OPERATOR'S MANUAL

FOR ROTAX ENGINES

TYPE 377 AND 503

ENGINE EXECUTION WITH

- BOSCH CONTACT BREAKER IGNITION SYSTEM
- BING CARBURETOR

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TECHNICAL DATA

Specification		Twin-cylinder-, two-stroke Otto engine, lubricated by fuel-oil mixture, fan-cooled
Cylinders		light alloy cylinders with cast iron sleeves
Bore	(type 377)	62 mm
	(type 503)	72 mm
Stroke		61 mm
Displacement	(type 377)	368,3 c.c.
	(type 503)	496,7 c.c.
Compression ratio	(type 377)	11,6
	(type 503)	10,8
Ignition unit		BOSCH magneto generator SCP2 12V 140W (alternating current)
Ignition timing		1,83 ÷ 2,33 mm BTDC (0,072 ÷ 0,092 in)
Contact breaker gap		0,30 ÷ 0,40 mm (0,012 ÷ 0,015 in)
Spark plugs		NGK B8ES or equivalent electrode gap 0,4 ÷ 0,5 mm (0,015 ÷ 0,02 in)
Carburetor		BING slide carburetor type V54/36
Fuel pump		MIKUNI
Starter		- Rewind starter or - Rewind starter and electric starter
Fuel		Regular grade gasoline,octane number not below MON 83 or RON 90
Lubrication		- If engine is installed with cylinders upright (spark plug on top): Super 2-stroke oil, mixing ratio 1 : 50, e.g. Castrol Super TT - If engine is installed with cylinders downward (spark plugs at bottom): Outboard oil (BIA TCW), mixing ratio 1 : 50 e.g. Castrol Biolube

GENERAL

The ROTAX engine is a fan-cooled 2-stroke engine. Careful and extensively tested design and rugged construction as well as the use of high quality parts warrant maximum reliability and durability. With proper maintenance and care and with the use of suitable fuel and oil the engine will give you trouble-free service for many years.

The ROTAX design incorporates the latest technical developments. In order to take advantage of future developments we reserve the right to make modifications in the ROTAX design without notice.

FUEL - OIL - MIXTURE

The ROTAX engine is operated by a mixture of standard grade gasoline and

- Super 2-stroke oil, if the engine is installed with cylinders upright (spark plug on top)
- Outboard oil (BIA TCW), if the engine is installed with cylinders downward (spark plugs at bottom)

the oil lubricating the moving engine parts.
Mixing ratio fuel - oil is 50 : 1; this mixing ratio has to be respected.

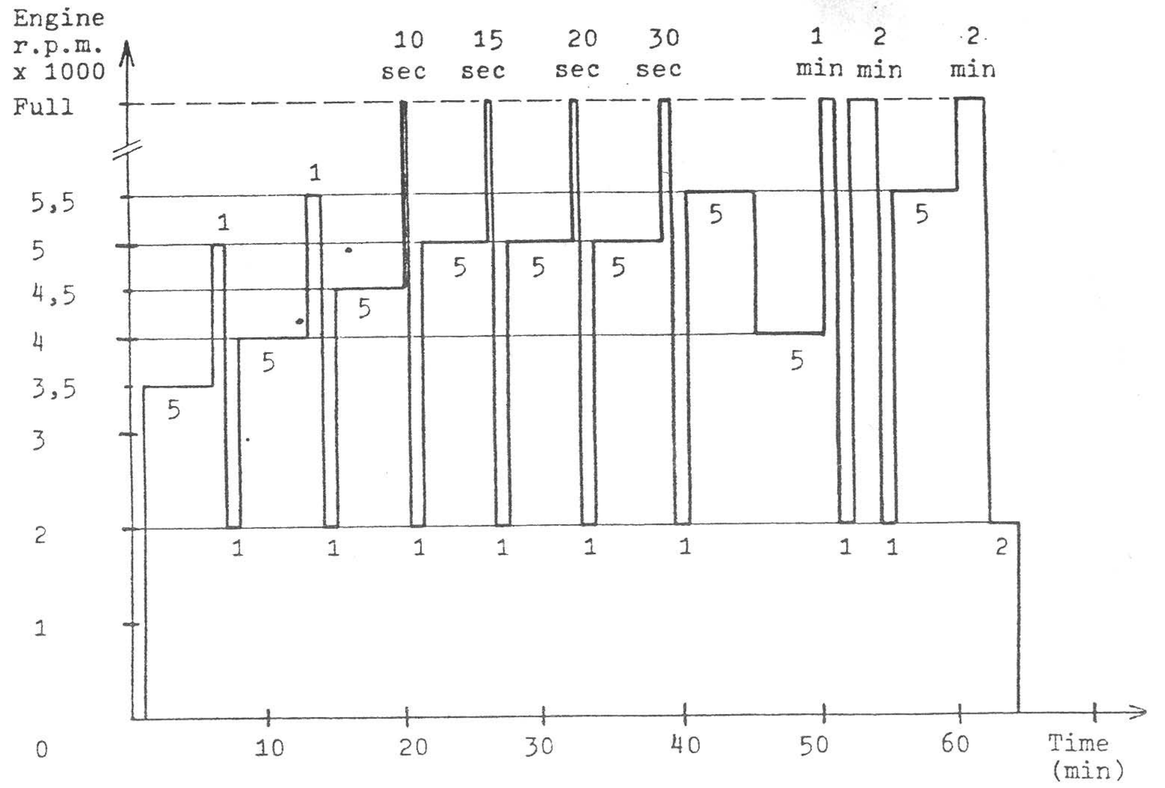
Too much oil will cause carbon deposits on the spark plug, on the piston, in the cylinder ports and in the muffler and will cause problems. In addition, the piston ringsmay stick.

