M56 Tech Notes

DIAGNOSING SPARK PLUG BY APPEARANCE

The spark plug is a very important part of the engine. Two temperatures are very important for the spark plug. First, the temperature at which the spark plug burns itself clean is about 930 degrees. The second temperature, which causes spontaneous ignitions, is about 1650 degrees. The temperature mentioned first must always be reached to prevent damage of, for instance, the piston. For that reason, the spark plug has a very specific heat range which has been determined by means of extensive thermal research. The specification for the spark plug is Bosch W175T1, or Champion L85 as an equivalent. *[Editor: This is also equivalent to an NGK B6HS.]* The spark plug gap should be .020". Always check this, as thereare similar spark plugs with a gap of .028", which is too large for a magneto ignition. Always use the prescribed spark plug to prevent difficulties.

There are five different appearances of the spark plug, which help to indicate the condition of the engine. The first appearance is if the electrodes are grayish yellow-brown. The second is a velvet-like, dull, black deposit on the electrodes. The third is a spark plug with a greasy, black carbon, oily deposit on the electrodes. The fourth is a spark plug with melting pearls and a deposit consisting of lead components on the electrodes. The fifth, and last, appearance is a glassy pearl between the electrodes. Now, let's discuss each of these five appearances of the spark plug and their relation to the condition of the engine.

The first appearance is the electrodes being grayish yellow-brown. This being the case, the engine is in good condition; the heat range of the spark plug is correct.

The second appearance is a velvet-like, dull, black deposit on the electrodes. This deposit could be caused by: a jet too large; a shortage of air, caused by a clogged intake filter; too large a gap on the electrodes; or a spark plug of a too-cold type, causing a heat range too high. The jet needed for the 25 and 30 MPH engines is jet number 56. For the 20 MPH engine, use jet number 46.

The third possible appearance is a spark plug with a greasy, black carbon, oily deposit on the electrodes. This deposit may be caused by too much oil in the mixture, or a worn-out cylinder or piston rings. In order to prevent carbonization of the cylinder ports and exhaust muffler, Batavus has a specially developed two-stroke oil. From the very start, the fuel mixture should be two percent, which means 2.5 fluid ounces of oil to one U.S. gallon regular gasoline, or one Batavus pillow pack to each gallon of gasoline. The Batavus pillow pack contains 2.5 fluid ounces of oil plus 7 fluid ounces of a special additive, which prevents carbonization and corrosion. Use only regular gasoline.

To determine whether the cylinder or piston rings are worn out, remove the piston rings, put them in the cylinder bore, and measure the piston ring gap. If the gap is larger than .028", then the cylinder bore or the piston rings are worn too much. Due to the unique nickasil coating used on the Laura Motoren cylinder, it is virtually impossible to wear out the cylinder bore. To determine whether the piston rings of the cylinder bore is worn, put a new piston ring in the cylinder bore, and measure the gap again. If it is still larger than .028", then the cylinder bore is worn out. You will have to replace the cylinder.

The fourth possible appearance of the spark plug is finding melting pearls and a deposit consisting of lead components on the electrodes. This can be caused by a jet too small, a leaky spark plug, or a spark plug not properly tightened. This problem could also exist when the heat range of the plug is too low,

which indicates a too-warm plug. A spark plug of a warm type has a large insulator base and absorb considerable heat. A spark plug of a cold type has a small insulator base and absorbs a minimal amount of heat.

The fifth possible appearance of a spark plug is the formation of the glassy pearl between the electrodes. This formation may be caused by a dirty air filter.

