

Benelli

TORNADO 650

KICK START

OWNER'S MANUAL

\$1.50

COSMOPOLITAN MOTORS, INCORPORATED

JACKSONVILLE & MEADOWBROOK ROADS, HATBORO, PA. 19040 (215) OS 2-9100

SOLE U.S. IMPORTERS AND DISTRIBUTORS OF BENELLI MOTORCYCLES / PIRELLI TIRES / AGV AND COSMO HELMETS

Technical characteristics

ENGINE

Type	4 stroke
Number of Cylinders	2
Cylinder layout	Parallel
Bore	84mm
Stroke	58mm
Displacement	642.8 cc
Compression Ratio	9 : 1
Maximum H.P.	57 at 7400 R.P.M.
Crankcase	Aluminum alloy divided horizontally.
Cylinders	Special aluminum alloy with special cast iron sleeves.
Cylinder Head	Special aluminum alloy with valve guide and valve seat of special Bronze.
Crankshaft	Assembled on four (4) large supports two (2) large double race bearings and two (2) large needle cages.
Connecting Rod	Needle bearing at the upper and lower end.
Pistons	Special aluminum alloy and special steel band inserts.

VALVE TRAIN

Overhead valve of larger diameter at a 58° angle.
 Cam shaft assembly is on four (4) supports. Cam followers are made of special steel alloy stellite.
 Push rods are constructed of high quality aluminum alloy and steel. The valve train is force lubricated by a gear type oil pump.

CARBURETOR

Two (2) Dellorto type VHB 29mm with concentric float bowl and supplementary starter device.
 Gravity fuel supply 98 to 100 octane.
 Fuel tank capacity is 3 ¾ gallons.

LUBRICATION

Forced lubrication type.
 The engine supports of the crankshaft, connecting rods, cam shaft, cam followers, push rods, and rocker arm are force lubricated by a gear type oil pump, driven from the shaft by gears. The pump sucks the oil through a replacable oil filter, automotive type. Oil in crankcase is 2.66 quarts.
 The crankcase is equipped with an oil level window.

BATTERY 12 V 12 AH

D. C. current ignition system.
 Bosch type with centrifugal automatic advance, driven by the cam shaft.
 Fixed advance 5° - 6°
 Total advance 35° - 36°
 Spark plug Marelli CW 240 L
 Two (2) High Tension Coils Bosch type

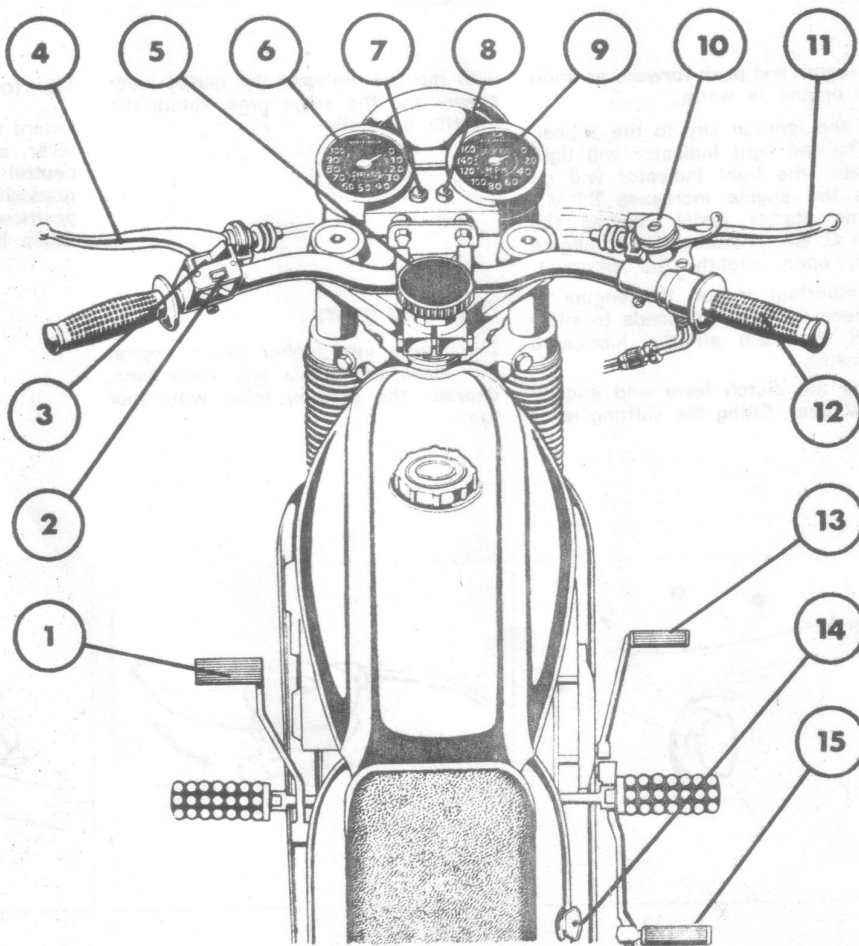
STARTING SYSTEM

Start by pedal, located on the right hand side of the vehicle.

TRANSMISSION	Primary transmission by helical gear. Ratio 1 : 3.210.	
CLUTCH	Multiple discs, wet type.	
GEAR BOX	Five (5) speed, constant mesh. The gear box is incorporated with the engine. The foot shift pedal is located on the R.H. side.	
GEAR BOX RATIO	1st gear	1 : 2.499
	2nd gear	1 : 1.383
	3rd gear	1 : 1.000
	4th gear	1 : 0.860
	5th gear	1 : 0.749
SECONDARY TRANSMISSION	By chain 5/8" X 9/16". Countershaft sprocket has 17 teeth, rear wheel sprocket 36 teeth. Ratio 1 : 2.117	
FINAL RATIO	1st gear	1 : 16.986
	2nd gear	1 : 9.405
	3rd gear	1 : 6.797
	4th gear	1 : 5.845
	5th gear	1 : 5.097
FRAME	Tubular, double cradle type.	
FRONT FORK	Rear swing arm with adjustable hydraulic shock absorbers.	
WHEELS	Front 2 1/2" X 18" Rim Rear 3" X 18" Rim	
TIRES	Pirelli - Front 350 x 18 RIB Rear 400 x 18 UNIVERSAL	
BRAKES	Expanding type brakes. Front 230mm diameter, four (4) leading shoes. Rear 200 mm diameter with foot brake lever, located on the L.H. side.	
OVERALL DIMENSIONS	Length	81"
	Width	32"
	Wheelbase	56"
	Seat height	31"
	Maximum height	46"
	Ground clearance	8.5"
	Handlebar width	32"
	Weight	407 lbs.
SPEED	1st gear	36 M.P.H.
	2nd gear	65.5 M.P.H.
	3rd gear	92 M.P.H.
	4th gear	104.6 M.P.H.
	5th gear	118.5 M.P.H.
FUEL CONSUMPTION	2 3/4 gallons x 100 miles.	