If too little oil is used, lubrication will be insufficient, the pistonswill seize and the bearings will be damaged.

Note: Poor oil quality cannot be compensated by using more oil!

BREAK-IN PROCEDURE

The break-in has to be performed with the engine in the airframe, loaded with the propeller. Tighten the plane to the ground and run the engine according to the following graph:



After this procedure the idle has to be adjusted.
Then short take-offs can be conducted.
After a few short full-load take-offs, but not later than 2 hours total running time, the cylinder head nuts have to be re-tightened to 18 ÷ 24 Nm (160 ÷ 210 in.lb). For this procedure the cylinder cowl has to be taken off.

Tools: Screwdriver
insert 13 (socket wrench 13)
torque wrench

Note: Use a cross-sequence for tightening the nuts.

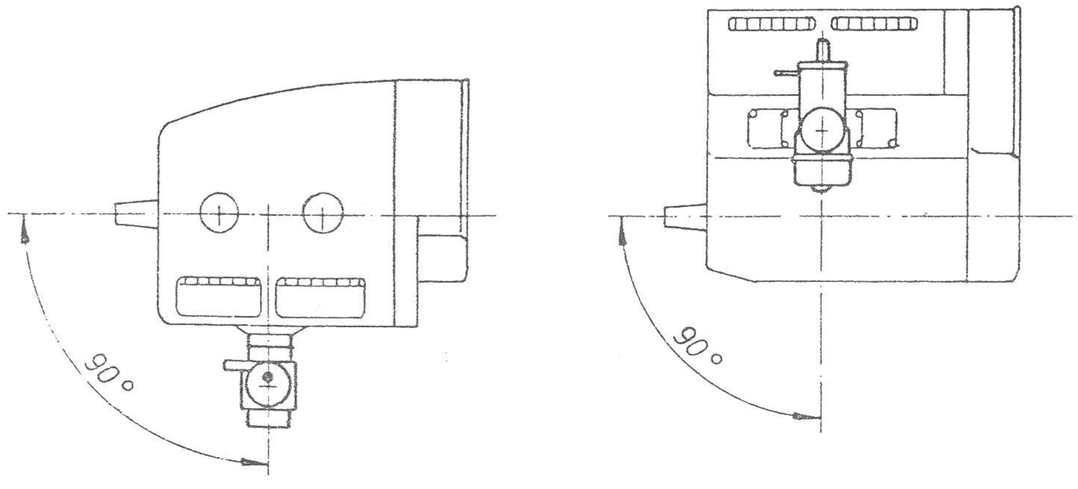
CARBURETOR

The BING carburetor is a piston type carburetor with float chamber. The carburetor can be adjusted by jets and adjusting screws. Changing of jets should only be done by a specialist or after consulting the engine manufacturer.