ENGINE ARCHITECTURE

The M-56 engine differs from the M-48 engine in the sense that it has an aluminum gasket between the cylinder and the cylinder head. This gasket is needed to ensure that the cylinder head will be sealed correctly. the cylinder head nuts should be torqued in a crosswise pattern with 6.5 foot pounds. The cylinder head gasket can be reused as long as it is not damaged or scratched. If it must be replaced, use only an original Laura Motoren aluminum gasket. By using any other gasket, you'll disturb the heat conduction from the cylinder into the cylinder head, causing an overheated cylinder, thereby causing seizuring of the piston. As you probably know, an aluminum cylinder can have different types of lined bores. as this requires a large piston clearance, the poorest quality lining is a cast iron or steel sleeve. Another possibility is having a chromium coating in the bore. There is no finer coating than the nickasil coating used on the Laura Motoren cylinder. A nickasil coating in the bore of the cylinder offers three very important advantages as compared to a chrmoium coated cylinder. First, a nickasil coating offers greater resistance against wear. Secondly, it's a lot softer than chromium coating. And third, and most important, is that its heat conduction is many times greater than that of chromium. Now, let's discuss in more detail how a nickasil coating in the bore of the cylinder offers three very important advantages as compared to a chromium coated cylinder. As we've already mentioned, the first advantage is that a nickasil coating offers a much greater resistance against wear. The second advantage of the nickasil coating is its characteristic of being a lot softer than the chromium coating, even though it has a higher resistance against wear. Therefore, normal cast iron piston rings can be used in a nickasil cylinder. This is impossible with a chromium-coated cylinder. Inasmuch as the chromium surface is too hard for the use of normal piston rings, it is necessary to use piston rings of an expensive allot when using a chromium-coated cylinder. The this, and most important advantage is that the heat conduction of nickasil is many times greater than the heat conduction of chromium. This makes it possible to have a very small piston clearance. The piston clearance in the Laura Motoren engine is a maximum .015 mm, or .0006". Nickasil is an alloy of nickel, potassium, and silicon. Nickasil is the European term for this advanced coating. Please note that on the bottom of the piston and on the top surface of the cylinder, there is a letter. Should it ever be necessary to replace one, or both, of the parts, be certain that both the parts assembled are marked with the same letter. There are six different letters, A through F. The configuration of the piston is adapted to every different temperature. The M-56 engine has an aluminum cylinder, making it cooler than the cast iron cylinder of the M-48. Because of the different expansion qualities and the conductivity of the M-56 aluminum cylinder in comparison to the M-48 cast iron cylinder, the configuration of the two pistons is different. And for this same reason, the piston material is different. So both pistons are not interchangeable; and the must be separated very carefully. Only the piston rings of both the M-56 and the M-48 pistons are exactly the same. The ports in the cylinder base gasket are symmetrical so the gasket cannot be fitted in the wrong way.

DISASSEMBLY

Remove the intake silencer, lifting the tab and removing the air intake silencer cover. Remove the intake filter. If the foam of the intake filter is clogged, clean it in gasoline and refit it while it is dry. It does not need to be oiled. Then remove the starter leaf spring. The primary drive is realized b y means of a tooth belt. This is a synthetic rubber tooth belt, with steel wires embedded in it to make it extremely durable.

It cannot be damaged by normal usage. However, if it is moved over sharp edges or rubbed against the thrust disc and this disc is scratched, the tooth belt will be damaged in a very short period of time. Also, if it is bent in half, it will be damaged. But, under normal circumstances, it cannot be broken. To remove the tooth wheel, block the drive shaft with a 13 mm open-end wrench. Loosen and remove the nut with a 17 mm closed-end wrench. The remove both philips screws in the thrust disc. The philips screws are self tapping; therefore, there are no screw threads in the clutch housing. Remove the circlips by means of the circlips pliers. Don't open them more than necessary for the circlips will lose their elasticity, and most likely will not fit properly thereafter. Dismount the three parts: clutch housing, tooth wheel and tooth belt simultaneously, because the tooth belt cannot withstand movement over sharp edges. There is a riveted lining inside the clutch housing which makes it easier to crank the engine. This lining should not require replacement. There is also a needle bearing inside the clutch housing. Should it be necessary to replace the needle bearing, press only on the side with the inscription, because that side is heat treated and it is thicker. Should pressure be exerted on the opposite side, the needle bearing will be damaged. Block the crankshaft with the special tool and a 19 mm closed-end wrench, removing only every other screw. Then block the clutch with the clutch steady tool, removing the nut from the crankshaft with the special tool and a 19 mm closed-end wrench. Take the clutch extractor, fitting the bolts on the clutch assembly, and then pull the clutch assembly off the crankshaft.

CLUTCH ARCHITECTURE

The coil spring inside the hub is 15 mm longer than the coil spring of the M-48, and for that reason, the coil springs are not interchangeable. The M-48 coil spring bears a red marking. The diameter of this spring is smaller than the diameter of its seat on the hub. This means the spring is pre-stressed on the hub. Notice that the spring hub, pressure plate end and end plate are connected with the crankshaft; that the parts, clutch housing and clutch plate are not connected the crankshaft. The clutch plate is via the cams connected with the clutch housing.

