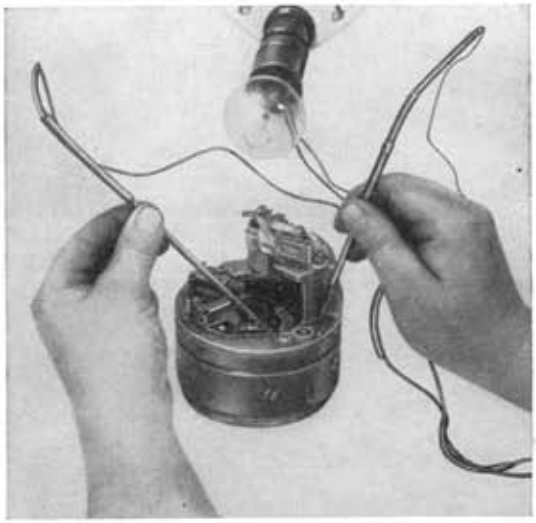


Fig. 89

A uniformly brown to grey-black colour of the commutator surface is without any significance. If, however, this surface shows tracks or scratches, have the commutator truned down (mandrel and cone) on a lathe by an expert, because the permissible amount the commutator may be out of true is 0.03 mm.

If the eccentricity of the commutator exceeds this value, the brushes will spark heavily (because the brushes "jump") and char the commutator surface; as a consequence, the dynamo cannot supply the full rated power.

Before turning the commutator, scrape out the slots between the commutator segments on a milling machine or saw. This timeconsuming work is necessary, otherwise the projecting mica sheet would rapidly wear down the carbon brushes.

In this connection it should be mentioned that the same condition is given if the radial play of the crankshaft main bearing is excessive. Oiled up and dirty commutator surfaces are cleaned by means of a non-fuzzy piece of cloth soaked in petrol.

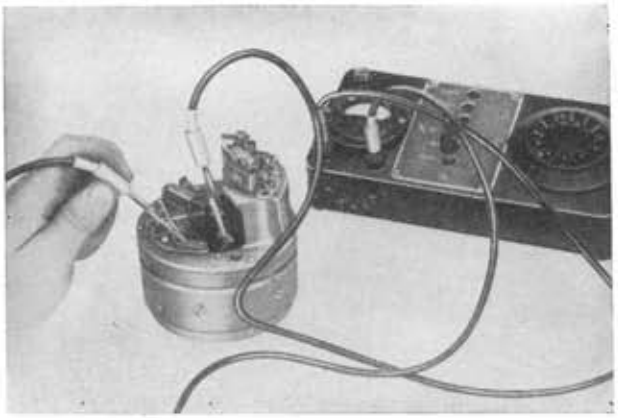


Fig. 90

Checking the Field Coils for Accidental Ground

Remove the adjustable resistor and neutralise the negative field connection (connected to the socket of the resistor). Apply one test point to the frame and the second one to the DF terminal. If the test lamp does not flash up, there is no accidental ground.

Checking the Field Coil for Shorted Turns

Apply the test pins of an ohmmeter to the positive and negative sides of the field coil. The ohmmeter must indicate any value between 1.7 and 1.8 ohm.

Lower value = shorted turn

No deflection = field coil interrupted.

Have the defective field coils replaced by the Electric Service only.

Carbon Brushes

After loosening the connections and withdrawing the brush springs, both brushes can be removed and cleaned by means of a piece of cloth soaked in petrol – but never by means of a file.

Also clean the brush holders, the brushes must be free to move in their holders.

Before re-inserting the brushes, put the compression springs (only use non-deformed springs which are in perfect working order) on the brushes and take careful note that the brushes engage with the spring end, otherwise the springs may be displaced laterally. Brushes worn down to about 9 mm must be replaced.

Fig. 91

Adjustable (Series) Resistor

An expert will identify a blown adjustable resistor by the irregular firing order and, perhaps, by ignition failures at high speeds. A charred insulation varnish on the resistor coil will then confirm this trouble.

Do not only replace the resistor, but remove the cause of the trouble. For example: wire D + is loose or disconneted from the regulator (short circuit).

The following connections have to be made:

(1) long cable (yellow-red) to D + (positive brush)
(2) short cable (black) to DF (field – positive)
(3) the cable socket "field – negative" is to be connected to the fastening screw of the resistor.

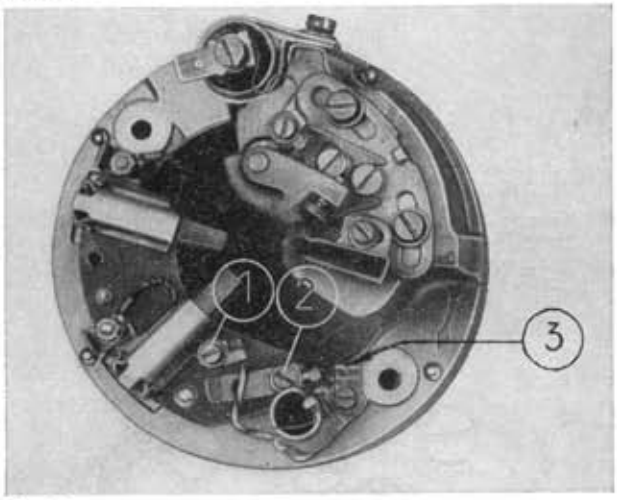


Fig. 92

5.2. Checking and Timing the Contact-breaker

The cam must be free to move easily on the cam carrier; however, the radial play must not esceed 0.15 mm, otherwise the contact-breaker will lift irregularly. A poor performance and ignition failures will be the result.

After removing the old remains of lubricant (use petrol), grease the pivot pins of the flyweights, the driver of the cam and the bearing points of the cam carrier with antifriction bearing grease "Ceritol" K 5 (or K 3).

(**For customers abroad:** Use a branded bearing grease with a drop point between 145 and 155 °C. To be used in the temperature range between – 25 °C and + 95 °C.)

When mounting the cam, take care that the stamped marking "0" on the cam coincides with the "0" marking on the cam carrier, otherwise the lobe of the cam will be in the B.D.C.

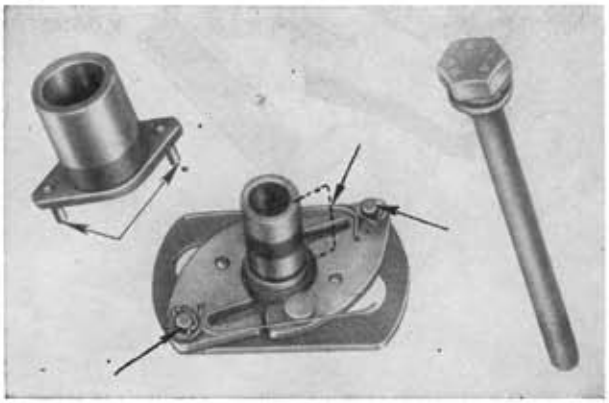


Fig. 93

Wipe the crankshaft end (cone). Check the fitting key (flat key); its upper surface should not uphold the armature with undue force, otherwise the armature will be out of true.

Fit the key and slip on the armature.

Mount the pole casing, make sure the locking pins and the centring edge are properly located.

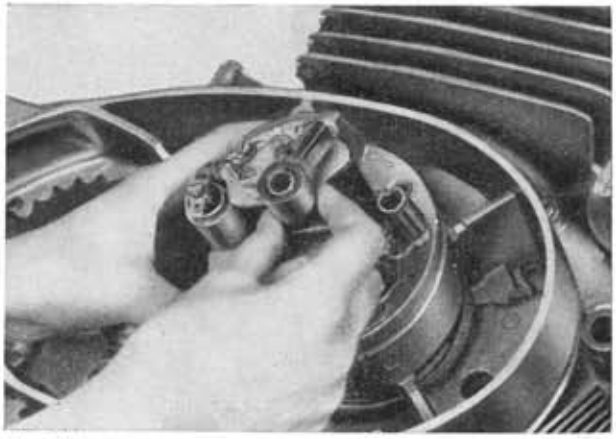


Fig. 94

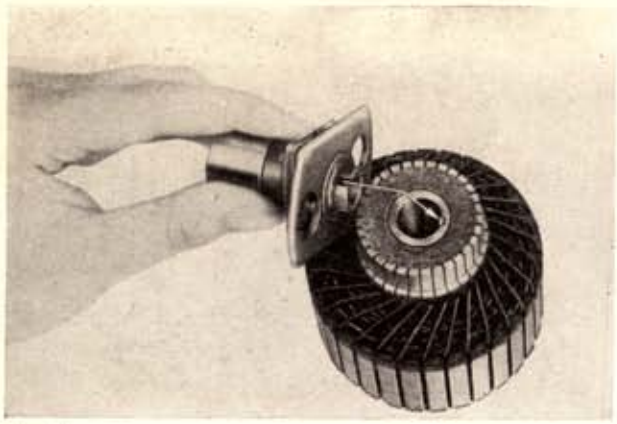


Fig. 95

To mount the cam carrier, withdraw the pole casing for about 5 mm. Then tighten the two screws of the pole casing – see above.
The cylindrical end of the cam carrier centres this part in the armature.

To ensure that the cam carrier runs true, the hole must be free from jags and burr.

Take care – the nose in the armature bore must engange with the groove in the cam carrier in undamaged state, otherwise the range of adjustment of the contact-breaker base plate will become insufficient.
Connect cam carrier and armature by tightening the M 7 screw.
The washer, but not the spring ring, must contact the cam. If there is still a spring ring, replace it by a spring washer.
It must be possible to rotate the cam opposite to the sense of rotation of the engine (spring pressure).

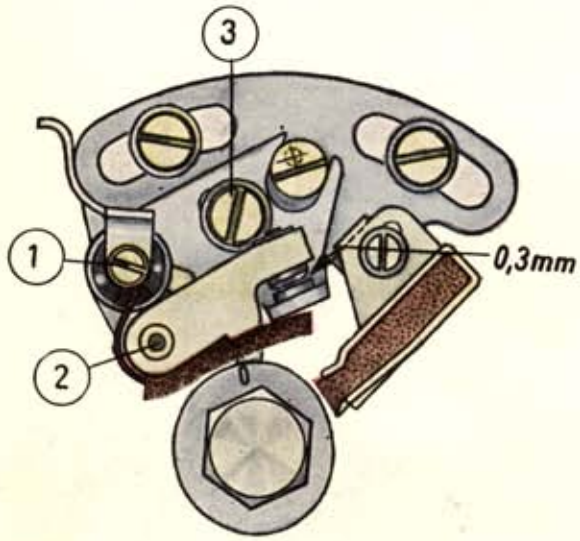


Fig. 96

Ignition timing starts with checking the contact-breaker points:
Loosen the terminal screw (1) of the contact rail from the capacitor, remove the contact lever.
Clean the breaker point faces by means of an emery stick. If they are seriously pitted, insert new parts.
The breaker points must make contact with their full face; adjustment of the contact angle is possible.
Remove remains of old lubricant from the pivot pin (2). Uniformly apply a drop of B-2 or Hypoid oil and refit the contact lever.
For foreign countries: Use pressure-proof (E.P.) gear oil with a pour point of – 15 °C (roughly corresponds to SAE 90).
Seriously burnt contact faces are indicative of a defective capacitor (initial stage). If several plies of the capacitor winding break down, the engine will be able to idle, but will stall when it is accelerated (any effort to adjust the carburetter will in this case be in vain).
Make sure the ground contact is in order.
To adjust the contact-breaker points gap, which is 0.3 mm, the crankshaft must be rotated until the high-level portion of the cam lifts the contact lever.
The test gauge must slightly pass over both breaker points, in other words, it must not jam or clatter.
The gap is adjusted by turning the eccentric screw, after loosening the clamping screw (3). When the specified gap is set, tighten the clamping screw and check the gap once more. It may happen that the setting is changed when the clamping screw is tightened.
If the contact-breaker points gap widens (instead of becoming smaller) when further cranking the engine, the cam is out of true. Either re-adjust it by tapping against it or once more dismantle the cam carrier.

Measure the gap with particular care when the firing point has already been timed and only the contact-breaker points are readjusted.

Note:

If the contact-breaker points gap is increased, the advanced ignition is further advanced (the cam starts lifting the contact breaker already at the beginning of the lobe of the cam).

If the contact-breaker points gap is reduced (due to wrong adjustment or wear), the advanced ignition is retarded. (In this case, the contact breaker only slightly contacts the high-level portion of the cam. The ignition coil is not capable of building up the required high voltage, a weak spark will result. The engine causes the carburetter to "splash".)

Ignition timing is exclusively carried out with the flyweights fully flown out. Only in this position, the set firing point will be effective over the whole speed range without any variation. The flyweights do not regulate, but fully open after actuating the kickstarter. They only are a precaution against kick-back in starting. The amateur constructor should bear in mind that varying the spark in relation to engine speed (or by hand) will not increase horsepowers.

Due to the off-centre arrangement of the sparking-plug, the timing gauge H 8-2104-3 (special tool) must be used. If it is not available, there is the possibility of timing with the aid of the graduated dial (see also Fig. 70).

In any case, timing must be carried out with every care and precision because this and an appropriate carburetter tuning are preconditions of a good engine performance.

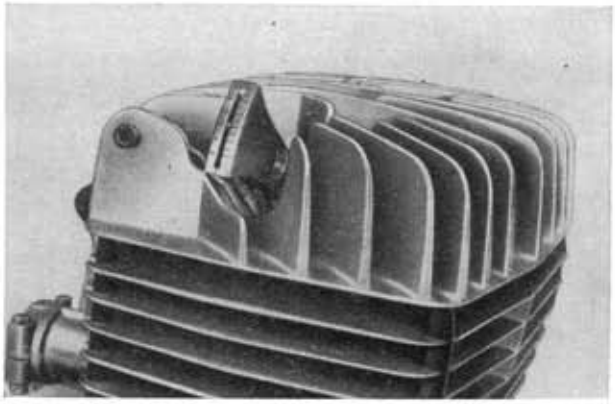


Fig. 97

When timing the ignition, always use a test lamp!

Apply one terminal of the lamp to connection "1" at the capacitor (or contact rail) and the second terminal to the frame. If the spark is timed with the equipment removed from the vehicle, then connect the positive terminal of the 6-V battery to "1" and the negative terminal to the earth.

Set the piston to T.D.C., note the position of the pointer on the vernier of the setting gauge or mark it by means of a lead pencil. Lift the flyweights up to the stop and retain them in this position. Turn the crankshaft opposite to the normal sense of rotation of the engine (arrow in circle) until the specified value is indicated at the gauge. The test lamp must flash up at this instant. If this is not the case, slacken back the two screws (A) and shift the contact-breaker base plate laterally. Finally, make sure the flyweight springs are in their correct position.

Advanced ignition: 3.0 mm before T.D.C. with the flyweights fully flown out and 0.3 mm contact-breaker points gap (for both motor-cycle models).

In terms of crank angles: 22° 15′ before T.D.C.

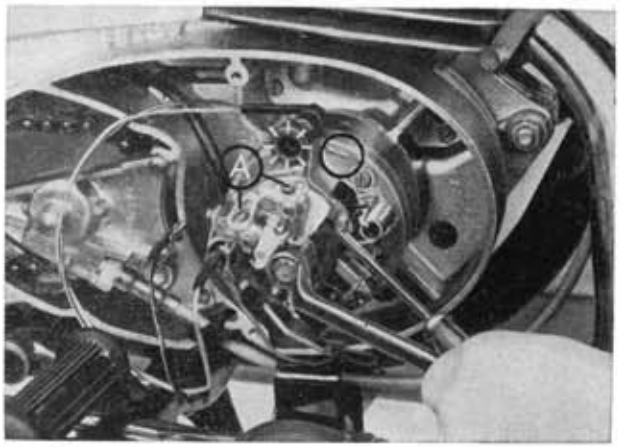


Fig. 98

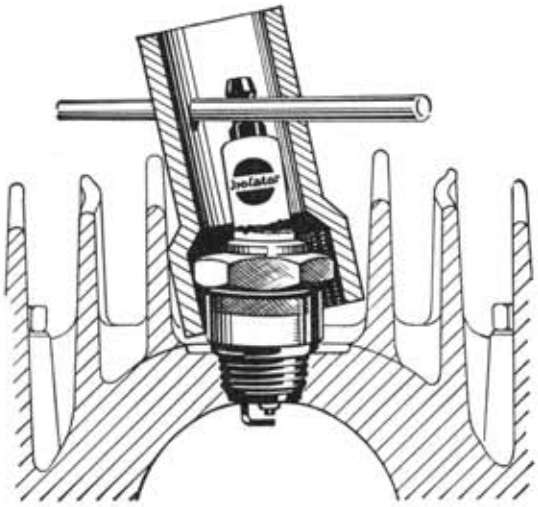


Fig. 99

5.3. Sparking-plug and Plug Cable Connector

Sparking-plugs should not be treated in this way! Almost invisible hairline cracks in the ceramic body will render it useless. If the plug is removed from the engine, an intense spark will flash over between the electrodes, however, in the engine (under pressure) the ignition current will take a different way.

The proper functioning of the sparking-plug also depends on the good condition of the plug sealing ring. It must provide a gas-tight seal, otherwise leaking gases of combustion will heat the plug to such an extent that incandescent surface ignition will occur, although the plug has the correct calorific value.

The fissured interior of the plug absorbs a larger amount of heat than the smooth chamber of combustion; however, a severely deformed sealing ring obstructs the exchange of heat. At the firing instant, more than 2,400 °C are involved.

The threaded part of the plug must be flush with the surface of the combustion chamber. Projecting threads of plug or cylinder head will lead to overheating.

Lead tetraethyl is added to high-octane fuels which, especially in the case of over-aged fuels, may form deposits of lead oxide. Lead oxide is transparent, besides a slight "glaze", nothing else can be seen in the interior of the plug.

This glaze will become electrically conductive at a temperature of 300 to 400 °C, whereas it is non-conductive in the cold state. If the cold engine starts properly, whereas ignition failures occur when the engine is hot, the only remedy is a new sparking-plug.

The bridging of earth and central electrodes, also known as "plug bridge", is the result of increased electrode temperatures in connection with insufficiently filtered intake air. The electric field built up by the spark carries air current particles to the earth electrode where they are deposited until the plug is short-circuited.

For normal operation, the Isolator sparking-plug M 14/260 should be used. Sports motorists are recommended to use the Isolator plug RM 14/250 S. The plug thread is M 14 × 1.25 mm pitch.

Frequently, the partially shielded plug cable connector causes ignition lag (reduced engine output) or ignition failures; in these cases, the connector is frequently replaced by a new one. However, in this way material is wasted, because the old connector can quickly and simply be restored to perfect working order.

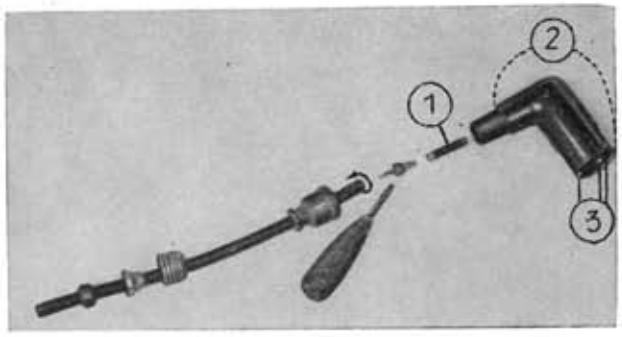


Fig. 100

The sparks flashing over between the electrodes produce a high-frequency electric field which radiates through the supply line to the surrounding. The ignition cable (especially if it is wet and dirty) then acts as an antenna.

An anti-interference resistance damps these oscillations. It would produce the best effect when installed close by the electrodes. However, sparking-plugs

with incorporated anti-interference resistance are not yet installed in the standard equipment.
Normal sparking-plugs are radio-shielded by a resistance (1) shielding the cable of the plug. The surface of the cable connector is provided with a metallic shielding coat (2) which diverts the electric field of the connector over the spring-loaded bottom part (3) to ground. If the care for this shielding is neglected, ignition failures will be inevitable:

The dust, water and oil particles contained in the air-stream are attracted by the high-frequency electric field and diverted at high speed to the interior of the connector and the shielding (ground). In the course of time, a conductive coating is formed in this way. As a consequence, the spark becomes weaker and weaker until it will fail completely.

Remove this coat by means of a brush and a washing agent of dry-cleaning spirit, blow out the connector and rub it until it is dry.
The contact springs (3) must contact the hexagon portion of the plug, otherwise the VHF and television reception will be interfered with to an impermissible degree.
The contact faces of the resistor (1) must be free from oxides. The contact area in the connector is cleaned by means of a small stick of wood. Resistors which have become loose ane sooted are useless.
Do not shorten the plug cable, the original length has been carefully selected to ensure that high-frequency radiations emitted from the cable are reduced to a minimum (radio and TV reception).

5.4. Ignition Coil and Horn

Tighten the clip (K) of the ignition coil with every care, otherwise the secondary winding, a parcel of wires as thin as hair, will be damaged.
The two terminal posts are marked; lead "15" is live when the ignition is switched on (terminal 15 at ignition lock). The line for terminal post "1" leads to the contact breaker and is conneted to earth when the contacts are closed.

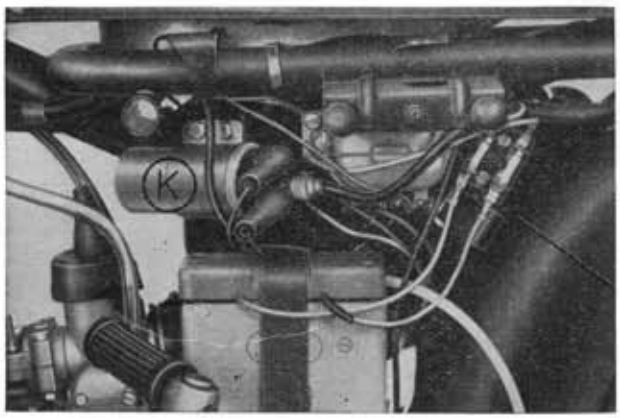


Fig. 101

The contact breaker of the horn can be re-adjusted, if required, by means of the slotted screw (E). By way of trial, turn the screw slowly through a quarter of a revolution, clockwise and anti-clockwise, until the sound of the horn has the desired level.
Air for combustion is sucked up through opening (1) and then passed through the filter systen.