Controls

- 1 - Rear brake pedal
- 2 - Horn
- 3 - Light switch
- 4 - Clutch lever
- 5 - Steering damper
- 6 - Tachometer
- 7 - Green light (generator charging indicator)
- 8 - Red light (electrical system)
- 9 - Speedometer
- 10 - Starter lever (choke)
- 11 - Front brake lever
- 12 - Throttle twist grip
- 13 - Shifting lever
- 14 - Ignition key
- 15 - Kick starter



Operating instructions

Before using the motorcycle, check the following:

Battery as per instructions on page 28.
Engine oil as per instructions on page 19.

Tire pressure - front tire 22 lbs. Rear tire 28 lbs.

Fill fuel tank with 98-100 octane fuel.
Brake adjustment, front and rear suspensions.

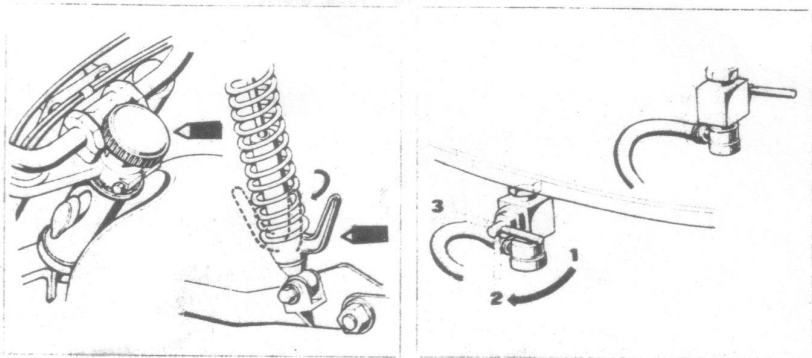
Adjust steering damper which must be free for smooth road surface, and tight for rough road.

Adjust rear shock absorber as neces-

sity requires, by turning the lever at the lower part of the shock absorber. Adjust both shock absorbers at the same position.

Starting

Put in neutral position, the gear box, half-way between 1st and 2nd gear. Open the two fuel petcocks (no. 1 position, close - 2, open - 3 reserve). Pull the starter lever (only when en-



gine is cold) and push forward as soon as the engine is warm.

Rotate the ignition key to the 2 position. The red light indicator will light up (note: the light indicator will go out as the engine increases R.P.M.) kick the starter pedal keeping the throttle at idle position. (When engine is hot, open slightly the throttle).

It is important to run the engine at idle speed for a few seconds to allow the oil to reach all the lubricated components.

Depress the clutch lever and engage the first gear, lifting the shifting lever

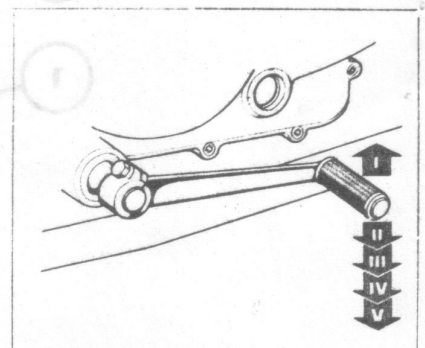
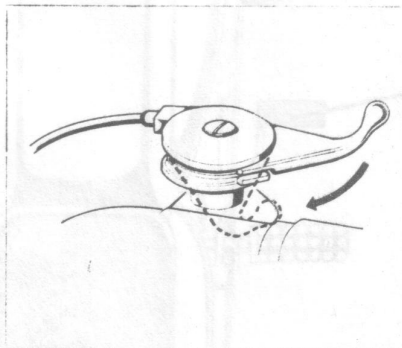
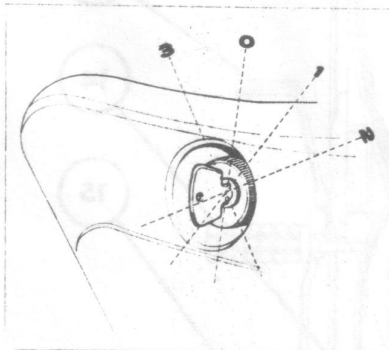
with the toe. Release the clutch lever slowly and the same time, rotate the throttle gradually.

To stop

Retard the throttle, depress the clutch lever, and put the foot shift lever in neutral position, apply both brakes gradually, turn the ignition key to position marked "O". Close both fuel petcocks.

Changing gears

To change into higher gears, repeat the same procedure and each time, depress the shifting lever with your toe.



Light switches

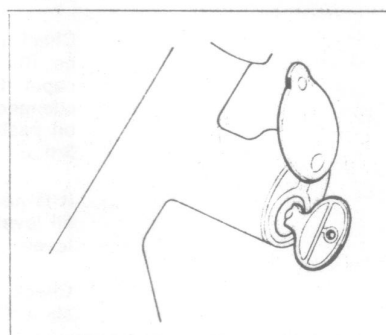
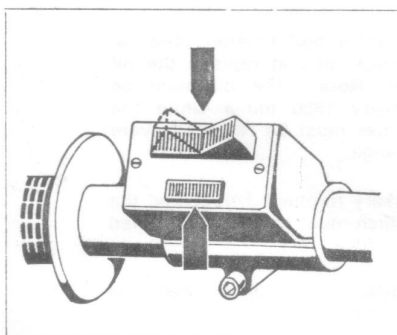
Turning the ignition key to position n. 3 (see fig. « A » on page 15), you turn on the main lights, the panel lights and red indicator light.

The dimmer switch is located on the L.H. side of handlebar. The n. 1 button operates the high and low beams while the n. 2 buttons is for the horn.

Anti-theft lock

The lock is located on the L.H. side of the steering tube. To lock, turn the lock cover and insert the key. Press in the key and at the same time rotate from right to left.

Rotate the handlebar to the right, until the steering is locked. Pull the key from the lock.



Break-in period

Your cycle is made to a very close tolerance. Because of its precision fitting components, a break-in period of 1600 miles, is recommended.