The air-fuel mixture at idle speed is adjusted by the air adjusting screw (see ill. no. 30).

The idle r.p.m. is adjusted by the carburetor piston adjustment screw (ill. no. 32).

Note: The carburetor must be in an exact right angle position in relation to the crankshaft in both views from top and from the intake side to ensure an equal mixture distribution to both cylinders.



Does the engine run well at high r.p.m.? — no →

1. Engine "four-stroking"
a) Air cleaner element dirty
b) Needle jet worn
c) Jets too large
d) Too much oil in the gasoline
e) Faulty ignition timing
f) Exhaust port and exhaust pipe blocked
g) Needle position too high

2. "Spitting" in carburetor
a) Fuel filter blocked
b) Dirt in carburetor
c) Dirt in needle valve
d) Carburetor not secured properly
e) Needle position too low
f) Faulty ignition timing
g) Spark plug loose or dirty
h) Incorrect electrode gap
i) Incorrect caloric value of spark plug
j) Ignition cable loose or poorly insulated
k) Piston rings stuck
l) Crankshaft oil seal worn

3. Engine "knocks"
a) Faulty ignition timing
b) Poor fuel supply
c) Heavy carbon deposits in cylinder ports (glow ignitions)
d) Play in gudgeon pin
e) Big-end bearing or cylinder bore worn