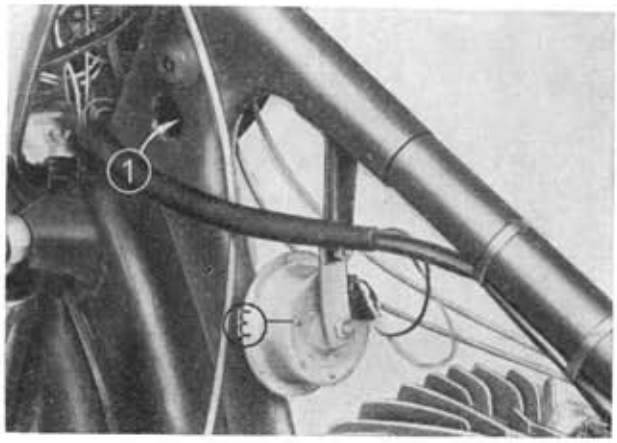


Fig. 102

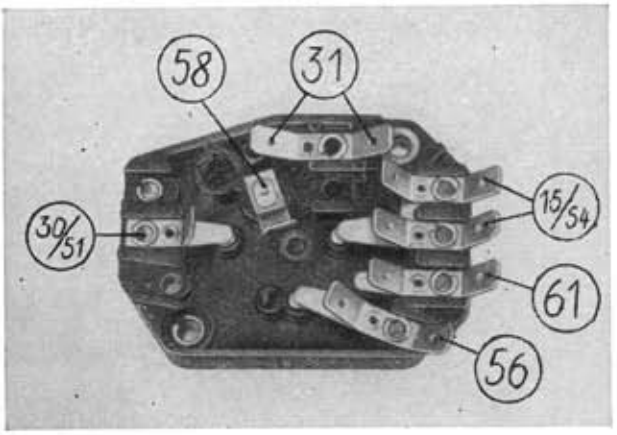


Fig. 103

5.5. Headlamp

To facilitate the identification of the terminals when the ignition lock is installed, take notice of the clue given in the accompanying illustration.
Terminal 57 has been omitted, line 57 (parking light) is connected to 58. That is why the parking light will be on together with the full headlight beam and passing beam. The terminal 31 (earth) is in front of the arrangement, when viewed in the direction of travel.
Consider the wiring diagram.

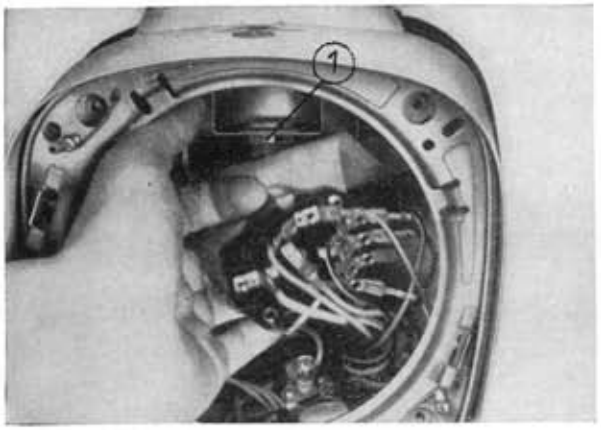


Fig. 104

To remove the ignition lock, bend up the tongues of the switch cover from the inside by means of a knife blade. After removing the fastening screws, the lock is accessible. Take care of the packing.
Tighten the nut of the speedometer strap (1), otherwise the rotor shaft of the speedometer is jammed and the speedometer needle oscillates or deflects to the end position.

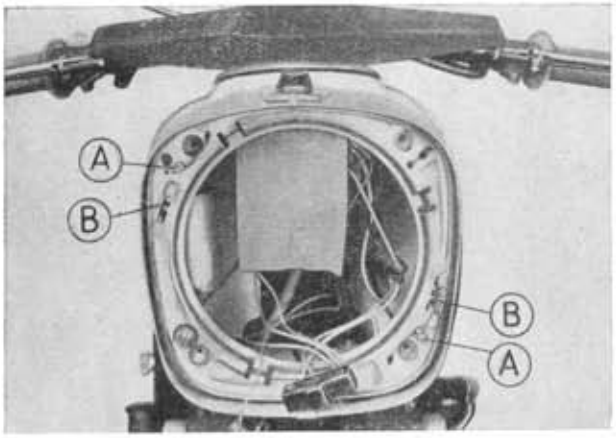


Fig. 105

By turning the adjusting screws (A), the reflector frame is moved so that the beam of light can be set to the desired position (see focusing schema, Fig. 108).
For rough focusing, the lower headlamp holder is provided with slots.
The reflector is held by two elastic claws (B) which are lifted or engaged by means of lifters included in the tool kit.

Withdraw the terminal strip straight ahead (of thermosetting material), do not tilt it, otherwise the contact blades will be distorted so that the passage of current may be interrupted. This is of particular importance to terminal 31 (earth) because of the high current passing through.
If necessary, bend the contact blades into the desired position and polish them with a fine-grained emery cloth. The three poles of the twin-filament bulb should be subjected to the same treatment.
If the raod is illuminated insufficiently (dim light), remove the oxide from the two 15-A fuses and their holders.
Contaminated contacts lead to a drop in voltage of up to 50 per cent.

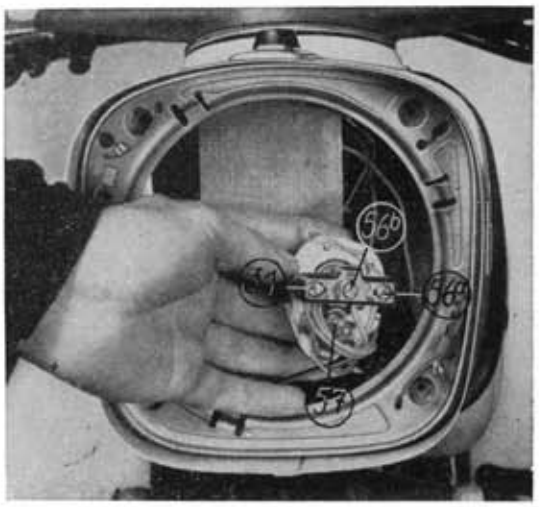


Fig. 106

To replace the twin-filament bulb (6 V, 45/40 W) lift the holding spring (A). Then lamp holder and bulb are accessible. Handle the glass bulb only with a clean piece of cloth or tissue paper, because clean fingers will leave traces of grease on the glass.
When fitting the bulb, take care that the noses at the lamp socket engage with the notches in the reflector.
Dispersion plate and reflector are glued together, do not separate them unnecessarily.
When locating short circuits within the headlamp system, do not omit the twin-filament bulb, a short circuit may be in the lamp socket.

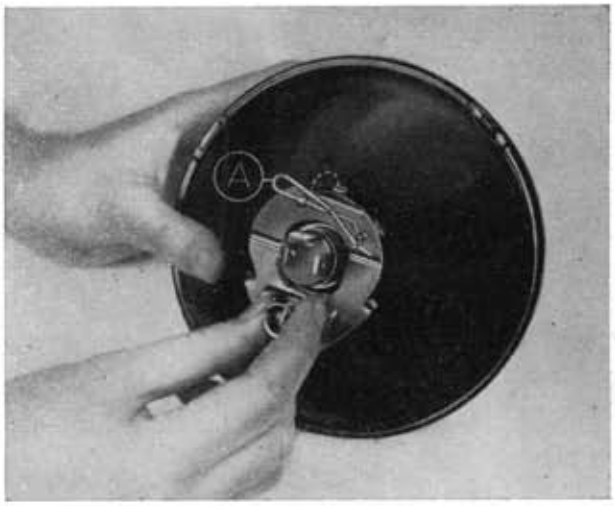


Fig. 107

Headlamp Focusing Scheme

The vehicle is placed according to the scheme, loaded with the driver. The suspension units are set to "soft".
The light/dark boundary must not lie above the "Z"-line, the angular deflection of the asymmetric passing beam starts in the centre between the lines "V" and "W".
For the check-test, the suspension units are set to "hard" and the motor-cycle additionally loaded with a pillion rider.
The "Z"-line complies with the road illumination of 25 m for the passing beam as stipulated by the lighting regulations of this country.

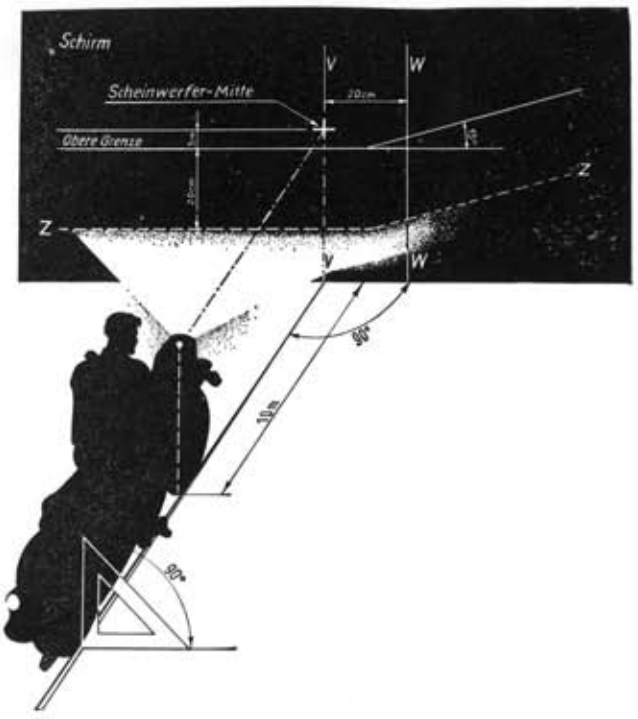


Fig. 108

Schirm	screen
Scheinwerfer-Mitte	centre of headlamp
obere Grenze	upper boundary

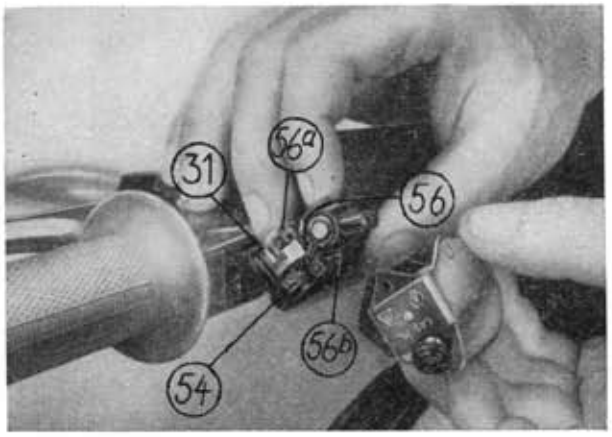


Fig. 109

Any installation operations at the combined dimmer switch have to be done with every care because of the high current passing through it (45/40 W). Properly tighten the screws, but not so tight that the flexible cable is squeezed; lock the screws with a dot of paint. Clean the contact plates of horn and by-pass light signal.
Do not omit the intermediate rubber layer, otherwise ground leakage via the handle-bars will be inevitable.
(56) Current supply to main light
(56a) to high-beam headlight
(56b) to passing beam
(31) negative lead to horn
(54) by-pass light signal.
Connect the main light properly:
lever in low position = dimmed
lever in upper position = high-beam headlight.

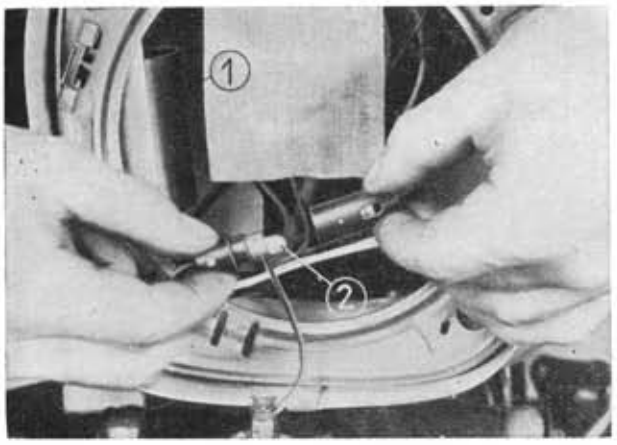


Fig. 110

5.6. Flashing-light Indicators

The flasher unit (1) is susceptible to impacts and shocks, therefore, the elastic suspension must not be changed.
When repairing the flasher unit or flashing indicators, always remove the ignition key.
To protect the flasher unit from damage due to short circuits, a 4-A fuse (2) is interposed. The fuse can be replaced by twisting the plastics capsule (bayonet fitting).
When the flashing-light indicator system fails, at first check the fuse and then remove the fault.
Only use 18 W tubular lamps for the flashing indicators, other types, e.g. 15 W, will change the flashing frequency, which is 90 ± 30.

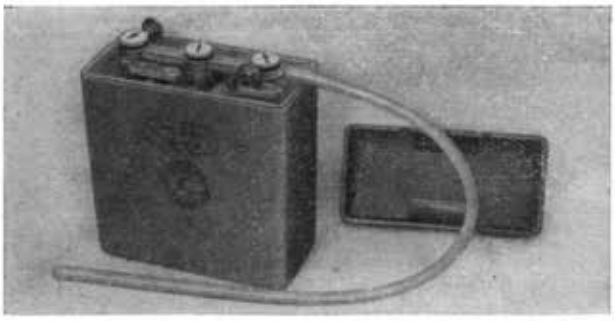


Fig. 111

5.7. Battery

The standard equipment includes a flat lead battery (6 V, 12 Ah). The new battery must be filled with accumulator sulphuric acid (density 1.24, in the tropis 1.22) up to the mark. After about three hours, when the plates will be soaked properly, the battery is charged at 0.6 A. The battery is completely charged when all cells uniformly evolve gas, the charging voltage has reached a value between 7.5 and 7.8 V and remains constant within the next three consecutive hours, and the density of the acid is 1.28.
After four weeks, the storage battery has reached its full storage capacity; then the battery is charged with 1.2 A.
Keep the acid level within the marking, top up with distilled water, check the density of the acid by means of a hydrometer.
When connecting the battery, always pay heed to the markings positive (+) and negative (–). The negative pole is always connected to the brown earth cable.
As a precaution, after connecting the positive cable, shortly ap the be negative pole with the negative cable, if sparks are released, (while the loads are disconnected) a short circuit is given.

Clean the pole connections and apply a film of acid-free Vaseline (special grease for terminals) to them at regular intervals.
Install the vent hose of the battery at the frame in such a way that, if the battery is defective, acid that is spilled or leaks out cannot damage lacquered parts.

5.8. Changing the Polarity of the Dynamo

If the battery has been connected in the wrong way and the engine started, the **polarity of the dynamo has been reversed.** Before the regulator fails completely, the correct polarity must be re-established. For this purpose, connect the negative cable of the battery to the fuse box. Tap the positive cable of the battery against the "D +" terminal at the dynamo; or the reverse-current cutout at the regulator must be pressed down 2 to 3 seconds. In any case, the regulator must be checked for charred contacts by an Electric Service Shop.
If the battery has been in operation with reversed polarity for some time, then it must be **slowly discharged** and **re-charged** on a separate current source **at 0.6 A.** Check the density of the acid.

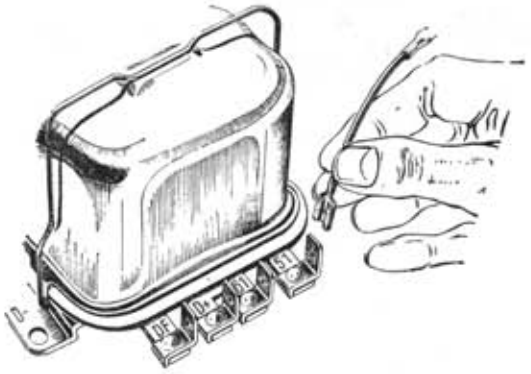


Fig. 112

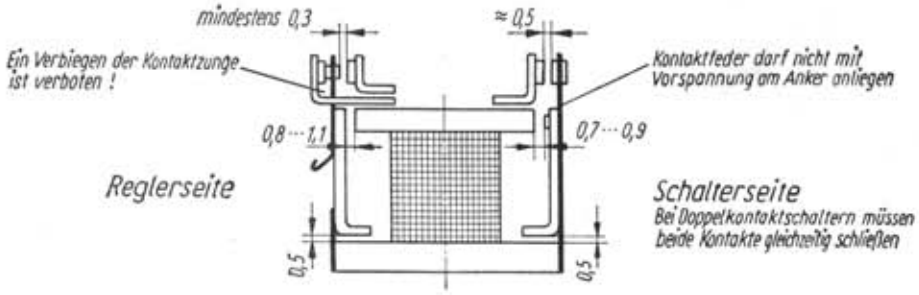


Fig. 113

mindestens
Ein Verbiegen der Kontaktzunge ist verboten
Reglerseite
Kontaktfeder darf nicht mit Vorspannung am Anker anliegen
Schalterseite
Bei Doppelkontakt-schaltern müssen . . .

at least
Bending the contact blade is not permissibel
Side of regulator
Contact spring must not be applied to armature with initial stress
Side of switch
In the case of double-contact switches, both contacts must close at the same time

5.9. Regulator

The adjustment scheme (Fig. 113) for mechanical adjustments by means of the feeler gauge is only included for emergency repairs, e.g. if a contact is charred.
For the final (electrical) adjustment, only the Electric Service (with test bench) is competent.
If the specified area of the road is insufficiently illuminated, do not adjust the regulator without previous checking, but at first check the contacts (fuses, regulator terminals, lamp socket, and earth line (31) to the twin-filament bulb).
Oxidised contacts cause the voltage to drop considerably.
Only use the standard RSC 6/60 regulator (positive regulation). A different make with negative regulation would destroy the dynamo.

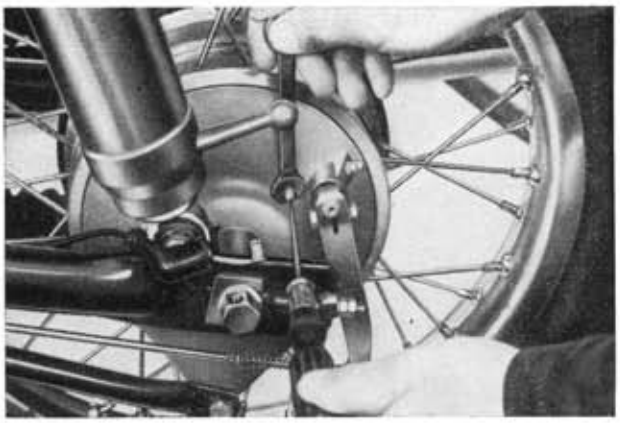


Fig. 114

5.10. Stop-light Switch

To re-adjust the stop-light switch (in the example shown in the accompanying illustration, the stop-light is shorted to earth), withdraw the rubber cap with plug and slacken back the nut (SW 9) by a quarter of a revolution. An assistant steps on the brake pedal to apply the brake shoes just far enough to allow them to slightly contact the wheel when it is turned. Retain the brake lever in this position and turn the slotted screw until, with the ignition system switched on, the stop light flashes up. Tighten the nut with the necessary care, because the insulation bushing is of plastic material that may break.
If the operating range of the adjusting screw is insufficient, the contact spring at the brake spanner can be re-adjusted.
See Fig. 138.

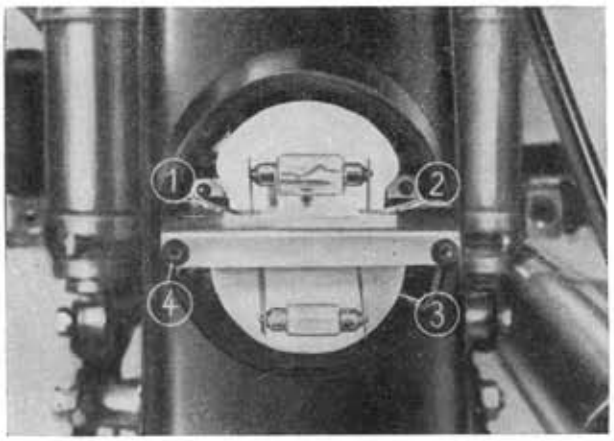


Fig. 115

5.11. Combined Stop, Tail and Number-plate Lighting Fitting

(1) Connection for stop-light, terminal 54
(2) Negative lead to stop-light switch at rear brake cover
(3) Connection for number-plate light, terminal 58
(4) Connection for negative line (to regulator socket – earth).

When cleaning the parabolic reflectors, use a dry cloth only.

Legend of Fig. 116

Schaltplan der MZ-Motorräder	Wiring diagram of MZ motor-cycles
Zündeinstellung	Ignition timing
vor OT	B.T.D.C.
fest eingestellt	fixed
bei ausgedrückten Fliehgewichten	with the flywights fully flown out
Stromkreise	Circuits
Batterie und Zündung	Battery and ignition
Lichtmaschine	Dynamo
Verbraucher	Load
Masseanschlüsse	Earth connection
Feld	Field

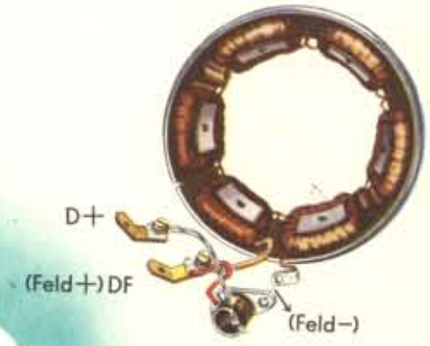
schwarz	black
grün	green
weiß	white
blau	blue
grau	grey
braun	brown
gelb	yellow
rot	red

Schaltplan der MZ-Motorräder

ES 175/2 und 250/2

Zündeinstellung

ES 175/2 - ES 250/2: 3,0 mm vor OT
(bei ausgedrückten Fliehgewichten)
Kontaktabstand 0,3 mm



Stromkreise

- Batterie und Zündung
- Lichtmaschine
- Verbraucher
- Masseanschlüsse

6. Induction System

The carburetter is not an independent part, but a component of an integrated system which starts with an air filter and ends in the silencer tail piece. The timing diagram is also a part of the whole system. If, after a longer period of operation, the fuel-air mixture becomes too lean or too rich, it is not necessarily the carburetter which is to blame. All members which operate in conjunction with the carburetter must be checked together with the carburetter.

6.1. Intake Muffler with Dry Air Filter

The main component of the induction system is the intake muffler. Casing and cover are parts made of thermosetting plastics and must be treated with every care. The casing (1) is elastically suspended at the frame by means of the two M 8 × 60 screws and one compression spring (2) for each screw. For sealing, two foam rubber rings (3) are placed on the tapped holes between casing and frame and one foam rubber ring (4) on the induction aperture.
Before assembling, carefully clean casing and cover and check them for cracks and damage (air leaks). The induction pipe (5) must be properly tight throughout the casing, otherwise air leaks will be inevitable. The induction pipe is fastened to the carburetter by means of a wire clip (6).
The combustion air is sucked up through the two apertures at the sides of the steering head, passes through the upper tube of the frame, the bore in the casing and the filter to the engine. When the engine is running, a partial vacuum prevails in the casing and the dust retained by the filter (7) is deposited on its inner surface.
This must be taken into consideration when cleaning.
Since the **air filter is of the dry (micronic) type,** it should be carefully tapped for cleaning or brushed with a dry, clean hair brush.
The filter is mounted on the centring edge of the induction aperture, the cover (8) fitted and retained by an elastic strap (9). Take care to see to it that the filter fits properly on the centring edge, otherwise air leaks will be inevitable.
The foam rubber ring (10) for the casing cover (11) must be fitted properly to ensure the required perfect seal.
After putting the cover on the two tie-bolts, slip a foam rubber ring on each bolt.

Accessories must not be kept in the muffler casing!

