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BMW AG

**INSTRUCTION BOOK FOR THE
BMW MOTOR CYCLE R 5**

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Instruction Book for the

BMW Model R 5

Flat Twin 500 c.c. Touring and Sports
Motor Cycle with foot-gear change

BAYERISCHE MOTOREN WERKE A.G. MUNICH 13

Codes: ABC 5th & 6th Edition u. Rudolf Mosse. Telegr.: Bayernmotor. Telephone: 32516.

All goods to be send: München-Milbertshofen

**Original
aus dem BMW
Archiv**

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Preface

The present manual brings in concise and yet detailed form a description and service instructions for our new tubular frame motor cycle type R 5: a 500 c. c. O. H. V. flat-twin model with four speed gearbox and foot control.

The endeavour to make our customers acquainted with all important details as far as possible has resulted in the manual being illustrated by a large number of photos and drawings.

Special attention is called to the suspension of the front wheel by a telescopic fork with enclosed oil damper which has already brilliantly proved its worth with our 750 c. c. type. With the R 5 type the fork suspension shows another novel feature by the adjustment of the oil damping being made possible in riding, which endows the motor cycle with riding properties lying far beyond the average.

A thorough study of this manual is urgently recommended to all motorcyclists, particularly to beginners.

In case of trouble the nature of which is not recognised with certainty, we recommend most urgently not to proceed to make any alterations oneself, but to inform the competent representative or the works, indicating the type, the frame and engine number so as to have the faults mended in a proper way.

Customers are requested to give their orders for spare parts to the competent representative and to state without fail the type, frame and engine number so as to avoid any unnecessary request for further information and delay of delivery caused thereby.

The extent of delivery is, however, not governed by the contents of this manual, but exclusively by the contract of purchase.

Munich, August 1936

**BAYERISCHE MOTOREN WERKE
AKTIENGESELLSCHAFT
MUNICH 13**

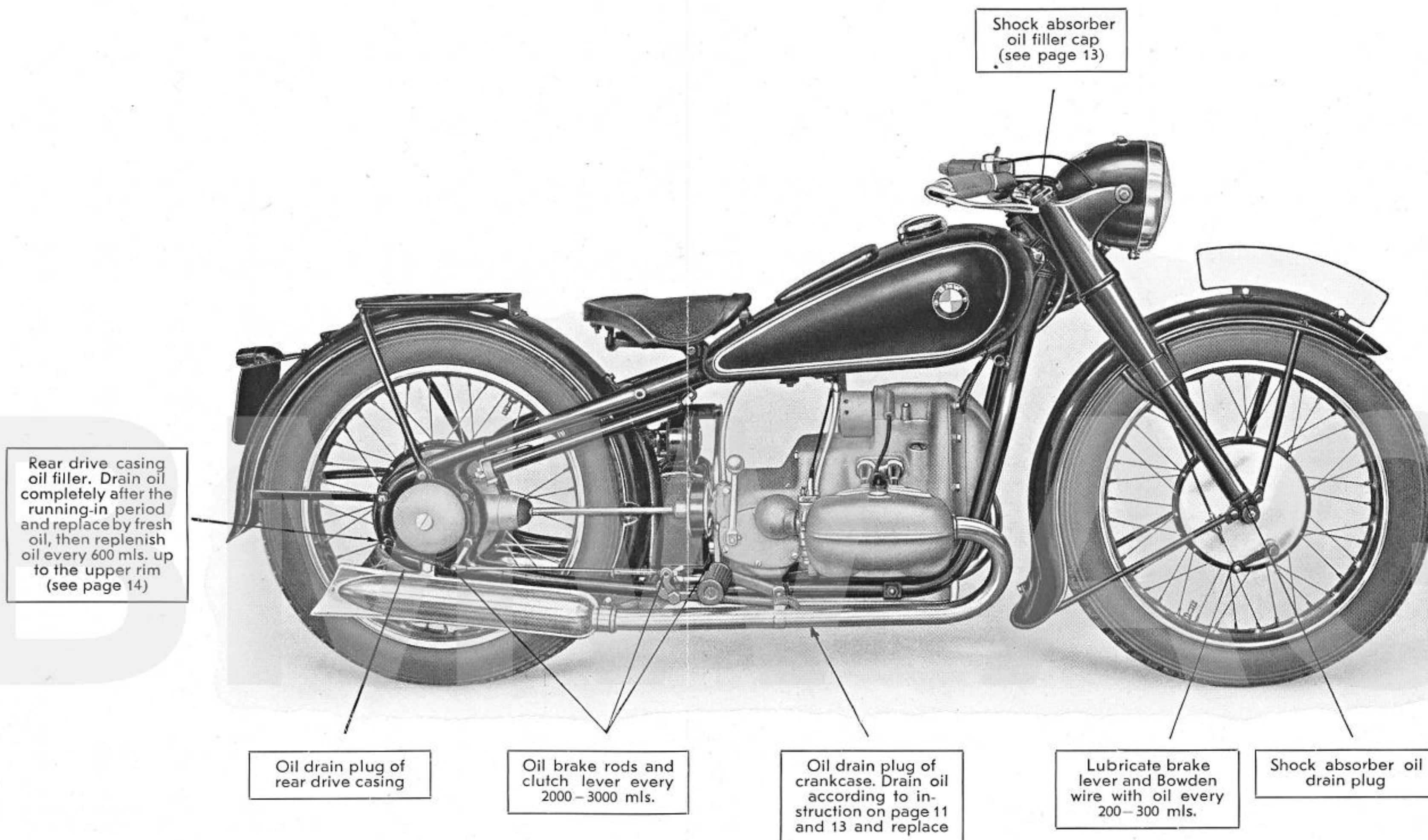
Specification

Number of cylinders	2		
Arrangement of cylinders	horizontally opposed		
Cylinder bore	2,68 ins.	(68 mm)	
Piston stroke	2,68 ins.	(68 mm)	
Cylinder capacity	30	cub.in (494 c.c.)	
Number of revolutions per minute at a speed of 37 m. p. h.	2450		
Maximum speed approx.	87	m.p.h. (140 km/h)	
Brake output (guaranteed maintained output)	24	b.h.p.	
Capacity of petrol tank approx.	3,3	gal. (15 ltr.)	
Capacity of oil tank (in crankcase) . . approx.	0,45	gal. (2 ltr.)	
Fuel consumption per 100 km approx.	$\frac{3}{4}$	gal. (3,5 ltr.)	
Oil consumption per 100 km approx.	0,03	gal. (0,1—0,2 ltr.)	
Saddle height	27	ins. (0,69 mtr.)	
Length of motor cycle	84	ins. (2,13 mtr.)	
Width of motor cycle	31	ins. (0,8 mtr.)	
Height of motor cycle	37	ins. (0,95 mtr.)	
Wheel-base	55	ins. (1,4 mtr.)	
Gear ratios:			
1 st gear	1:3,6		
2 nd gear	1:2,28		
3 rd gear	1:1,7		
top gear	1:1,3		
Reduction from gearbox to rear wheel:			
solo	1:3,89		
with sidecar	1:4,62		
Dimensions of tyres (wired-on tyres)	26x3,5"		
Weight of the motor cycle, ready for			
service , with fuel tank, filled approx.	364	lb. (165 kg)	
Carrying capacity approx.	470	lb. (210 kg)	

Illustr. 1

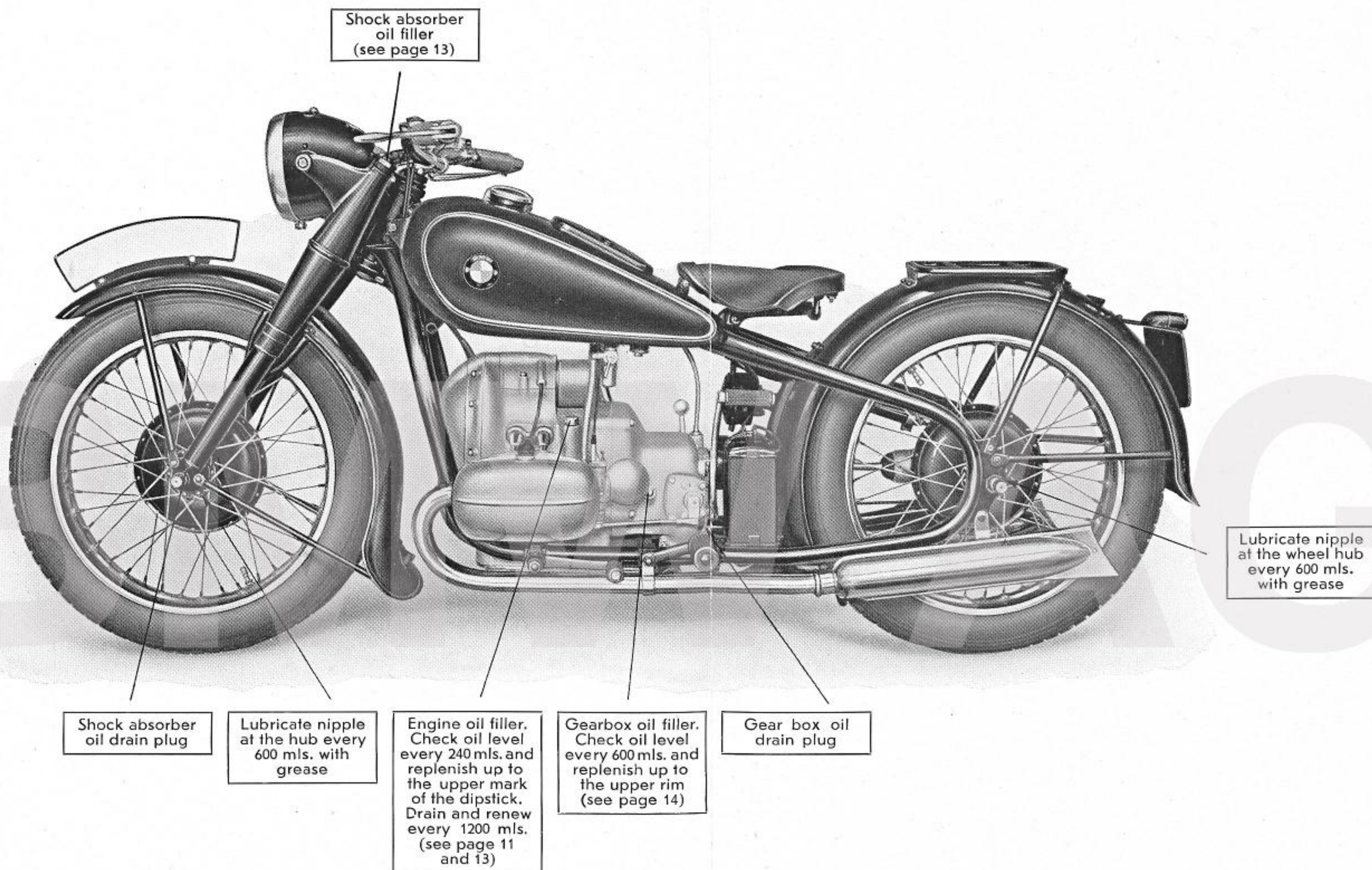
R 5 machine viewed from the rear drive
side with lubrication chart