yes ↓

Does the engine run well when idling? — no →

1. Incorrect idle adjustment
2. Faulty ignition timing
3. Faulty spark plug
4. Poor cylinder sealing

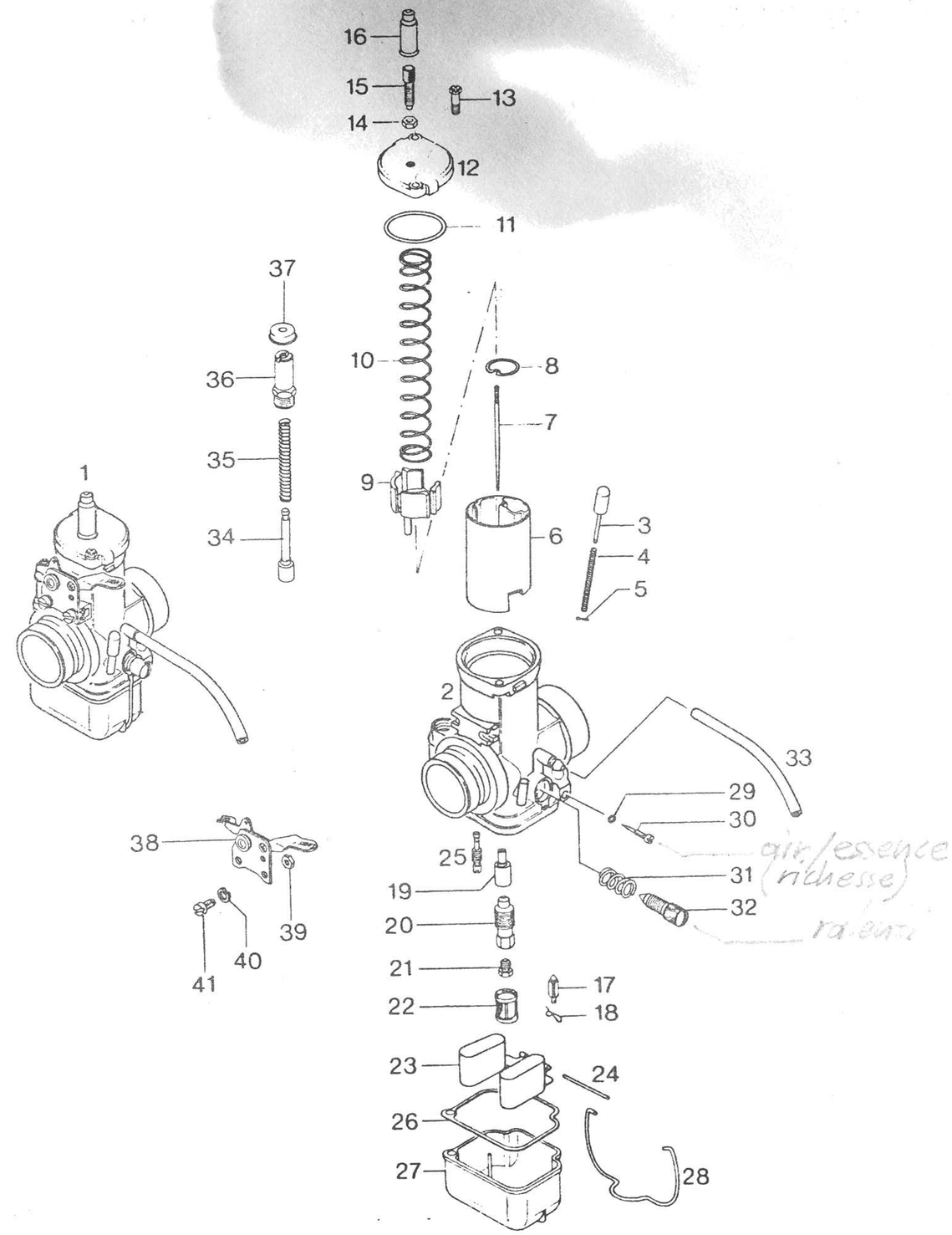
yes ↓

Now all should be well, but remember to work in a methodical sequence when tracing faults.

FAULT-TRACING SCHEDULE

		Probable fault
Open the fuel cock		
↓		
Does gasoline reach the carburetor?	no →	1. Gasoline tank empty 2. Blockage in tank cap 3. Blockage in fuel cock 4. Blockage in fuel line 5. Needle valve blocked
yes ↓		
Does gasoline reach the engine?	no →	1. Blockage in carburetor
yes ↓		
Does the carburetor keep flooding?	yes →	1. Float stuck 2. Float leaks 3. Needle valve does not seat properly
no ↓		
Has the engine become wet with fuel?	yes →	1. Too much use of starter 2. Faulty ignition system 3. Incorrect fuel mixture
no ↓		
Is there a spark at the spark plug protector?	no →	1. Poor contact between ignition coil and ignition cable 2. Ignition cable broken or short-circuiting 3. Faulty ignition coil
yes ↓		
Is there a spark at the spark plug?	no →	1. Electrode gap too large 2. Bridging between electrodes 3. Insulator broken or wet 4. Spark plug oily Change the spark plug
yes ↓		
Is the engine difficult to start?	yes →	1. Faulty ignition timing 2. Float needle does not seat properly 3. Air cleaner blocked 4. Fault in carburetor 5. Defective spark plug
no ↓		

BING CARBURETOR



STARTING THE ENGINE

On cold engine use choke.
Don't set throttle.
Start the engine.
After the first ignitions open throttle and shortly after close choke.

Attention: Throttle opening reduces the effect of the choke.

If the engine is started too long with the choke, the engine gets flooded with fuel. If this happens, the spark plugs have to be unscrewed, cleaned, dried and the engine has to be started (cranked through) several times. If the engine still does not start, see chapter "Fault Tracing Schedule".

SPARK PLUG

If the engine fails to start or operates only on one cylinder, it should be checked whether the ignition wiring is disconnected from the spark plug protectors or from the spark plugs. Then the condition of the spark plugs has to be checked (bridged between the electrodes, oily, sooty etc.).

If the spark plug heat range and the carburetor calibration are correct, the spark plugs look brownish.

With too high heat range (cold plug) and too rich carburetor calibration they look black and sooty.

With too low heat range (hot plug) or too lean carburetor calibration the spark plugs are burnt white and the electrodes are covered with melt drops.

ATTENTION: Heavy oil deposits on the electrodes and insulator cause engine troubles and have to be removed regularly (every 10 hours).

DECARBONIZING

After approx. 50 hours of use the combustion chamber should be de-carbonized.

To do so:
Remove cylinder top cowling and -head. Hold cylinders in place by suitable means. Using a scraper, the carbon scales on the combustion chamber of the cylinder head and on the top of the piston should be removed. Piston at top dead center.