After a longer period of operation, wear may be caused between the joints (1) of the parts of thermosetting material, "casing for intake muffler" and (2) "carrier for governor and ignition coil" (3). In order that these two parts are properly fastened, the hubs (4) must be treated with a file so that a gap of 2 mm is left between the hubs when the parts are adapted to the central part of the frame. Two foam rubber sealing rings are added for sealing.

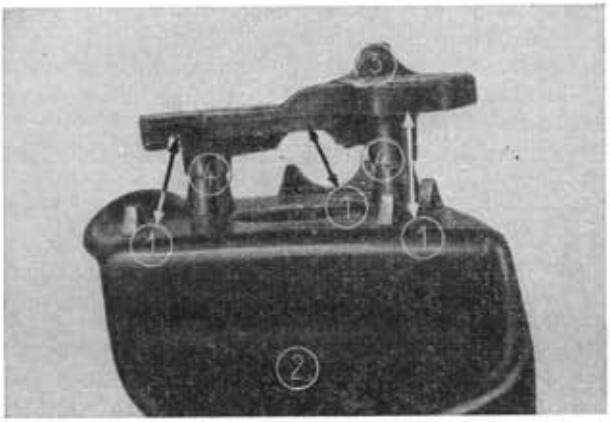


Fig. 118. Mounting the intake muffler

6.2. Trouble Shooting
(fuel-air mixture is too lean)

Symptoms of overheating, inclination for jamming, deposits at the sparking-plug

a) Air filter damaged, unrestricted air passage
b) Filter fails to fit properly on the centring edge

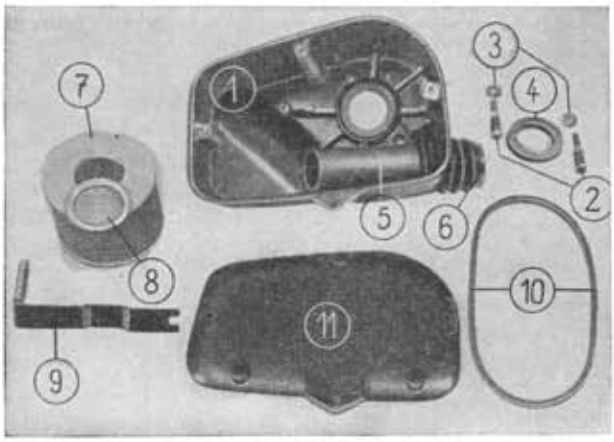


Fig. 117. Intake muffler dismantled

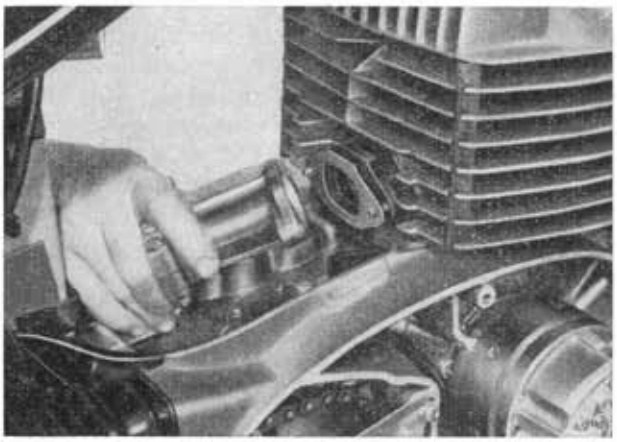


Fig. 119. Induction socket with insulating flange and two packings

c) Induction pipe leaks inside the muffler casing or protective bellows torn.

d) Casing of intake muffler damaged or leaky.

e) Cover sealing forced out of its seat due to splashing of carburetter.

f) Insulating flange between induction socket and cylinder is torn or porous.

These air leaks in front of or behind the carburetter reduce the suction at the upper edge of the needle jet so that a reduced amount of fuel is carried off – the mixture becomes too lean, though the carburetter is properly tuned.

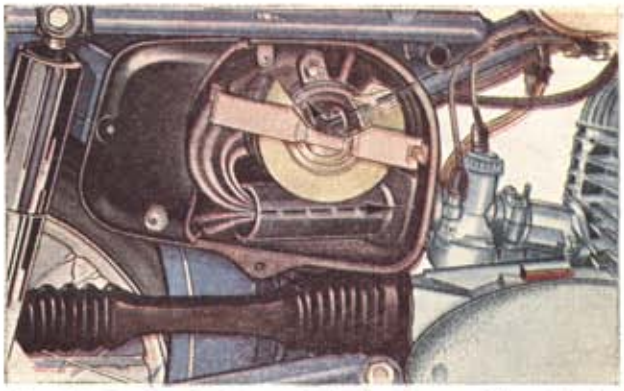


Fig. 120. Sectional view of the intake muffler (of the filter only a broken-out section is shown to reveal the paper element)

6.3. Trouble Shooting
(fuel-air mixture is too rich)

Difficult starting, engine lacks power, Sparking-plug oiled up

a) Paper filter element is worn out because of high atmospheric humidity, nearly choked or over-aged (more than 15,000 km).

b) Muffler tail pieces clogged by products of combustion or a component that has worked loose blocks the bore-holes.

c) Central float distorted, fails to close the float valve.

d) Firing point retarded (breaker points gap?) or the flyweights of the contact-breaker fail to set to "advanced". Cam carrier mounted in tilted position = two sparks per revolution.

Explanation regarding item a)

Due to the choked air passage in the filter, the suction at the needle jet is increased so that an increased amount of fuel is carried off. Therefore, the fuel-air mixture is too rich, though the carburetter is tuned properly.

Explanation regarding item b)

Since the cross-sections are narrowed down, the gases of combustion cannot be expelled quick enough. Larger amounts of residual gases remain in the cylinder. This entails a poor degree of filling and a poor output. The abnormal backpressure is effective up to the carburetter intake socket and the carburetter itself – consequently, the carburetter "sprays" back.

Explanation regarding item c)

See legend of Fig. 127.

7. Carburetters BVF 26 N 1-1 and 28 1-1

7.1. General

Correct tuning and proper performance of the carburetter are decisive not only for a good engine output, a reasonable fuel consumption, and excellent startablility, but also for reliability in operation and minimum wear. If, e.g. in the case of poor tuning or air leaks, the operating temperature rises considerably, it is doubtful whether the desired minimum of wear can be ensured.

The terms "gasifier" (for carburetter) or "to step on the gas", used in some countries, are incorrect. The carburetter is not used to "gasify" anything, because this would require heat from which the carburetter must be protected (thermal insulation flange). Heated air has a larger volume than cold one and would impair the charge of the engine and reduce its output. (That is why the engine lacks power in the heat of midsummer, whereas the full output is given in the cool morning.)

For the internal combustion of 1 litre of petrol, about 9,300 litres of air are required. This enormous quantity of air (with only about 20 per cent of oxygen) must be mixed with fuel so thoroughly that a fine fuel "mist" is produced by the carburetter. Everything depends on the correct "density" of this vapour for the engine to produce the rated output.

In this connection, the terms "fuel-air mixture too lean" and "fuel-air mixture too rich" are used. What does this mean?

Which effects are produced?

To determine the ratio of air to fuel in the mixture, the unit λ (lambda) is used. The mean value adopted for $\lambda = 1$ ($\triangleq$ 13.8 parts by weight of air and one part by weight of fuel). Values over 1 express an excessive supply of air, whereas values below 1 express an insufficient supply of air. (1 m^3 of air has a weight of 1.2 kg at a temperature of 10 °C and a pressure of 1 atm.) Since the tuning of the carburetter must be equally effective at an ambient temperature of plus 20 °C and of minus 20 °C, the standard tuning provides for a slightly richer mixture ($\lambda = 0.95$ to 0.90).

This small lack in air of about 7 per cent ensures:

a) a good full load performance (full load operation requires a slightly rich mixture because the suction at the needle jet is slightly reduced due to the completely open carburetter passage).
b) good cold starting and proper transition (the slightly rich mixture provides for a compensation for the fuel drops condensing in the cold intake pipe and crankcase).

The permissible carburetter tuning range (partial load needle) is given with $\lambda = 0.95$ to 1.0. Since neither a repair shop nor an amatuer constructor normally have an engine test bench with the appropriate measuring equipment, a test run over a distance of at least 10 km is the only alternative for adjusting the carburetter.

The engine must have reached normal operating temperature, otherwise misinterpretations of the engine behaviour will be inevitable.

The driving performance and the plug appearance are the criteria of the correct tuning. A short trial run is useless, because the change in the tuning will not be shown in the plug appearance after such a short operation.

Too Rich Mixture Below $\lambda = 0.9$

If the mixture is too rich, an insufficient supply of oxygen will occur in portions of the mixture, consequently "retarded combustion" will occur which results in poor engine performance. Due to the incomplete combustion, not only the relatively harmless carbon dioxide (CO_2), but also the colourless but poisonous carbon monoxide (CO) are produced. The latter is combustible, this means that fuel energy is wasted.

Especially in short-trip riding, hydrocarbon particles remain in the engine which cause corrosion at the big-end bearing, cylinder liner and piston. **This** is one of the main causes of premature wear.

A certain quantity of oil found in the crankcase after its disassembly is no sign of normal operating conditions, but a rather doubtful symptom. This emulsion is motor oil saponified together with hydrogen and possess no lubricating power and should be termed as acid.

Symptoms: Engine starts from the cold state even with the air choke fully open. The output of the engine is satisfactory as long as the engine is cold, but decreases with increasing engine temperature. Inclination for "four-stroke cycling". Black exhaust gases, high fuel consumption, sparking-plug of correct thermal value is oiled up.

Causes: Dry air filter contaminated, wet or overaged (more than 15,000 km of operation). Float needle seat pocketed or loose. Needle jet loose or worn (with partial load needle). Central float distorted, there fore the float needle valve fails to close properly. Main jet too large (bored? To be checked by means of jet gauge.)

Too Lean Mixture Over $\lambda = 1.0$

The air percentage in the mixture is excessive, the speed of combustion is extremely high, the exhaust gases are not visible and contain only little poisonous gases, there are no deposits in the engine which increase the rate of wear.

Symptoms: Engine starts well with correct setting of the pilot air screw, however, it must be run with a more or less closed choke for a longer period. The engine output is satisfactory up to about half of the throttle valve opening, with increased throttle opening drop in output. If the engine is run within the range from half load to full load, the operating temperature will rise abnormally.

The engine causes the carburetter to "splash"; pinking and inclination to seize are further signs. Due to overheating, the sparking-plug shows blue-grey deposits and beads, and the electrodes are rapidly consumed.

Causes: Air leaks in induction system or directly at the engine. Central float distorted, fails to open

sufficiently wide, float needle sticks, fuel feed obstructed (tank cap, fuel shut-off cock?).
Silencer inserts removed, therefore, back-pressure too low (losses of fresh gas).

7.2. Description of the BVF Carburetters 26 N 1-1 and 28 N 1-1

These two types of carburetters are starting carburetters which are basically of the same design. They are only distinguished by different throttle openings and different sets of jets and tuning characteristics.
The name "starting carburetter" indicates that these two types of carburetters are provided with a cold-starting device in the place of the conventional "choke". This cold-starting device practically is a small carburetter in itself.
It is actuated by the starter lever at the right-hand handle-bar:

starter lever drawn (towards the rider)
= position for cold starting
starter lever towards the front
= position for operating.

With the starter lever closed, the starter piston (1) and the sealing disk attached to it (2) must close the starter mixing tube (3).

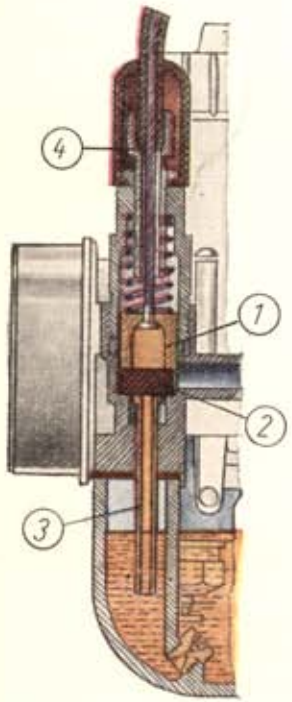


Fig. 121. Starter piston in the closed position (driving position)

For this reason, a clearance of 2 mm is required between cable control setscrew (4) and cable control sheath so that the compression spring can completely close the starter piston. In the case of high fuel consumption, also check the sealing disk for leaks because the engine may get fuel through it if the piston fails to close or the sealing disk is damaged.
When starting from the cold state of the engine, the starter piston is lifted when the starter lever is

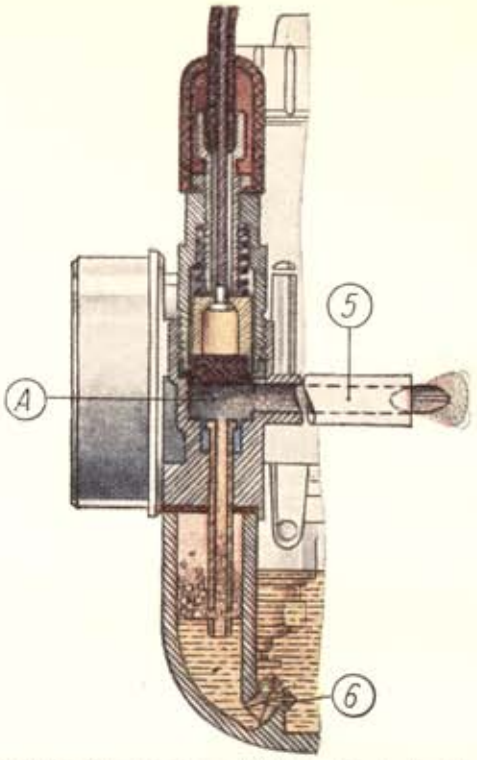


Fig. 122. Starter piston lifted (cold starting)

drawn. The fuel in the starter-mixture delivery duct is carried off and sucked up by the engine through the starter duct (5). This duct discharges into the intake pipe behind the throttle valve (see also diagrammatic representation, Fig. 124). To provide the intense suction in the starter system required for cold-starting, **the throttle valve must be in the idling position.**
The valve must not be fully closed, otherwise the engine stalls when it is opened.

When cold-starting, do not open the throttle, otherwise the starter device is of no effect.

The starter-mixture delivery duct discharges into a duct which is in connection with the float chamber

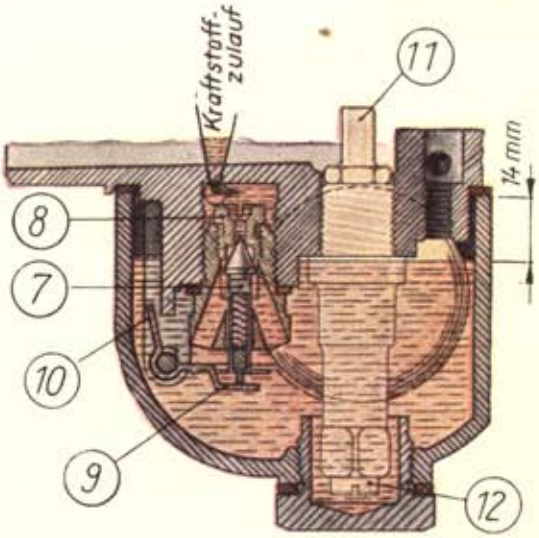
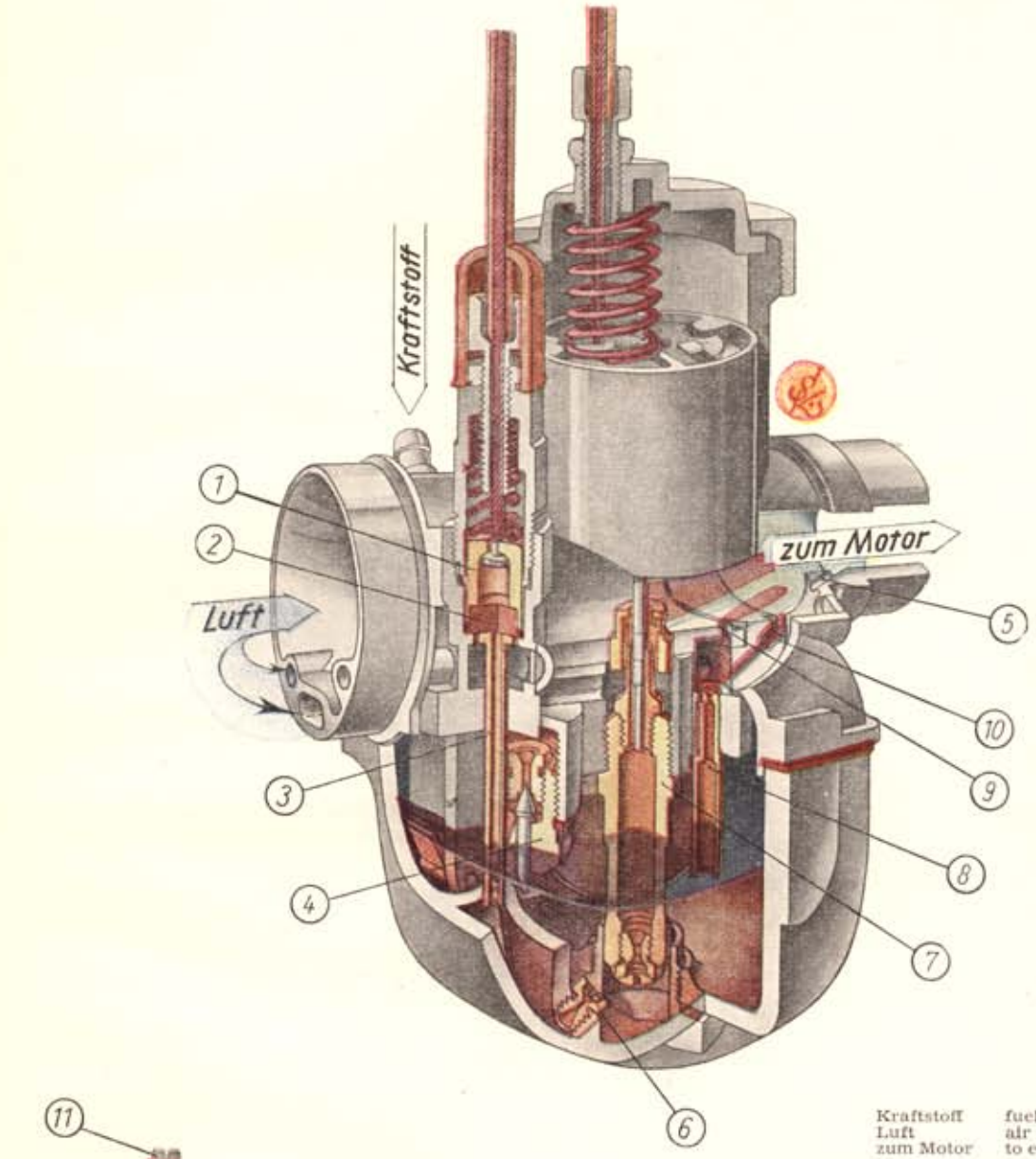


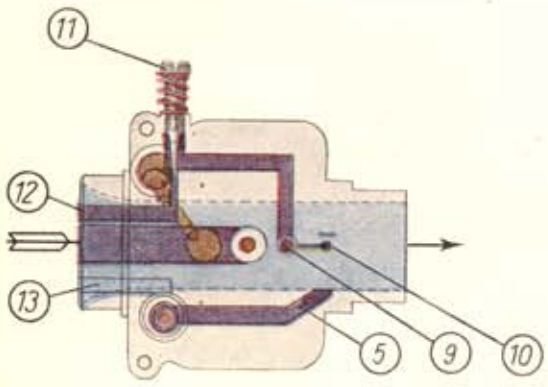
Fig. 123. Sectional view of float valve
Kraftstoffzulauf fuel delivery

through the starter jet (6) whose bore is designed in such a way that, after the full quantity of fuel has been sucked up from the duct, only such an amount of fuel is allowed to pass through the starter jet that the engine perform a four-stroke cycle but will not be "flooded" if the starter lever is drawn for too long a period.
The fuel is pre-mixed in the starter duct, the air is admitted through a recess in the upper edge of the duct from the float chamber. It is ventilated through a bore-hole in the semispherical lug at the outside close by the starting device. The transfer bore is below the carburetter outlet.

The starter air duct is not provided with a passage to the mixing chamber (A).

The float needle (7) is of the elastic type in order to reduce wear and to keep the fuel level almost





Kraftstoff	fuel
Luft	air
zum Motor	to engine

Fig. 124. Sectional view of starter carburetter
The diagrammatic section shows the system of ducts in horizontal position

(1) Starter piston
(2) Sealing disk
(3) Starter mixing tube
(4) Float valve, complete
(5) Starter duct
(6) Starter jet
(7) Jet holder with needle valve and main valve
(8) Slow-running jet
(9) Transfer bore 1.5 mm
(10) Idling bore 0.8 mm
(11) Pilot air screw
(12) Idling air duct
(13) Starter air duct (without passage and function)

constant. In the event of a worn float valve (more than 30,000 km), only the float needle and the valve seat (8) have to be replaced. When ordering valve seats, state the size, please, as in the case of all jets. Treat the central float with every care when dismantling the carburetter. If the two float bodies are displaced in relation to each other or the link (9), lifting the float needle or limiting the stroke (10), is distorted, the fuel level no longer complies with the requirements of a proper performance. The needle jet (11) is screwed to the top of the jet holder and the main jet (12) to the bottom of the holder.
Wear limit for needle valve and step needle 30,000 km.

7.3. Trouble Shooting and Tuning

Carburetter tuning is largely dependent on the sparking-plug appearance. The interior of the plug – the plug insulator – must have a light sand colour. The colour must be of a light tint because the active substances added to the additive-type two-stroke motor oils reduce the deposition of products of ombustion not only inside the engine, but also inside the sparking-plug.
If the specified sparking-plug M 14/260 shows weld beads at normal operation, do not use a plug with a higher thermal value, but locate the cause and remove it. Further, do not ream the jets to change the basic tuning of the carburetter, but take any factor bearing on the function of the carburetter into consideration and restore the system to normal condition.
The following factors are at the bottom of symptoms of **overheating:**

a) Air leak at the induction socket between carburetter and cylinder (insulating flange, packings).
b) Air leak in the induction system – filter box untight. Filter is off the centring edge. Rubber induction tube leaky.
c) Filter paper element damaged by improper handling, therefore, unrestricted air passage.

Symptoms of too rich a fuel-air mixture manifested in the appearance of the plug (at normal carburetter tuning) can be caused by the following faults for which the carburetter is not to blame:

A. Paper element of the air filter contaminated (clean by tapping) or wet; consequently, the air flow is obstructed or reduced. Though the paper elements are impregnated, a wet element is useless.
B. Silencer (especially the tail end) is clogged with products of combustion. The back-pressure in the exhaust system will become higher than permissible, residual combusted gases remain in the cylinder (poor degree of filling with fresh mixture). Retarded combustion which results in a dark appearance of the plug.
C. Instead of the specified mixing ratio of 33 : 1, a ratio of 25 : 1 has been used.