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Illustr. 1

R 5 machine viewed from the rear drive side with lubrication chart



Illustr. 2

R 5 machine viewed from the kickstarter side with lubrication chart

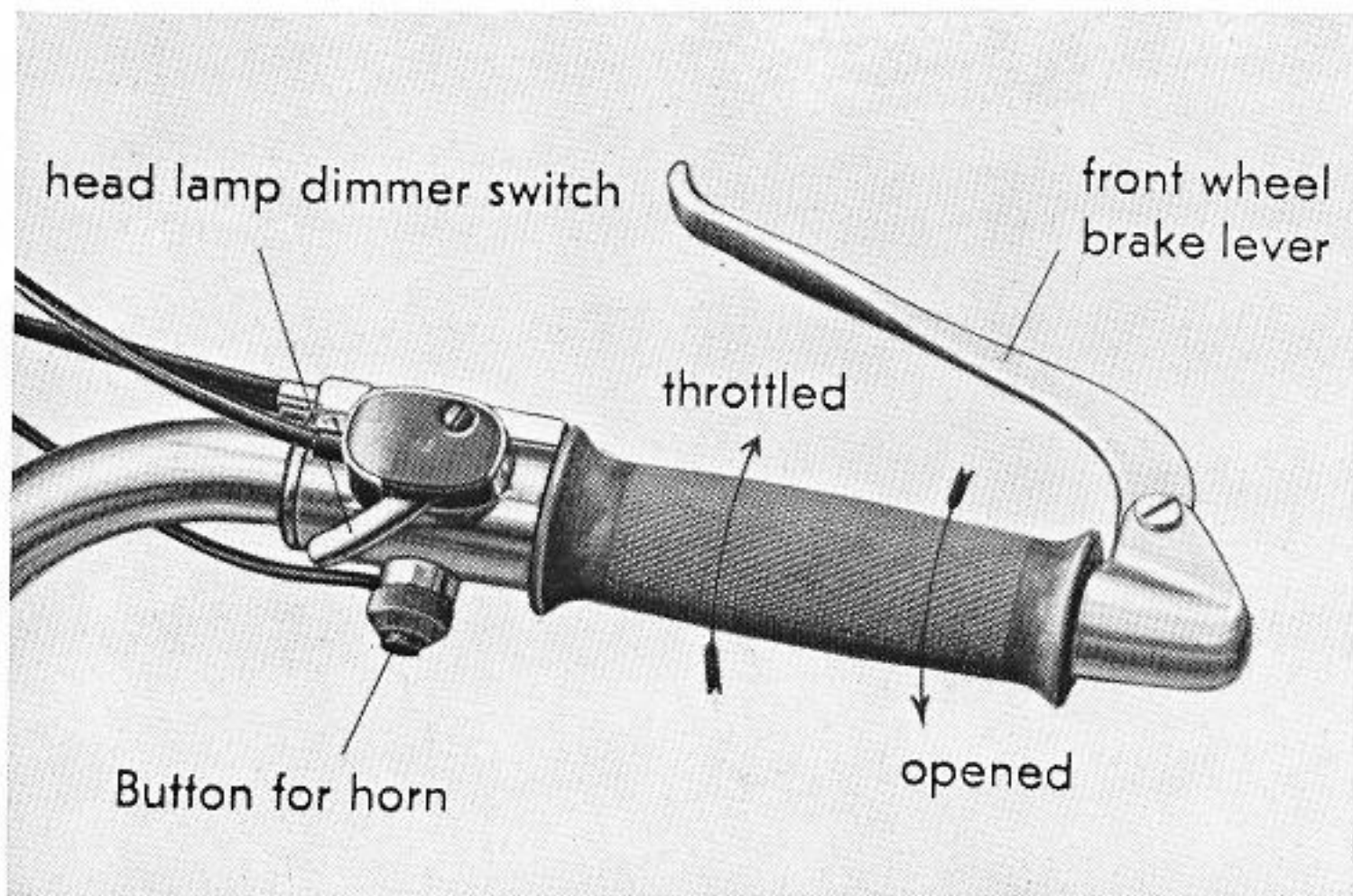
I. Operation

1 Arrangement of the operating levers

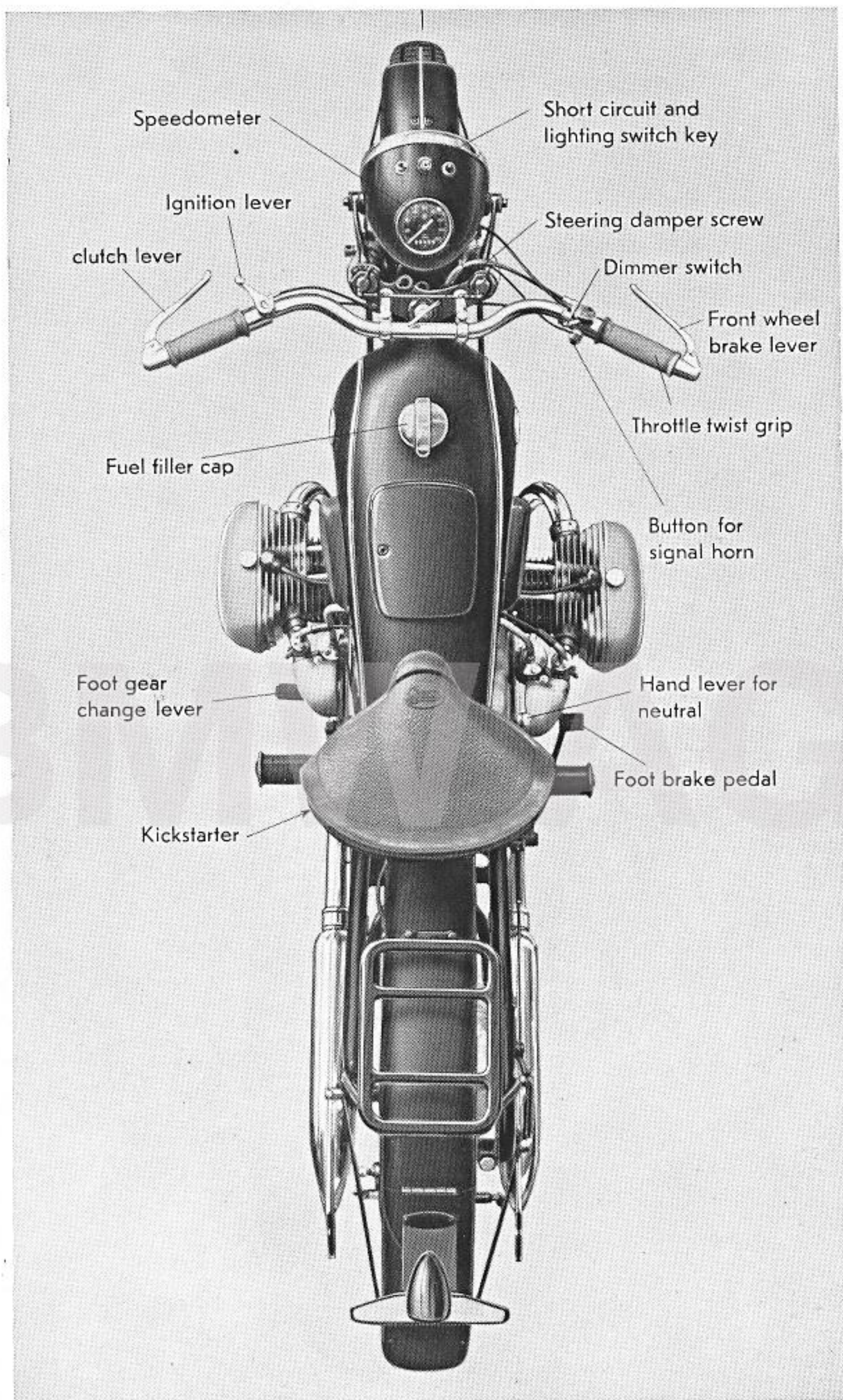
As shown by illustr. 4, the majority of the hand levers is arranged conveniently on the handlebars. At the right there is the throttle twist grip and the press button for sounding the horn, further the headlamp dimmer switch and the front wheel brake lever. On the left side, there is the clutch lever and the ignition lever and in the middle of the handlebars there is the steering damper screw and on the fork bars the adjusting levers for the shock absorber regulation. The gear change is effected by the foot control lever arranged on the left side; the hand control lever arranged on the right side serves to engage the idling with the machine at a standstill. The foot lever to control the rear wheel brake is arranged in front of the right foot rest and the kickstarter behind the left foot rest.

2. Operation of the control levers

a) Throttle twist grip: The twist grip operating the throttle slide valves of the two carburetters by means of Bowden cables opens by being turned to the left and closes by being turned to the right forwards (illustr. 3).



Illustr. 3. Righthand end of handlebars (throttle twist grip)

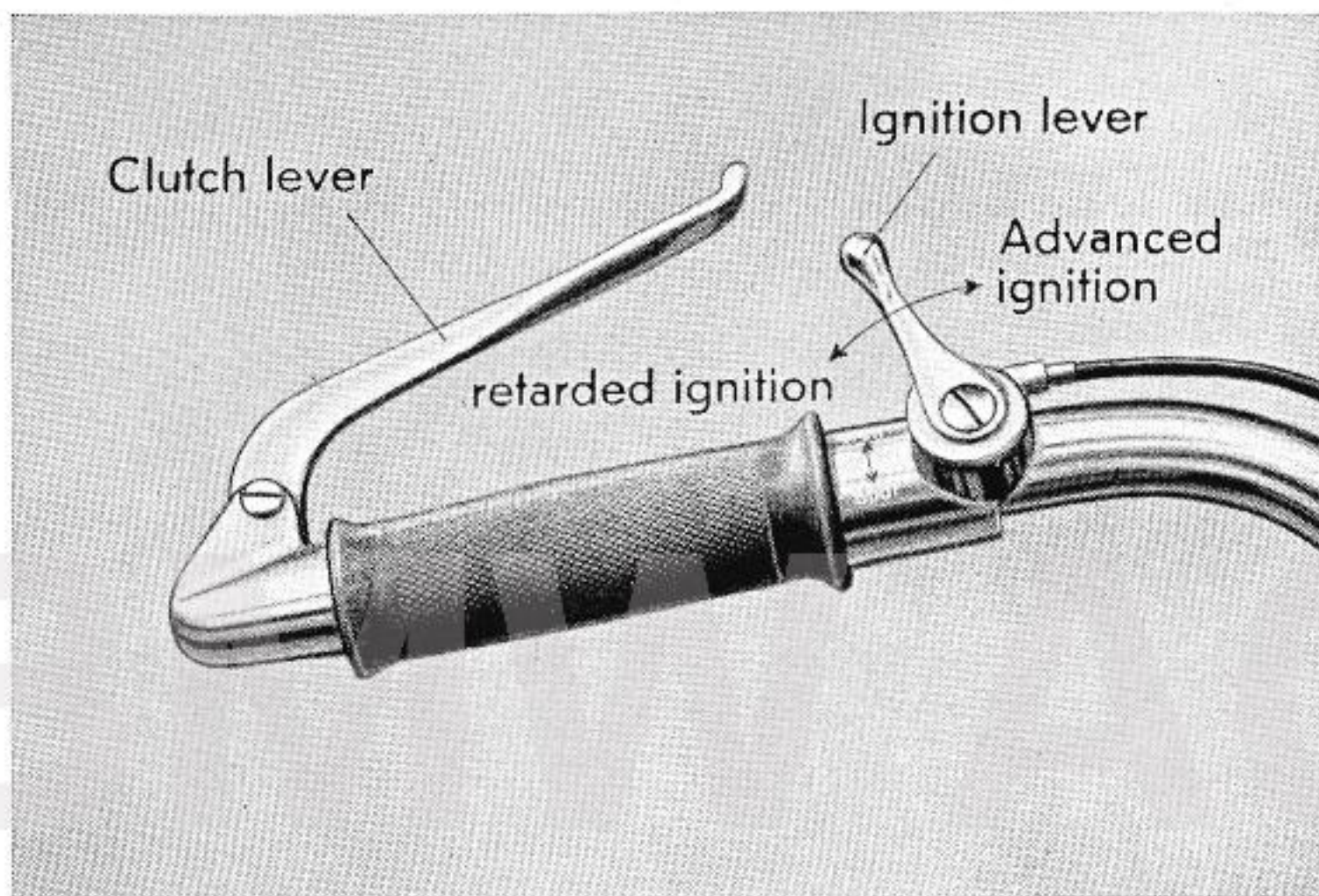


Illustr. 4. The operating levers at the BMW motor cycle R 5

b) Ignition lever: The ignition lever, operating the adjusting lever of the contact breaker by means of Bowden cable and thus changing the moment of breaking of the contact, adjusts the contact breaker to advanced ignition by turning forward and to retarded ignition by turning backward (illustr. 5).

To start the engine, the ignition lever must be adjusted to retarded ignition to avoid back-fire.

When the engine has warmed up, the ignition must be regulated according to the number of revolutions of the engine. For cruising with full speed on level road full advanced ignition should be adjusted. Any knocking of the



Illustr. 5. Left handlebar end

engine, particularly when riding up-hill, is removed by retarding the ignition. If the knocking does not disappear even then, the fuel is possibly unsuitable, in which case 50% of benzol should be added.

Retard the ignition as soon as the engine starts knocking until the knocking ceases. In case of quick acceleration the ignition should be retarded somewhat for a short time.

c) Gear change control lever: The use of the foot control offers considerable advantages as compared to the gear changing method used heretofore:

With foot control both hands may keep resting on the handlebars during the changing process, and thus the number of revolutions of the engine can be regulated accordingly even during the changing operation.

To engage the **1st gear** the foot control lever must be moved **upwards** (when the engine is stationary, the first gear may be engaged by moving back the

hand control lever); to engage the 2nd, 3rd and top gear, the foot control lever must in every instance be pressed **downwards** up to the stop and released again. Whenever a gear has been engaged, the foot control lever returns to its original position.

For **changing gear down** the foot control lever is moved by the tip of the left foot **upwards** as far as the stop and allowed to return to its original position every time after having engaged the next lower gear. The hand control lever on the right side works in conjunction with the foot control lever during the changing operation and remains in the gearing position occupied at the time; it only serves to engage the neutral **while the engine is stationary** and in the neutral position it stands vertical or coincides with the nose **13** cast to the gear-box cover.

For changing gear up (1st - 2nd - 3rd - top gear) declutch and close throttle, when changing gear down (top - 3rd - 2nd - 1st gear) declutch and open throttle slightly.

Use the first gear for moving off only, and shortly afterwards engage second and then third gear, allowing the engine to remain in the latter gear for some time; if the town traffic is not too dense and on level roads engage top gear. In dense town traffic third or second gear should be used. When cruising top speed, take care not to allow the speed to drop below 19 m. p. h. (30 km/hr) on level ground, and not below 22 m. p. h. (35 km/hr) with heavy load or when driving up-hill.

d) Brakes. It is advisable to apply both brakes simultaneously, if possible, so as to ensure uniform wear. We recommend with prolonged down-hill driving to use hand and foot brake alone alternately so as not to heat them both simultaneously. In bends only the foot brake should be applied. When driving down steep hills, the motor should be used as a brake by engaging second or third gear.

e) Adjustment of the steering damper. In the middle of the handlebars a large wing nut is provided, by means of which the steering may be adjusted harder or softer according to road conditions.

f) Adjustment of the shock absorber. By means of the small wing levers arranged on top of the fork bars and firmly connected with each other the return shock absorption of the fork may be adjusted softer or harder according to the marks **W** and **H** indicated below the left lever.

3. Preparations for riding and riding proper

Make sure that the fuel tank is full and that the oil tank in the engine is filled with oil up to the upper ring mark of the dipstick, the gearbox and rear drive casing up to the lower threads of the filler orifices.

Before depressing the kickstarter, open the fuel tap located at the bottom of the tank, and press in fully the switchkey arranged on top at the head-light; the flashing-up of the red control lamp indicates that the ignition is connected.

Never keep the red light burning during prolonged stops, as otherwise the battery is discharged over the ignition coil.

To set the cold engine in motion, depress the ticklers of both carburetters and open the throttle twist grip by about one third. Make sure that the gearbox is in neutral position and then depress the kickstarter as quickly and vigorously as possible.

Let the cold engine warm up at medium engine speed; do not move off before the engine has well warmed up.

To set the warm engine in motion, the throttle twist grip must be kept closed and tickling the carburetters must be dispensed with, as otherwise there would be an excess of fuel owing to the starting, which instead of facilitating starting the engine, would make it more difficult. The ignition lever must be opened half-way.

For engaging the other gears, declutch in every instance and close throttle. In the top gear at a speed of **over 37 m. p. h. (60 km/hr)**, advance spark fully.

To stop the motor cycle, close throttle, pull the clutch lever and stop the motor cycle by applying the brakes, the engine continuing to work in neutral. Whilst stopping it is advisable to change down to first or second gear so as to be either ready to start again at once or to engage neutral by hand with one movement.

In case of danger, close throttle and apply both brakes simultaneously **without** declutching as the engine acts as a brake; when the cycle is almost at a standstill, one still might declutch quickly so as not to choke the engine.

The **engine is stopped** by pulling back the switch-key to its lower rest. When the engine is stopped, close the fuel tap.

4. Lubricants and fuels

For lubrication use only high grade engine oil for the engine, gearbox and rear drive casing. According to our experience, we recommend:

	in summer:	in winter:
for the engine	Gargoyle Mobiloil D	Gargoyle Mobiloil BB
for the gearbox	Gargoyle Mobiloil	Gargoyle Mobiloil BB
for the rear drive casing	Gargoyle Mobiloil D	Gargoyle Mobiloil D

In **winter**, at temperatures below -10°C , **Gargoyle Mobiloil Arctic** should be replenished.

For taking part in competitions the transitory use of such racing oils as **Gargoyle Mobiloil R** is recommendable.

Castor oil must by no means be added to other oils; when changing over from mineral oil to castor oil or vice versa, the engine must be rinsed thoroughly.

The fuel to be used must be only a mixture of equal parts of petrol and benzol.

It is **absolutely necessary** to add to the fuel a good top lubricant e. g. **Gargoyle top lubricating oil** (according to the mixture chart attached to every can) during the running-in period.

Should there be no special top lubricant available, the oil prescribed for our engine might also be added to the fuel as a top lubricant by **way of substitute**. In this case the quantity of the oil added must not exceed 10%.

To grease the nipples of the wheel hubs we recommend the use of **Gargoyle Mobilcompound No. 4**.

To lubricate the brake rods, the clutch lever, the change gear lever and the Bowden wires the same oil as for the engine should be used.

5. Running-in new engines

Important!

Set the engine in motion with retarded ignition. Specially in cold weather, allow the engine to run warm when stationary with medium engine speed and do not move off before the engine has well warmed up. Heavy strain on the cold engine leads to trouble.

Run in the machine properly. Open the throttle for a short time, then close it again, that is allow the machine to run at low speed.

To have a certain guarantee for proper running-in, the carburettors of the machines newly delivered are supplied with a sealed throttle which provides for a limitation of the stroke of the gas slide. This pin must not be shortened after 600 mls. (1000 km) or removed after 1200 mls. (2000 km) by the competent representative until after the prescribed running-in period. If the seal is damaged or the throttle pin altered without authority, any claim of guarantee will be forfeited.