To obtain the best performance and longer life for the engine, the following instructions are recommended.

Do not operate your engine at a high R.P.M. until it is sufficiently hot.
Do not exceed the prescribed speed.

Do not maintain the specified speeds for a long period of time and as soon as the engine decreases in R.P.M., reduce the speed.

IMPORTANT

After the first 300 miles, change the engine oil, preceding as indicated on page 19.

	R.P.M.	1st	2nd	3rd	4th	5th
A - first 450 miles	4500	25	37	50	62	68
B - 450 to 1000 miles	5500	31	43	56	74	90
C - 1000 to 1600 miles	6000	37	47	62	84	99

Maintenance

Periodic maintenance is important to the efficiency of the engine and frame components.

After the break-in period (1600 miles): Tighten, with engine cold, the cylinder head nut to 25 ft. lbs.

Tighten the intake manifold, exhaust pipe flange nuts and all the frame bolts, particularly the engine bolt, front and rear wheel axel, shock absorber nuts and the swing arm bolt.

Check point gap .016".

Check spark plug gap .024".

Check and adjust if necessary, valve clearance (as indicated on page 20).

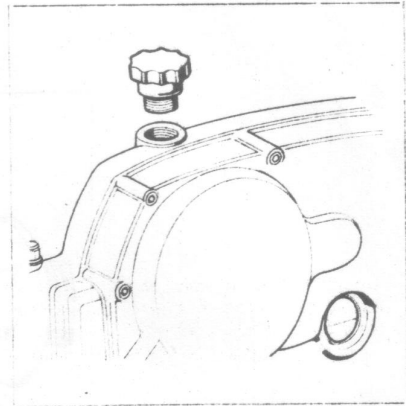
Check generator bolt tension (see page 19) change oil and replace the oil paper filter. **Note** - the oil must be changed every 1600 miles while the oil paper filter must be replaced every 3rd oil change.

It is necessary to check frequently, the oil level which must be at the specified level.

Check battery electrolyte level as shown on page 28.

Lubrication and the majority of the remaining maintenance operations can be made with the tool supply with your motorcycle (see page 32).

However, we suggest always to see your dealer, where you will receive the best and accurate assistance.



Every 1600 miles, change the oil as follows: change oil with engine hot.

- 1) Remove nuts that fasten the cover of the oil pump filter.
- 2) Be careful not to damage the gasket
- 3) Remove oil filter and clean it with gasoline and compressed air.
- 4) Reassemble, after the oil is completely drained, the filter gasket and cover, as shown. It is important that the hole with the rubber ring is facing the left hand side of the motorcycle.

NOTE

To facilitate the oil draining, it is advisable to remove the plastic plug of the filling hole.

The oil, paper filter, must be changed every 3rd oil change.

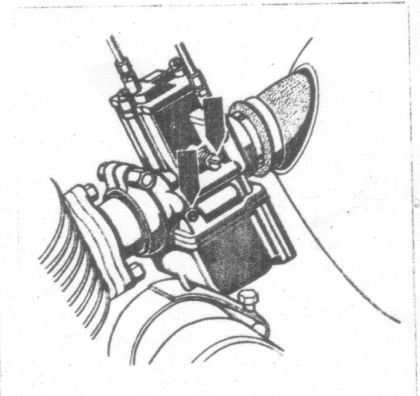
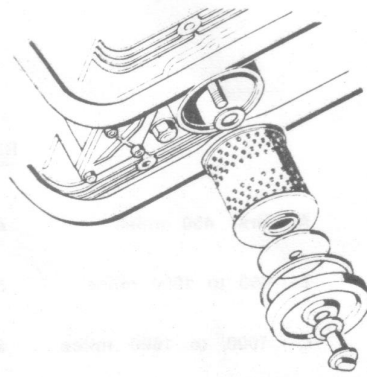
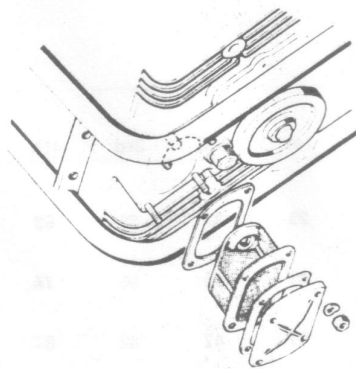
Remove the special nut with 12 mm wrench. Pull out the filter element and the respective washers and gaskets. When reassembling, follow accurately the sequence shown below.

CARBURETOR ADJUSTMENT

Your carburetor is equipped with two (2) 29mm concentric Dell'orto type carburetors.

The normal adjustment of the idle screw « C » is 1½ turn open from locked position while the screw « B » adjusts the idle speed (the slide).

To obtain an equal opening of the carburetor slides, adjust the throttle cable with the adjusters located on the cables.



Check, and if it is necessary, adjust the generator belt tension.

Applying a normal pressure, the belt should have a play greater than 5/16" or 3/8". To adjust generator belt, loosen the rear brake rod and remove the L.H. cover.

Remove the three (3) pulley fastening nuts with an 8mm wrench.

Remove the necessary spacer washers from the internal half of pulley and relocate the spacer equally, in order to maintain the perfect alignment of the two (2) pulleys. Reassemble the

pulley locking nuts and tighten alternately.

NOTE

Before locking the nuts, turn the engine over, using a 19 mm wrench, to prevent the belt from fitting in without being locked between the two half pulleys.

NOTE

To replace the generator belt, the driving pulley must be removed from the

crankshaft and the driven pulley disassembled.

Follow the same above instructions to align belt.

After the cover is reinstalled, readjust the rear brake rod.

IMPORTANT

The valve clearance must be checked and adjusted when the engine is cold. Remove seat, fuel lines, and fuel tank. Remove valve cover.

Turn engine to T. D. C. in compression stroke. Check valve clearance using a feeler gauge - exhaust valve .005" - intake valve .004".

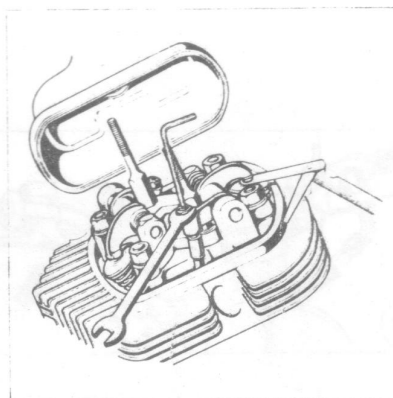
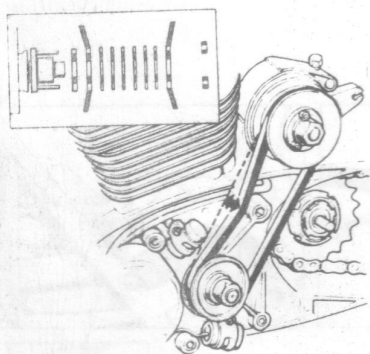
And proceed to adjust if necessary, as follows:

Loosen with 12mm wrench, the adjusting screw locking nut.