MAIN TORQUING SPECIFICATIONS

	Nm	in.lb
Cylinder head nuts M8	18 ÷ 24	160 ÷ 210
Crankcase screws M6	8 ÷ 10	70 ÷ 88
M8	18 ÷ 24	160 ÷ 210
Magneto housing nut (M22 x 1,5)	80 ÷ 90	710 ÷ 800
Fan nut M16 x 1,5	60 ÷ 70	530 ÷ 620
Crankcase nuts (or -screws) M10	36 ÷ 40	320 ÷ 354
Exhaust manifold screws M8	18 ÷ 24	160 ÷ 210

Pull out the starter rope fully to the end, hold starter housing (1) and rope sheave (3) together in their position. There is an opening in the rope sheave. The key clamp (4) visible in the opening has to be pushed out in the opposite sense of the pulling direction. Pull the rope out of the rope sheave.

Then insert the new starter rope into the rope sheave, mount the key clamp in the same position as it was before and remount the parts 5, 6, 7, 8 and 9.

Caution! Do not remove spring container (2), this might cause injuries!

MOUNTING OF V-BELT

1) Mount the fan - sequence as per spare parts list (without V-belt!).

2) Place V-belt diagonally between two blades of the fan, turn the fan until the V-belt has moved into the pulley.

3) Fix V-belt pulley and starting pulley with one of the 3 screws, but loose. Put V-belt in the pulley groove and turn crankshaft in order to tension the belt and bring the pulleys on their centering. Now the 2 remaining screws can be mounted.
Screw torque: 20 Nm

ATTENTION: The tension of the V-belt can be adjusted by shims between the V-belt pulley half and the fan resp. the protection sheave. The V-belt is correctly tensioned when it can be depressed 8 - 9 mm with normal finger pressure (in the middle between the 2 V-belt sheaves). The exact adjustment of the V-belt tension is best left to a professional workshop.

Caution: Never put adjustment shims between protection sheave and fan, because this might cause breakage!

If even after cleaning or changing the spark plug there is no spark, the spark plug protector and the ignition cables and finally the ignition unit should be checked.

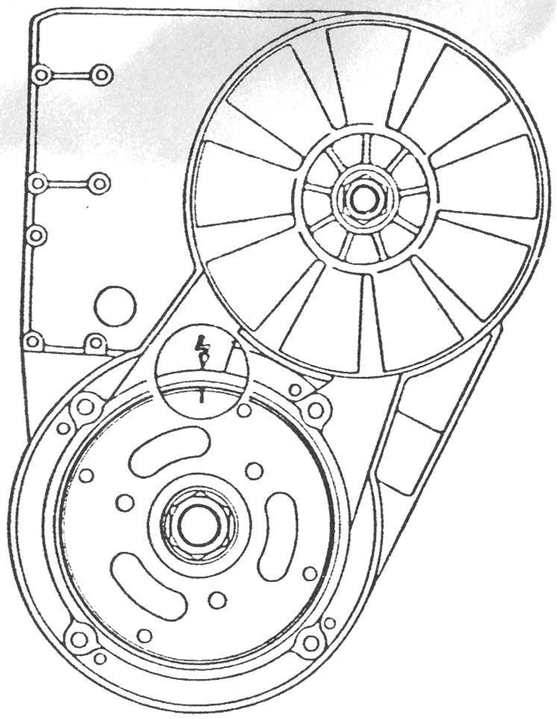
IGNITION UNIT

The ROTAX engine is equipped with a BOSCH magneto generator 12V 140W producing the current necessary for the spark. The ignition unit has been set most carefully and precisely by the factory. Make no changes unless absolutely necessary. In case of troubles observe the following:

If the ignition fails intermittently or if there are other troubles that are due to neither spark plug nor jets nor carburetor, the contact breakers may be the cause.

Contacts must be clean and must not be burnt. With new engines the cam-follower of the contact breaker must still adjust itself. Re-setting of contacts may therefore be necessary after some time. The breaker contacts are accessible after removal of the rewind starter and the starting pulley. The magneto housing need not be removed.