When starting the engine, pull the start lever, which bends the starter leaf spring, and thereby pushes all parts, end plate, clutch plate and pressure plate together. When beginning to pedal, the tooth belt moves, forcing the clutch housing to turn. If the clutch housing turns, the clutch plate will turn. When there is sufficient friction between the clutch plate, end plate, and pressure place, the crankshaft will turn. This sequence of events starts the engine. By releasing the starter lever, the crankshaft will revolve, but the end plate, clutch plate and pressure plate will not remain engaged, thus causing the engine not to move the moped. By opening the gas grip, revolutions of the crankshaft increase. At a certain number of revolutions, the centrifugal force of the steel balls in the spring will be sufficient to force the spring to the outside. When the spring moves to the outside, it will move along the sloping side of the spring hub, forcing it to the left, therefore pushing the pressure plate, clutch plate, and end plate together. If there is sufficient friction, the pressure plate and end plate will rotate the clutch plate with them. Since the clutch plate is connected via the cams with the clutch housing, the clutch housing will rotate and the tooth belt will move, thus propelling the moped.

If an M-48 coil spring is fitted on the M-56 clutch, the spring will be pre-stressed too much. This means that the clutch will be engaged at a number of revolutions higher than the number of revolutions at which torque is at a maximum, thus causing poor acceleration of the moped. The clutch clearance can be measured between the end plate and the clutch plate, or between the pressure plate and the clutch plate. This clearance has to be a minimum of 0.5 mm or .020". On the clutch lining is a small leaf spring, which prevents noise while the engine is idling, and does not interfere with the function of the clutch. The leaf spring must be fitted on one of the cams of the lining. On the crankcase side, there is a felt ring on the clutch hub, which keeps the grease inside the oil seal and ensures a better seal.

Dismount the woodruff key in the shaft and take off the plain steel washer and the second washer, which has one side tapered. This washer should always be fitted in such a way that the tapered side points in the direction of the engine, this keeping the circlips inside the groove of the shaft. take off the circlips of the drive shaft with a screwdriver. Dispose of the circlips as it's been stretched and has lost too much of its elasticity.

CARBURETOR

Remove the carburetor. Notice that the bolt on top of the flange is mounted from the outside to the inside of the engine. note the placement of the insulation and undulated wahsers. The carburetor for the 25 and 30 MPH engines is a carburetor type H12, having a 12 mm opening and a jet number of 56. Remove the plastic cover of the throttle valve and choke piston chamber.

The choke differs from the M-48 carburetor. In the M-56 carburetor, there is a choke piston rather than a choke valve. This choke piston gives the engine a richer mixture by providing more gasoline when pulling the choke lever. On the M-48 carburetor, the air is shut off, making a richer mixture. On the M-56 carburetor, there are two o-rings, manufactured out of synthetics. This ensures that the o-rings won't swell when they come into contact with gasoline. The uppermost o-ring seals in the air; the lower one seals the mixture as long as the choke lever is not pulled. If the choke piston is refitter, it must be done in a rectilinear fashion, thus preventing the o-rings from being damaged. Should the choke cable require replacing, remove the little screw in the choke piston and slide the cable through the opening.

On the float chamber cover are the same banjo bolt and strainer as used on the M-48 carburetor. The strainer can be clogged, and if so, clean it in gasoline and refit it on the banjo bolt. The float inside the float chamber is exactly the same plasitc float as used in the M-48 carburetor. By holding the float against the light, one can determine the presence of gasoline and, if so, it will have to be replaced. The float chamber covers are also identical with the exception that there is no air vent on the M-56 float chamber cover. On the M-56 carburetor the air vent is inside the float chamber, connected to the outside via an opening in the flange of the carburetor. When removing the float, be sure that the pointed side of the needle is up, that it matched the guide in the bottom and the orifice in the cover correctly. To determine a proper fit, shake the carburetor and you will hear the float moving freely inside the float chamber.

On the bottom of the carburetor is the jet and jet holder. To remove the jet from the jet holder, block the jet holder with a 9 mm wrench, removing the jet with a small screwdriver. On top of the carburetor, there is an idling speed adjusting screw. By screwing it into the housing, the throttle valve moves to the top of the housing, increasing the carburetor opening, thus increasing the idle speed. By screwing it out of the housing, the spring will move the throttle valve to the bottom of the carburetor, decreasing the carburetor opening, thus decreasing idling speed.