The cruising speeds during the running-in period are as follows:

Maximum speeds:	1st gear	2nd gear	3rd gear	top gear	
from 0— 600 mls.	9	19	28	43 m. p. h.	must not be exceeded
(0—1000 km	15	30	45	70 km/hr)	
from 600—1200 mls.	12	25	37	55 m. p. h.	must not be exceeded
(1000—2000 km	20	40	60	90 km/hr)	

The above maximum speeds should only be maintained for distances from 220 to 550 yds. (200 to 500 mtr), then the engine should be allowed again to run with the throttle almost closed, etc. Between 1200 mls. (2000 km) and 2000 mls. (3000 km) limit the maximum speeds to shorter distances to begin with, that is **give full throttle only after 2000 mls. (3000 km) for longer distances**. Adjust the ignition lever in accordance with the number of revolutions: with low engine speed (during the running-in period) give only half spark advance.

Give full advance only with high engine speed and low loads and engage second or first gear on level ground.

After the running-in period utmost care should be taken not to exceed in first, second and third gear the speeds marked red on the speedometer dial: 1st gear: 45 km/hr, 2nd gear 75 km/hr, 3rd gear 100 km/hr.

II. Maintenance

1. General instructions

All nuts and pins must be checked for tightness in the beginning at short intervals. This is particularly important with the knock-out spindles, cylinder heads, intake pipes and gearbox.

2. Lubrication

All the places of lubrication indicated in illustr. 1 and 2 must be lubricated regularly.

During the running-in period frequent change of oil for the engine is strongly advised. **Every 300 mls. (500 km) the oil should be completely drained from the crankcase**, which should be thoroughly rinsed with rinsing oil, and fresh oil should be filled in up to the upper mark of the dipstick (abt. 2 ltr). The oil level in the engine should be examined **regularly every 250 mls. (400 km)** and in case of need replenished up to the prescribed height.

After the running-in period the oil must be drained every 1200 mls. (2000 km) and replaced.

To examine the oil level in the crankcase the bottom part of which forms at the same time the oil tank, a dipstick T provided with a hexagon head is arranged on the left side of the casing (illustr. 15). When replenishing the oil should reach the upper annular mark of the dipstick and care should be taken that in no case **more oil** is filled in, and further, that the oil level does not sink below the lower annular mark of the dipstick.

In general the **front wheel fork** does not require any particular lubrication; any oil that should have spilled out must be supplemented from time to time. Only in case repairs are necessary, the oil must be drained and about 160 c. c. of oil (we recommend Gargoyle Mobiloil Arctic) should be filled in each half of the fork. For this purpose the connecting rod 1 (illustr. 19) must be removed and the screw 2 at each fork-half undone; now the thumb lever 3 with the adjusting rod attached to it may be removed from each fork half. A mark is provided at the adjusting rod that serves to control the oil level in each fork half; when renewing the oil entirely or replenishing it the oil must reach exactly this mark **with unloaded engine and discharged fork**.

For assembling one proceeds in the reverse way, care being taken that the end of the adjusting rod engages the slit of the regulating valve arranged in the interior of the fork.

The oil in the gearbox and the rear drive casing must be drained completely after the running-in period and replaced by fresh oil. The oil level must be checked regularly **every 600 mls.** (1000 km) and oil replenished **until it runs over** at the filler orifice (illustr. 1 and 2). Apart from the change of oil after the running-in period, the oil should be drained completely and replaced in the gearbox and rear drive casing regularly **every 9500 mls.** (15 000 km).

The rear drive casing holds abt. $\frac{1}{8}$ ltr of oil and the gearbox abt. $\frac{3}{4}$ ltr.

We recommend to have the oil for gearbox and rear drive casing changed by the competent representative.

The grease nipple at **the front and rear** hub should be lubricated with good grease **at least every 600 mls.** (1000 km) (we recommend Gargoyle Mobil-compound No. 4).

Regarding the lubricants to be used see chapter "Lubricants and Fuels", page 11.

About every 12 000 mls. (20 000 km) or in case of general overhauling of the engine also the hot-bearing grease in the ball bearings of the dynamo and in the contact breaker the lubricant in the felt for the cam lubrication should be replaced preferably by a **Bosch representative**. In this connection we still wish to draw attention to the instructions for "Lubrication" given in the attached Bosch booklet.

We recommend particularly to have the motor cycle and the engine overhauled at least once a year. At that opportunity also the thrust bearing of the front wheel fork should be supplied with fresh grease.



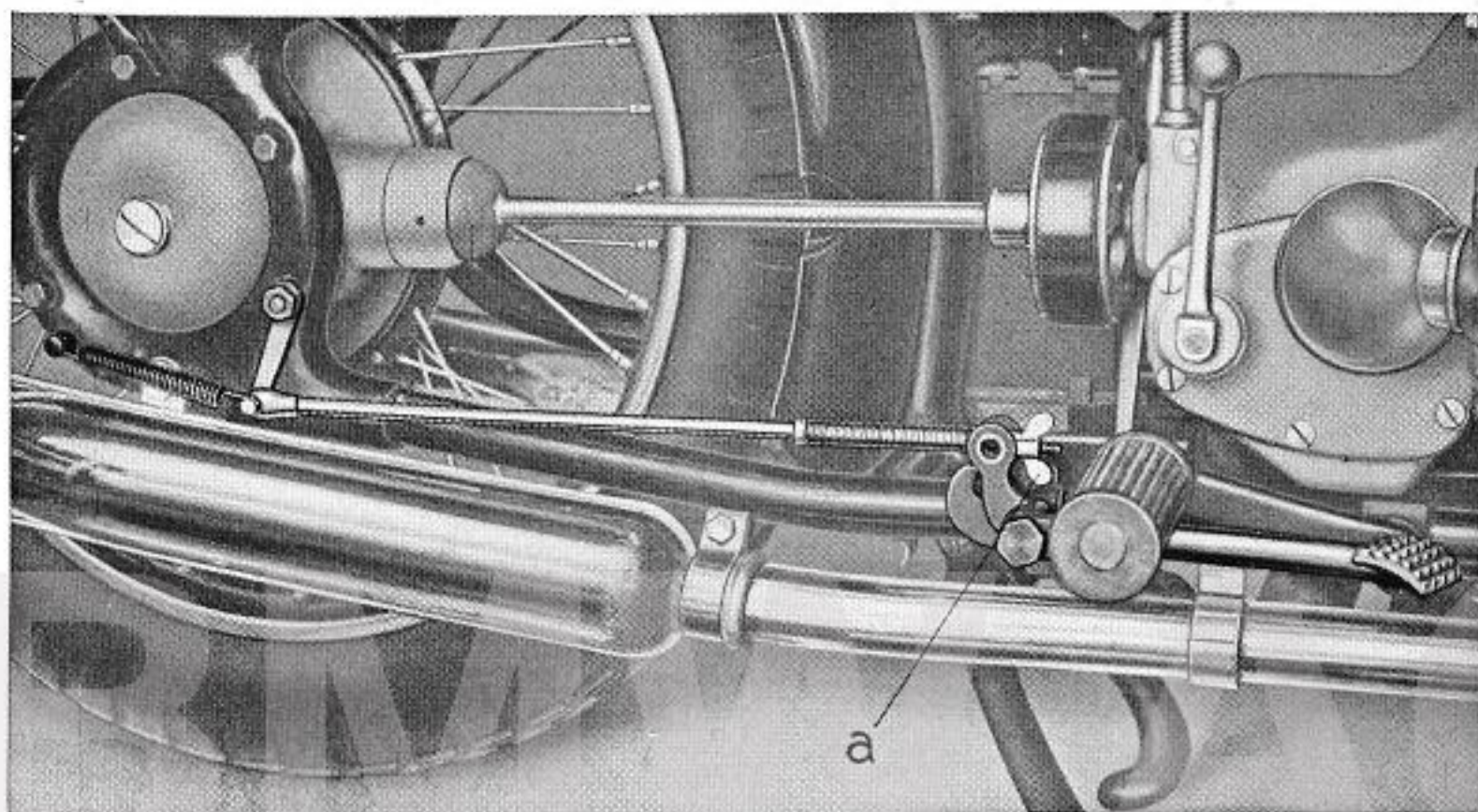
Illustr. 6. Front wheel brake

3. Supervision of the brakes and coupling

A **regular supervision** of the brakes is imperative for safe driving so as to be able to rely in every case on their faultless working.

The adjustment is effected with the **front wheel brake** by unscrewing the wing screw arranged in the middle of the brake case, in which the Bowden wire ends, by a few turns. (See illustr. 6.)

The adjustment of the **rear wheel brake** is effected in the simplest manner by tightening the wing nut a, located at the brake tension rod. (See illustr. 7.)



Illustr. 7. Rear wheel brake

When adjusting the brakes it is advisable to check also the clutch wire and, if needful, to adjust it by means of the wing nut located at the declutching lever.

When adjusting the brake and the clutch, great care should be taken that there is some play between the point of attack and the neutral position of the operating levers, as otherwise the lining of the brake or the clutch is subjected to excessive wear.

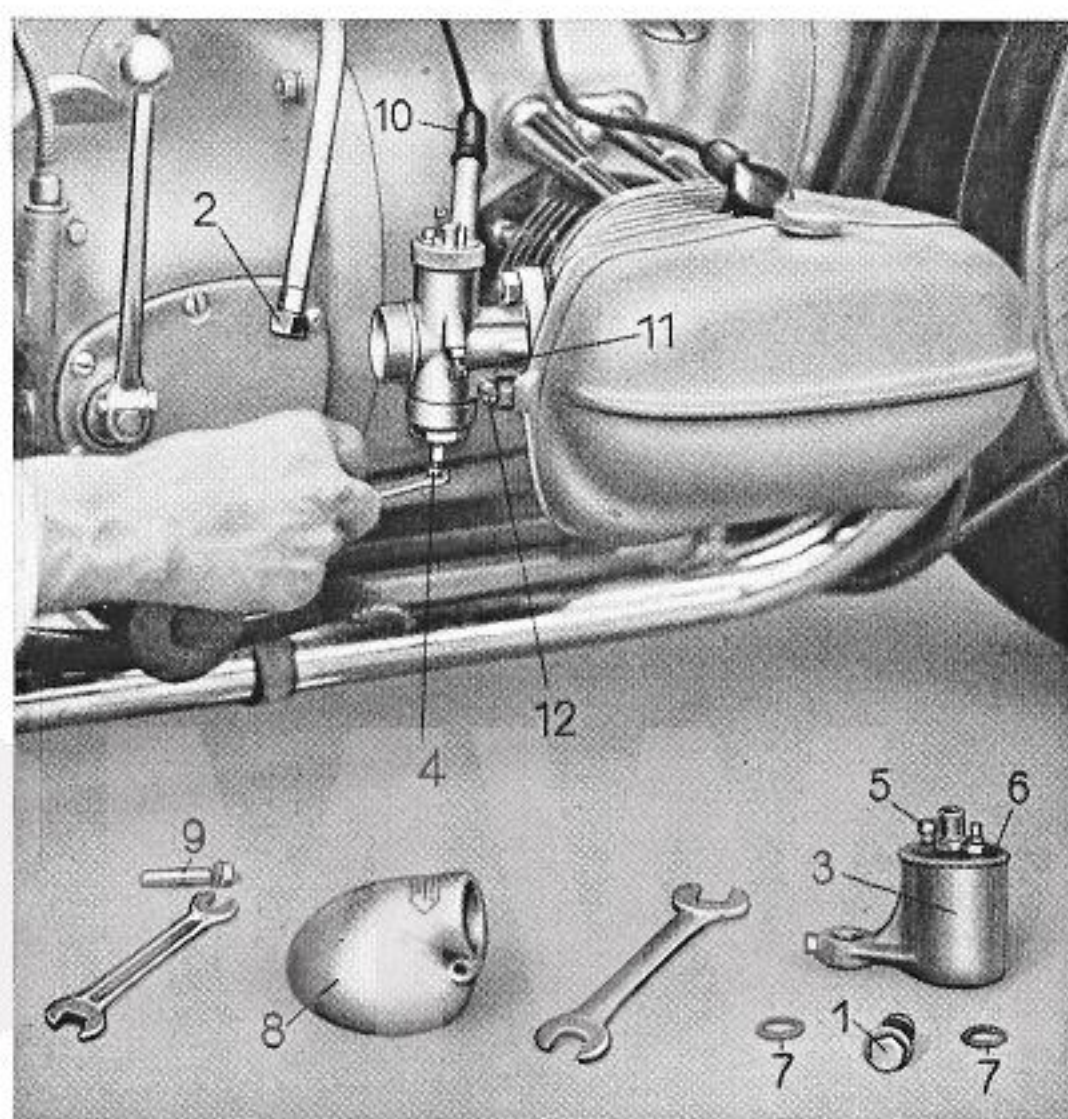
4. Treatment of the carburettors

To maintain the output it is important to clean the carburetter from time to time. Especially **in the beginning** the jets, the float chamber and the carburetter valve needle should be cleaned frequently.

a) Cleaning: All that is needed to clean the jets and the float chamber is unscrewing the fixing bolt 1 (illustr. 8) and removing the fuel piping from the float

chamber **3** by unscrewing nut **2**; now the float chamber **3** can be taken off and the main jet **4** can be removed by means of the small jet key and cleaned. The bore in the jets should only be cleaned by blowing or by means of horse hair; **never use any pointed instrument (pin etc) for it as the bores of the jets would be changed thereby.**

To clean the **float chamber 3**, the cover **6** must be unscrewed after having loosened the binding screw **5**; then the float **T** (illustr. 16) and the valve needle **V** may be taken out and all parts cleaned thoroughly.



Illustr. 8.
Cleaning the carburetter

In assembling it must not be overlooked to tighten the fixing screw **5** (illustr. 8) at the cover of the float chamber and to insert the copper-asbestos packings **7** above and below at the fixing flange of the float chamber. When the assembly is completed, the pipings and joints should be checked regarding tightness.

The **air filters 8** fixed to the carburetters may be taken off after unscrewing the nut and removing screw **9**; they should be cleaned with petrol from time to time and soaked in a little oil to increase the effect. Superfluous oil should be slung out before assembly to prevent the sparking plugs from being clogged with oil.

b) Adjustment:

The **normal adjustment** of the carburetters is:

slide valve $5/4$, main jet 105, position of valve needle 3, i. e. the fixing spring is in the third groove from above.

By adjustment of the jet needle the carburetter may be adapted to summer or winter conditions or also to definite fuels.

Idling adjustment. Idling should only be checked adjusted when the engine is warm.

Before adjustment, the throttle Bowden wires must be loosened by screwing in the adjusting screws which become accessible after taking off the rubber sleeve **10** (illustr. 8). Then adjust the idling as evenly as possible in each carburetter at the slide-valve detent screws **11** located at the side of the slide valve case, keeping the throttle twist grip closed and with fully retarded ignition. (Before doing so, the conternut must be loosened). Further, the correct composition of mixture must be obtained by means of the air throttle screw **12**. To check the adjustment, remove the ignition cable of the one cylinder from the sparking plug. Then the second cylinder must continue to work slowly and evenly. The same should be done with the other cylinder.