To check whether the ignition timing is correct there is an arrow on the fan housing. Further there is a mark on the magneto housing. At the moment of ignition (i.e. when breaker contacts open, check with test lamp, buzzer etc., connected to shorting cable of the respective cylinder and to mass),the mark on the magneto housing must correspond with the arrow on the fan housing (see illustration).



ADJUSTMENT OF IGNITION TIMING

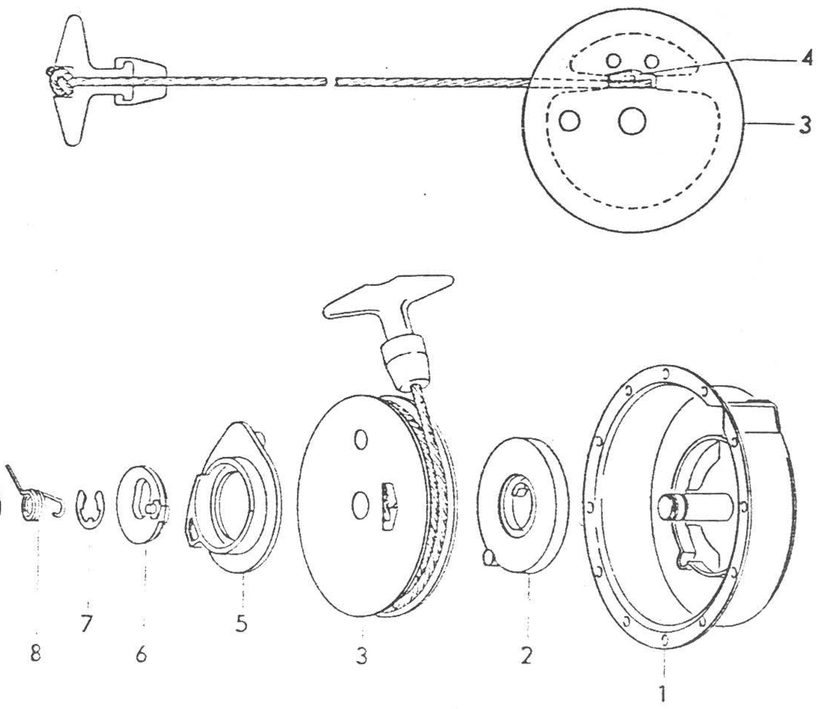
The ignition timing is adjusted after loosening the fixing screw G next to the adjusting groove H (see wiring diagram), so that the contact breaker starts opening when the piston is 1,83 ÷ 2,33 mm (0,072 ÷ 0,092 in) before T.D.C.

Check with test lamp or buzzer as described before. When cranking the engine, the breaker contacts must open 0,30 ÷ 0,40 mm (0,012 ÷ 0,015 in). If this is not the case, turn the stator plate and repeat the above procedure.

REWIND STARTER

Pull starter grip out slowly until resistance is felt, then pull out vigorously but not fully up to the end. As far as possible pull in the direction the rope comes out of the sheave. By a rewind spring the starter grip returns to its original position. Don´t let the starter grip fly back.

Do not operate the engine if the rewind starter is defective.



CHANGING THE STARTER ROPE

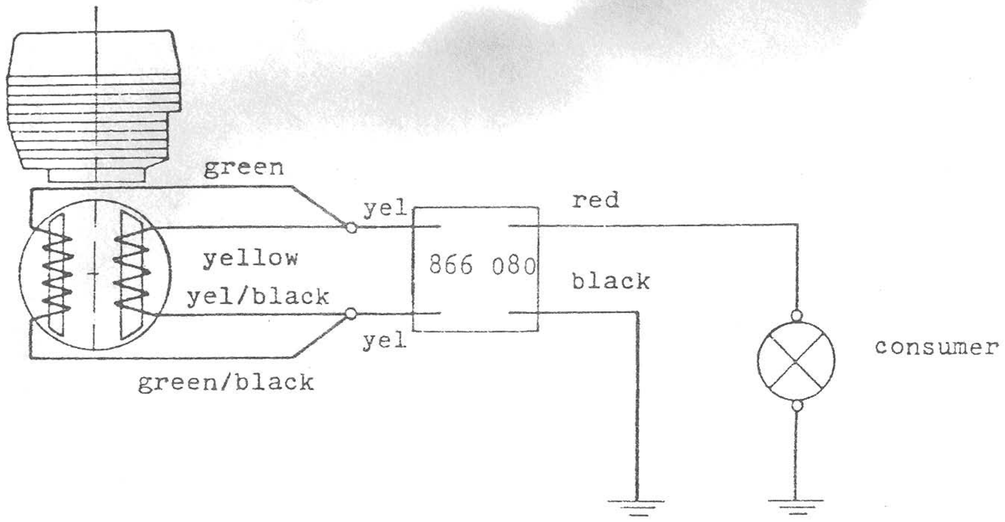
(The numbers stated in brackets refer to the illustration)