INTAKE GASKET AND REED VALVE

On the flange of the carburetor, there is a minute protrusion, which ensures that the carburetor is sealed correctly. This protrusion is impressed in the gasket, making it necessary to always use a new gasket. If the gasket is reused, the impression probably shifted, causing the carburetor to leak. Although the outside contours of the carburetor gasket and the reed valve gasket are exactly the same, the inside openings differ. Therefore, if the reed valve gasket is inadvertently fitted on the carburetor housing, the groove which provides the flow of gasoline for the choke will not be sealed. Underneath the carburetor gasket, there is an insulation flange, a gasket, and a reed valve gasket. The reed valve gasket and the reed valve are exactly the same as in the M-48 engine.

FLYWHEEL AND STATOR

Block the flywheel with the special tool and remove the nut with a 13 mm wrench, pulling the flywheel off the crankshaft with the flywheel extractor. Inside the flywheel are two coils fitted on the stator. One fifteen-watt coil is the primary high tension coil and also the coil which charges the brake light. It can also be used to charge the battery if a turn signal set is mounted. A second 27-watt coil charges the head lamp and the tail-light. To facilitate repairs on the ignition, all wires are connected with screws, rather than being soldered. Underneath the stator is a felt ring, which keeps the grease in the oil seal and ensures a better seal.

CHAIN WHEEL AND CASE

Block the chain wheel on the drive shaft with a chain wrench and remove the nut with a 19 mm closed-end wrench. Take off the tab washer and remove the chain wheel. Next, remove the fill and drain plug and drain the oil. Remove the screws from the crankcase. Before taking the crankcase apart, heat it around the crankshaft and all around the housing to 212 degrees. Dro some water on the crankcase. If the water evaporates immediately, it has reached the prescribed temperature at which the crankcase may be taken apart without damaging the bores.

Inside the crankcase on the clutch side is a ratchet wheel assembly, which replaces the free wheel in the rear wheel. This design has three very important advantages. First of all, the free wheel is totally covered and protected against dirt. Secondly, the free wheel runs in oil, thus ensuring a longer life. Thirdly, only one chain to the rear wheel is needed. To remove the ratchet wheel, a special tool is needed to block it. Remove the chain sprocket with a chain wrench. Put the special tool on the ratchet wheel, and then put the special tool in a vise. Inside the gearbox are the drive and lay shafts, both of which have diagonal teeth. Underneath the ratchet wheel is one plain steel washer, which causes less friction, thus diminishing the loss of power. On top of the ratchet wheel is another plain steel washer, which also prevents loss of power. Underneath the drive shaft are two steel washers, essential to prevent friction on the aluminum gearbox housing.

BEARINGS AND BEARING ARCHITECTURE

If a bearing must be replaced, use the extractor. The extractor clamps are interchangeable and thus suitable for every bearing. When removing the ball bearings of the crankshaft, protect the screw heads with a special tool. When remounting the bearings, support the crankshaft with the special plate, to prevent bending of the webs. Put the special plate on a vise, using a dolly to remount the bearings in the proper position.

Due to our advanced technology, it is possible to machine the crankshaft with a very high accuracy. The bore for the big-end bearing is honed with a tolerance of a maximum of .003 mm, or .0001", and the size of the deviation is a maximum of .001 mm, or .0004". This accuracy cannot be realized by grinding the bore. The described manner of machining the connecting rod allows a very small radial clearance of the big-end bearing, which is .012 mm or .0005". Previously, grinding was the accepted machining of the bore. Since Laura Motoren began honing the bore, we have manufactured nearly 800,000 crankshafts and haven't had even one damaged big-end bearing. Because the accuracy is so high and the clearance is so small, it is virtually impossible to replace a connecting rod since very highly refined instruments and tools are required.

Should it ever be necessary to replace a connecting rod, replace the complete crankshaft. Should the bearings on the drive and lay shafts need to be replaced, use the suitable extractor clamps. Support the shaft with a dolly and use another dolly to place the bearing on the lay and/or drive shafts in the proper positon. it is not necessary to heat the bearings. Should it be necessary to replace the needle bearing in the crankcase housing, do it so that the needle bearing is depressed approximately 0.5 mm from the gearbox surface. Press only on the side of the needle bearing where the inscription is, because that side is heat treated and it is thicker. Pressing on the other side will damage the needle bearing.

OIL SEALS

Should it be necessary to replace the oil seals, use the special tools to be certain that the oil seals won't be damaged and that they will be fitted in the right position. Before remounting the engine, provide the seals of the crankshaft with heat resistant grease.