With 5mm allen wrench, turn adjusting screw and tighten at same time, the locking nut.

After valve of one cylinder is adjusted, turn the engine one (1) turn and adjust valve of second.

Check if rubber gasket properly fits the seat and reassemble the cover. Tighten nut = A = 5 kgm.



ADJUSTMENT OF SPARK PLUG GAP - IGNITION POINTS - IGNITION TIMING

Check spark plug gap .024".
Check points gap .016".

In the event that the engine has signs of efficiency loss, if not caused by other malfunctions, proceed to check the ignition as follows:

Loosen the rear brake rod and remove the L.H. cover. Turn engine until the piston of the L.H. cylinder reaches the T.D.C. position. The « O » mark of the driven pulley will align with the line mark on the case « rib ». Using a 19mm wrench, turn the engine clockwise until the lower ignition point (which

refers to the L.H. cylinder) is completely open. Check with a feeler gauge 0.16" the point gap. To adjust, loosen then retighten, slightly, screw « A » with a screw driver. Apply leverage (see figure) to obtain correct gap. Retighten firmly, the screw « A ». Repeat operation, turning the engine clockwise a complete turn (360°), to adjust upper ignition points (right hand cylinder).

After the points gap is adjusted, proceed to check the ignition timing.

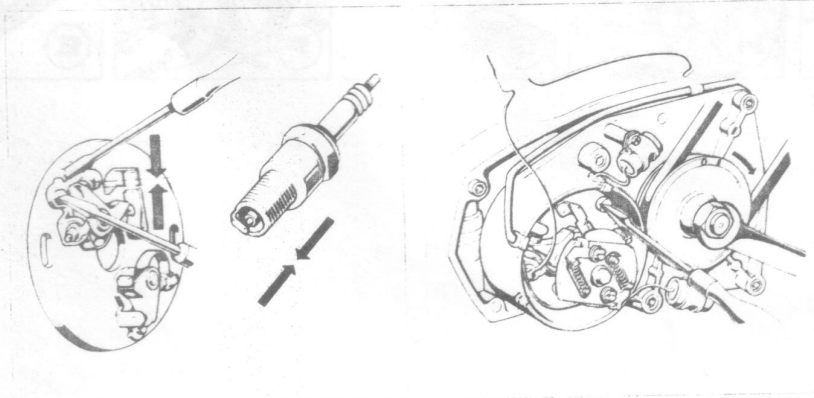
Connect timing light to upper ignition points of right hand cylinder and turn engine to compression stroke until the light goes out. The line mark of the

pulley must coincide with the line mark of the crankcase « rib ».

To time the left hand cylinder: Connect the timing light to the lower ignition point.

Turn the crankshaft clockwise a complete turn (360°) and repeat the same operation as per right hand cylinder. Check and lubricate the automatic advance components and check the spring tension.

Every 6000 miles, it is necessary to fill the groove of the automatic advance shaft, and impregnate the grease point felt with grease type bosch 5200-005000.



Lubrication

Every 1600 miles.

Change oil as indicated on page 19. Lubricate all the controls as shown (fig. B-D-G) with multipurpose grease « Shell Retinax A ».

Thoroughly clean the chain and lubricate with chain lube. These operations are of maximum importance and must be repeated periodically.

Every 6000 miles or as needed, replace the oil of the front fork tubes (fig. L) proceeding as follows: Unscrew the fork tube top plugs and fill each tube with 210 C.C. of « Shell Donax A1 » hydraulic oil (see fig. C). Lubricate with « Shell Retinax A »

grease (using a grease pump) the swing arm shaft (fig. C) until the grease will surge around the trusts parts of the shaft.

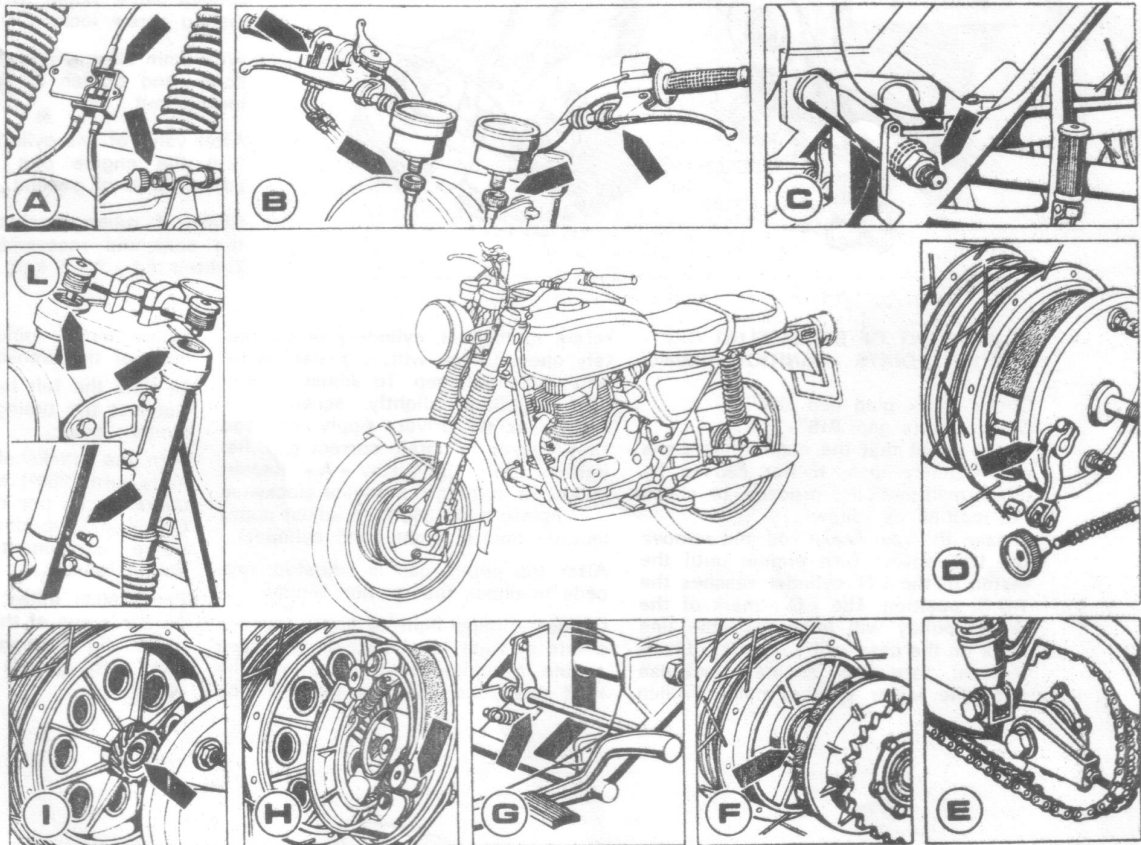
Lubricate the wheel bearing with bearing grease « Shell Retinax A » (fig. I & F).