Normal fuel feed is the precondition of a proper function of the carburetter. Before re-tuning the carburetter, disconnect the petrol-proof hose from the nipple of the carburetter, open the fuel shut-off cock for a short time to check that a sufficient amount of fuel passes through the hose. Otherwise, any efforts to tune the carburetter will be in vain. Normal rate of flow through the filter cock is about 12 litres in 60 minutes.

Causes of a reduced fuel flow may be:

1. The vent holes in the tank are clogged by preservation wax or polishing agent.
2. The holes in the rubber seal ring in the filter cock are compressed or clogged by abraded material, because the two screws of the holding disk at the filter cock were excessively tightened. The fuel still allowed to pass through will be sufficient for half throttle, in the case of full throttle, however, the performance will decrease or the engine stall, because the float chamber of the carburetter is almost empty.
3. The inlet filter at the fuel-shut-off cock is clogged by deposits from admixtures of graphite or MoS_2 preparations to the fuel. This will also lead to an insufficient supply of fuel – see above.

Trouble shooting at the carburetter should be started with checking the position of the partial load needle. For normal operating conditions, the needle positions 3 to 4 (see Tuning Chart) will suffice. However, do not proceed without discrimination because the selection of the needle position largely depends on the appearance of the plug. Thus, it may be necessary to select needle position 5 during the running-in period and to suspend it at the 4th notch later on in order to achieve optimum operating conditions.
Only the appropriate adjustment is the most economical! With an extremely close setting, gears have to be shifted earlier and more frequently (then engine tends to pink) – this consumes more petrol.
An elastic double plate, the needle holder, guides and supports the partial load needle. When adjusting the needle, it should be borne in mind that the **lower plate** is to be used in connection with the needle notch to be engaged (the notches must be counted from top to bottom). The upper plate is engaged with the notch above.

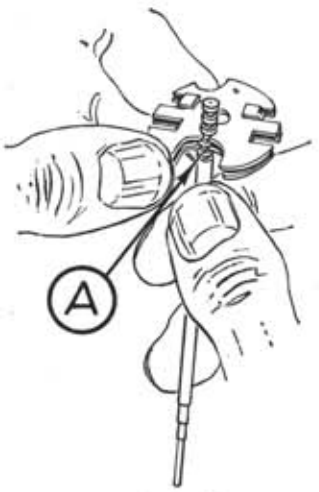


Fig. 125. Needle holder
(A) = Setting notch

Fig. 126. Partial load needle with needle holder fitted in the throttle valve

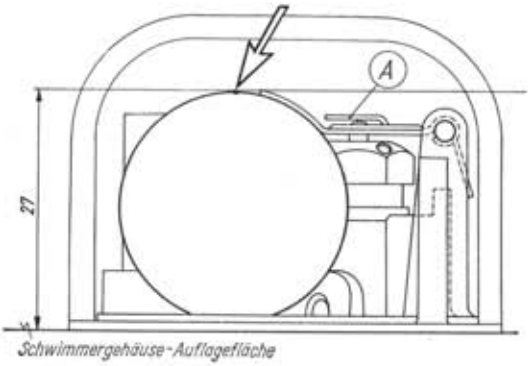


Fig. 127. Closed float valve, spring pin pressed down
(A) Valve lever
Schwimmergehäuseauflagefläche float chamber contact surface

When fitting the needle holder with step needle, take care that the holder fully contacts the plane bottom of the throttle valve, otherwise setting errors (differences in height) or a distorted partial load needle will be the result.

A **float body distorted** by improper treatment can easily be restored to proper working condition by means of checking devices which can be made easily. Either an old float chamber is milled down to a height of 27–28 mm (from the closed side) or a U-shaped wire or a sheet-metal template having the required dimensions is made.

For testing, the needle jet carrier is unscrewed and the carburetter held in the manner shown in Fig. 126.

Then place a ruler or a sliding caliper on the milled chamber at the point marked by an arrow and parallel to the centre of the float.

A uniform clearance of 0.3 to 0.5 mm must be left between the two float bodies and the ruler (arrow). If this is not the case, bend the valve lever (A) to obtain the specified clearance.

This dimension must strictly be observed because the desired fuel level is dependent on it: below 27 mm, the float may contact the carburetter body so that the carburetter will flow over.

If the floats are above 27 mm, starting difficulties, poor transition etc. will be the result, because the fuel level is too low.

When testing with the aid of the U-shaped wire or the sheet-metal template, sliding caliper or ruler are replaced by the central part of the gauge.

It goes without saying that neither one nor both float bodies must be tilted, they must be properly in line.

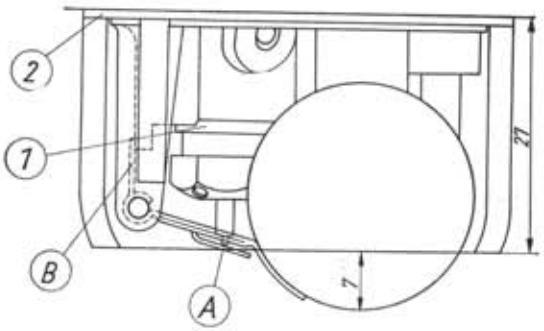


Fig. 128. Open float valve
(A) Valve lever
(B) Stop lever for maximum float lift
(1) Standard packing 1.5 mm in thickness
(2) Standard packing 0.5 mm in thickness

To ensure that the float valve opens wide enough, the position of the stop lever (B) is of particular importance. The dimension of 34 mm (27 + 7), measured from the sealing face of the body to the lower edge of the float, must also be set precisely. This dimension is shown in Fig. 128.

If this is neglected, the fuel feed will become insufficient in full load operation and the engine will stall or the maximum speed is not achieved.

If this dimension is exceeded, the floats may contact the body and will be damaged.

In the shown final position, the valve lever (A) must just release the spring pin. If this is not the case, slightly tighten the float valve. Take every care to prevent the packing ring from being squeezed.

Only use standard packing rings which are 1.5 mm thick, otherwise the specified level cannot be maintained.

The fuel-air mixture for slow running is prepared in the **slow running system** with the help of the slow running air screw (11) (see diagrammtic sketch in Fig. 124) for metering the slow running air flow and with the help of the slow running fuel jet (8). In the same way as in the partial load and full load range, this system must also provide the engine with fuel and air in the correct, i.e. ignitable, ratio. An excessive supply of slow running air causes the engine to run irregularly – if the rider suddenly accelerates, the engine will stall.

If the slow running air screw is almost closed, the engine tends to cycle like a four-stroker – the layman will suppose a defective connecting rod. This shows that good startability and a proper transition from slow running to normal operation

depend on the position of this screw. When the throttle valve is opened, the transition bore (9) (Fig.124) will become effective in addition, however, much depends also on the position of the air screw. In order to improve the driving style, more attention should be paid to the adjustment of the slow running system than so far:

With the engine at operating temperature, the slow running speed is regulated in such a way that the engine is just allowed to continue running when the throttle twist-grip is in the idling position. This adjustment is carried out with the help of the cable control setscrew for the throttle valve. (A high slow running speed causes gearchange noise!)

Then – starting from the position "2 revolutions open" – the slow running air screw is slowly screwed down and slackened back by way of trial. This is done to find the position of the highest engine speed. Proceed slowly enough to enable the engine to react to the changes.

After having regulated the idling speed down to normal, screw down the air screw for about 1/4 of a revolution – this is done to provide for a good transition in cold starting.

A precondition of an appropriate adjustment of the slow running system (i.e. idling speed and slow running air supply) is the appropriate adjustment of the partial load and full load range, otherwise the engine will fail to respond to the adjustment of the slow running air screw.

As a rule, all jets have to be measured with the help of a jet gauge in order to replace jets which have been widened by amateurs. In this way, time-consuming efforts to adjust the carburetter under false presuppositions will be avoided.

The designations 65 or 67 of the needle jets mean that their holes are 2.650 and 2.670 mm in diameter, respectively. The third place after the decimal

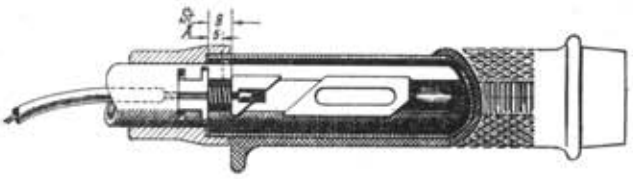


Fig. 129

point means that the tolerances on the dimensions are very close, i.e. ± 3 µm in each case.

Explanations of the terms "close the throttle twist-grip" and "throttle-twist grip in idling position":

A small compression spring is interposed between twist-grip throttle and abutment of the cable control. In slack position, this spring is the stop for the idling position. The throttle valve releases an opening of 1.5 mm. When stopping the engine, the twist grip must be closed; with this, the compression spring is compressed to a size of about 5 mm. Then the throttle valve completely closes the air passage.

Take careful note of the following:

The proper tuning of the carburetter is invariably associated with the correct timing of the ignition and the correct breaker points gap. If, for example, the cam carrier is out of true, the contact breaker will lift twice per revolution. Consequently, the high-voltage field required at high speeds cannot build up in the ignition coil – the ignition will fail. This is usually attributed to an insufficient fuel feed, however, an inspection of the sparking-plug will show that it has a **dark-coloured appearance** which means that the ignition system is to blame. Similar symptoms can be observed in the case of insufficient breaker points gap, retarded ignition, defective capacitor or defective series resistor.

7.4. Basic Carburetter Tuning

	ES 175/2	ES 250/2
Type	BVF 26 N 1-1	BVF 28 N 1-1
Opening	26 mm	26 mm
Main jet	100	107
Needle jet	65	67
Partial load needle No.	K 2 with 5 notches	K 3 with 5 notches
Needle position from top	3rd to 4th notch [1]) (4 th for running in)	3rd to 4th notch [1]) (4 th for running in)
Starter jet	90	100
Slow running jet	35	40
Float needle valve	18	18
Slow running air screw	1 1/2 to 2 1/2 revolutions open	2 to 3 revolutions open
Throttle opening	3 (30)	3 (30)
Transition bore	1.5 mm	1.5 mm
Idling bore	0.8 mm	0.8 mm

[1]) The tuning largely depends on the driving performance and sparking-plug appearance

8. Chassis

8.1. Removing the Fuel Tank

The first thing to do is to remove the two fastening screws of the handle-bars cover plate (1).
Then remove the two fastening screws of the fuel tank (2) – take care not to lose the rubber pads. Then the tank can be removed by pushing it towards the rear and lifting it (take care of the fuel shut-off cock).
When mounting the tank, make sure the mushroom-shaped rubber pads at the side of the steering head are present.
For mounting **leg guards**, the locking plates are put on the studs.
For this purpose, the rubber cord on either side of the headlamp is slotted longitudinally at the height of the plates by means of a sharp knife and then the plates put through. After fitting and tightening the lower fastening clips and the tie-bolt, headlamp screen ring and reflector are removed and the M-6 nuts (together with their spring rings) are uniformly tightened by means of a socket wrench.

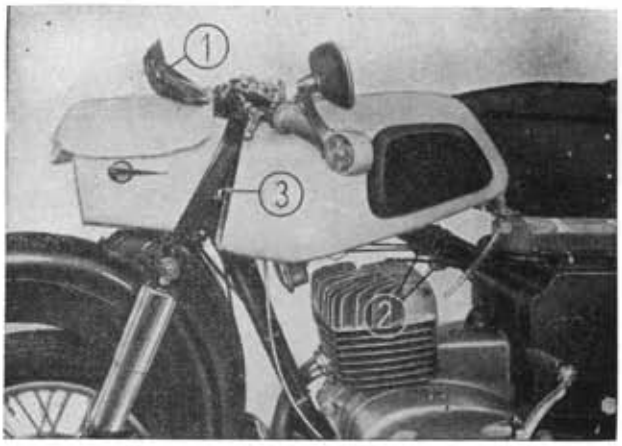


Fig. 130

8.2. Checking and Adjusting the Steering Bearing

Shake the mudguard with one hand, while feeling the upper and lower steering bearings with the fingers of your other hand. The bearings must be free to move easily, but they must be absolutely free from play.
For adjusting, fold over the lock plate and retighten the slotted nut by means of a hook-spanner (see also Fig. 132). Refit the lock plate.

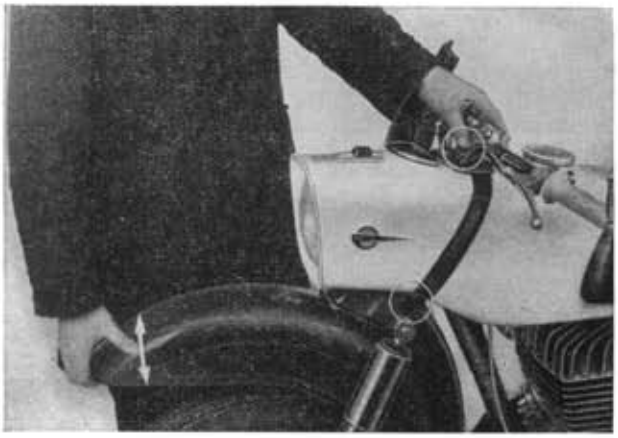


Fig. 131

8.3. Dismounting the Handle-bars

Place a chock at the front-wheel to prevent the fork from slipping through. Fold up the lock plate (2) and remove the slotted nut (1) with the help of a hook-spanner. Then remove the clamping screw (3) with lock plates. It is not sufficient to slacken back the screw because it is seated in a recess in the column tube (4).
Check the upper fork bearing ring for wear (tracks or pocketed). If wear marks are found on this ring, the wear on the lower steering bearing naturally will be more severe. In this case, all races and balls must be replaced by new ones.
A new fork bearing ring can only be fitted at elevated temperature. Heat to a temperature of about 80 °C and press the bearing down until it properly contacts the seat, using an appropriate piece of tube.
A loosely fitting fork bearing ring is one of the main causes for the "floating" of the vehicle. Use 22 balls with a diameter of 6.35 mm; do not use more balls.
When assembling, only use new lock plates. The clamping screw must be tightened with a torque of 5 kg-m. (use a socket wrench).

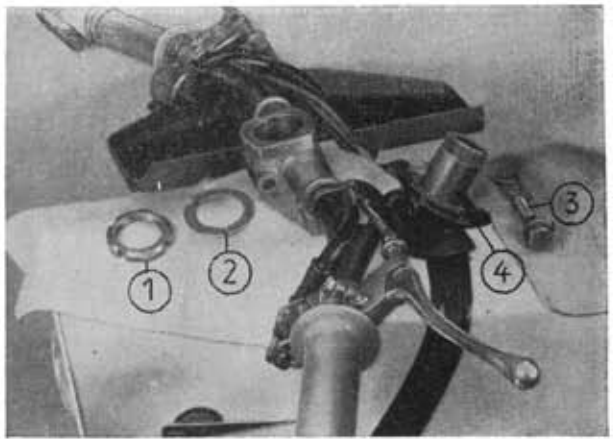


Fig. 132

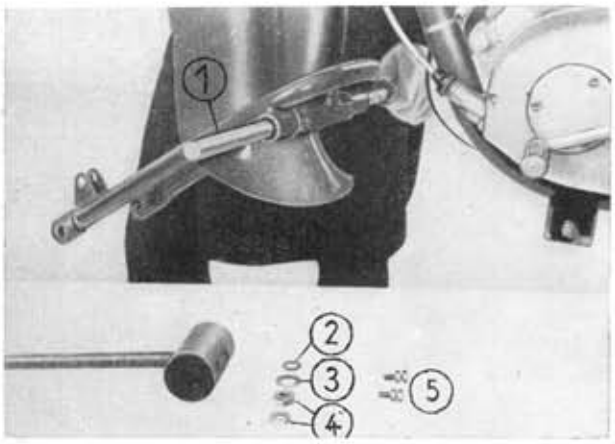


Fig. 133

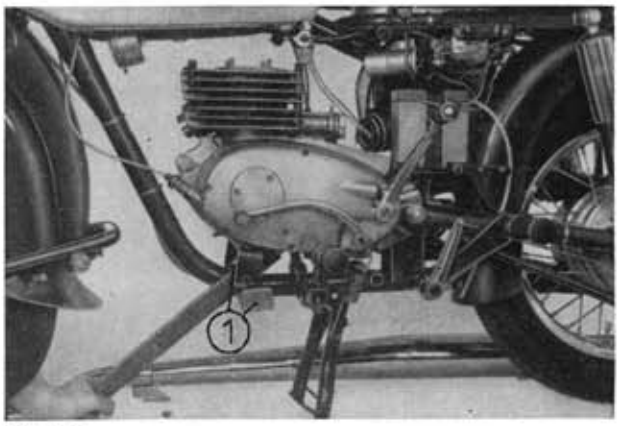


Fig. 134

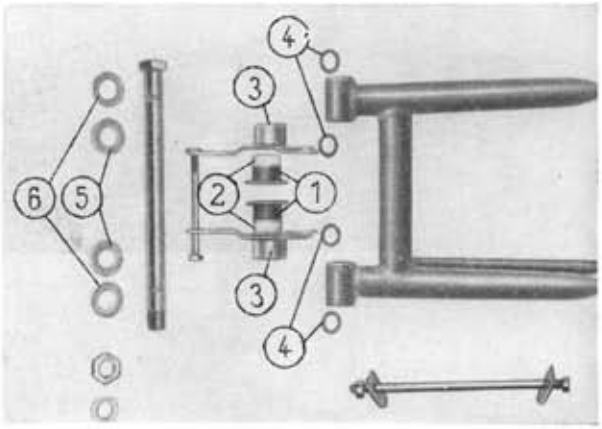


Fig. 135

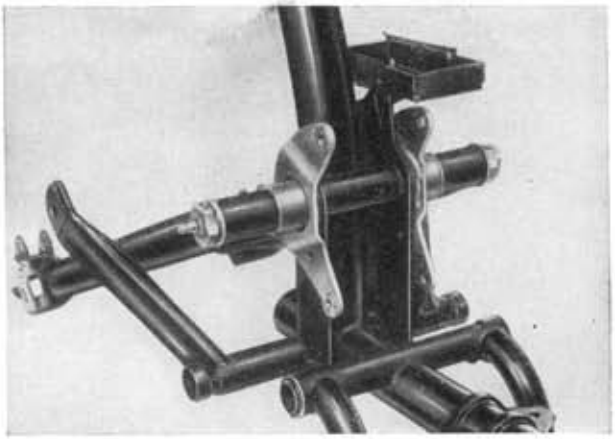


Fig. 136

8.4. Replacing the Swinging Arms Pivot Pin

Using the centring-pin (1) No. 05-MW 26-4, fix the swinging arms and insert the new pivot pin from the right (prior to this, tighten the nut on the short threaded end).

Observe the following sequence of operations:

The rubber packing rings (2) must properly contact the bearing bushes on either side to ensure that the lubricating points are oil-tight. Each packing ring is covered by a protective cap (3). The swinging arms must move downwards by gravity without any axial clearance. The nuts are used to balance (and lock) (4).

The retaining screws (5) with check nuts prevent the pin from turning and must properly contact the pivot pin areas designed for this purpose. If this is not observed, difficulties will be encountered when the arms are dismantled the next time (because of the wear marks produced by pressure).

Only use GL 60 or motor oil for lubricating.

8.5. Replacing the Front Silent Blocks

At this stage of disassembling, the two front silent blocks (1) can be changed. When assembling, fit the silent blocks in such a way that the lugs engage with the recess in the strap.

Protect the rubber blocks from petrol and oil.

8.6. Rear Elastic Engine Suspension

The components involved are pushed on the supporting tube at the frame in the following sequence:

(1) Bearing rubber pad, (2) Miramid spacer rings, (3) engine fastening brackets.

Using a cramp which is applied to the front end of the brackets, compress the bearing assembly. As a makeshift, a M 6 × 230 stud bolt with two disks or flat iron pieces can be used as a tool.

The inner faces of the bearing bushes of the rear swinging fork are provided with a rubber sealing ring (4) on which a smooth check plate (5) is put. Then the swinging arm is mounted and fixed by means of the centring-pin 05-MW 26-4 (which is also used for the front swinging arm) which is applied from the left.

Also put a sealing ring (4) and a check plate (6) on each side of the outer ends of th ebearing bushes; the convex side of the plate must show to the packing ring. Insert the oiled pivot pin from the right-hand side.

Rear elastic engine suspension in assembled condition.

Wear limit: about 30,000 km.

The pivot pin must be turned in such a way that the two fastening bolts bear on the face of the pivot pin. Then lock them by means of check nuts.

The swinging arms must be absolutely free from any play, but they must be free to move easily so that they go down on their pivot by virtue of their own weight.

The axial clearance is neutralised by means of the nut of the bolt; lock it by means of the second nut.

Only use GL 60 or motor oil for lubricating.

This illustration shows the bottom side of the ES/2.
(1) Oil drain plug for primary drive
(2) Oil drain plug for gearbox
(3) Fastening screws for footrests
(4) Gear detent screw.

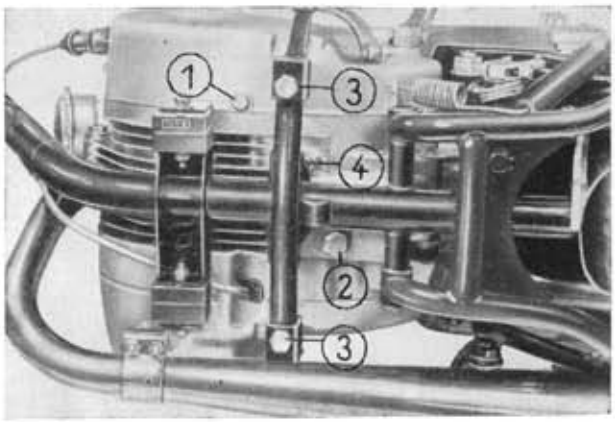


Fig. 137

8.7. Repairing the Brakes

This illustration shows the anchor plate, one brake shoe is removed. The two pivot pins must have a tight fit, otherwise the brake tends to block.
Lubricate pivot pins and brake spanner with anti-friction bearing grease "Ceritol".
Before removing the brake shoes, mark them for identification so that they can be re-fitted in the place where they have run in.
Remove wear marks, provide the leading side of the brake shoes with a chamfer.
Clean the contact blade (2) for the stop-light (here it is connected to earth) and the face of the contact screw. If necessary, bend the contact blade so that it is applied to the contact with some initial stress when the brake lever is actuated.