Finally remove in both throttle cables the plug at the Bowden wire adjusting screws, while the throttle twist grip must remain closed as before, and tighten the couternut at the adjusting screw **11**. The idling adjustment is then finished.

5. Maintenance of the electric equipment

a) Contact breaker points



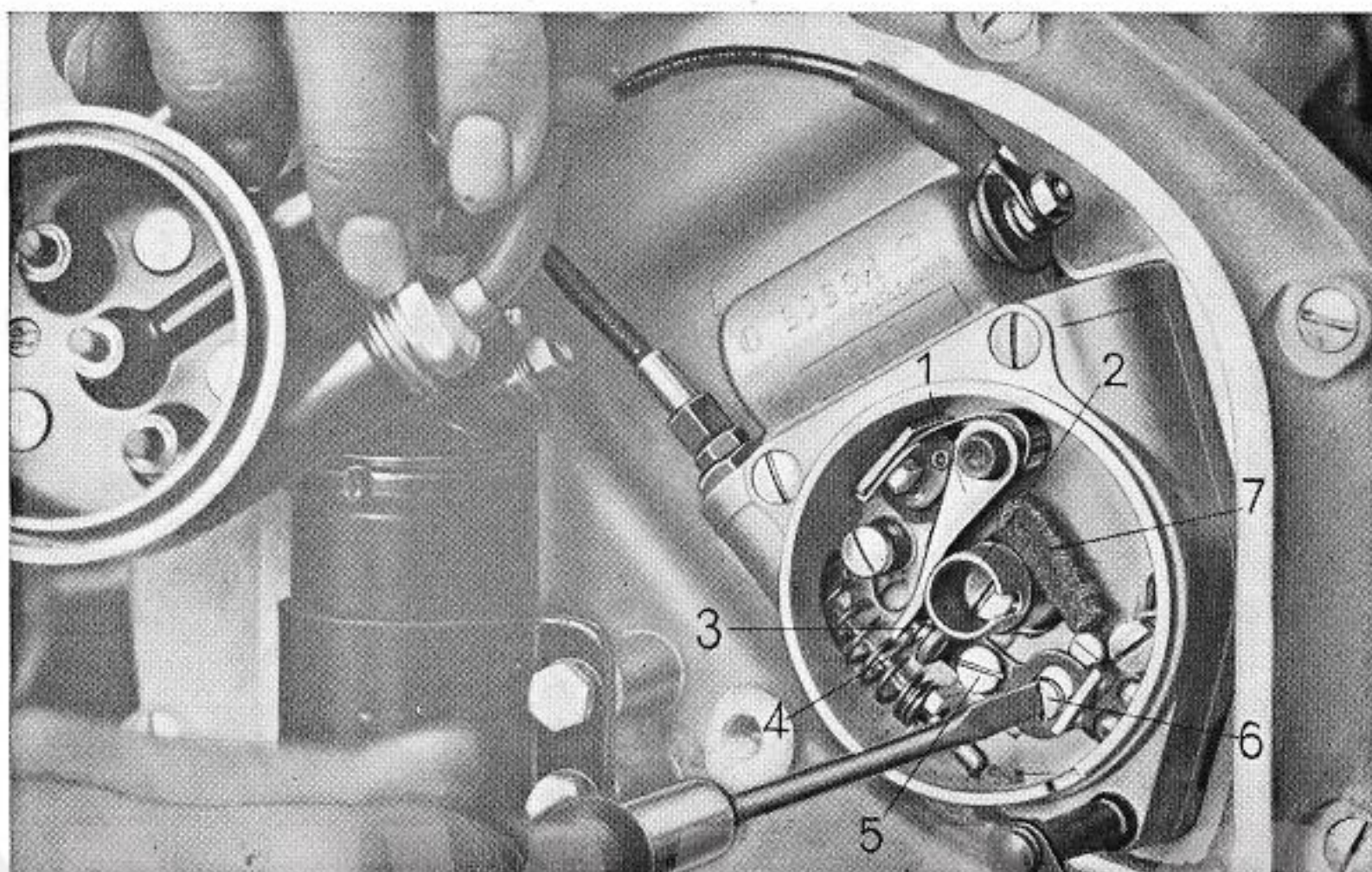
Illustr. 9

Contact breaker points (exposed)

In order to get at the contact breaker points one only need take off the front protective cover **1** (illustr. 9) after removing the fixing screws **2** and then lift off the contact breaker cover **3**. Now the distributor piece **4** is accessible which can be taken off by means of a screw-driver after unscrewing the slit screw **5**. Now the contact breaker points and the adjusting screws as well as the lubricating felt for the contact breaker camshaft are accessible.

Regularly after abt. 8000 km the contact breaker points should be cleaned or adjusted, if required.

During the interruption, i. e. when the insulating piece of the contact breaker **1** (illustr. 10) runs against the camshaft **2**, the points **3** and **4** of the contact



Illustr. 10. Adjusting the breaker contacts

breaker must be 0,016—0,02 ins. (0.4—0.5 mm) removed from one another. This distance can be adjusted by regulating the contact **4**. For this purpose the fixing screw **5** is unscrewed and the proper distance is adjusted by means of the excenter screw **6**. Then the fixing screw **5**, is screwed in again tight. If this is omitted, ignition troubles will ensure.

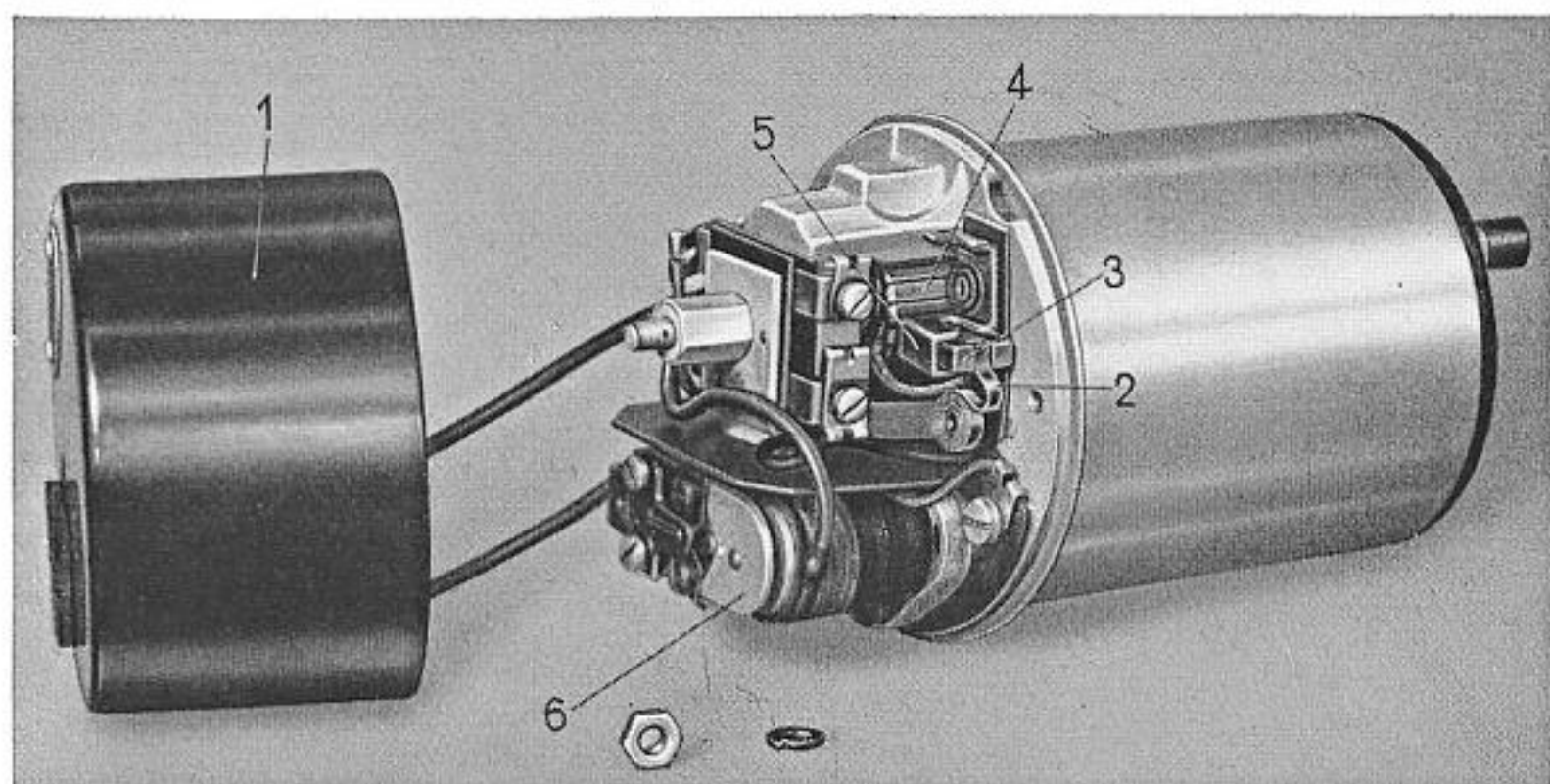
If the contact points are very dirty, they must be cleansed with a clean rag.

By lifting off the contact breaker **1** with the finger, the points **3** and **4** are separated from one another and can be cleaned easily. When adjusting the points, the lubricating-felt **7** should be soaked with a few drops of some good oil at the same time (illustr. 10).

Good care must be taken that no oil gets to the contact breaker points, as oil is a non-conductor and the ignition would be caused to work irregularly.

Emeral paper or emeral linen must not be used to clean the points.

b) Dynamo: The brushes and the collector of the dynamo should be checked regularly after every 3000 mls. (5000 km). The brushes must be examined to see whether they are dirty and whether they have sufficient play in their guides in the brush-holder.



Illustr. 11. Dynamo with the protective cover taken off

After taking off the protective cover **1** (illustr. 11) the springs **2** pressing the brushes **3** on the collector **4** are lifted a little, and one tries to move the brushes **3** forwards and backwards in their guides **5**. If a brush is dirty and has not enough play, it must be taken out and cleaned with some clean rag and petrol. At the same time the brush-holder **5** must be cleaned thoroughly. **The blank grinding surface of the brushes must not be treated under any circumstances with emeral paper or a file.** If a brush is worn to such an extent that its copper wire touches the groove of the guide, it must be replaced.

If dirty, the collector must be cleaned with a clean rag.

Before starting any work at the dynamo, the wire 30 between dynamo and battery must be disconnected at the battery under all circumstances.

The governor switch **6** of the dynamo is adjusted exactly at the works; **this adjustment must not be tampered with under any circumstances.**

c) Sparking plugs. According to our experience we recommend

Bosch sparking plug W 240 T 1.

This is a small Bosch sparking plug with 14 mm thread and 20.5 mm span of jaw.

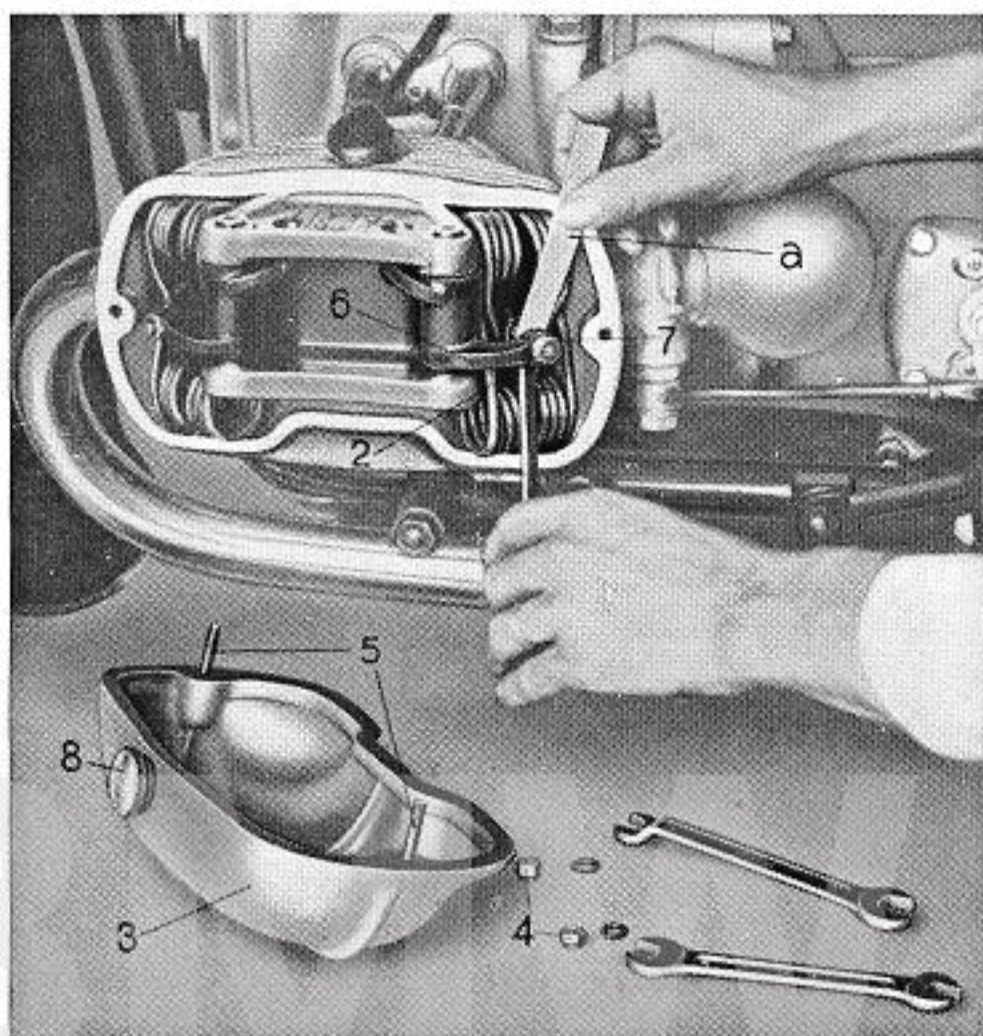
d) Service instructions for the battery: The loading and treatment of the loaded battery should be effected according to the Bosch instructions.

e) Cables: Check regularly every 3000 mls. (5000 km) whether the cables are not worn through at any place; special attention should be paid to the cables at the handlebars and to the battery cable. Damaged cables should be replaced by new ones.

We refer to the Bosch instructions supplied with the motor cycle regarding the maintenance of the entire electric equipment.

6. Adjustment of valve clearance

The valve clearance between the valve stem **1**, and the thrust screw **2** (illustr. 13) which should amount to abt. 0,004 ins. (0.1 mm) with the **cold** engine, must be checked from time to time. For this purpose, one uses best a narrow strip of note paper which corresponds approximately to the thickness. The adjustment of valve clearance is described in the following; as said before, it must not be done except with the **cold engine**.



Illustr. 12
Adjustment of valve clearance

First the two nuts **4** (illustr. 12) with the corresponding washers are unscrewed and removed from the fixing bolts, whereupon the protective cap **3** is taken off. Now the engine is rotated by means of the kickstarter in such a manner that the rocking lever **6** can be moved by its maximum amount. Then loosen the counternut **7**, adjust the thrust screw **2** with the strip of paper **a** to the proper distance, and then tighten the counternut **7** again. After replacing and screwing on the protective cap, fill the latter with abt. 1/8 ltr. of oil (the same as used for the engine), which may be done after removing the air breather screw **8**. This oil serves to lubricate the valve action and should be checked every 950 mls. (1500 km) and replenished, if needful.