Lubricate the front brake and the choke cable controls (fig. A).

Lubricate battery terminal with vasoline as indicated on page 28.

Lubricate the brake shoe cams (fig. H). Be careful that the oil does not enter inside the brake hubs.

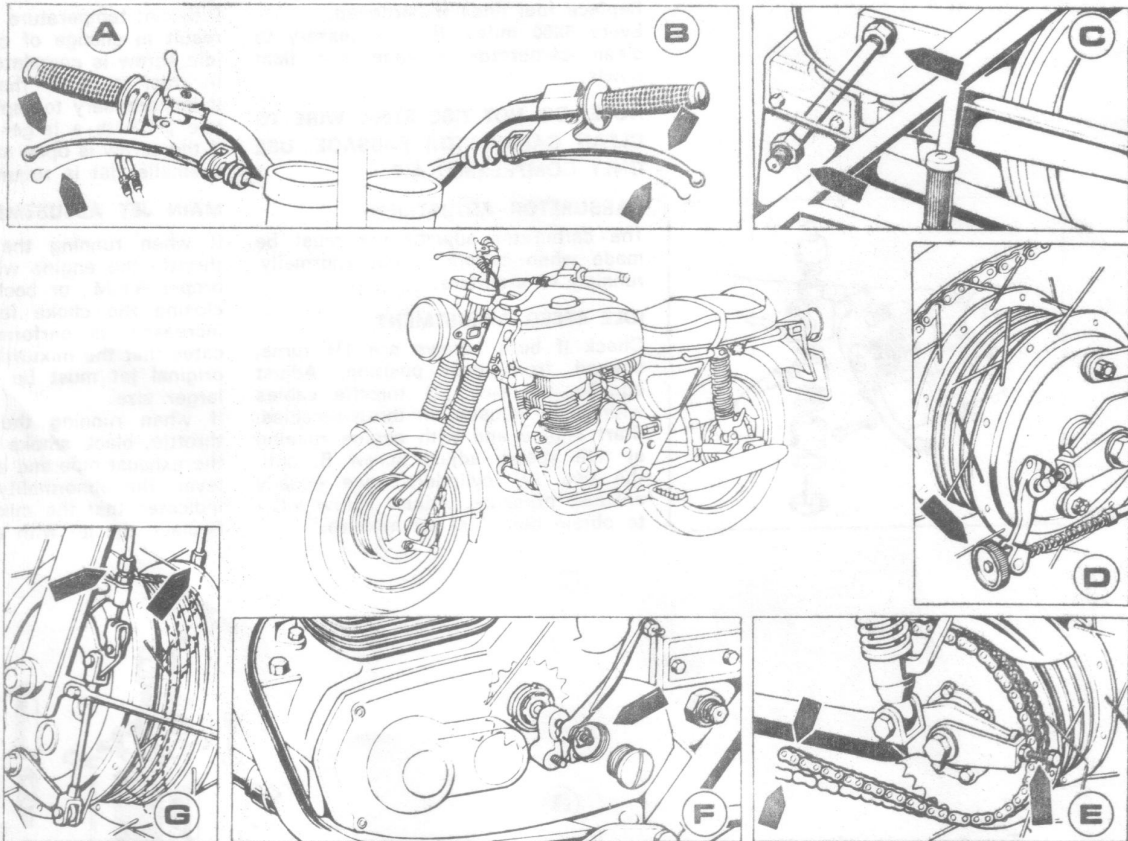
Lubricate the shaft and grease the felt as indicated on page 21.



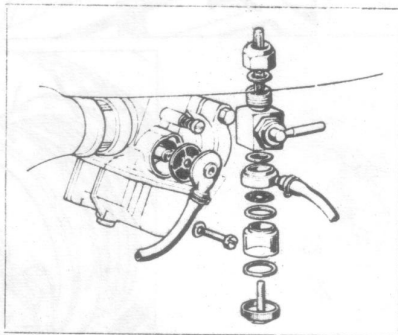
Adjustment

Adjust front and rear brakes frequently, leaving some play at the controls. The front brake can be adjusted at the handlebar lever (fig. A) or if necessary, with the two adjusters shown at fig. G. **Adjust evenly.** The rear brake system is equipped with a simple adjustment on the brake rod (fig. D). Figure B, shows the adjuster of the clutch lever on the handlebar. If necessity requires, adjust the clutch with screw on clutch lever (fig. F). To adjust chain, remove cycle from

the stand and loosen axel, and anchor rod nuts. Sit on motorcycle and adjust turning the chain tensioner bolts. Lock axel nuts and check wheel alignment. If needed, adjust rear swing arm as follows: Loosen with 22mm wrench, the nut on the R.H. side and with 30mm wrench, loosen the nut on the other side of the swing arm shaft. Using a 16mm wrench, tighten swing arm bolt until the swing arm turns freely without side play. Lock the two (2) shaft nuts at 25 ft. lb.,



Fuel system



Clean, with compressed air, fuel lines, petcock and carburetor filters, if necessary.
 Replace fuel lines if hardened.
 Every 6000 miles, it is necessary to clean carburetor passage and float bowls.

NOTE: DO NOT USE STEEL WIRE TO CLEAN CARBURETOR PASSAGE. USE ONLY COMPRESSED AIR.

CARBURETOR ADJUSTMENT

The carburetor adjustments must be made when engine is hot (normally, running temperature).