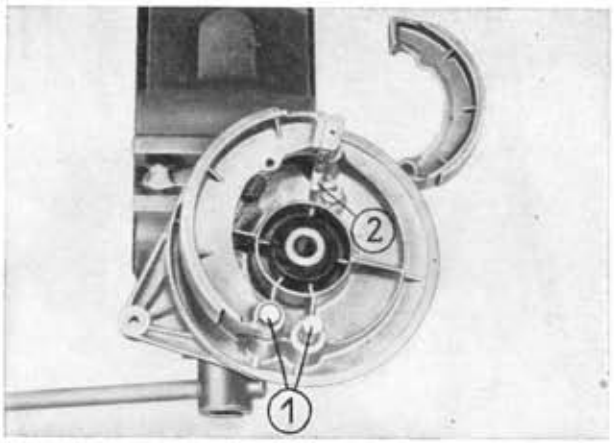


Fig. 138

The standard brake shoes are ground so that they have a good bearing.
Reconditioned brake shoes or shoes riveted in place must be touched up.
Mount the brake and actuate it several times. The chalk lines applied for touching up show where the brake shoes are properly applied and where not.
Elevated spots must be removed by means of a roughing file, starting from the centre, until at least three quarters of the surface have a good bearing. Chamfer the leading sides.
If a lathe is available, the riveted linings should be turned. For this purpose, the complete anchor plate is chucked at the bore for the wheel spindle.

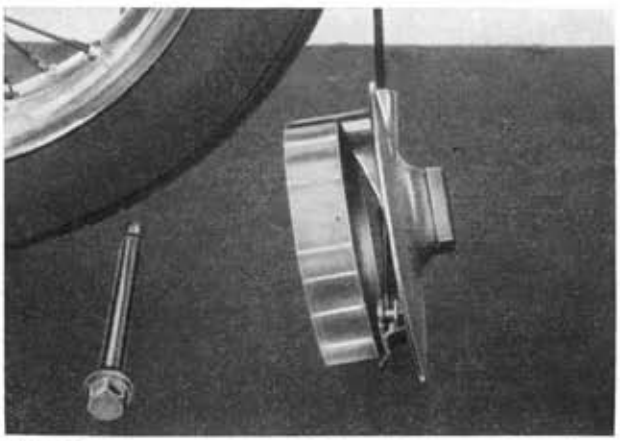


Fig. 139

8.8. Dismantling the Rear Axle Drive

Remove the nut from the flanged bolt and remove the complete drive.
Remove the 47 × 1.75 circlip by means of pointed pliers.

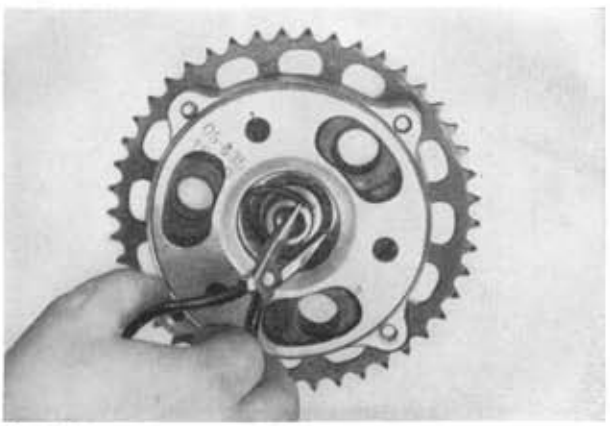


Fig. 140

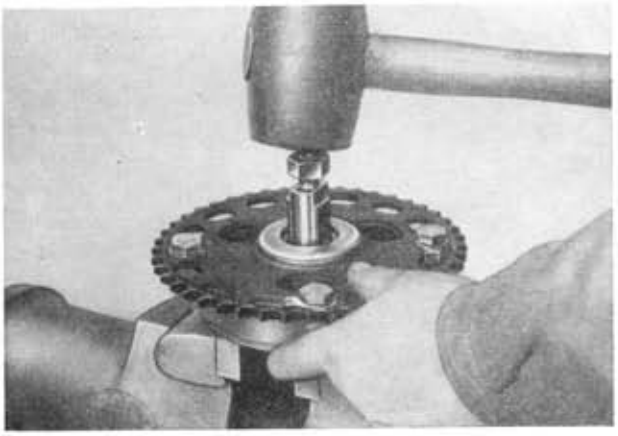


Fig. 141

Drive out the flanged bolt together with the 6005 bearing.
The nut of the flanged bolt is screwed home in such a way that it is flush with the bolt end so that the first thread cannot be damaged.

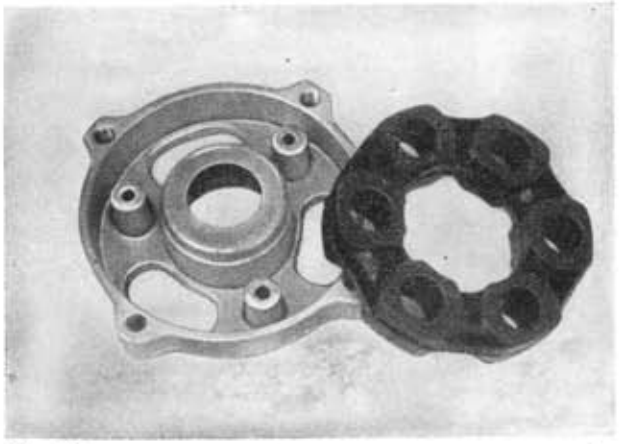


Fig. 142

Replace the damping rubber pad.
Fold over the lock plates of the four M 10 × 25 screws and remove them (see also Fig. 141 and Fig. 143). With this, the damping rubber pad can be removed.

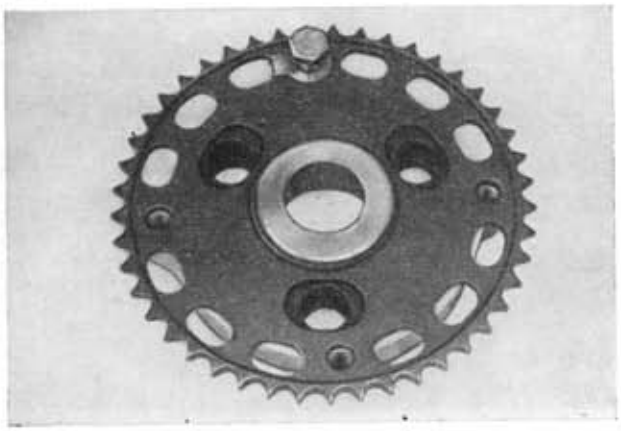


Fig. 143

When assembling, take care that the sprocket is not mounted in the wrong way:
The oblong holes in the sprocket must coincide with the holes in the damping body and damping rubber pad.
The smooth side of the sprocket contacts the rubber pad.

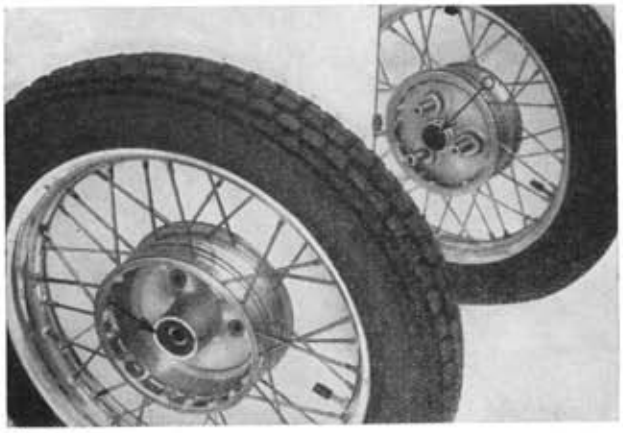


Fig. 144

Do not omit the rubber packing ring at the wheel bearing on the side of the brake ring so that the brake cannot be contaminated by grease thrown off from the wheel and rendered useless. No rubber packing is provided at the driver side (mirror view).

8.9. Replacing the Road Wheel Bearings

For changing the raod wheel bearings (6302), use the expanding mandrel H 8-820-3.
Slacken back the screw in the expanding sleeve and, after having driven out the bearing, screw home this screw. In this way, sleeve and mandrel are released and the bearing can be taken off.

Fig. 145

8.10. Fitting or Replacing the Secondary Chain

Draw the chain out of the protective hoses by means of a wire hook.

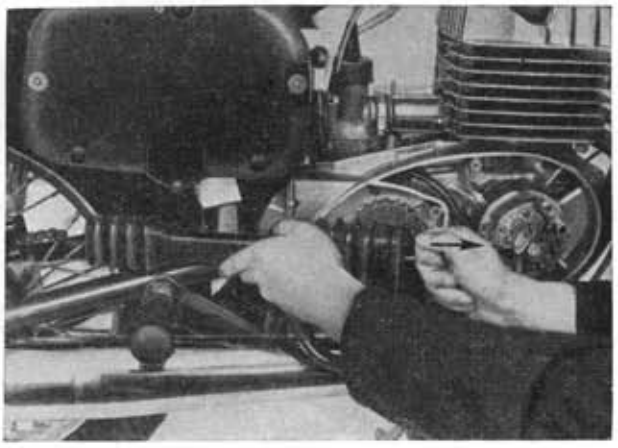


Fig. 146

To check the chain (on the complete motor-cycle), attach an old, clean chain (with the locking spring in place) to the chain to be checked and withdraw the latter. This will save you a lot of time.

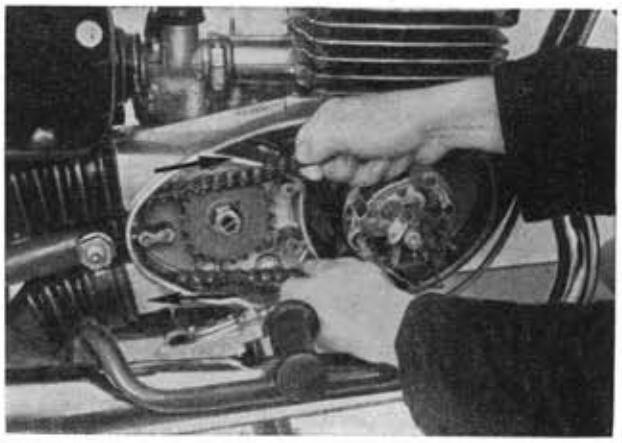


Fig. 147

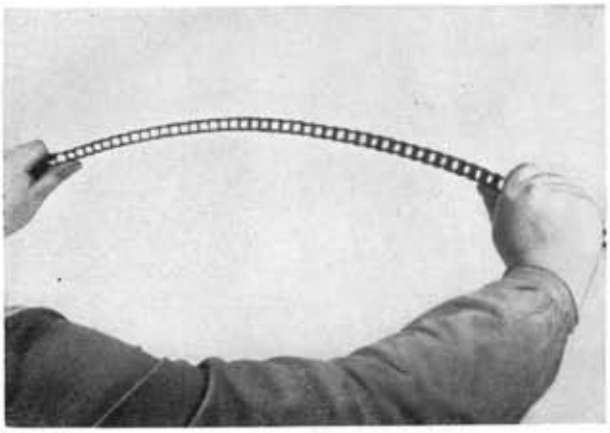


Fig. 148

If the backlash of the chain in the rollers and pins is excessive (see illustration), the chain must be replaced by a new one.
If the gearbox sprocket is worn to such an extent that it shows the so-called "shark-teeth", then this sprocket must also be replaced.
Parsimony is not to be recommended here, because the damage caused by a broken chain will by far outweigh the costs of a new chain.

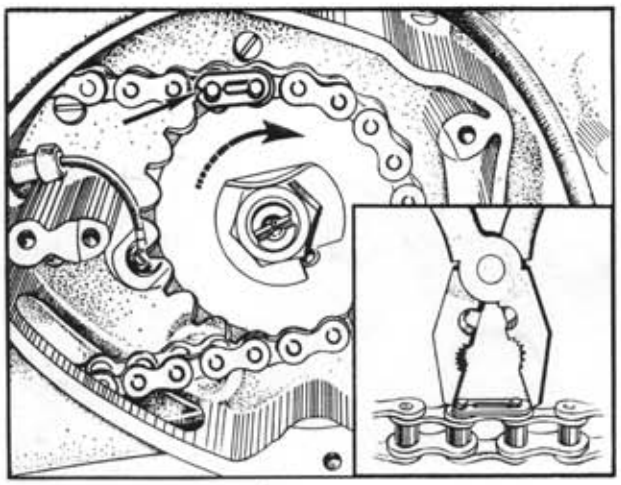


Fig. 149

To fit the chain lock, compress the chain ends with the aid of pointed pliers and slip on the lock from the rear. Take care that the lock spring fits tightly. Only use standard chain locks, because the pin diameter of the various chain makes varies. The new chain may break when using a chain lock that does not fit properly.

Fig. 150

Section of the chain protective hose.
The central projections guide the chain, therefore, take care to see that they are lubricated at regular intervals.
Do not use chassis grease, but GL 60 gear oil.
Customers in **foreign countries** are recommended to use SAE 40 motor oil.

8.11. Speedometer Drive

Speedometer drive in dismantled state.
When the secondary drive has been changed (side-car operation, replaced engine), the speedometer drive must be adapted to the changed conditions.
When the lubricating nipple (1) is unscrewed, the bearing bush (2) becomes accessible and can be withdrawn together with the pinion.
Helical gear (3) and pinion (4) are marked on their faces:

ES 175/2:	$\frac{175}{17}$
ES 250/2:	$\frac{300}{21}$
ES 250/2 with side-car:	$\frac{175}{17}$

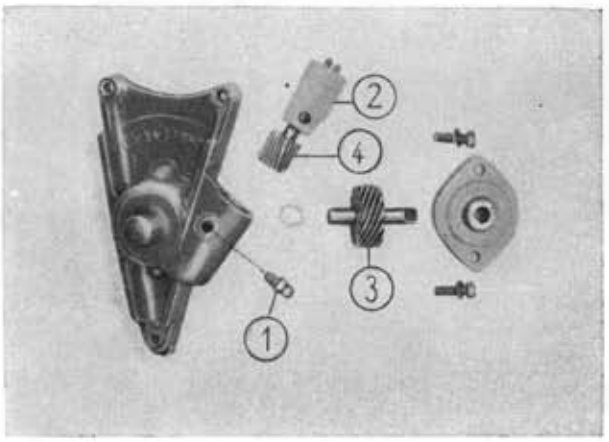


Fig. 151

Speedometer drive in assembled condition.
It is lubricated with GL 60 gear oil.
Make sure the hole in the speedometer shaft is not clogged, otherwise excessive supply of lubricant will be delivered into the speedometer, rendering it useless. This is due to the fact that the speedometer shaft is twisted.
Tighten the knurled knut of the spiral at the speedometer with every care, otherwise the bearing of the drive shaft of the speedometer may be jammed.

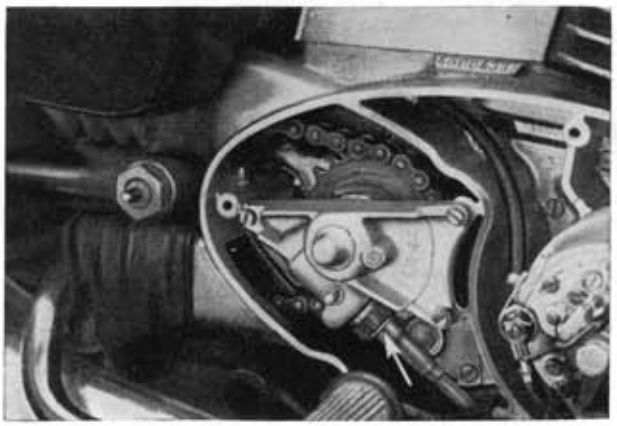


Fig. 152

8.12. Cleaning the Silencer

The illustration shows the dismantled silencer.
Remove deposits of products of combustion from the dotted areas. If the whole system is badly soiled, the tuning of the carburetter must be checked (wear?); on the other hand, the specified mixing ratio of fuel to oil might not have been observed.
Do not clean the exhaust pipe – the layer of carbonaceous oil deposits protects the pipe from uncalled-for heat absorption.
When assembling, do not simply tighten the two nuts (1), but lock them properly. The joint at the tail piece (3) is covered by the clip (2). Interpose asbestos cord having a diameter of 2 mm.
The tail piece must be put on in such a way that the bore-holes (4) in the pitot tube are staggered by 90° in relation to the two jets (5). If this is not observed, the engine output may drop by about 0.5 h.p.

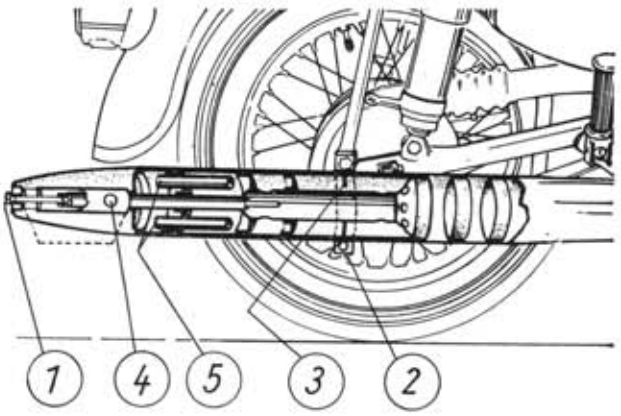


Fig. 153

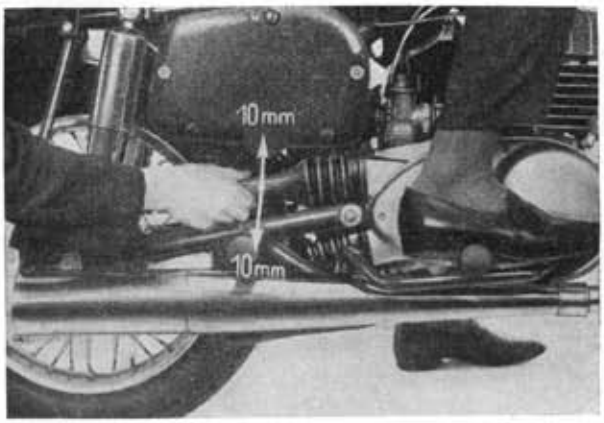


Fig. 154

8.13. Checking the Chain Sag

The chain sag is checked while the vehicle is loaded; the full turn of the chain is to be checked.
Do not check when the motor-cycle is unloaded, because in the central position of the swinging arms (this means when the vehicle is unloaded) the chain sag has the minimum value. Do not only check the elastic chain guard, but also the chain itself!

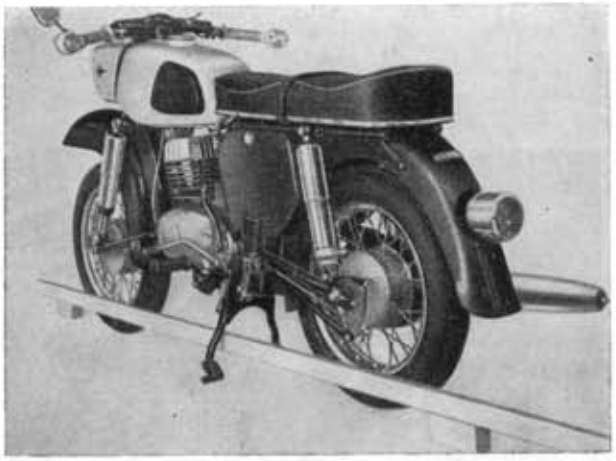


Fig. 155

8.14. Aligning the Road Wheels

This shows how the road wheels should be aligned. The test rod must contact the tyres at four points. Take into consideration that the rear-wheel tyre has a size of 3.50 inch and the front-wheel tyre a size of 3.25 or 3.00 inch. Therefore, a uniform gap must be left on either side of the front-wheel.
Wheels which are not properly aligned will cause the motor-cycle to "float" and in bends the vehicle will tend to slip off.

Therefore, align the wheels after any removal of the rear wheel.

9. Repairing the Suspension Units

Disassembling the suspension units.
Press down the upper protective sleeve; this releases the two halves of the supporting ring which then can be taken off.
Withdraw the protective sleeves and the compression spring. Remove the locking nut by means of the special wrench No. 05-MW 82-4 and take out the complete shock absorber unit.
Carefully clean all parts with dry cleaning spirit, also rinse the tubular shell.

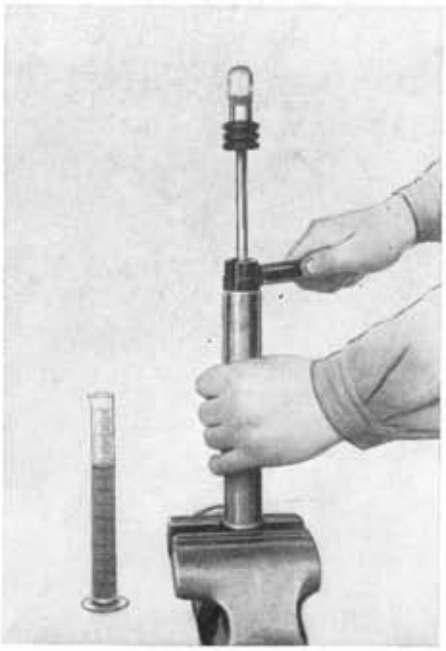


Fig. 156

The accompanying illustration shows the cylinder (1) of the shock absorber and the bottom member (2) in dismantled state.
A disk-type check valve is arranged at the top of piston (3) and, at the bottom of the piston, an adjustable damping valve. The latter is used to regulate the damping pressure. The valve at the bottom member functions as a safety valve if, due to overloading or low ambient temperatures, the damping fluid is not allowed to flow quickly through the small bore-holes in the piston. The reservoir between outer shell and cylinder collects the displaced damping fluid which returns to the cylinder when the springing action ceases. The reservoir is almost pressure-less, the damping action proper takes place in the cylinder.

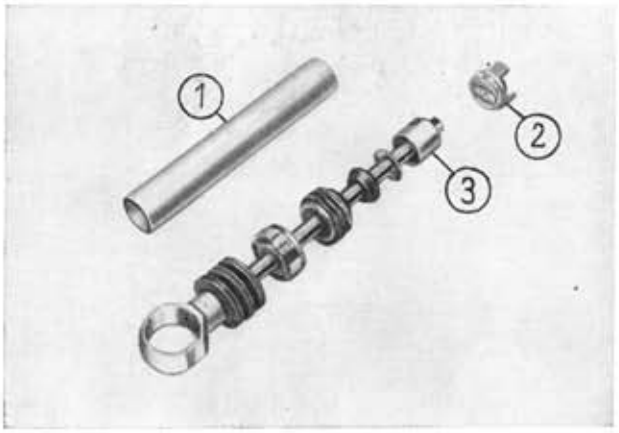


Fig. 157

Common faults and their causes:

1. The shock absorbers are inactive, although there is no visible oil leakage.
   Cause: Foreign particles between the diaphragms of the piston valve.
2. Instead of starting smoothly, the damping action starts jerkily. The suspension units are said to "stamp".
   Cause: insufficient amount of damping fluid or bottom valve leaky..
3. Damping liquid leaks out.
   Cause: Radial sealing ring AC 10 × 19 × 7 (A) leaky.

Take notice of the following: When the suspension unit is correctly assembled for mounting, the lip of the sealing ring must show downwards (pressure side).