7. Cleaning

When hosing down the engine, care should be taken that the jet of water is not directed on the engine, the gearbox and the rear drive casing, so that no water enters there.

It must be avoided under any circumstances that water is squirted on the dynamo. For this purpose the latter must be covered properly before hosing down the motor cycle.

8. Pressing in of tyres

With the engine unloaded, the tyres should show a but slight impression. The prescribed air pressure should amount with solo engines to 1.1 atm in the front tyre, to 1.5 atm in the rear tyre, and with engines with sidecars to 1.3 atm in the front wheel, and 1.7 atm in the rear wheels.

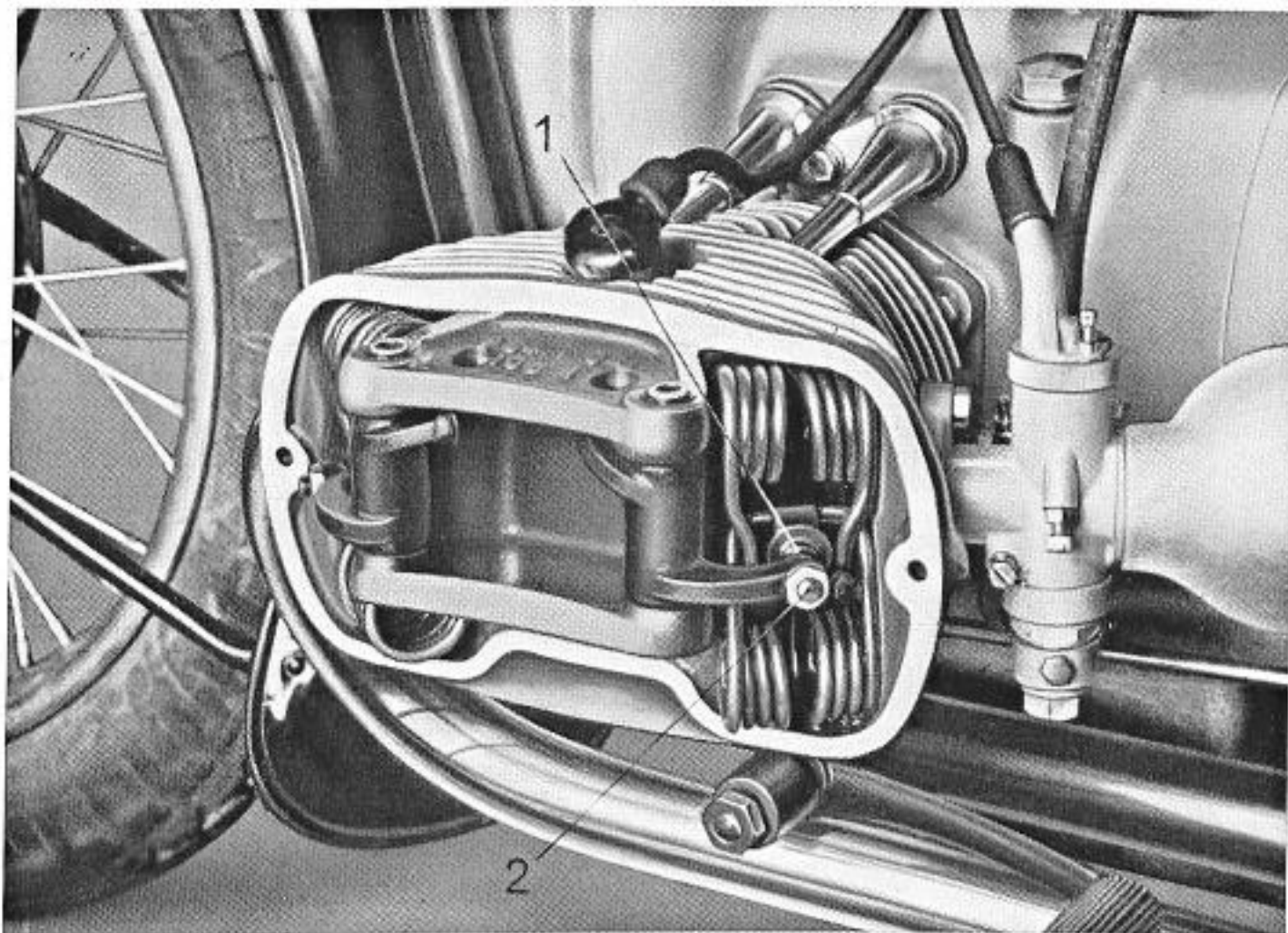
III. Description

A. Engine and gearbox unit

1. Crankcase, cylinders and pistons:

The crankcase is formed as a tunnel casing whereby the horizontal separating groove between the upper and the lower part of the casing is eliminated and thus any oil leak is prevented. The cylinders are made of grey pig-iron and have radial cooling fins. Detachable cylinder heads cast of light alloy in conjunction with their large cooling fins provide for good cooling. The latter is also transmitted to the sparking plugs which are cooled, at it is, by their being exposed to the current of air in driving. For riding in rain it is advisable to protect the sparking plugs against short-circuit by sparking plug protecting sleeves.

The light alloy pistons employed are provided with three piston rings and one oil scraper ring. The hardened and ground piston pin is supported in the cross head end of the connecting rod and secured by strut rings.



Illustr. 13. Arrangement of the hairpin valve springs

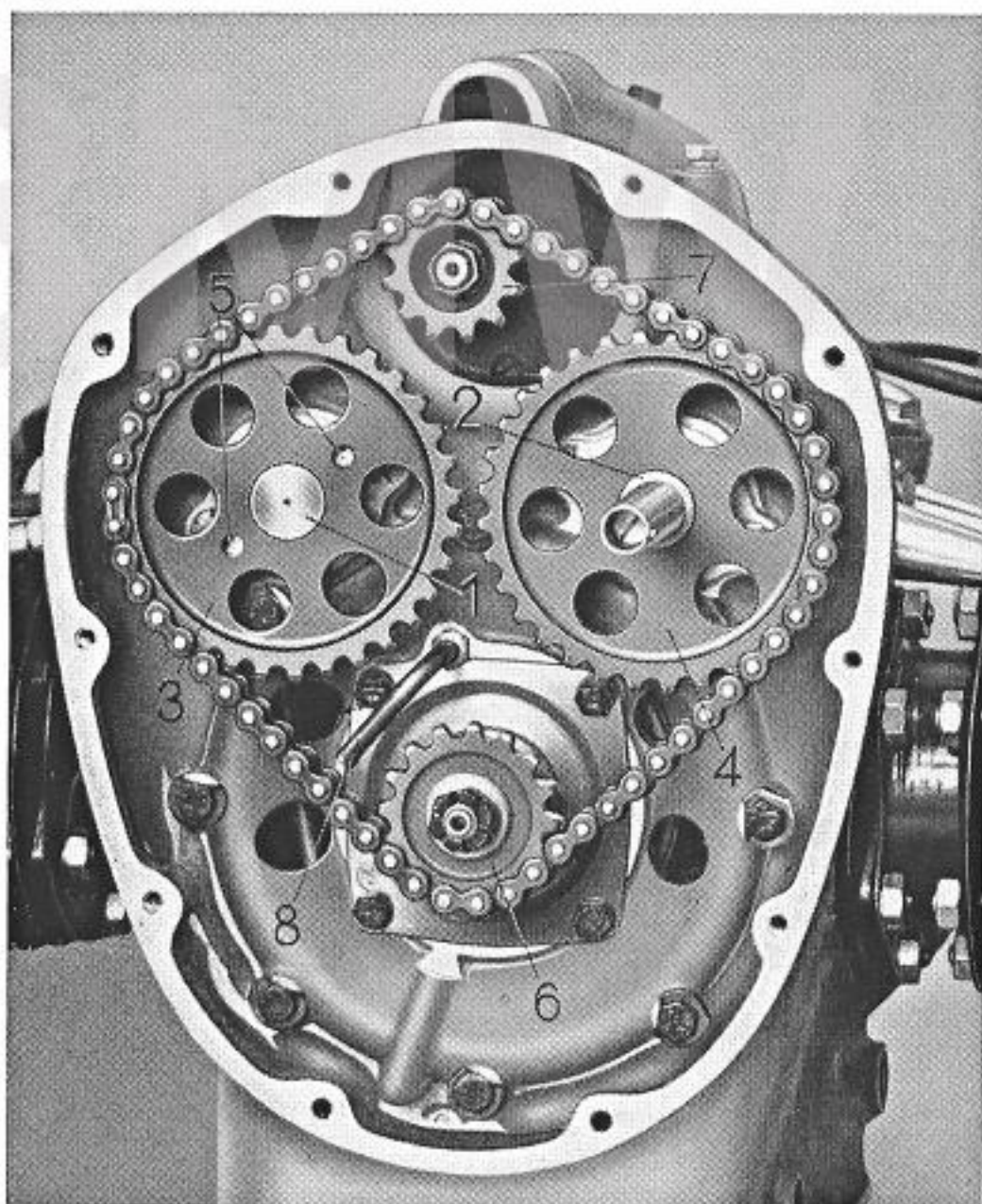
2. Valves:

The valves are suspended in the cylinder head and are operated through enclosed pushrods **10** (illustr. 15) by the rockers **11** supported by pins. The pushrods **11** are actuated by the tappets **12** adjoining the camshaft **2** and **1**. The oil is prevented from escaping by the protective tubes of the pushrods in which the oil can run off into the protective cap of the cylinder head where it serves to lubricate the valve action. The easily detachable protective cap enables in a simple manner the adjustment of the clearance between the thrust screw and the valve stem. (See page 20).

The valves are pressed on their seats by two strong hairpin springs. (See illustr. 13).

3. Steering:

One sprocket wheel each **3** and **4** is fastened with a wedge to the front ends of two camshaft **1** and **2** (illustr. 14) arranged above the crankshaft and supported by two plain bearings each. The camshaft **2** is extended forwards and operates the contact breaker; the bores **5** of the camshaft **1** are engaged by the rotary slide valve for the air evacuation of the crankcase.



Illustr. 14. Camshaft and dynamo drive

The camshafts **1** and **2** are driven by the sprocket wheel **6** arranged on the crankshaft by means of a noiseless chain which is engaged above by the sprocket wheel **7** of the dynamo. By turning the dynamo the steering chain may

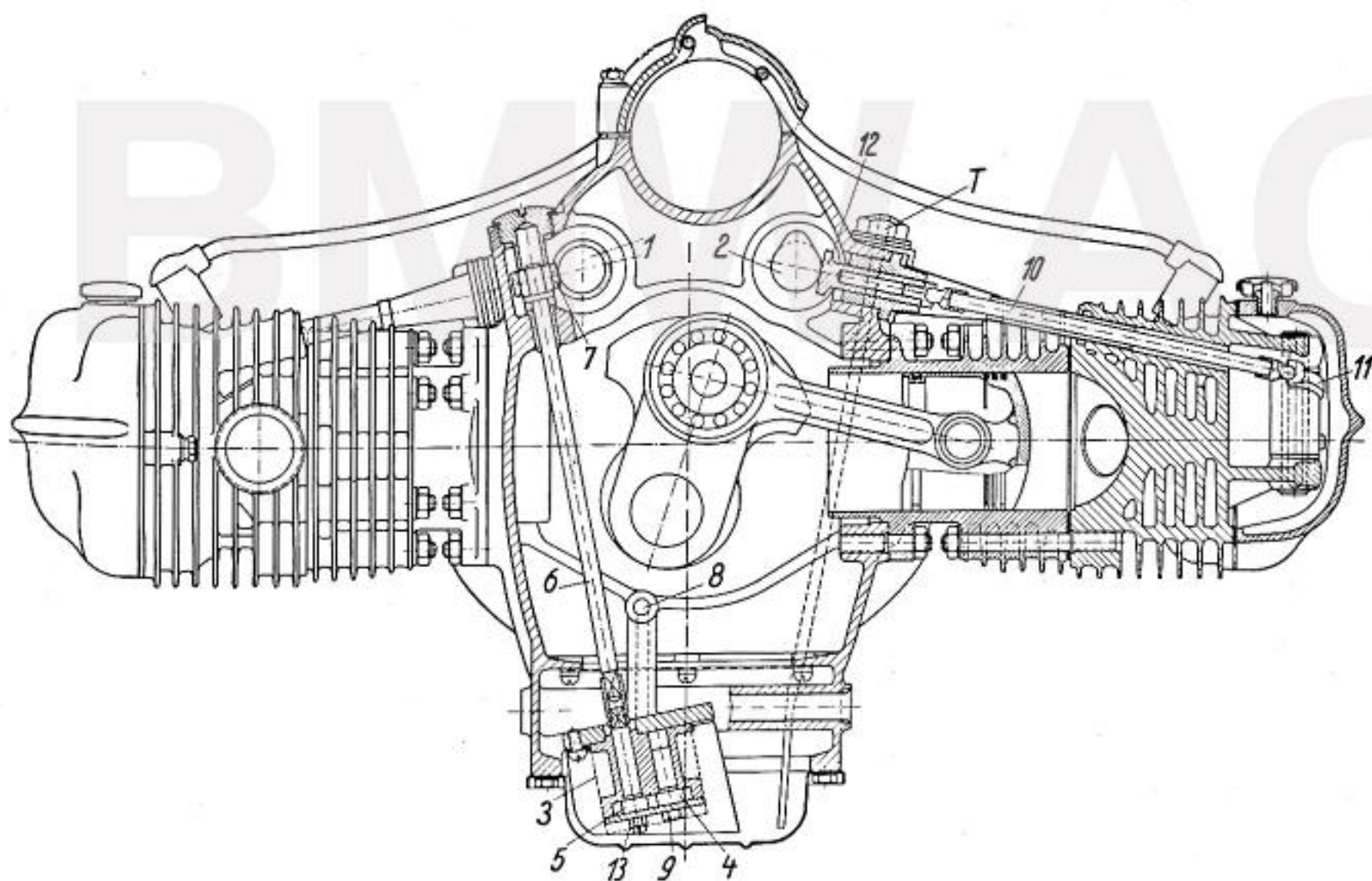
be tightened with the excentrically supported sprocked wheel **7** (See page 32, Illustr. 21). The steering chain is supplied continuously with fresh oil from the oil joint **8**.

4. Breather

As briefly mentioned above, the air breather of the crankcase is constituted by a rotary slide valve housed in the cover of the casing of the driving mechanism (Illustr. 14) and engaging the bores **5** of the sprocket wheel **5** by fitting pins. The air which is condensed on the entering stroke of the piston is conducted through bores in the rotary slide valve and its guide to a piping arranged outside which conveys the air to the open.

5. Lubrication and oil checking:

A gear pump (Illustr. 15) built in the lower part of the crankcase sucks the oil through a filter through the action of the two gear **4** and **5** the latter of which is driven by means of a shaft **6** and worm wheel **7** by the worm on the steering shaft **1**.



Illustr. 15. Engine cross section

From the front ball bearing a further pressure oil pipe leads to the chain for the drive of the camshaft and dynamo whereby also the front steering camshaft plain bearings are amply provided with oil through the oil carried along by the chain.