IDLE SPEED ADJUSTMENT

Check if both screws are 1½ turns, opened from lock position. Adjust equally, the two (2) throttle cables with cable adjuster on throttle cables. Start engine and with engine running at idle speed, adjust screw B, until the two (2) cylinders have equally exhaust pressure. Adjust screw « C » to obtain best fuel air mixture.

Readjust screw « B » to obtain the idle speed desired and same exhaust pressure.

Different temperature and altitude may result in change of carburetor, if the idle screw is completely closed.

In order to obtain the proper mixture, it is necessary to replace the existing idle jet with a larger size. Viceversa, if the screw is open more than normal, a smaller jet is required.

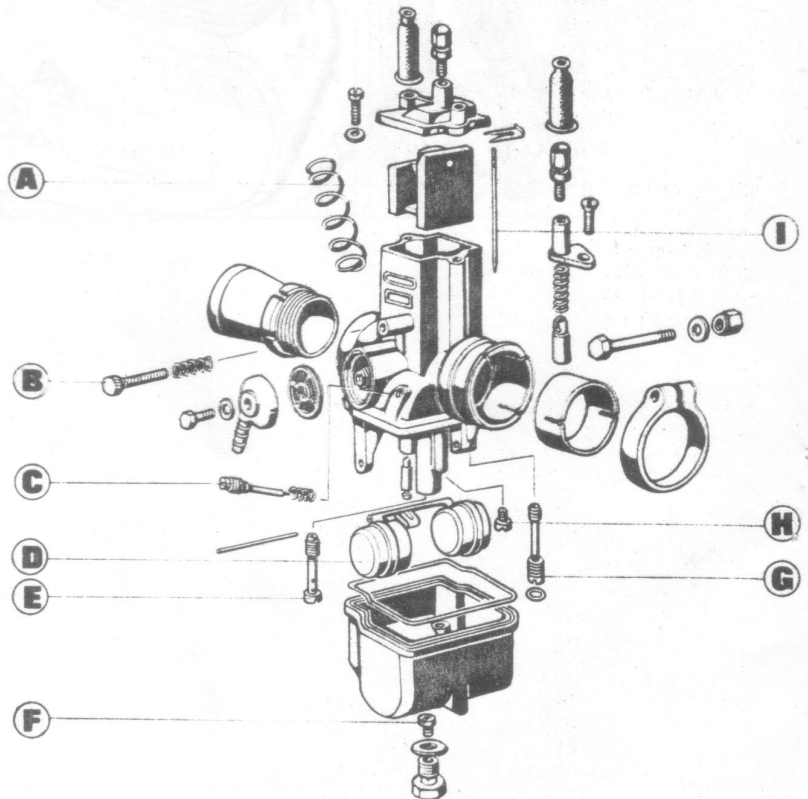
MAIN JET ADJUSTMENT

If when running the engine at full throttle the engine will not reach the proper R.P.M., or backfires, and when closing the choke lever, the engine increases its performance, this indicates that the mixture is too lean. The original jet must be replaced with a larger size.

If when running the engine at full throttle, black smoke is emitted from the exhaust pipe and closing the choke lever, the abnormality increases, this indicates that the mixture is too rich. Replace the jet with a smaller size.

Tuning specifications

- A - Slide (size 60)
- B - Slide screw
- C - Idle adjusting screw (open 1½ turn)
- D - Float bowl
- E - Needle jet
- F - Main jet
- G - Starter jet
- H - Idle jet
- I - Needle



Electrical components

BATTERIES (BOSCH 0.180.001.213)

The 650cc Benelli is equipped with two (2) 6v batteries connected in series, which are located under the seat.

To service the batteries after the seat is removed, dismantle the two (2) side covers, using a screw driver.

Remove the wing bolt located under the seat and pull out batteries.

1) Fill the battery to approximately .080" above the plates with pure sulfuric acid having a specific gravity of 1280 at 36° F.

2) Let the battery rest for two (2) hours and bring back to the required level by adding sulfuric acid, as much as required. Then charge the battery

for 8 to 15 hours at a rate of one-tenth of battery capacity (1.2AH).

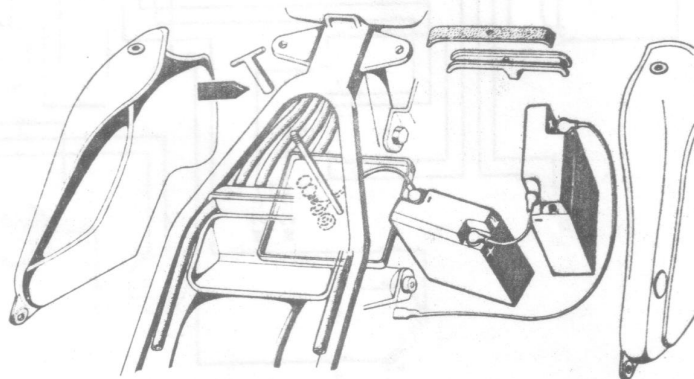
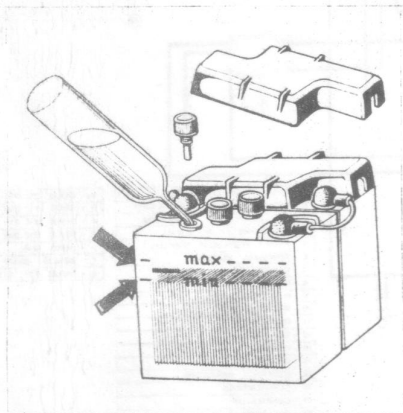
NOTE: The temperature of the plates during the battery charge, must not exceed 81° F. Interrupt the charge if the temperature exceeds such temperature.

After two (2) hours the battery is completely charged.

Bring the solution level back to the proper level, over the plates.

Periodically check battery level adding only if necessary, chemically distilled water.

Every 6000 miles, clean the battery terminals and lubricate with pure vasoline.

**GENERATOR (BOSCH EH (R) 14V. 11A. 19)**

Every 6000 miles clean accurately, the generator armature, at the contact point of the brushes, with a clean cloth impregnated with gasoline.

Check the generator brushes wear, and if necessary replace.

Note: Adapt new brushes to the armature.

HIGH TENSION COIL 2 TYPE (BOSCH TJ 12/3 0.222.003.003.000)

Regulator type.

Note: The regulator is sealed, therefore, if damaged, it must be replaced with another of the same type.