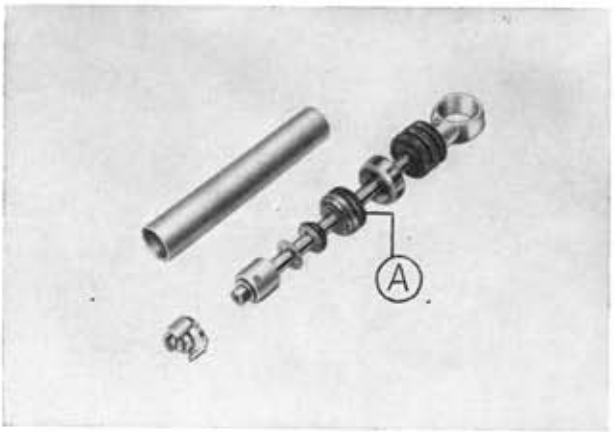


Fig. 158

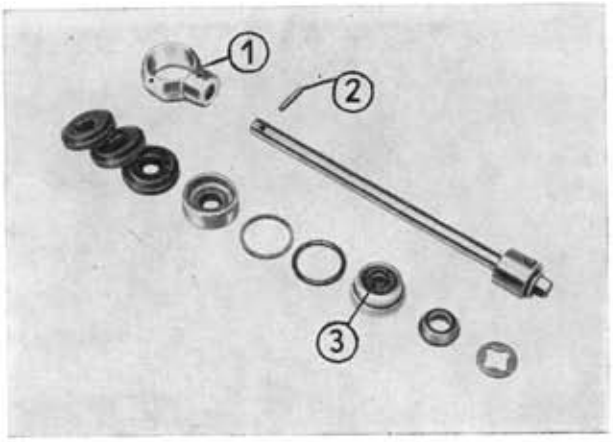


Fig. 159

To replace the AC 10 × 19 × 7 radial sealing ring, remove the upper holder (1) of the suspension unit: Drive out the 4 × 20 cylindrical grooved pin (2), applying the drift to the small-diameter end (distinguishable by marks left from driving-in). Mark the upper holder and piston rod by means of a punch to ensure that both parts are re-assembled in the original position (at the same sides).
After withdrawing the holder of the suspension unit, burr the hole for the grooved pin through the hard-chromium plated piston rod on either side by means of an oil stone. Pack the interior of the new radial sealing ring (3) with a graphite paste (high-melting point grease Ceritol. Bosch or a similar brand with colloidal graphite).

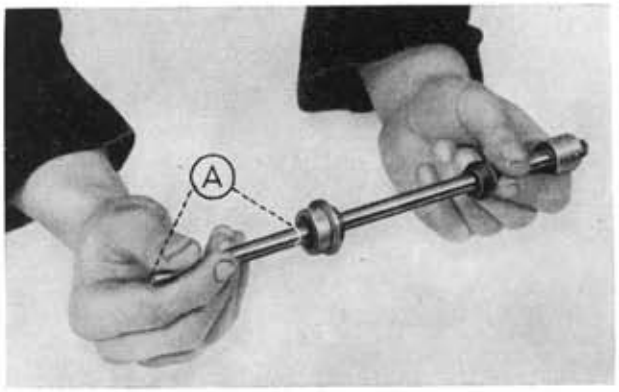


Fig. 160

In any case use the tapered fitting sleeve No. 05-MV 93-4 (A) to put the new sealing rings on the piston rod, otherwise the sharp-edged piston rod could damage the sealing lips.
When fitting the upper holder of the suspension unit, pay attention to the marking.
Only use new cylindrical grooved pins.
For driving them in place, put them into the wider end of the bore- hole.
Other components of the shock absorber, especially the regulating members, cannot be replaced because a relatively expensive hydraulic machine is required for adjusting them. That is why two complete shock absorber units must be used to ensure the same damping action on either side.
After a longer period of operation, when the damping action of the unit is already somewhat reduced, though the unit is in proper working condition, replace both units to ensure the same damping action on either side.
Use the cylindrical upper part of the special wrench No. 05-MW 82-4 to press disk and rubber seal down into the tubular shell and tighten the threaded piece, using a torque of about 5 kp-m — it should be noted that the pressure in the working cylinder may come up to 85 atm. gauge pressure.

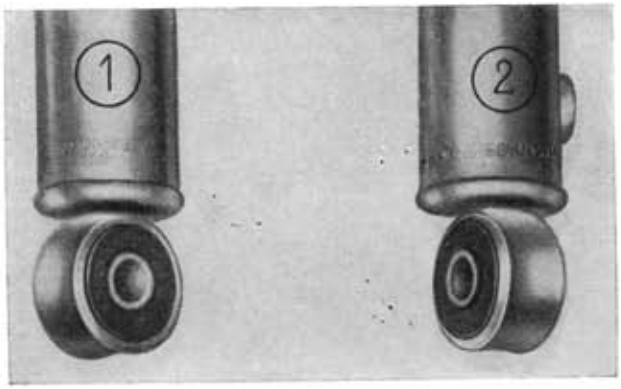


Fig. 161

The **markings** on the suspension units include the test specifications (hydraulic test equipment):

A	with circular upper holder for suspension unit
120	test speed (rpm) for front suspension unit
100	test speed (rpm) for rear suspension unit
64	damping power in kp for front
76	damping power in kp for rear
/8	return in kp
OV	without provisions for adjustment (front)
MV	with provisions for adjustment (rear)
1.51	drawing No. of manufacturer.

The permissible damping power tolerance of 16 kp is divided into two groups and marked on the upper suspension unit holder (aluminium part) by a line (chisel mark) or a dot (punch mark). The damping elements to be matched must have the same values — line must be matched with line or dot with dot.
In the case of the new suspension unit holder of steel, the marking is by a colour dot in the inside of the holder, at the face of the piston rod.

Yellow = upper limit
Green = lower limit

Match yellow with yellow and green with green!
From the 2nd quarter of 1969, the damping power of the rear damping unit has been raised from 76 to 94 kp; please take notice.

(1) front shock absorber
(2) rear shock absorber

Provisionally check the damping action in the following way:
Pump the two shock absorbers ten times through their full stroke and suspend them at a pipe (or broomstick). Release the two weights at the same time and observe (if necessary, together with an assistant) whether the two shock absorbers reach their final position at the same time or not.

The same damping action of a pair of suspension units is prerequisite to a good roadability.

The test weights should not exceed 2 kg to ensure that the shock absorbers go down slowly so that differences in their damping action can be perceived.

Shock course at the front	4 to 4.5 seconds
Shock course at the rear	5 to 5.5 seconds.

The compression springs of the suspension units are tested and matched with each other. Therefore, never replace one single suspension unit or compression spring, but always the pair of them.
When assembling the suspension units, grease the compression springs with a highly viscous grease (unless they are provided with a coat of protective varnish by the manufacturer). The grease is applied not only to protect against corrosion, but also to suppress noise. Automotive grease for general chassis lubrication or oil are unsuitable for this purpose, because the temperature of the shock absorber units rises under heavy loads; consequently, the dripping oil or grease would give the impression of a leaky shock absorber which, of course, is wrong.
The "spring noise suppressor" is arranged between tubular shell and compression spring in the front suspension units. This Pertinax sleeve prevents the conpression spring from buckling and thus suppresses the noise emitted by the protective sleeves when they are not shielded in this way.
If desired, this sleeve can also be used in the rear suspension units.

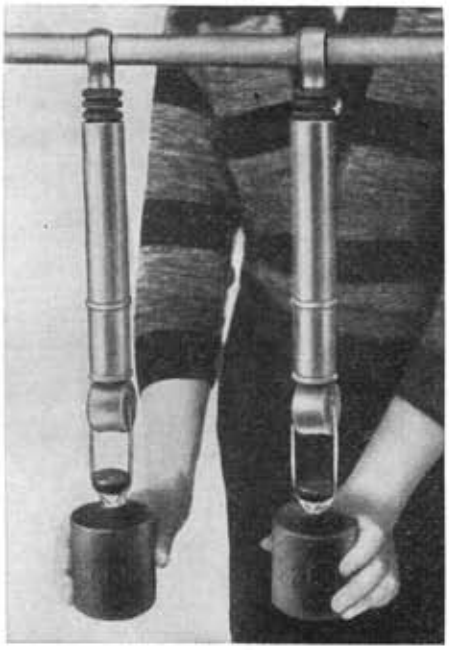


Fig. 162

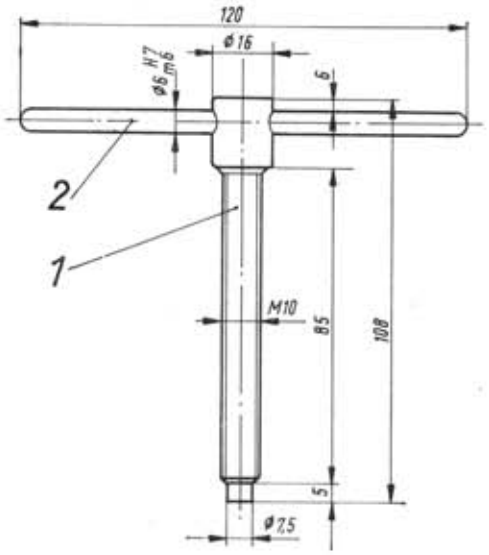
10. List of Special Tools

1.	02-MW 39-4	Armature puller
2.	05-MW 45-3	Holder-on for gearbox sprocket
3.	05-MV 45-3	Puller for gearbox sprocket and driving gear with 68-teeth
4.	05-MW 20-4	Clutch puller
5.	05-MW 15-3	Holder-on for 68-teeth driving gear
6.	05-MV 190-3	Gudgeon pin ejecting device
7.	05-MV 70-2	Crankcase dismantling screw with annular insert for crankshaft
8.	05-MV 71-2	Dismantling screw for driving shaft
9.	05-MV 69-2	Crankshaft pusher
10.	05-MW 92-4	Drift for 6305 crankshaft bearing
11.	05-MW 91-4	Drift for crankshaft seal ring
12.	05-MW 106-4	Drift for 6204 bearing on driven shaft and 6203 bearing on driving shaft
13.	02-MW 60-3	Profiled socket wrench for selector cylinder
14.	05-ML 24-3	Test mandrel (22 mm) and ruler for straightening the connecting rod
15.	05-MV 49-4	Guide sleeve for selector cylinder
16.	05-MW 16-4	Piston support
17.	05-MW 141-4	Piston ring pliers
18.	06-MW 3-4	Expander for 58-mm piston rings (ES 175/2)
19.	05-MW 147-4	Expander for 69-mm piston rings (ES 250/2)
20.	05-MW 19-4	Guide mandrel for gudgeon pin
21.	05-ML 13-4	Measuring device for axial clearance of 28-teeth drive gear
22.	05-MV 150-2	Clutch tensioning device
23.	05-MW 26-4	Centring-pin for setting the swinging arms
24.	H 8-820-3	Expanding mandrel for wheel bearings
25.	05-MV 93-4	Fitting sleeve for radial seal ring
26.	05-MW 82-4	Special wrench for shock-absorber locking nut

11. Sketches for Special-Tool Making

Armature puller

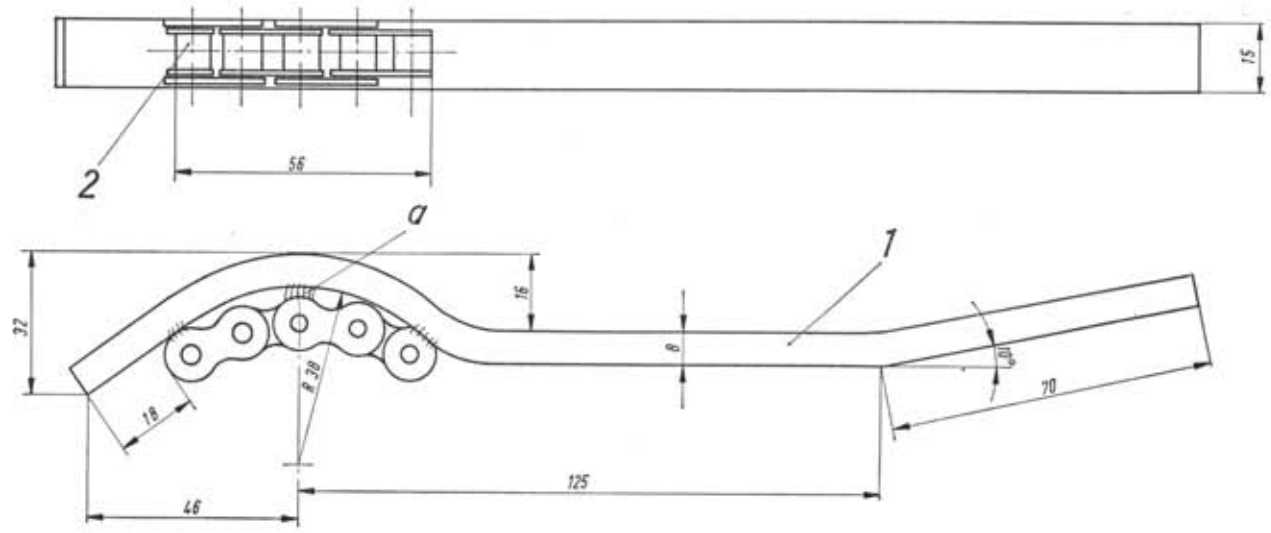
02-MW 39-4



Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Screw	St 50 K	16 dia. × 112	
2	1	Cylindrical pin 6 m 6 × 120	St 50 K	6 dia. × 120	

Holder-on for gearbox sprocket

05-MW 45-3



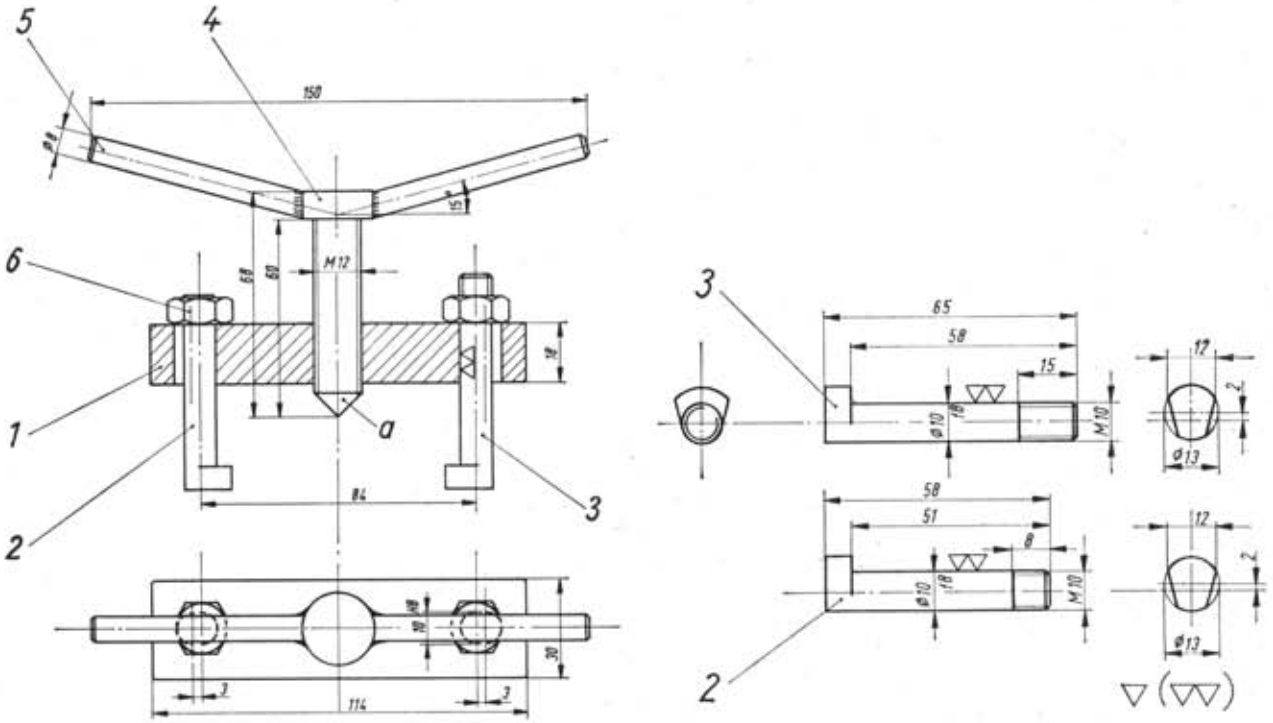
(a) Electrically tacking and welding at three points on either side
degreased, phosphate-treated

Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Spanner	St 3 b	15 × 8 × 270	TGL 0-8180
2	1	Roller chain 12.7 × 8.51	St 3 b	15 × 8 × 270	TGL 0-8180

welded part

Puller for gearbox sprocket and driving gear with 68 teeth

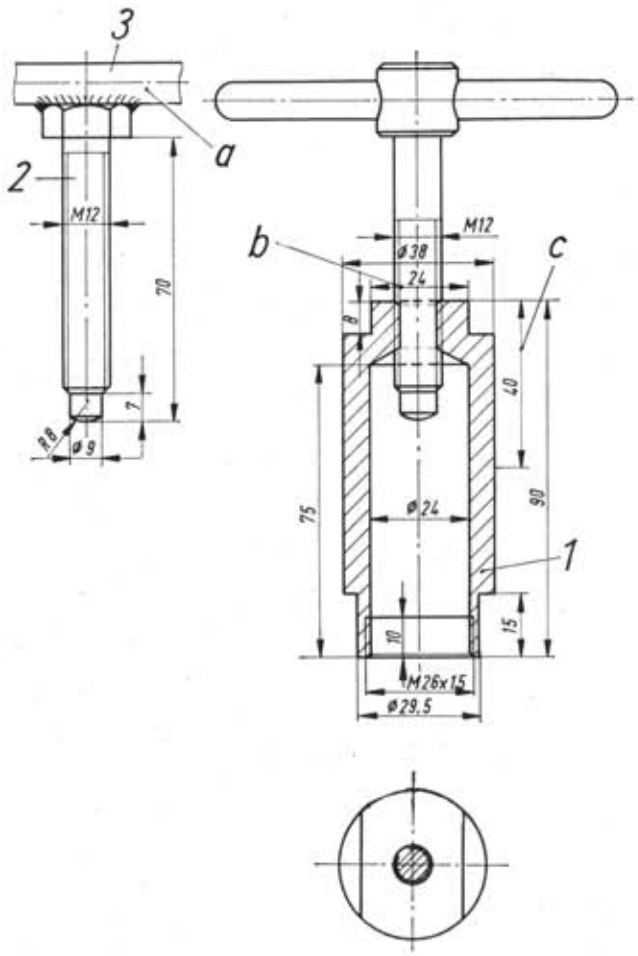
05-MV 45-3



Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Plate	MSt 3	30 × 20 × 118	degreased, phosphated
2	1	Puller pin	C 45	18 dia. × 62	
3	1	Puller pin	C 45	18 dia. × 70	hexagon head screw modified
4	1	Tightening screw | welded part	– 4 D	M 12 × 60	TGL 0-561 point to be turned and hardened
5	2	Handles | welded part	MSt 3		
6	2	Hexagon nuts M 10	– 5 D	8 dia. × 70	TGL 0-934 thread to be caulked

Clutch puller

05-MW 20-4

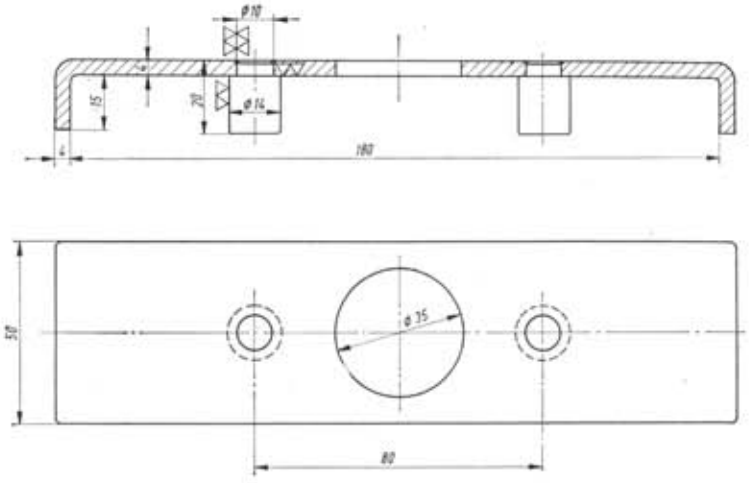


(a) Alternative solution
(b) Width over flats 24
(c) to be knurled

Part	Quantity	Description		Material	Rough Size	Remarks
1	1	Clutch puller		C 45	40 dia. × 95	75 kp/mm² annealed, degreased, phosphated
2	1	Hexagon head screw M 12 × 70	alter-native solution			TGL 0-933
3	1	Cylindrical pin 10 m 6 × 100				TGL 0-1

Holder-on for 68-teeth driving gear

05-MW 15-3

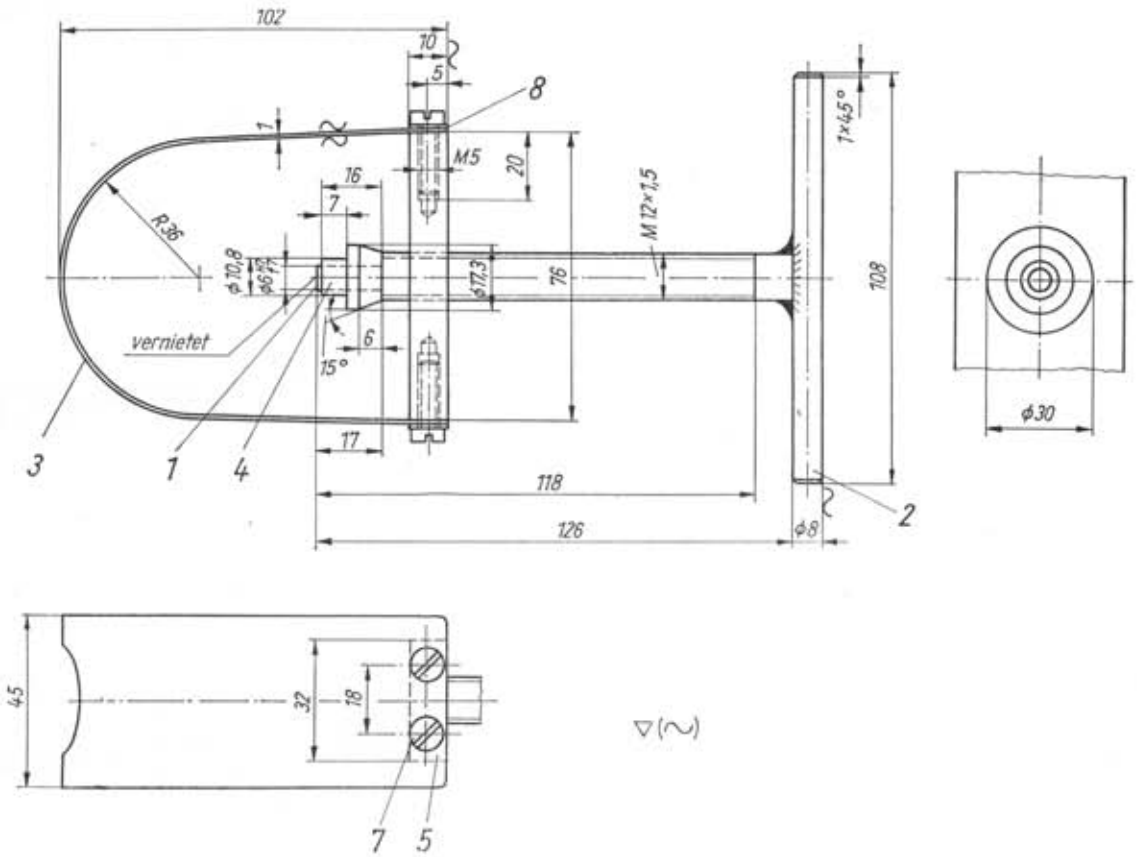


degreased, phosphate-treated

Part	Quantity	Description		Material	Rough Size	Remarks
	1	Holder-on	welded	St 38 u/2	50 × 4 × 220	
	1	Bolt		MSt 3	18 dia. × 25	