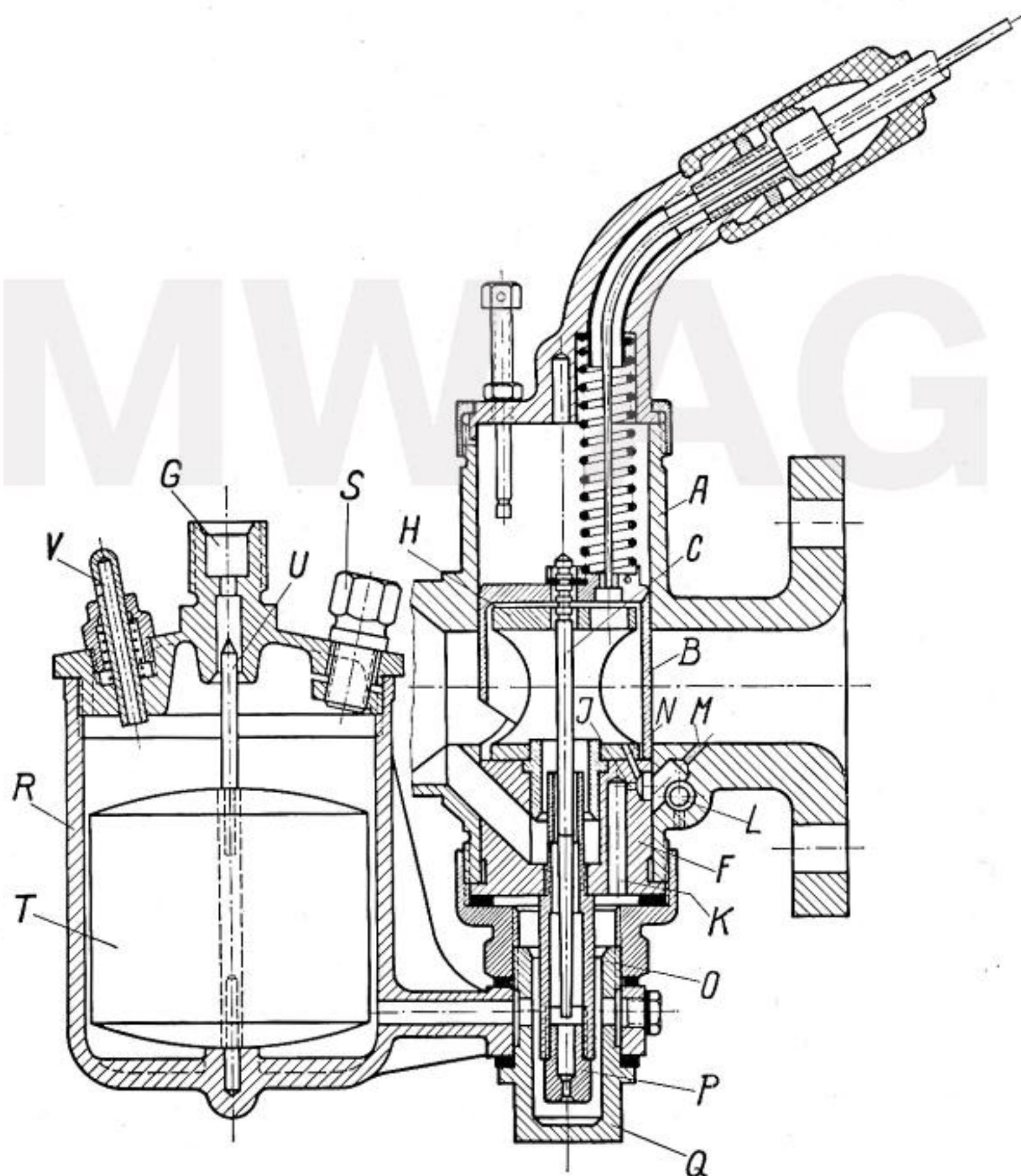
The lubrication of the back camshaft bearing and the roller bearings of the connecting rods is amply ensured by the centrifugal oil of the crankshaft which reaches the individual bearings through correspondingly arranged bores; the piston and piston pins are likewise lubricated with centrifugal oil.

The oil flowing back from the driving mechanism into the oil well is purified by an oil filter fastened in the lower part of the casing before entering the oil well.

6. Carburettors

Two Amal single slide carburettors are employed whose method of action and structure will be briefly explained in the following (Illustr. 16).

The carburetter consists substantially of the slide valve casing **A**, in which



Illustr. 16. Carburetter

the cylindrical downwards open throttle valve **B** is conducted, the jet body **F**, in which the main jet insert **O** with the main jet **P** inserted therein is screwed, and in which a fine bore **J** is provided as free running jet and the float chamber **R**.

In the upper bottom of the throttle slide valve which is supplied below at the suction side with an arch-like notch, the cable of the throttle wire is suspended which is surrounded by a screw spring which rests on the upper guide piece on the slide valve case and against the bottom of the slide valve and which holds the slide valve in its final position or continuously presses it back into it. The supply of the fuel through the main jet **P** or through the main jet insertion **O** is regulated by a jet needle **C** which is tapered in its lower part, is likewise suspended in the bottom of the slide valve by means of a small fixing pin seated in a notch of the pin, and extends into the main jet insertion **O**.

When the throttle slide valve is opened only a little, the annular cross section remaining in the needle-jet between the jet needle and the main jet insertion **O** is small, the depression acting on the main jet is low and the supply of the fuel through the main jet is likewise low. When the throttle slide valve is opened further this annular cross section is enlarged owing to the tapering, and the supply of fuel is consequently increased. By higher or lower suspension of the needle in the bottom of the slide valve and by placing the fixing spring into higher or lower situated notches of the needle, a possibility is offered for regulating the composition of the mixture.

The fuel flowing into the float chamber **R** the quantity of flow of which is regulated by the needle valve **V** operated by the flow **T**, enters the bores of the sleeve nut **Q** through the bore of the arm of the float chamber, the float chamber **R** being connected with the slide valve case by the sleeve nut **Q**, whereupon the needle jet and bore **K** in the jet body **F** are filled with fuel. When the throttle slide valve is opened but little, air is sucked through the idling air orifice **L** and fuel through the idling jet **3** owing to the depression caused by the sucking action of the engine, and the mixture of air and fuel produced in this manner is conducted to the motor through the idling outlet **M**.

The further the throttle slide valve **B** is opened, the less is the sucking action at the outlet **M**, but a higher sucking action is achieved at the transition jet **N**, and the idling mixture flows through this bore as well as through the outlet **M**.

The fuel inlet **G** is arranged above at the float chamber. In the cover of the float chamber which is secured against turning by the fixing screw **S**, a tickler **V** is arranged which keeps the float valve **V** open when pressed down, which makes it possible to convince oneself of the due supply of fuel. When kick-starting the engine more fuel is supplied to the jets by operating the tickler **V**; thus the engine receives a mixture richer in fuel which considerably facilitates the starting. Regarding the maintenance of the carburetters see page 15.

7. Ignition:

The igniting current is supplied by a 6 volt Bosch battery fed by a 75 Watt dynamo. The dynamo is arranged on top of the crankcase and is driven by a noiseless chain (Illustr. 14) which can be tightened by turning the dynamo (see page 33). The battery is fastened to the engine by means of the tie band on the left side.

The dynamo is a shunt-dynamo with automatic regulation of tension.

The regulation of the terminal tension offers the great advantage **that the engine and the dynamo can be operated even with disconnected or damaged battery** without fluctuations arising in the intensity of light or the bulbs being burnt. In such a case all consumers of current with exception of the ignition coil must be cut out, when starting the engine, and it is necessary to set the engine into motion by pushing.

The **contact breaker** and the **ignition coil** — completely protected against outside influence — are mounted inside an easily detachable cover on the front side of the engine. The low tension current supplied by the battery is transformed into a high tension current by the co-operation of contact breaker and ignition coil, and conducted to the sparking plugs through the distribution running piece **4** (Illustr. 9) arranged below the cover of the interruptor corresponding to the ignition sequence, where it jumps as ignition spark between the two electrodes.

The **adjustment of the moment of ignition is effected** by the ignition lever arranged at the left of the handlebars (illustr. 5).

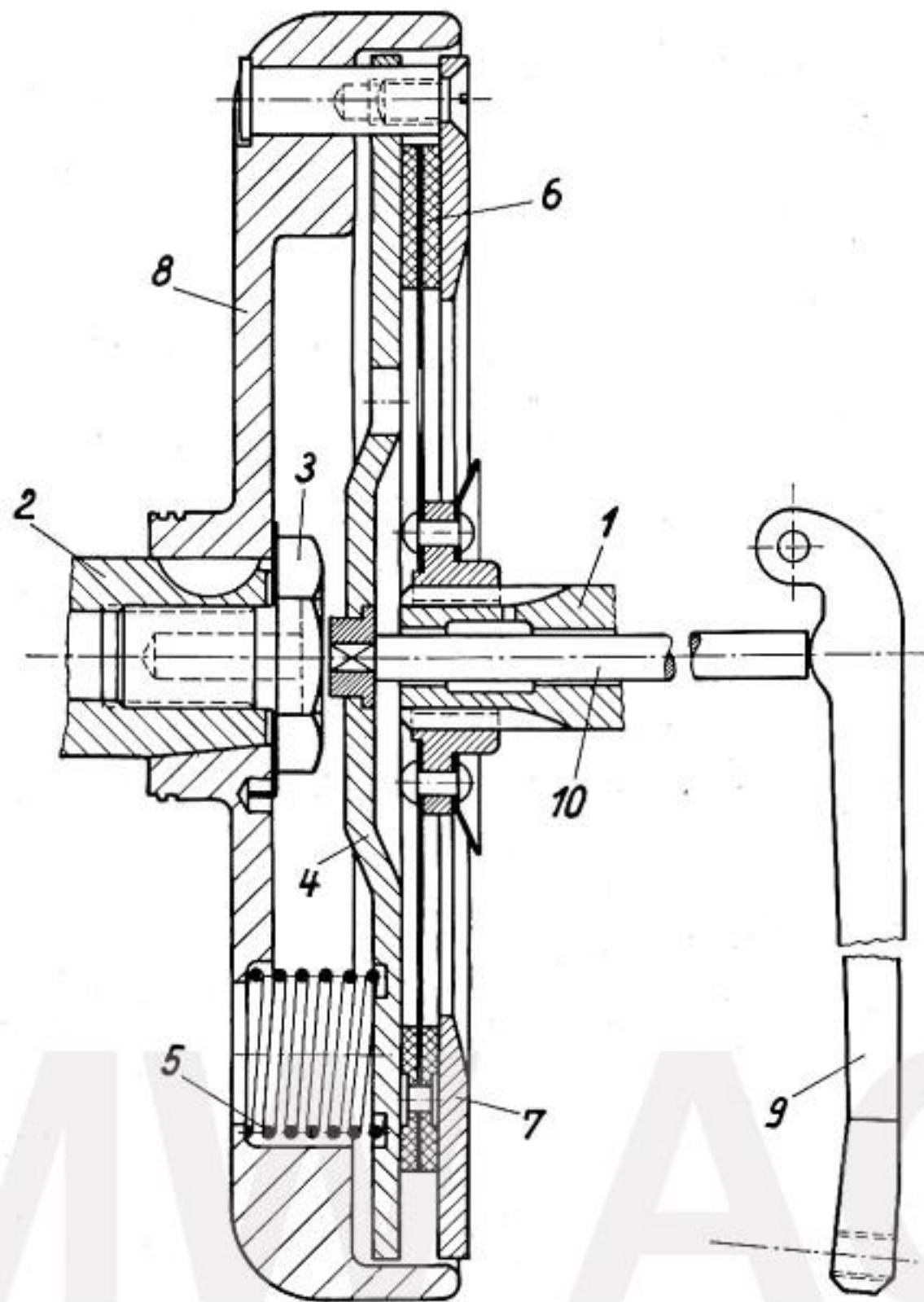
Regarding the maintenance of the entire ignition installation we draw particular attention to the Bosch instructions supplied with the machine.

8. Clutch:

For a single-disc friction clutch is provided as shown in illustr. 17. The driving part of same is the flywheel **8** resting on the tapered, pin of the crankshaft **2** and secured by means of wedge and screw **3**. Six clutch springs **5** arranged in recesses of the flywheel **8** and of the thrust shoulder **4** press the latter against the clutch plate **6** provided on both sides with friction lining and against the non-displaceable end disc **7**.

In this manner the clutch plate **4** which is arranged displaceable lengthways on the gearbox main shaft, is taken along and the rotating motion of the crankshaft **2** is transmitted to the main shaft **1** of the gearbox.

The operating lever for the clutch is arranged at the end of the left throttle twist grip (illustr. 5) and acts on the declutching lever **9** at the end of the gearbox by means of Bowden wire. The declutching and thus the interruption of the transmission of power from the motor to the gearbox is effected by pulling the operating lever at the handlebars, whereby the thrust shoulder **4** is lifted off the clutch plate **4** by the thrust rod. **10**.

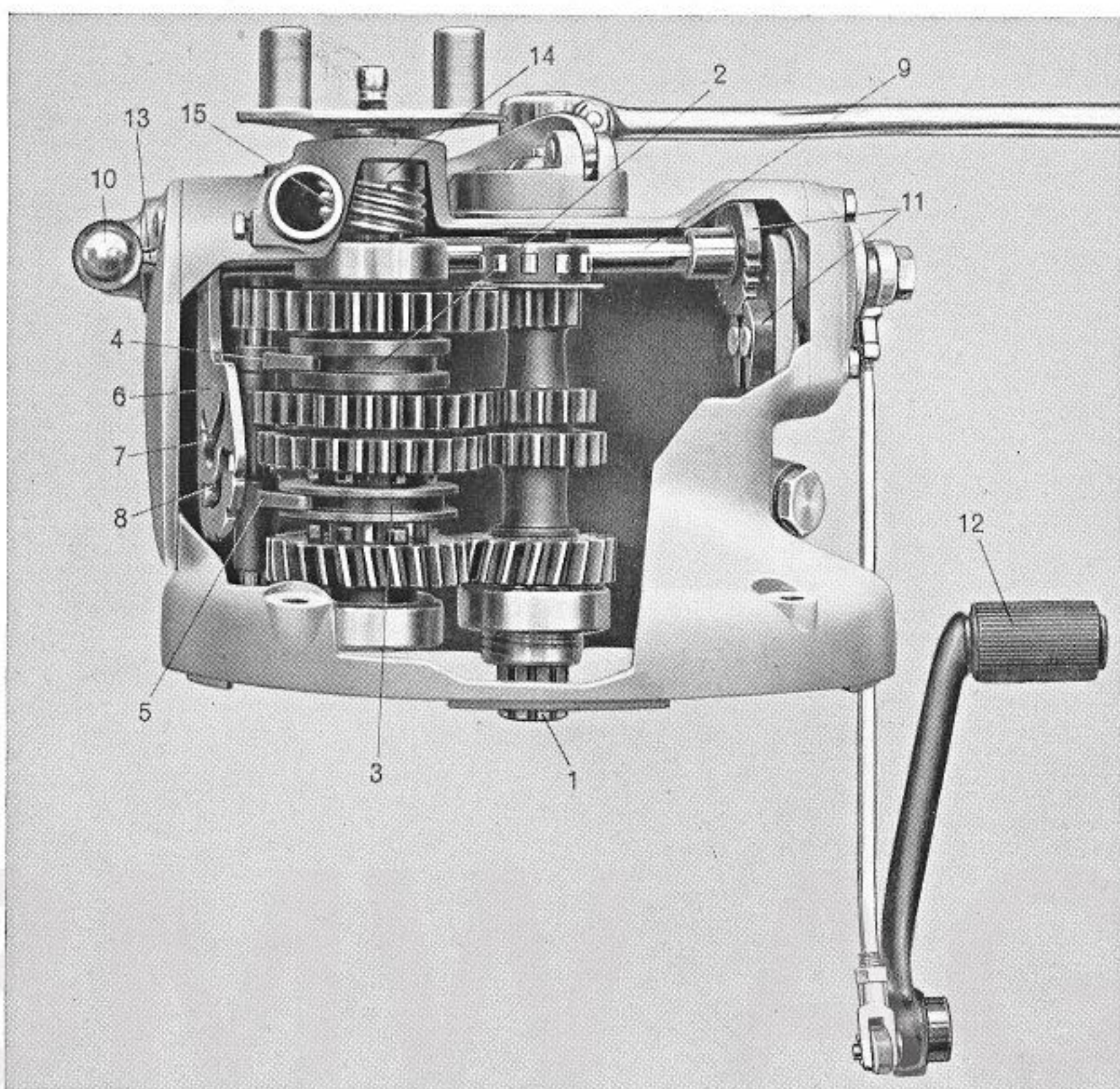


Illustr. 17.
Section through
the clutch

9. Gearbox and power transmission:

The torque delivered by the engine is transmitted to the gearbox main shaft **1** through the clutch. The manner of action and control of the gearbox shall briefly be explained (illustr. 18).