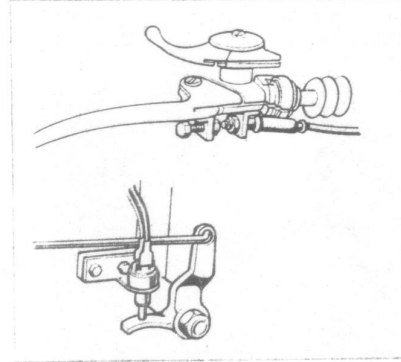
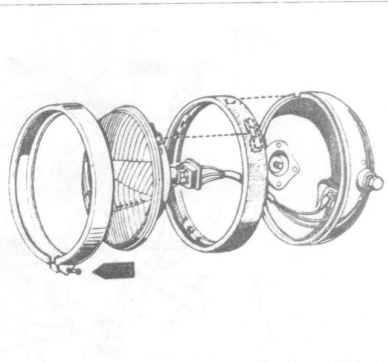
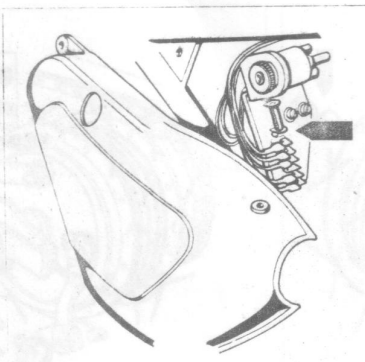
HORN TYPE 12V (BOSCH 0.320.023.001)**HEADLIGHT (CEV 137 SAE M66)**

To replace sealed beam, unscrew lower rim fastening screw. Remove clips. It

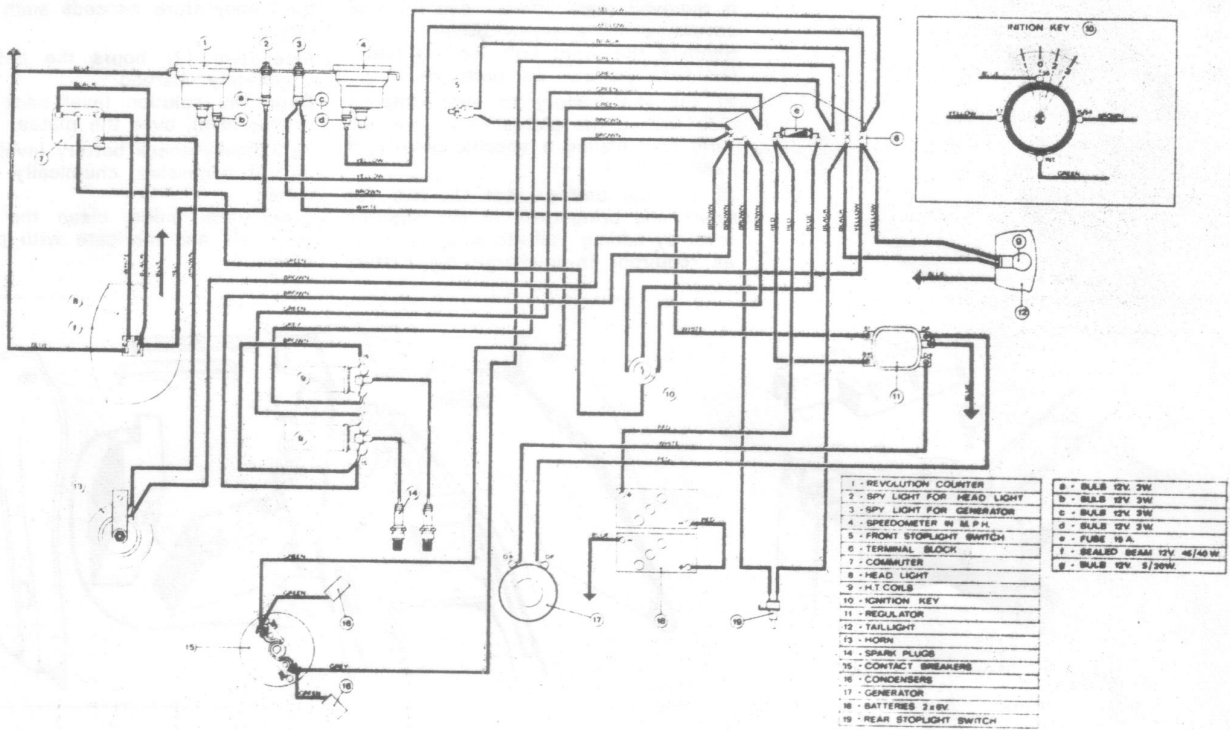
is important that wires are re-assembled in their original position.

TAIL LIGHT TYPE (CEV 127 SAE STLB 66)**STOP LIGHT SWITCHES (CEV 9343)**

Front brake switches are located on the handlebar. Front brake lever (right hand side). The rear brake stop light switch is attached to the frame on the right hand side, next to the front of the rear wheel.



Electrical system

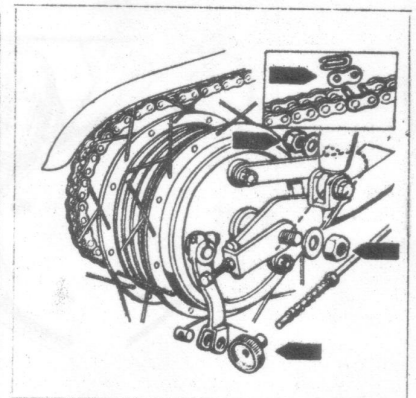
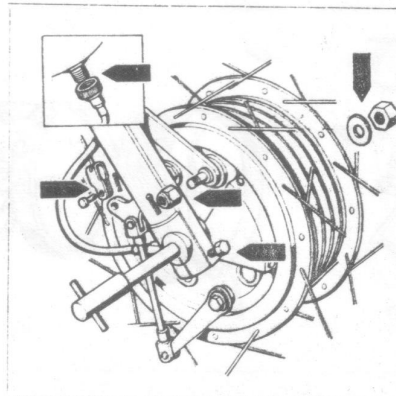


To remove front wheel

Remove the cotter pins and pins of the brake cables (fig. 1).
 Unscrew the brake plate anchor arm fastening nuts (fig. 2).
 Disconnect speedometer cable from speedometer.
 Unscrew the axel nut (fig. 3) and pull out the shaft after the axel pinching bolt is loosened.
 Pull the two (2) anchor plate arms from the bolt and remove wheel.
 To reassemble, reverse operation.
 The anchor arms must be fitted on the even threaded parts of the fastening bolts.
 Remember to refit all the cotter pins.