Gudgeon pin ejecting device

05-MV 190-3



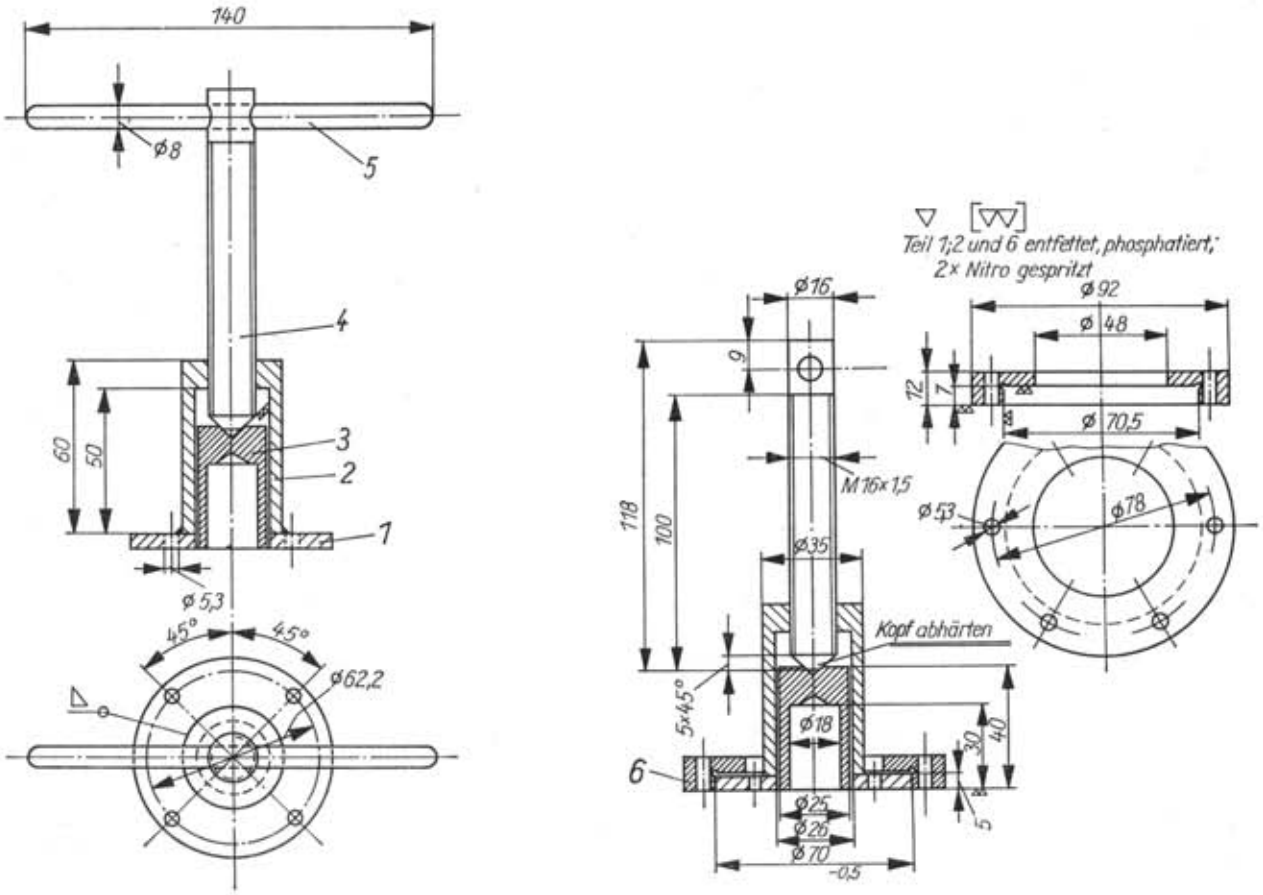
▽(~)

vernietet riveted

Part	Quantity	Description	Material	Rough Size	Remarks
1	1	welded part	C 45 K	12 dia. × 130	
2	1		St 37 K	8 dia. × 112	
3	1		St G-A 4	1 × 45 × 250	
4	1		St 38 u-2	20 dia. × 20	
5	1		St 38 u-2	10 × 32 × 80	TGL 11 161
7	4	Cylindrical pin M 5 × 18			TGL 0-84
8	4	Washer 5.3			TGL 0-125

Crankcase dismantling screw with annular insert for crankshaft

05-MV 70-2



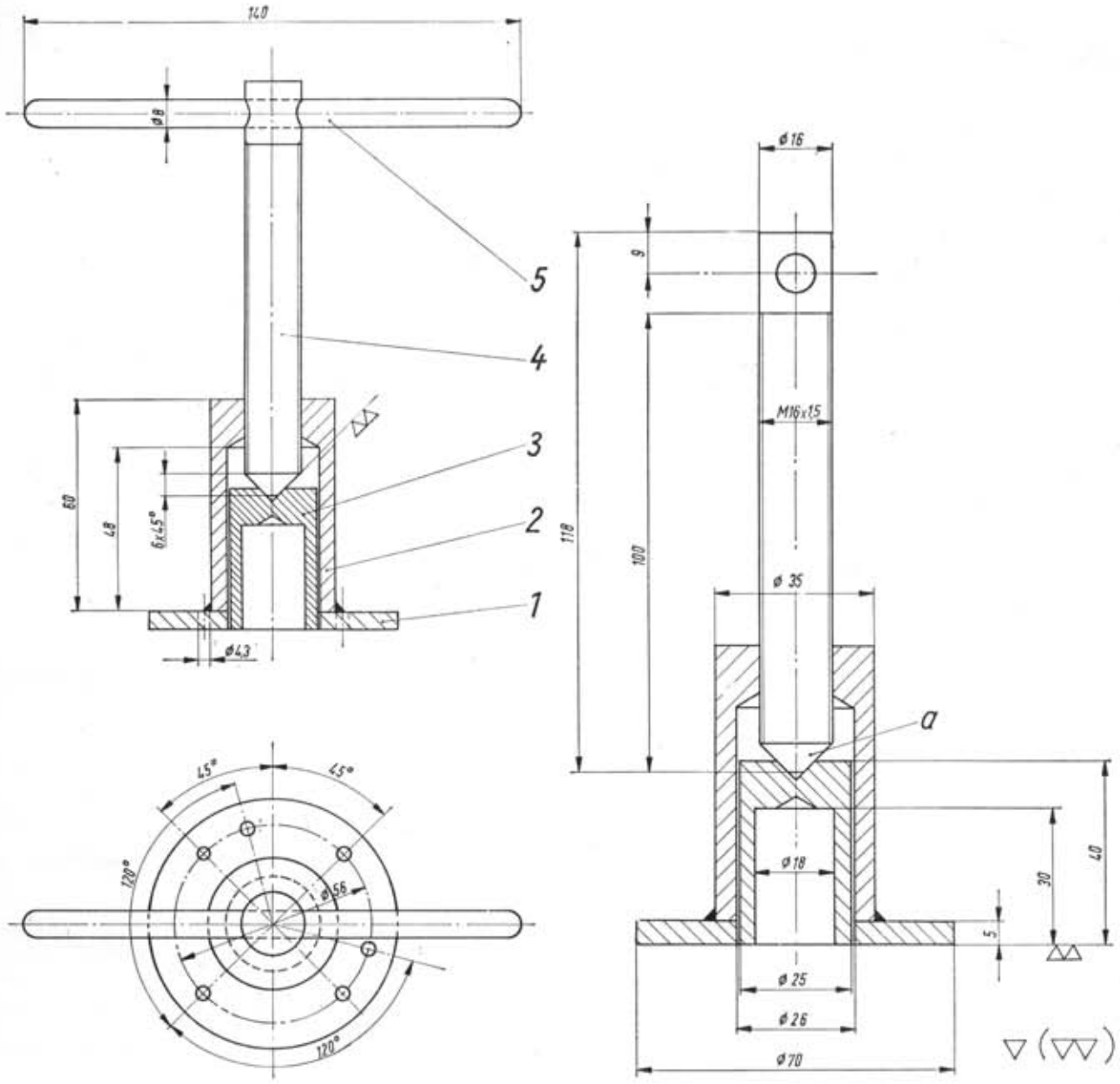
Teil 1; 2 und 6 entfettet, phosphatiert
Kopf abhärten

Part 1; 2 and 6 degreased, phosphate-treated
Head to be hardened

Part	Quantity	Description		Material	Rough Size	Remarks
1	1	Plate	welded part	MSt 3	72 dia. × 8	
2	1	Holding sleeve	welded part	MSt 3	38 dia. × 65	
3	1	Sleeve		C 45	25 dia. × 45	
4	1	Screw		C 45 K	16 dia. × 126	
5	1	Tommy		St 37 K	8 dia. × 145	
6	1	Plate		MSt 3	100 dia. × 15	

Dismantling screw for driving shaft

05-MV 71-2

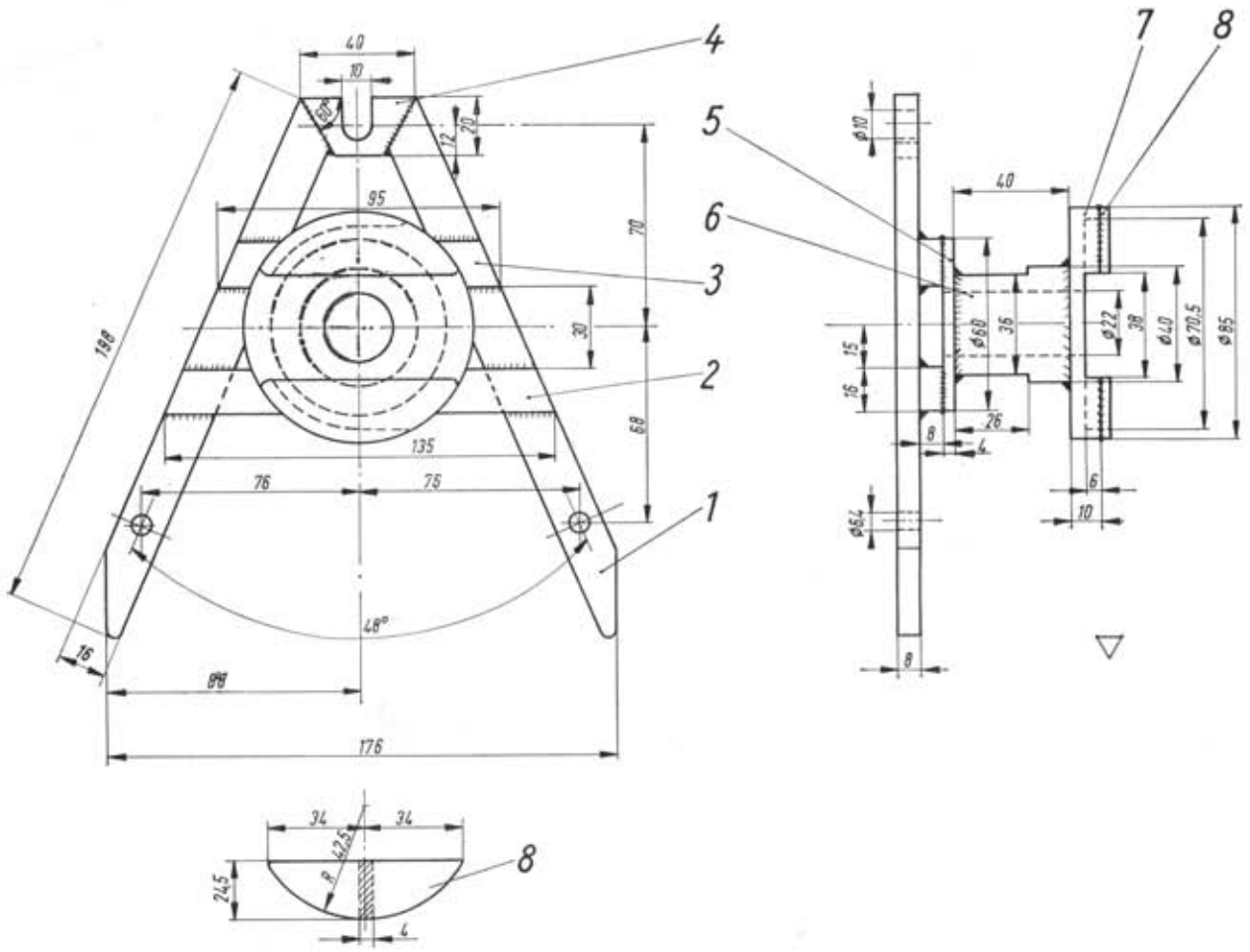


(a) Head to be hardened

Part	Quantity	Description		Material	Rough Size	Remarks
1	1	Plate	welded part	MSt 3	72 dia. × 8	degreased, phosphated
2	1	Holding sleeve	welded part	MSt 3	38 dia. × 65	degreased, phosphated
3	1	Sleeve		C 45	28 dia. × 45	
4	1	Screw		C 45	16 dia. × 122	
5	1	Tommy		St 37 K	8 dia. × 145	

Crankshaft pusher

05-MV 69-2

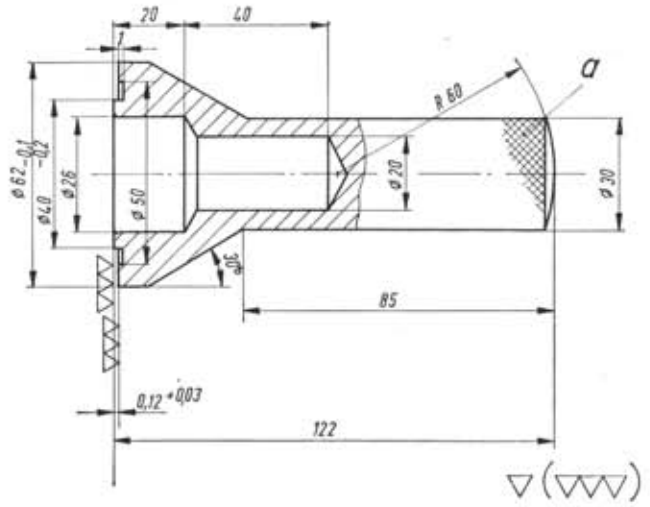


degreased, phosphate-treated

Part	Quantity	Description		Drawing No.	Material	Rough Size	Remarks
1	2	Strips	welded part	TGL 7960	St 33	8 × 16 × 202	TGL 7973
2	1	Web		TGL 7960	St 33	8 × 16 × 140	TGL 7973
3	1	Web		TGL 7960	St 33	8 × 16 × 100	TGL 7973
4	1	Bridge		TGL 7960	St 33	8 × 20 × 42	TGL 7973
5	1	Plate			MSt 3	60 dia. × 6	
6	1	Bush			MSt 3	40 dia. × 45	
7	1	Holder			MSt 3	85 dia. × 15	
8	(2) = 1	Holder-on			MSt 3	85 dia. × 6	

Drift for 6305 crankshaft bearing

05-MW 92-4

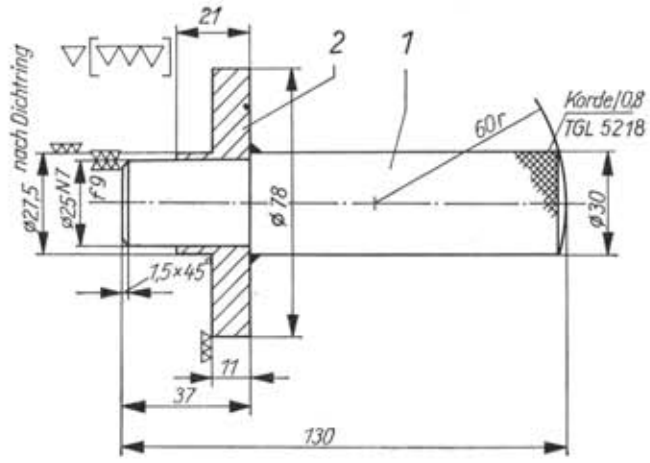


(a) Knurl 0.8 TGL 5218
Ko 10 to be dipped

Part	Quantity	Description	Material	Rough Size	Remarks
	1	Drift	C 15	65 dia. × 130	case-hardened

Drift for crankshaft seal ring

05-MW 91-4

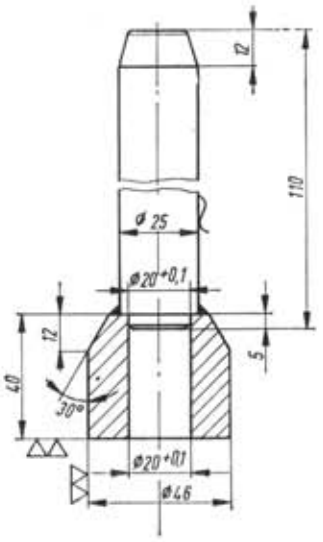


nach Dichtring — after sealing ring
Kordel 0.8 TGL . . . — knurl 0.8 TGL 5218

Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Mandrel	C 15	35 dia. × 135	case-hardened
2	1	Flange	C 15	80 dia. × 26	

Drift for 6204 bearing on driven shaft and 6203 bearing on driving shaft

05-MW 106-4

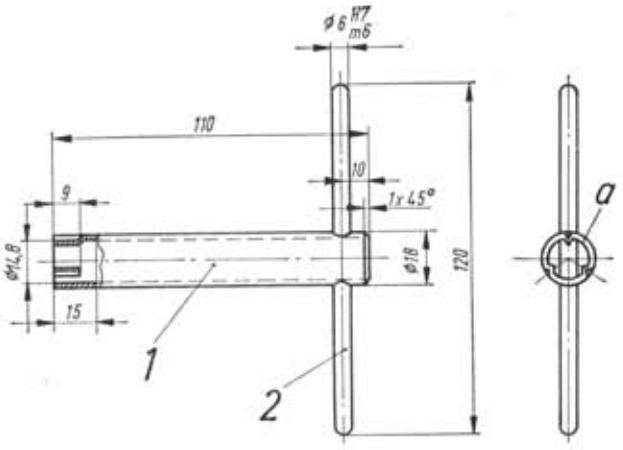


degreased, phosphate-treated

Part	Quantity	Description		Material	Rough Size	Remarks
	1	Sleeve	welded	C 45	50 dia. × 45	
	1	Bolt	part	C 45	25 dia. × 115	

Profiled socket wrench for selector cylinder

02-MW 60-3

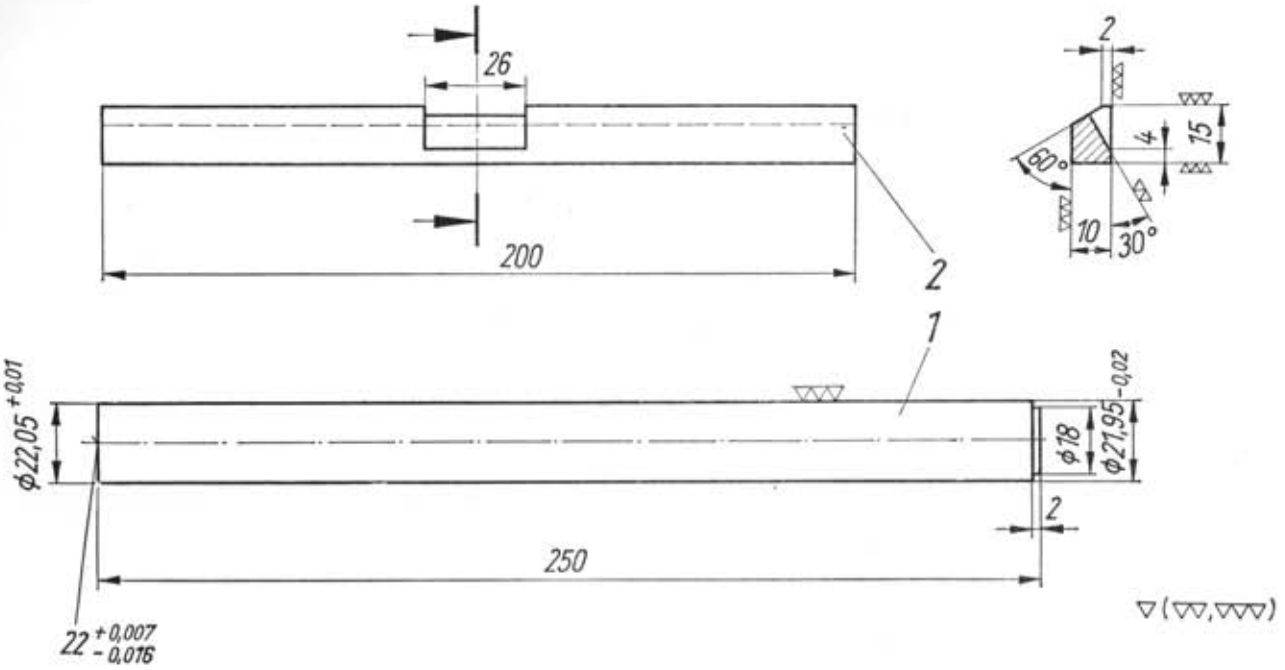


Together with pusher H 8-657-2
(a) Profile of wrench according to cam drum 02-847.04-0
degreased, phosphate-treated

Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Pipe	Steel pipe	18 × 2 × 112 (Gost)	
2	1	Handle	St 37 K	6 dia. × 125	

Test mandrel (22 mm) and ruler for straightening the connecting rod

05-ML 24-3

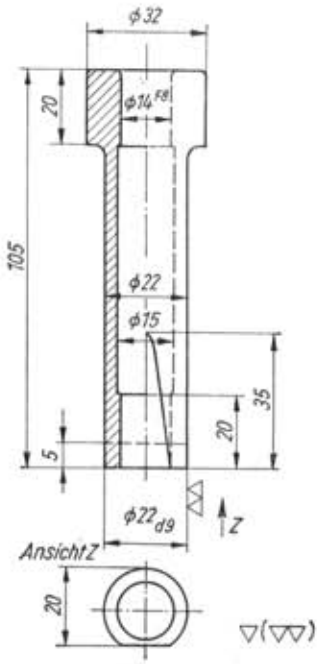


eingesetzt, gehärtet und geschliffen — fitted, hardened and ground

Part	Quantity	Description	Material	Rough Size	Remarks
1	1		C 15	25 dia. × 255	case-hardened
2	1		C 15	205 × 20 × 15	