All the wheel pairs are in constant engagement and are engaged by displacement of the dogs **2** and **3**. To engage the individual gears the dogs **2** and **3** are moved by the operating levers **4** and **5**, the latter being guided by correspondingly formed slits **7** and **8** in the gate **6**. The gate **6** is welded onto the shaft **9** to which the hand lever **10** is secured on the one side, and at the other end the latch safety device **11** is arranged which is operated by the foot control lever **12**. By moving the foot control lever **12** upwards or downwards the gate **6** is swung downwards or upwards by the shaft **9**, and thus the various gears are engaged in the manner described above. The hand control lever **10** serves to engage neutral (in illustr. 18 the gear is in neutral position) the lever being in vertical position and aligned with the nose **13** cast onto the casing cover.



Illustr. 18. Gearbox

After reaching the secondary shaft **14** from the main shaft **1** over the pair of wheels thrown into gear at the time the torque is transmitted from this to the rear wheel driving shaft, a flexible coupling being interposed. The driving shaft engages with its rear end a toothed coupling which receives any power to the rear wheel over a pair of bevel wheels. Both bevel wheels are spiral-toothed and run almost noiselessly.

The driving pinion of the speedometer shaft engages the worm gear **15** on the secondary shaft **14**.

B. Frame structure and wheels

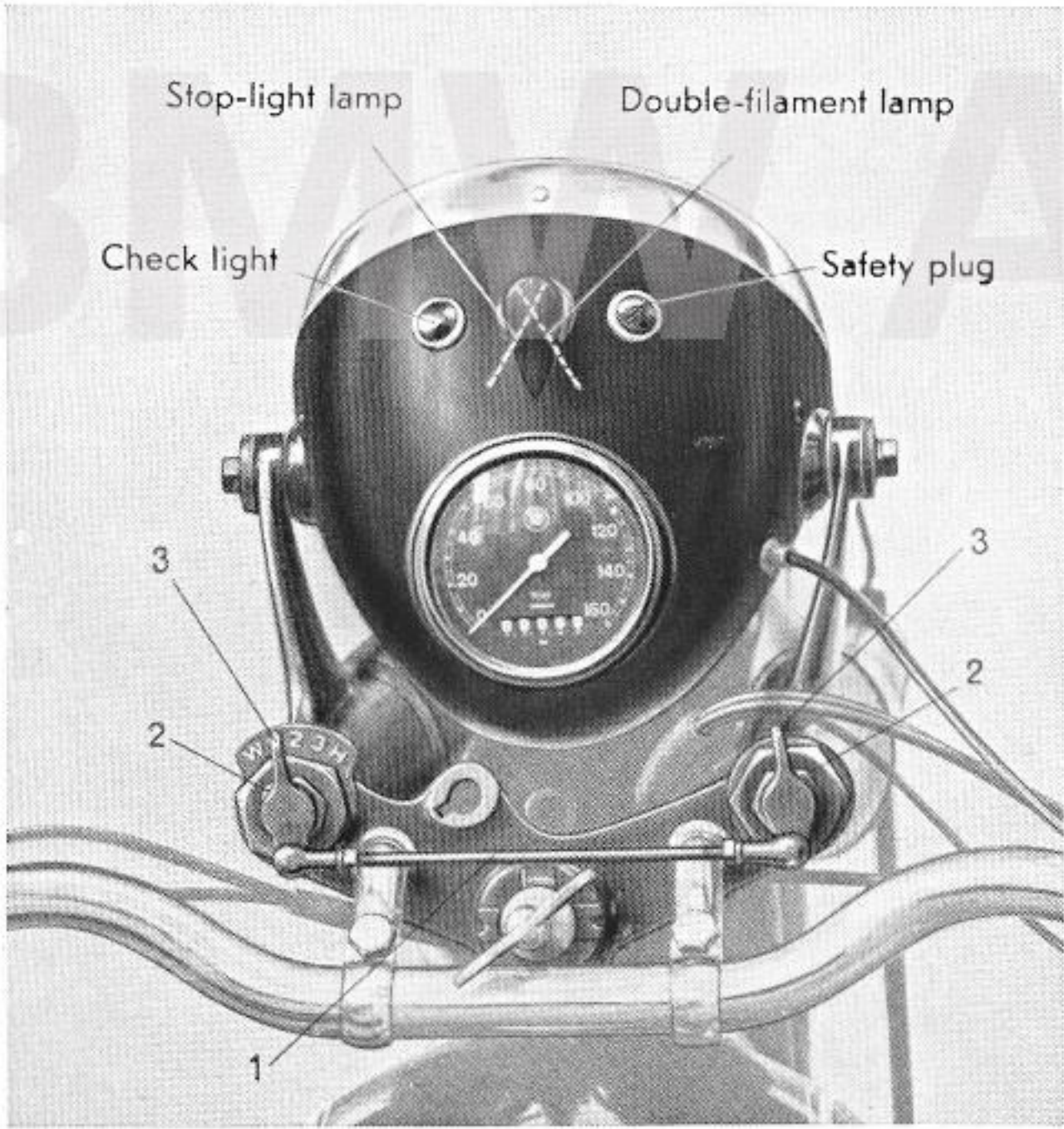
1. Front wheel fork:

It consists of tubes with frictionless coil springs gliding into one another in which the adjustable oil shock absorber valves are mounted. This type

of construction endows the motor cycle with riding properties lying far beyond the average as any shocks acting on the front wheel are absorbed by it softly and almost without friction, whilst recoils are considerably lessened.

Movable tubes gripping the knock-out spindles of the front wheel immediately are pushed over fixed tubes connected with the steering axle and brace themselves against coil springs. The guidance of the tubes is effected by two plain bearings each in each fork bar, the only parts of the fork which are subject to slight wear, contrary to front wheel forks of the usual design with their numerous outer bearings subjected to considerable wear.

The oil shock absorber valves are arranged inside the fixed tubes, they are turned by the cam lever **3** (Illustr. 19) and release at the given instance a return-flow cross section for the shock absorber oil depending on the position of the cam lever recoils. Thus, recoils are considerably lessened by displacing the cam lever to "hard" whereby the unpleasant swinging of the fork on rough roads is avoided; the action of the coil springs always remains the same.



Illustr. 19. Headlamp from above with positions of the switch-key and shock absorber adjustment.

2. Wheels and brakes:

The wheels possess double thick ended spokes and the 19x2 $\frac{1}{2}$ " safety rims used internationally. Generally they are supplied with wired-on low pressure tyres 26x3.50", but they may also be supplied at any time, if desired with wired-on cable high pressure tyres 26x3.25" on 19x2 $\frac{1}{2}$ " rims.

In the same way as the rear wheel also the front wheel is provided with a knock-out spindle, which extremely facilitates the construction of the motor cycle. As a particular advantage we may point out that the front and rear wheel, and in case our sidecar is used, also the wheel of the sidecar are interchangeable.

The brakes provided are internal expanding brakes and by their size they warrant most rapid stopping in moments of danger. They are completely enclosed and protected against water and dirt.

3. Mudguards:

With the rear wheel mudguard the back end may be raised. This makes it possible to take off the rear wheel easily without having to tilt the engine laterally or to lift it.

4. Saddle:

The saddle is arranged to swing freely and by screwing the nuts holding the supporting lever in and out it can be raised or lowered. Further the bolt linked to the spring can be displaced upwards or downwards in the long hole of the supporting lever after unscrewing the front nut. In this manner the suspension can be adjusted softer or harder according to the weight of the rider.

5. Fuel tank:

The fuel filler orifice is supplied with a very quickly and simply operated spring cap fixed firmly to the tank. The tank holds abt. 3,3 gal. (15 ltr.) which is sufficient for covering a distance of abt. 220 mls. (350 km). The fuel cock is supplied with a reserve position; in this manner there is always some fuel left and the tank with the cock adjusted to "open" which may then be used when the cock is moved to "reserve".

Behind the filler orifice, there is the particularly easily accessible tool-box which is secured by a lock against unauthorised opening.

6. Motor cycle stand:

The engine is equipped with a motor cycle stand arranged below the frame which is kept in raised position by a spring and makes standing the motor cycle up easy. Furthermore the lower mudguard support may be let down to raise the front wheel (Illustr. 22) and be used as a stand.

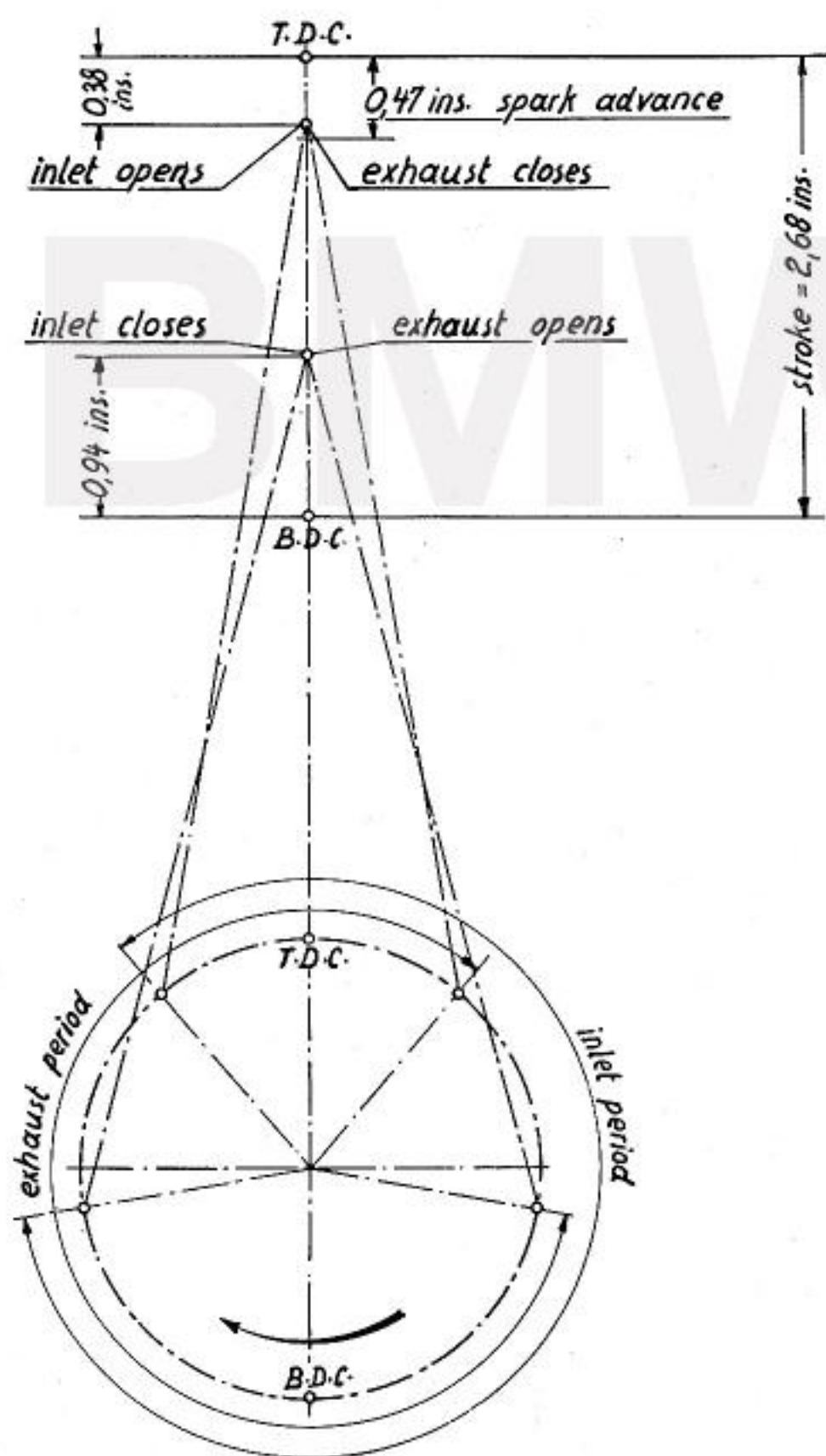
7. Headlamps:

The search light contains a two-filament lamp for far distance and dimming light and an auxiliary lamp for stop-light. To set the engine in motion, insert the switch key into the orifice arranged above the speedometer and push it into same entirely whereby the circuit is closed which is confirmed by the check lamp in the headlamp case flashing up. By returning the key to the left or to the right the stop light or the two-filament lamp is cut in. (See Illustr. 19.)

The optional cutting-in of the far distance or dimming light of the two-filament lamp is effected by a dimming switch fixed to the right grip of the handlebars (illustr. 3). The speedometer is housed in the headlamp casing and driven by means of a worm and worm-wheel from the gearbox.

8. Tools:

The tools are housed in a handy and very easily accessible manner in a box which is sunk into the fuel tank and can be locked.



Illustr. 20. Timing diagram

Note: The sketch of adjustment is viewed in reverse travelling direction. The direction of rotation indicated on it is consequently not correct except when looking towards the cam wheel drive.