First remove snap ring (9), loop spring (8), circlip (7), pawl lock (6) and the pawl (5).

Tools: Snap ring tongs
screwdriver

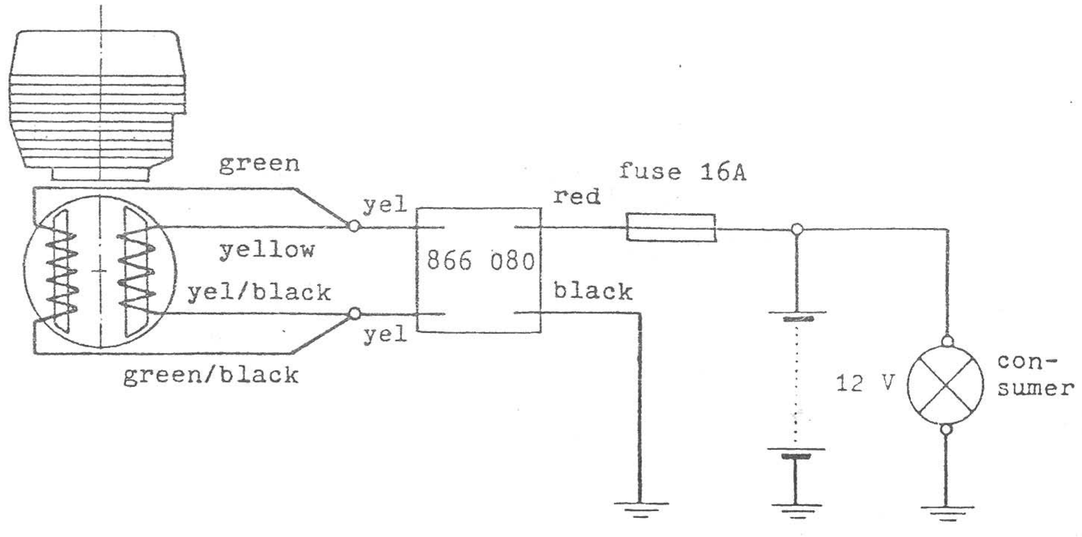
WIRING-DIAGRAM FOR RECTIFIER-REGULATOR 866 080