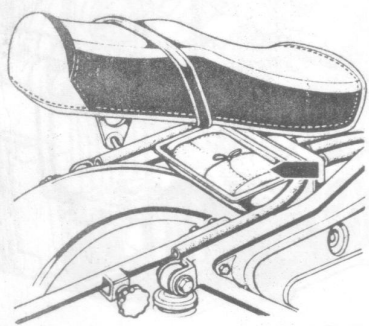
To remove rear wheel

Disconnect the rear brake rod adjusting knob (fig. 1) and remove the chain master link (fig. 2).
 Unscrew the anchor plate arm at the swing arm side (fig. 3).
 Remove one axel nut and pull out axel (fig. 4).
 To reassemble, reverse operation installing the master link clip as shown in the sketch.

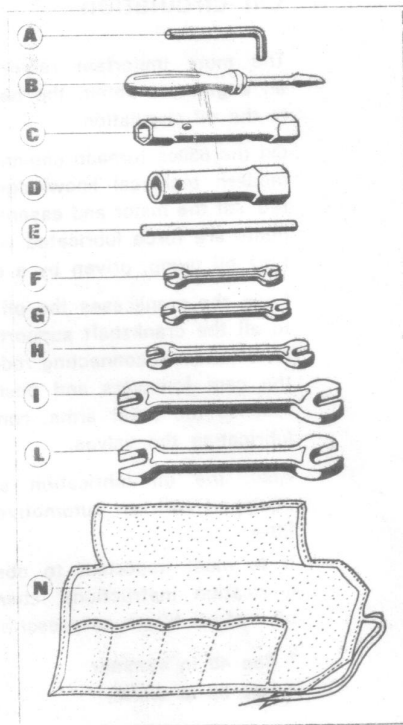


Tool kit components

The tool kit is located under the drivers seat.



- A) 5mm allen wrench
- B) Screw driver
- C) Tube wrench type 10/12mm
- D) Spark plug wrench 21mm
- E) Pin for tube type wrench
- F) Open wrench 5.5 and 7mm (for ignition points)
- G) Open wrench 8-10mm
- H) Open wrench 12-13mm
- I) Open wrench 17-19mm
- L) Open wrench 22-24mm
- N) Tool container



Trouble chart

DIFFICULTY

CAUSE & CORRECTION

Engine will not start or stop as soon, after running.

Clean fuel lines, filters, and carburetor jets.

Irregular flow of gas-carburetor flooded.

Close petcocks. Remove and clean spark plugs. Kick over, the engine, a few times. Re-assemble the spark plug.

Ignition.

Re-place spark plug. Check ignition points gap, ignition circuit. Battery, low charge. Switches.

Pre-ignition.

Replace fuel with higher octane. Check proper spark plug heat range. Carbon deposit on pistons and cylinder head chambers. Check ignition timing, carburetor mixture (see page 18 & 27).

Engine misses.

Check spark plug gap. Check ignition point gap. Flow of gas line through fuel lines and carburetor.

Loss of efficiency

Check carbon deposit on piston and cylinder heads. Spark plugs. Check valve adjustment. Cylinder head bolt torque, piston & piston ring wear. Valve leakage. Improper carburetor mixture. Check ignition timing.

Back firing from carburetor.

Carburetor mixture too lean. Close air adjusting screw. Check air leaks at intake manifold and at carburetor clamp. (See instructions page 27).

Oil circulation

The most important requirement for an engine, to obtain the best results, is the oil circulation.

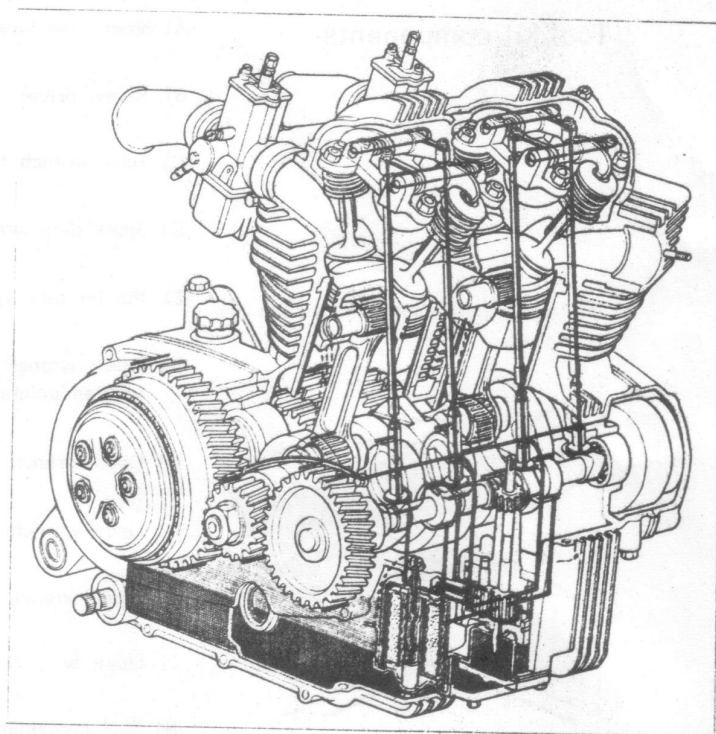
On the 650cc tornado engine, the most modern technical knowledge is adopted. All the major and essential components are force lubricated with a gear type oil pump, driven by a cam shaft.

From the crankcases the oil is forced to all the crankshaft supports and the lower ends of connecting rods, through the cam followers and push rods, it reaches the roker arms, consequently lubricating the valves.

Also, the oil lubrication system is equipped with an automotive type oil filter.

It is most important to observe the lubrication instructions, changing the oil and oil filters as prescribed.

- * Sae 40 in summer
- * Sae 30 in winter



Cleaning and storage preparations

All the painted parts must be cleaned with water using a sponge and dried. Do not wet carburetors.

The engine and all other parts of motorcycle must be cleaned with petroleum giving maximum attention not to impregnate the brake shoes. Lubricate all the controls.

To store for an extended period of time it is advisable that the tires should not touch the ground. This reduces the tire pressure. Remove batteries and store in a cool dry place. Recharge the battery every month.

Drain all the gasoline from the fuel tank and wash it with a mixture of oil and gasoline. Introduce a small quantity of motor oil into the cylinder through the spark plug hole and turn the engine over a few times.

Protect all the chromed parts with a solution to prevent rust.