REASSEMBLY

Use the special tool to protect the oil seal on the lay shaft from being damaged. Then put the lay shaft in the crankcase part, ignition side, after having first reheated the crankcase to 212 degrees. Don't forget the two shims on the drive shaft. Remember to fit the steel washer on top of the ratchet wheel. Fit the crankshaft with the ignition side into the crankcase. Take the special tools to protect the oil seal of the lay and drive shafts. Then fit the crankcase gasket. Then fit the crankcase part, on the clutch side, after having first reheated the crankcase up to 212 degrees. After tightening the screws of the crankcase, and the crankcase has cooled off and shrunk, retighten the screws. Cut the crankcase gasket so it matches exactly the crankcase surface to prevent damaging of the cylinder base gasket. Fit the chain sprocket and don't forget the small locking plate on the inside. Fit it by hand, because after starting the engine once, it will be tightened sufficiently. To mount the circlips on the drive shaft, use the special tool consisting of two ports. Put the part with the cone pointing away from the engine on the shaft. Put the circlips on the cone and fit the other part of the special tool, knocking the circlips into position. Fit the washer with the tapered side pointing to the engine, mount the plain steel washer, and mount the woodruff key.

Before mounting the clutch and the tooth belt drive, first mount the reed valve and the carburetor. Mount it in this sequence: gasket, reed valve, gasket, insulation flange, gasket, then carburetor. Mount the bolt o the top side of the carburetor from the outside to the inside, in this order: bolt, insulation washer, filter bracket, the undulated washer underneath the nut. Fit on the carburetor stud, in this sequence: the insulation washer, the undulated washer, and the nut. Mount the clutch assembly, not forgetting the undulated washed underneath the crankshaft nut, which prevents that nut from loosening. Also fit the felt ring. Torque the nut with 36 foot-pounds. To tighten the nut, block the clutch assembly with the special tool and tighten the nut with the special tool and a 19 mm closed-end wrench. Remember to mount the three screws from the clutch assembly.

Mount simultaneously the clutch housing, the tooth wheel, and the tooth belt. Move them on the shaft until the clutch housing is very near the plate or lining. Then fit the leaf spring on one of the cams of the clutch plate and guide the clutch plate so that the cams are matching the gaps of the clutch housing. On top of the tooth wheel, mount the larger flat washer and be sure that it is well-centered on the drive shaft. Fit the smaller flat washer, then the spring washer, then the nut. Block the drive shaft with a 13 mm open-end wrench and tighten the nut with a 17 mm closed-end wrench. Fit the circlips on the crankshaft, pushing the clutch housing in the direction of the crankcase.

Measure the distance between the bottom of the clutch housing and the top of the crankshaft. Pull the clutch housing against the circlips and measure the distance again. The difference between these measurements has to be regulated between .008" and .020". To achieve that, use as many shims as needed. The shims are available in gauges of .020" to .032". Check to be sure that the guiding surface of the starter disc is not damaged. Mount the disc with two philips screws to the clutch housing.
Mount the cylinder base gasket and the cylinder. Pinch the piston rings and be certain that the locating pins are inside the piston ring gap. Check the cylinder head gasket for scratches. Fit the cylinder hear gasket and cylinder head. Underneath the cylinder stud nuts, mount a flat steel washer and a spring washer. Torque the nuts with 6.5 foot-pounds. Tighten the cylinder nuts crosswise. Fit the felt ring on the crankshaft. Fit the stator on the crankcase. Be certain that the wires are not pinched between the stator and the crankcase.

There are four magnetos on the inside of the flywheel. They alternate in this manner: north pole, south pole, north pole, south pole. The primary high-tension coil on the stator is situated in the same manner. In a magneto, on the outside the magnetic flow goes from a north pole to a south pole and back again. Because the flywheel is turning, the situation will change constantly. At a certain position, the field starts to be distorted; and later, at another position, the field changes its direction. In the period between these positions, the inducted voltage and current are at a maximum. If this current is suddenly cut off by opening the breaker points and unloading the condenser, the inducted voltage will increase up to 25,000 volts. The position in which the field starts to be distorted is given my the manufacturer of the magneto, called the rupture distance. This rupture distance can be changed by adjusting the breaker gap, a larger gap making the rupture distance smaller, and a smaller gap making the rupture distance larger.

Adjust the contact breaker gap to .012", thus ensuring that the points will open in exactly the position that the inducted voltage is at a maximum. Because the flywheel of this ignition is small, it is difficult to adjust the breaker points if the flywheel is mounted on the crankshaft. Therefore, there is a special tool which makes it possible to set the points and adjust them without the flywheel fitten on the crankshaft. Check the gap with a feeler gauge. If the gap is not correct, loosen the connecting screw of the breaker points. Move the fixed part of the breaker points in the needed direction. Fit the flywheel, putting first the flat washer on the crankshaft and the tooth washer. Fit the nut and block the crankshaft with the special tool. Tighten the nut with a 13 mm socket.