in a circuit without battery



WIRING DIAGRAM FOR RECTIFIER-REGULATOR 866 080

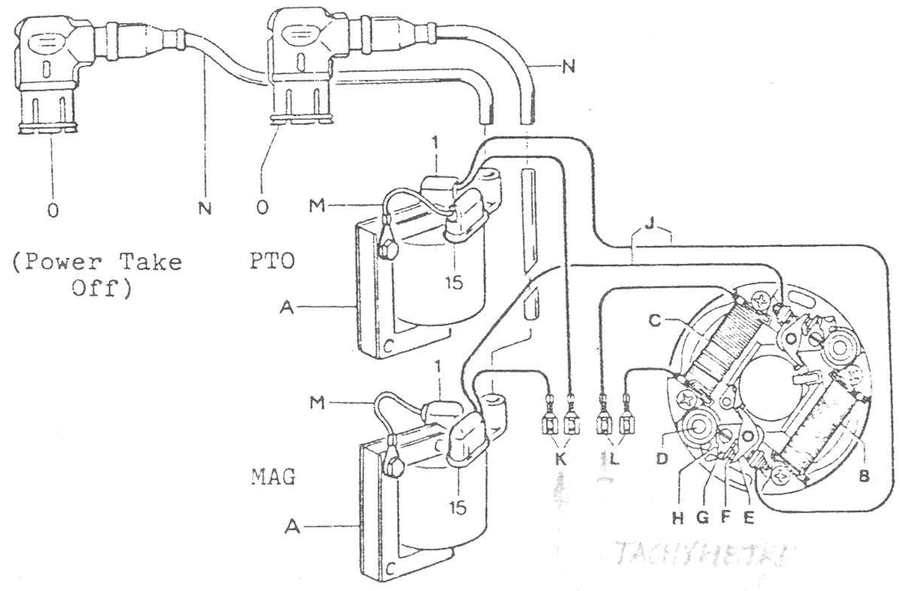
in conjunction with a battery



Timing adjustment and repair of ignition units should best be left to a skilled mechanic. Improper handling can easily cause more troubles with such delicate parts.

WIRING DIAGRAM

Particular care has to be taken that the ignition generator cables (J) and the mass cables (M) be correctly connected to the ignition coils (A), see illustration.



A	ignition coils	H	adjusting groove
B	generator coil (bottom lighting coil 30W (top)	J	generator cables
		K	shorting cables
C	lighting coil 110W	L	lighting cables
D	condenser	M	mass cables
E	contact breaker lever	N	ignition cables
F	breaker contacts	O	spark plug protectors
G	fixing screw		

To cut off the ignition, the 2 shorting cables K have to be connected together and/or to ground.

IGNITION DAMPING BOX

To prevent piston failures caused by glowing of deposits on spark plugs (due to certain fuel additives) it is necessary

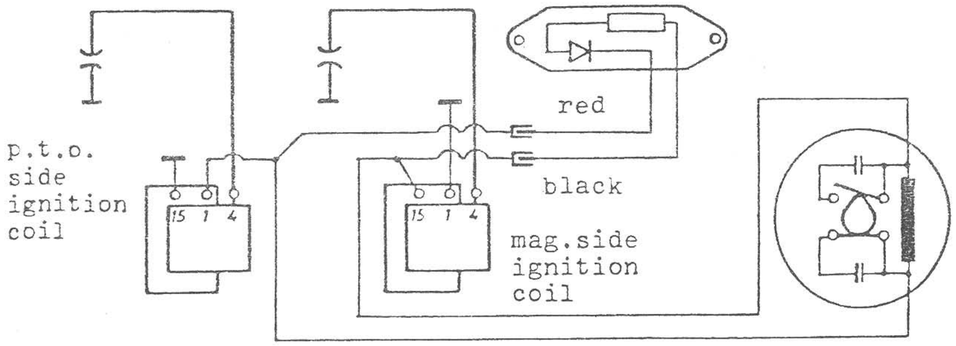
a) to clean the spark plugs every approx. 10 hours of operation or to replace them,

b) An ignition damping box, part no. 866 572, is mounted on the engine to reduce the spark energy and the glowing of the spark plug deposits.

WIRING DIAGRAM FOR MOUNTING IGNITION DAMPING BOX 866 572

- red cable to p.t.o. side ignition coil, connection 1
- black cable to magneto side ignition coil, connection 15

damping box 866 572



Damping box check

a) precaution check: Connect damping box with reversed polarity. There must be no spark on both plugs when cranking the engine. If there is still a spark, the damping box is defective.

b) in case of ignition troubles (no spark): Disconnect damping box, if there is now a spark, the damping box is defective.

LIGHTING CIRCUIT

The BOSCH magneto generator produces, apart from the electric current required for the ignition, 12V 140W alternating current which can be directly used for feeding lights and/or other users that can be operated with alternating current.

To avoid the voltage to rise above permissible levels, either users amounting to 140 watts have to be connected, or a voltage regulator has to be used.

To operate users requiring direct current (e.g. battery), a rectifier-regulator is required.

A rectifier-regulator, part no. 866 080, is available. For feeding lights only, this rectifier-regulator can also be used without battery. In this case the regulated RMS voltage will be between 11 and 12 Volts as long as a minimum load of 1 amp is provided.

In case of a battery it has to be capable to absorb approx. 1 amp. minimum continuous charging load, even with full battery (suggested min. battery capacity: 9 amp.h). Regulated voltage is 13.5 to 14.5 volts.