IV. Repairing

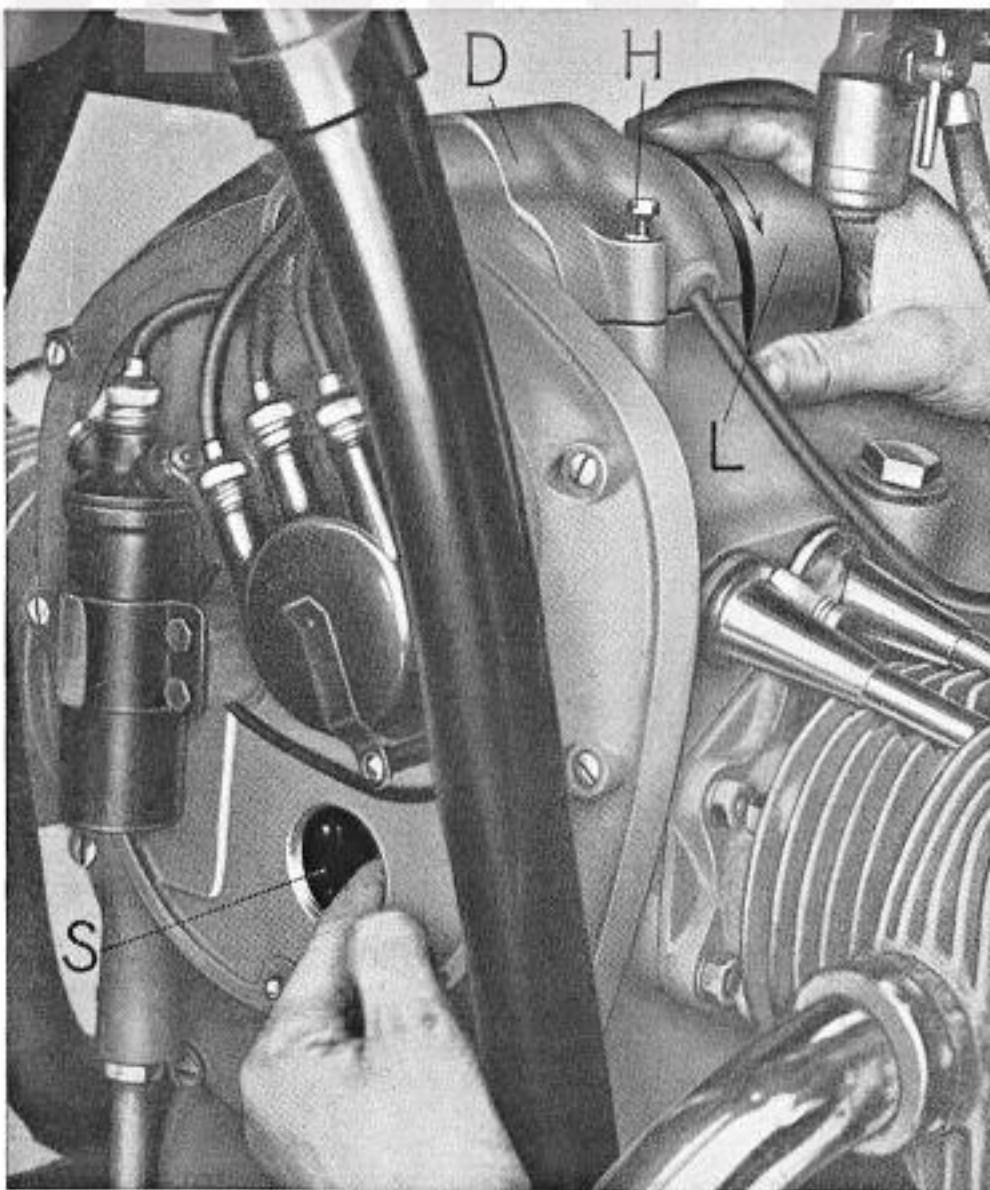
1. Adjustment of valve timing and ignition:

The **adjustment of valve timing** must be effected in the following manner:

Once the crankshaft is built in and the chain wheel fastened to it, adjust the piston of the adjustment cylinder (the cylinder lying at the **right** when viewed in the direction of motion) to the upper dead centre. When doing so, the mark on the chain wheel at the crankshaft must point vertically upwards. Now the two camshafts are turned in such a way that the marks made on the chain wheel are facing each other towards the middle of the engine and cover each other exactly in horizontal direction; then the chain is laid on the wheel. For guidance, it should be noted that in this position the inlet valve of the adjustment cylinder must be already opened, whilst the exhaust valve must be on the point of closing.

2. Removal of the oil pump:

To **clean or check the oil pump**, drain first the oil from the crankcase by unscrewing the screw-plug arranged at the oil well at the back on the right side, before dismantling the oil pump. Then the fixing screws of the oil well are unscrewed and the latter is taken off. Thus the oil pump is accessible and the safety wire by which the filter is kept in position, must be removed from the screw **13** (illustr. 15). After having taken off the filter, the two nuts **9** may



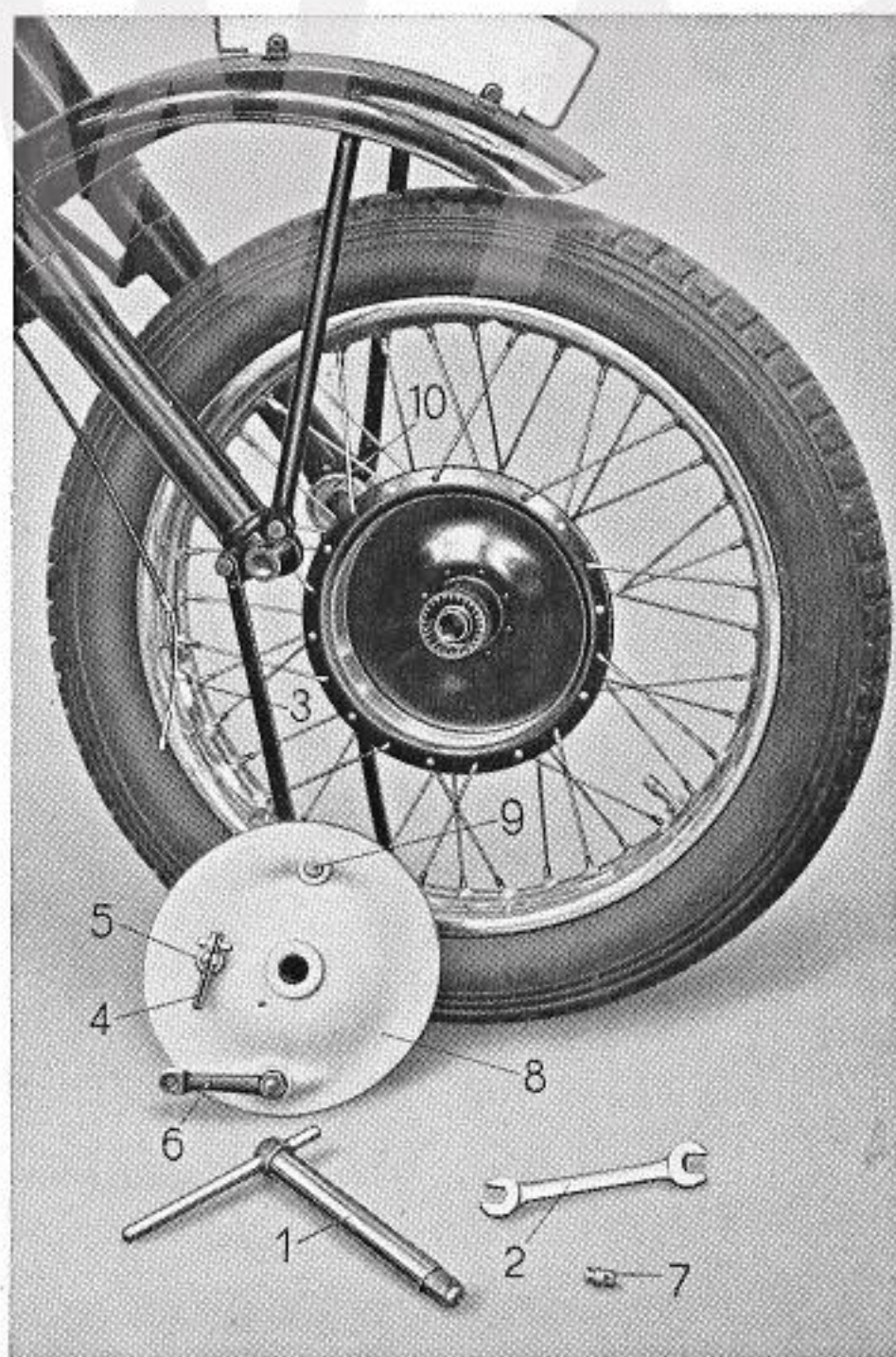
Illustr. 21.
Tightening the steering chain

be unscrewed, and then the oil pump can be taken off. After reassembling the pump, convince yourself by testing it with a little oil whether the pump has been mounted correctly, that is whether ample oil is delivered on turning the driving wheel. Furthermore, special care must be taken that the oil well sits perfectly tight on the crankcase.

3. Readjustment of the camshaft and dynamo driving chain.

The armature of the dynamo, the tapered shaft end of which bears the sprocket, is supported eccentrically by the pole casing. This bearing enables the steering chains to be tightened in the following simple manner:

After removing the fixing screw **2** the protective cover **1** must be taken off (Illustr. 9). Now the screw plug **6** is accessible after the removal of which the tension of the chain may be watched through the observation hole **S** (Illustr. 21). If the chain is to be tightened, the two screws **H** clamping the cover **D** and consequently the dynamo **L** must be loosened, and then the chain may be tightened by turning the dynamo in the direction of the arrow (illustr. 21). The right tension must be determined through the observation hole **S**. After completion of the adjustment the two fixing screws **H** must be tightened again firmly, so as to avoid any displacement of the dynamo.



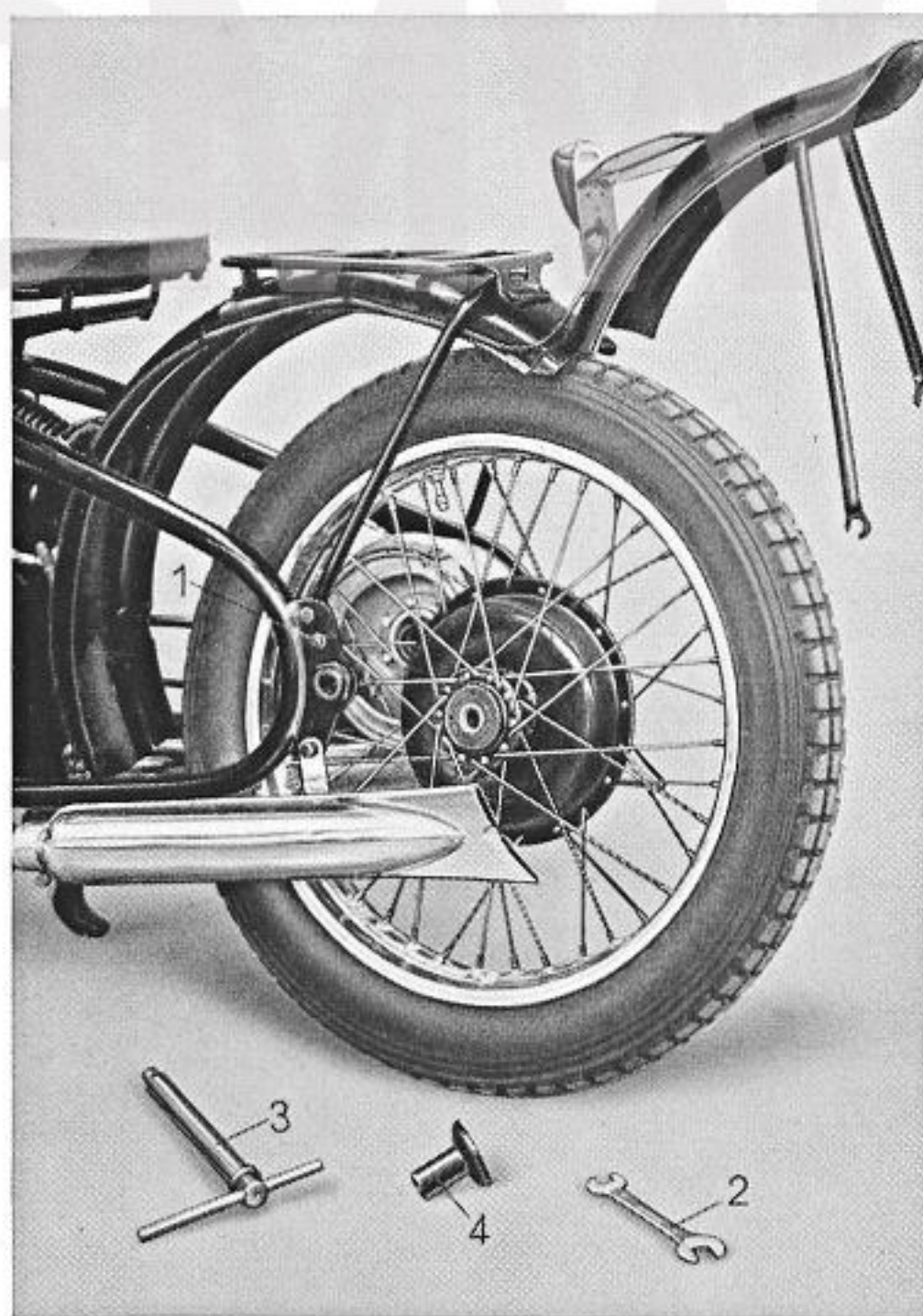
Illustr. 22.
Dismantling the front wheel

4. Dismantling the front wheel:

First place the engine on the front motor cycle stand which may be folded down after loosening the hexagon screw arranged below at the sheet iron underguard. Now the wire **3** (illustr. 22) to the front brake must be loosened first by screwing the adjusting screw **4** downwards, where the fixing bolt **7** and consequently the wire **3** may be removed from the brake lever **6** by lifting the latter. If it should not be possible to detach the wire in this manner, the slit in the adjusting screw **4** must be placed in such a way that it coincides with the one in the through-way screw **5**. Then the rope may be taken out of the slit and detached by lifting lever **6**.

Now the clamp-screw arranged at the lower end of the left fork-half must be loosened with the key **2** so as to be able to unscrew the knock-out spindle **1** in the direction indicated on it (clockwise) and to pull it out.

Now the front wheel with the brake shoe holder **8** may be taken out downwards. **When fitting**, care must be taken that the nose **9** comes to rest on the bushing at the right fork-half on the inside; **further the distance sleeve 10 in the fork first must be quite easily movable and if this should not be the case any longer, it must be taken out and cleaned and put back slightly greased.** After screwing in and tightening the knock-out spindle, the fork should be



Illustr. 23
Dismantling the rear wheel

vigorously shaken a few times, and only then the clamp-screw at the left fork-fist may be tightened.

5. Dismantling the rear wheel

To dismantle the rear wheel the nut **1** on each side must be loosened first with the key **2** so as to be able to tilt up the back part of the sheet iron under-guard (Illustr. 23).

Now all that is needed is to unscrew the spindle in the direction of rotation indicated on it (clockwise) and pulled out. After removal of the distance piece **4** the rear wheel may be pulled off from the brake shoes and driving grooves towards the left and taken out backwards.

Before reassembly, the knock-out spindle should always be cleaned thoroughly and greased slightly. Utmost care must be taken that no dirt enters the driving grooves when replacing the tyres and that the rear wheel is mounted with perfectly clean grooves.

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