Guide sleeve for selector cylinder

05-MV 49-4

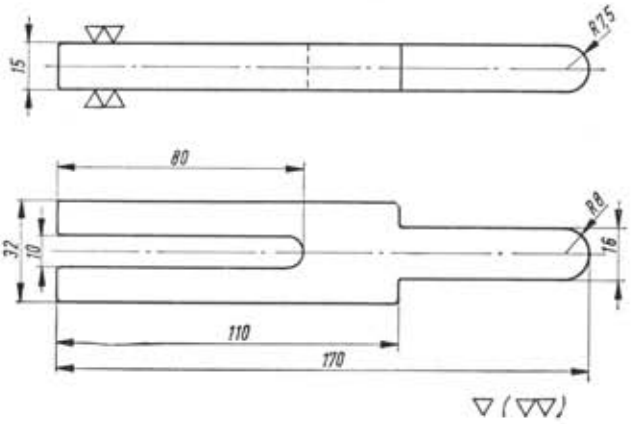


Ansicht in Pfeilrichtung — view in the direction of the arrow

Part	Quantity	Description	Material	Rough Size	Remarks
	1	Sleeve	MSt 3	35 dia. × 108	

Piston support

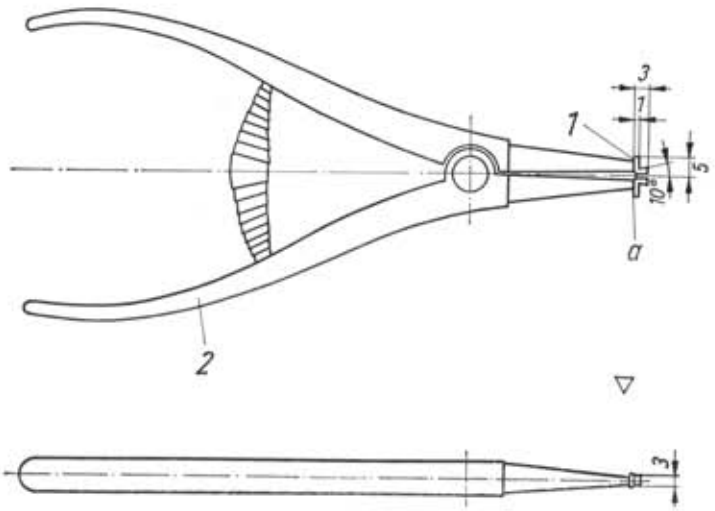
05-MW 16-4



Part	Quantity	Description	Material	Rough Size	Remarks
	1	Piston support	St 34 or hard wood	35 × 81 × 175	

Piston ring pliers (special pliers for assembling and disassembling special two-stroke piston rings)

05-MW 141-4

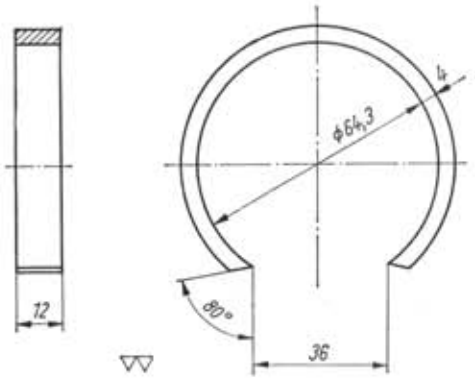


(a) brazed

Part	Quantity	Description	Material	Rough Size	Remarks
1	2		15 Cr 3	8 × 3 × 1	
2	1	Circlip pliers A 160 TGL 48-72 503			varnished, polished

Expander for 58-mm piston rings (ES 175/2)

06-MW 3-4

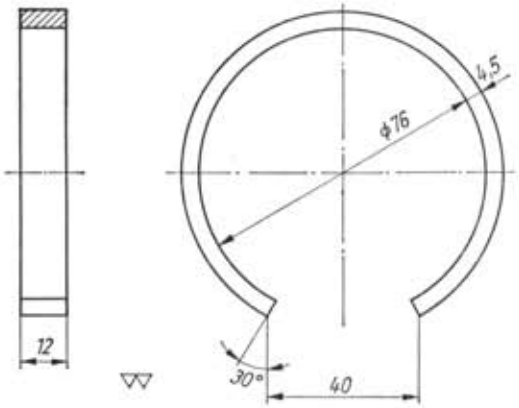


To be used together with special pliers 05-MW 141-4

Part	Quantity	Description	Material	Rough Size	Remarks
	1		Tube	76 × 13 15 long	

Expander for 69-mm piston rings (ES 250/2)

05-MW 147-4

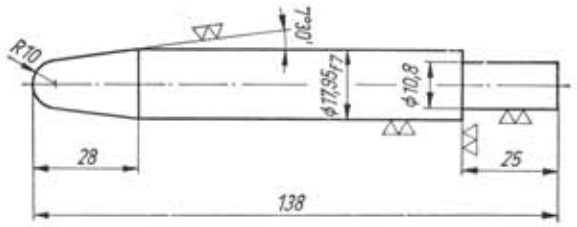


To be used together with special pliers 05-MW 141-4

Part	Quantity	Description	Material	Rough Size	Remarks
	1		St 38 u-2	90 dia. × 15	

Guide mandrel for gudgeon pin

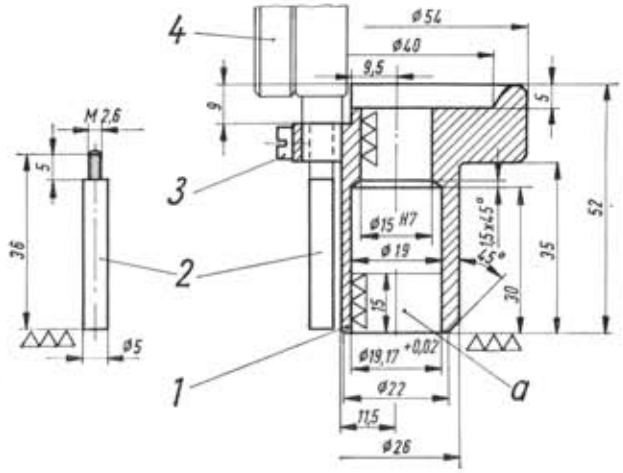
05-MW 19-4

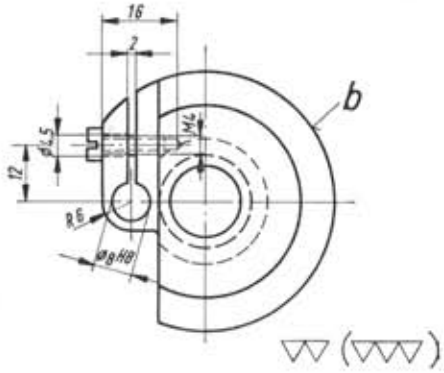


Part	Quantity	Description	Material	Rough Size	Remarks
	1	Mandrel	MSt 3	18 dia. × 140	—

Measuring device for axial clearance of 28-teeth drive gear

05-ML 13-4





▽▽ (▽▽▽)

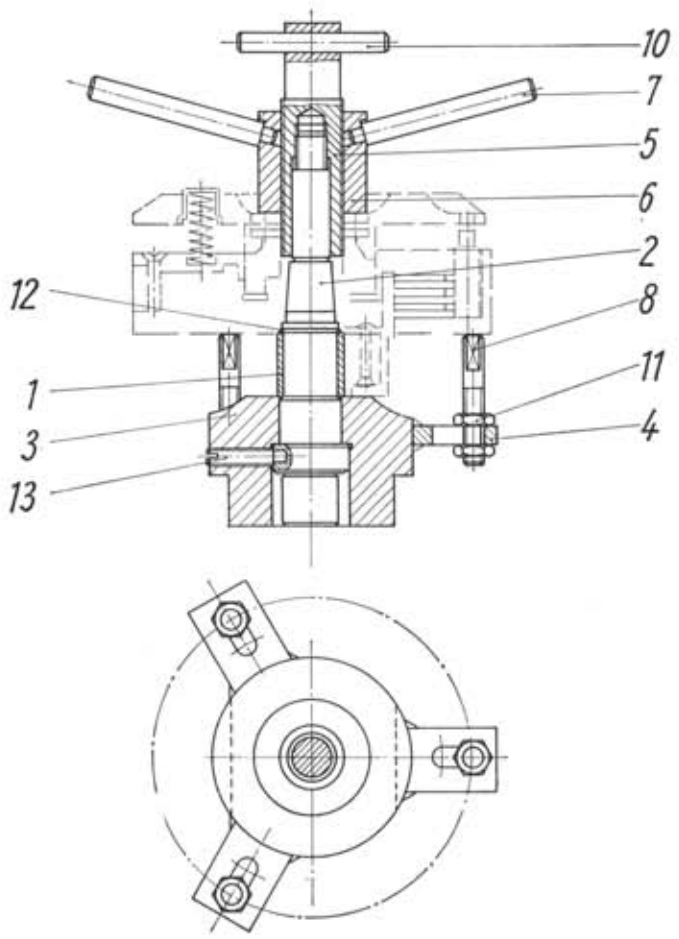
(a) to be ground
(b) knurled

Fits	Allowances
15 dia.$^{H\,7}$	$+\frac{0.018}{0}$
8 dia.$^{H\,8}$	$+\frac{0.022}{0}$

Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Holder	C 15	35 dia. × 55	case-hardened
2	1	Feeler pin	silver steel	5 dia. × 40	hardened
3	1	Fillister head screw M 4 × 12			TGL 0-84
4	1	dial 40 dia.			

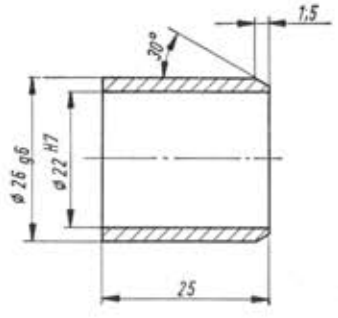
Clutch tensioning device

05-MV 150-2



Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Bush	C 15	30 dia. × 30	case-hardened
2	1	Retaining pin (Tail shaft 05-843.58-0)	16 MnCr 5	32 dia. × 160	hardened
3	1	Support } welded	MSt 3	85 dia. × 55	
4	3	Receptacle } part	MSt 3	30 × 8 × 35	
5	1	Thrust piece	C 45	30 dia. × 95	
6	1	Nut } welded	C 45	45 dia. × 45	
7	2	Handle } part	St 37 K	10 dia. × 80	
8	3	Studs	C 15 K	10 dia. × 55	
10	1	Cylindrical pin 8 m × 6 × 60			TGL 0-7
11	6	Hexagon nut M 8			TGL 0-934
12	1	Circlip 22 × 2			TGL 9045
13	1	Stud M 8 × 25			TGL 0-417

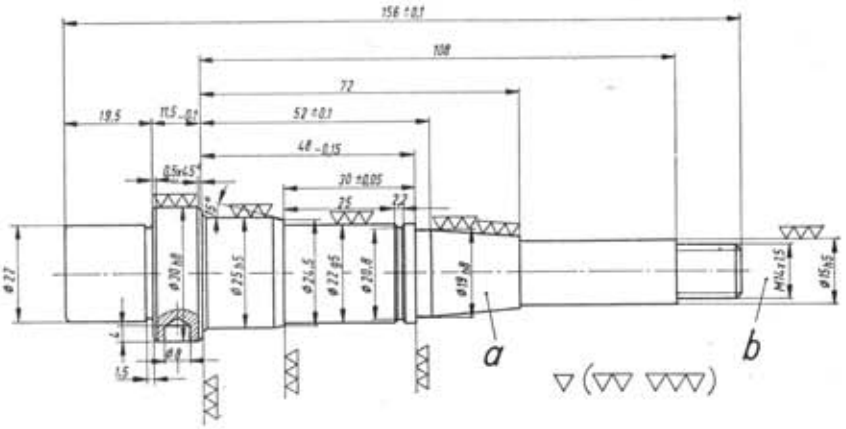
Part 1



case-hardened and ground

Fits	Allowances
22 H 7	+ 0.021 0
26 g 6	− 0.027 − 0.920

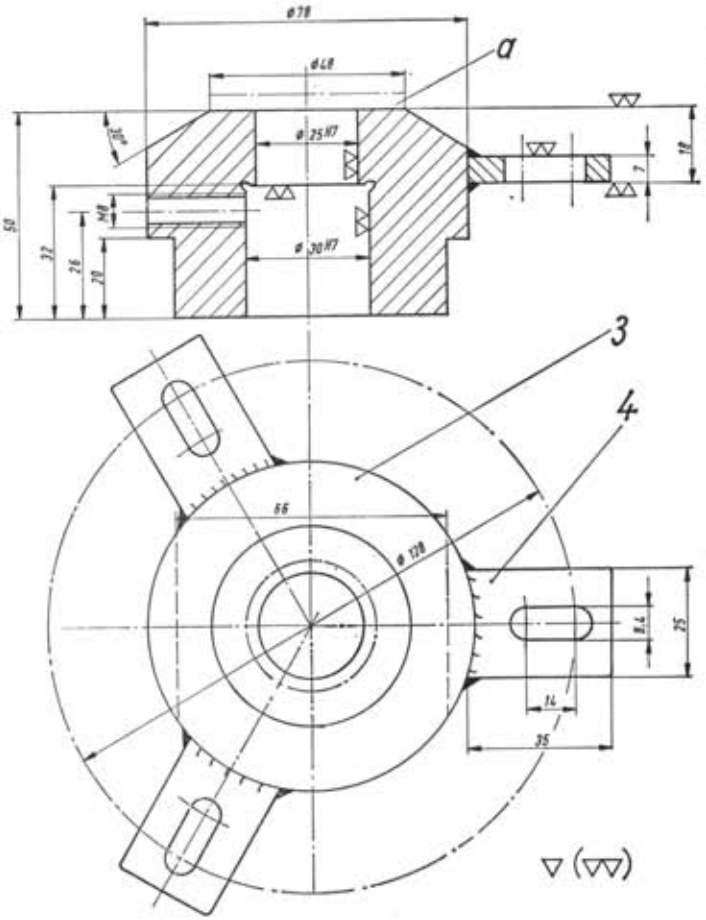
Part 2



hardened and ground
(a) taper 1 : 10
(b) thread soft
Dimensions of complete crankshaft 05-843.51-0

Fits	Allowances
$30^{h\,8}$	$^{0}_{-0.033}$
$25^{h\,5}$	$^{0}_{-0.009}$
$22^{g\,5}$	$^{-0.007}_{-0.006}$
$19^{h\,8}$	$^{0}_{-0.033}$
$15^{h\,5}$	$^{0}_{-0.008}$

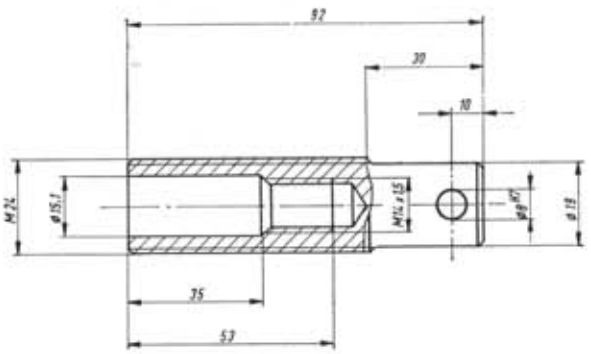
Part 3/4



greased and phosphate-treated

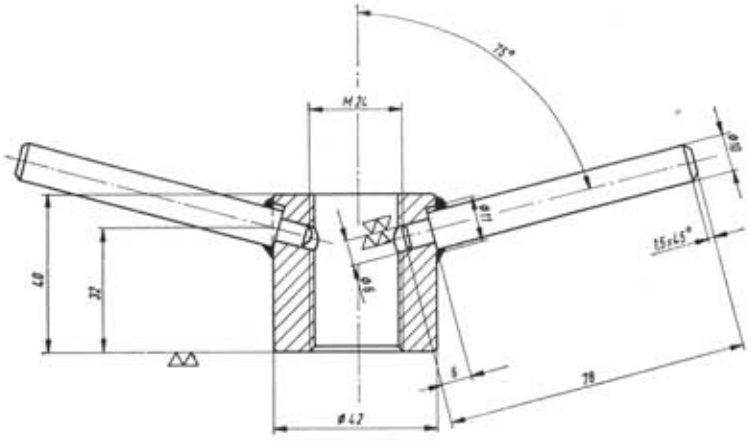
Fits	Allowances
$30^{H\,7}$	$^{+0.021}_{0}$
$25^{H\,7}$	$^{+0.021}_{0}$

Part 5

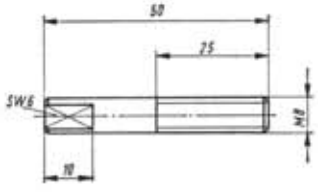


Fits	Allowances
$15^{H\,8}$	$+\,^{0.027}_{0}$

Part 6/7

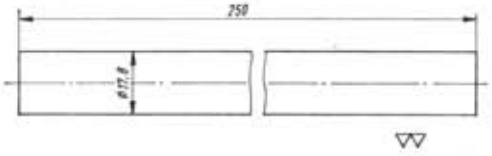


Part 8



Centring-pin for setting the swinging arms

05-MW 26-4

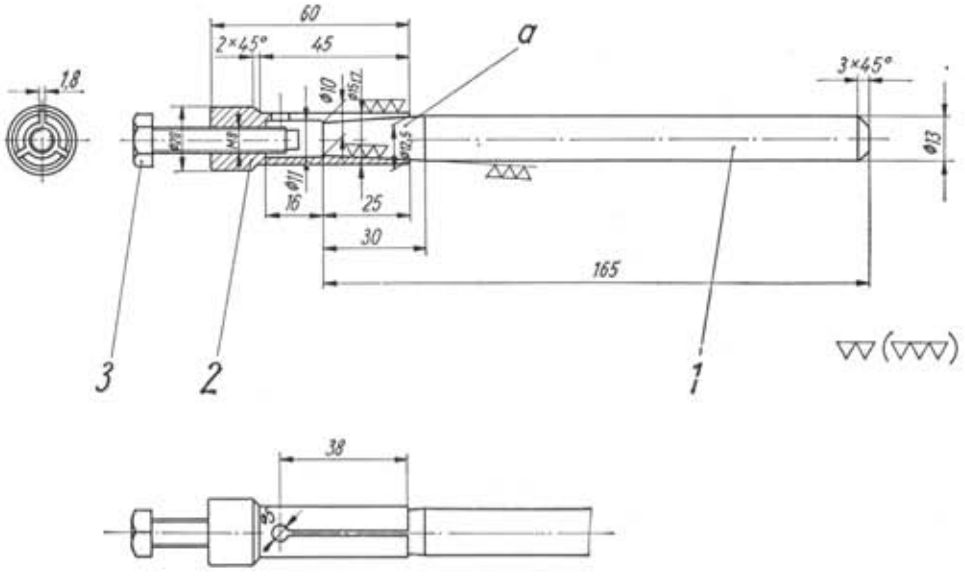


degreased, tin-plated

Part	Quantity	Description	Material	Rough Size	Remarks
	1	Centring-pin	C 15 K	18 dia. × 255	case-hardened

Expanding mandrel for wheel bearings

H 8-820-3

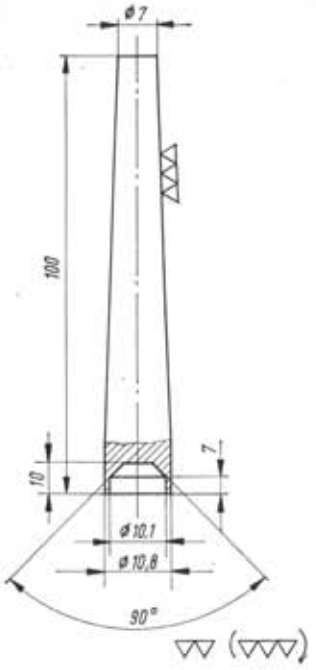


(a) taper 1 : 10

Part	Quantity	Description	Material	Rough Size	Remarks
1	1	Drift	C 15	15 dia. × 170	case-hardened
2	1	Expanding sleeve	67 SiCr 5	23 dia. × 65	hardened
3	1	Hexagon head screw M 8 × 45	– 4 D		TGL 0-561

Fitting Sleeve for radial seal ring

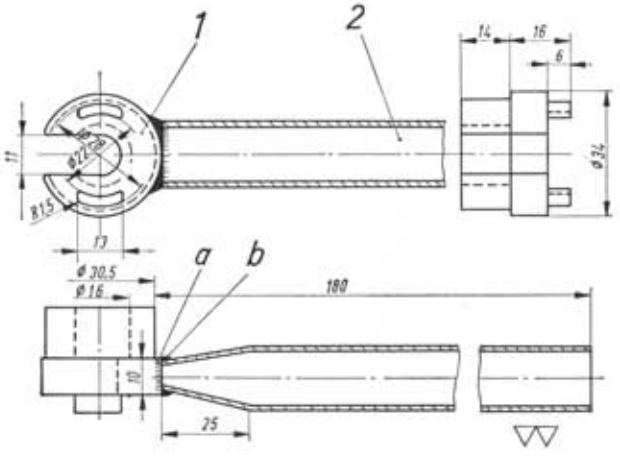
05-MV 93-4



Part	Quantity	Description	Material	Rough Size	Remarks
	1	Fitting sleeve	St 60	12 dia. × 105	

Special wrench for shock-absorber locking nut

05-MW 82-4



degreased, phosphate-treated
(a) pipe to be pressed
(b) weld seam must not project

Part	Quantity	Description		Material	Rough Size	Remarks
1	1	Rim	18 × 1.5	MSt 3	35 dia. × 35	
2	1	Pipe			185 long	

12. Conversion Table

1 international inch (″) = 25.4 mm
(from July 1, 1959, the English and the American inch are equal)

1 mile = 1.61 km

a) Millimetres to Inch

1 mm = 0.0394″
0.5 mm = 0.0197″
0.1 mm = 0.0039″
0.01 mm = 0.0004″

b) Fractional Inches to Millimetres

$^1/_{64}$″ = 0.397 mm
$^1/_{32}$″ = 0.794 mm
$^1/_{16}$″ = 1.588 mm
$^1/_8$″ = 3.175 mm
$^1/_4$″ = 6.350 mm
$^1/_2$″ = 12.700 mm

c) Kilometres to Miles

1 km = 0.621 miles
(1 mile = 1.61 km)

d) Centigrades to Degrees Fahrenheit

− 20 °C = − 4 °F
0 °C = 32 °F
50 °C = 122 °F
80 °C = 176 °F
100 °C = 212 °F

e) Litres to Gallons and Pints

1 US gallon = 3.785 litres (l)
1 US pint = 0.4732 litres
1 Imp. gallon = 4.546 litres
1 Imp. pint = 0.5682 litres.