IGNITION TIMING

Now let's discuss how to adjust the ignition. To adjust the ignition, use an ignition adjusting lamp, or better, a buzzer. Connect one of the wires of the buzzer with the blue wire of the ignition, being the cutoff wire. Connect the other buzzer wire to the ground, such as the cylinder head. Turn the flywheel clockwise, that's the direction in which is rotates if the engine is running. The indicator of the dial gauge will turn. By continuing to turn the flywheel, the indicator of the dial gauge will stop and change its direction. At this point, the piston is in top dead center. Then turn the flywheel counterclockwise until the sound of the buzzer changes. This is the moment the breaker points close, which is the moment the spark ignites. The advance can be measured by counting the turns of the dial gauge. By counting the turns, it can be determined what the distance is between the bottom of the piston and top dead center at the moment the spark ignites. Then the advance has to be adjusted. It must be between .055" and .063" for the 25 MPH engine. For the 20 and 30 MPH engines, it must be between .071" and .079". The advance can be changed by turning the stator after loosening then two connecting screws. If the distance is too large, which means the spark is igniting too early, then turn the stator clockwise. If this distance is too small, which means the spark is igniting too late, then turn the stator counterclockwise.

FINAL ASSEMBLY

Then mount the chain wheel on the lay shaft. Note that the chain wheels are different for each engine: the 25 and 30 MPH engines' chain wheels have 17 teeth, whereas, the 20 MPH has 13. Remember to fit the tab washer underneath the nut. Be certain that the protrusion is inside the hole in the chain wheel. Tighten the nut and, while tightening, block the chain wheel with the chain wheel wrench. Then bend the tab washer against one of the flat sides of the nut. Hold the engine at a 45 degree angle, filling it with oil to the bottom side of the fill and drain opening. By doing this, the gearbox will be filled with approximately 80 cc's of oil. Use motor oil SAE 50 or gearbox oil SAE 80. After the break-in period of 500 miles, the oil should be drained, refilled with fresh oil, and then should never require another change. Mount the fill and drain plug. Mount the starter leaf spring in this sequence: coil spring, starter leaf spring, then the nut. The distance betweeh the outside of the starter leaf spring and the edge of the crankcase must be regulated by the adjusting screw on the handlebar so that it is 1.89". This can be measured with a vernier calipers. After that, the starter leaf spring needs a second adjustment. This should be done with the nut of the starter leaf spring stud, so that the clearance between the started leaf spring and the copper thrust piece is between .020" and .039". Then grease the copper thrust piece. Now, the engine is ready to be mounted in the frame again.

Note: The following information is not included in the original dealer tech notes. It was copied from the Moped Army wiki: http://www.mopedarmy.com/wiki/M56

MAINTENANCE PROCEDURES

Carburetor

The carburetor is located on the right side, top of the engine, and behind the toothed drive belt. You'll need to remove the drive belt in order to remove the carburetor. The Encarwi carb is a two bolt flange mount, not a clamp mount. The top nut is attached to a bolt that goes through the top of the case, and the head of that bolt can be reached from the left side of the bike. The bottom nut is on a stud. You'll need a 10mm deep well socket to remove these nuts, and a 10mm socket or nut driver to hold the head of that top bolt.

Between the carb and the reed block is a plastic spacer. This may or may not come off with the carb, depending on which gasket is weakest. If you need to cut a new gasket for remounting, use gasket material rated for use with gasoline, because the choke circuit path uses the gasket as one of its walls.

The float bowl cover is held on with two screws. The float inside should be installed with the sharp pointed end up. There is a little wire screen inside the banjo bolt assembly. If the banjo bolt isn't leaking, don't remove it, but spray some carb cleaner backwards through it, from the inside side of the float cover, to flush out that screen.

The throttle and choke cables are attached with a cover that has one screw. When you remove it, the throttle slide and choke slide will both come out with the cables. Unless there's something horribly wrong, you won't need to take the slides off the cable ends. The throttle slide has a couple of tiny holes in it, for idling. Clean these out with some carb cleaner and a small piece of wire, like a wire tie with the paper ripped off. The edge of the throttle slide where the idle screw comes in may be bent or cracked. This bit can be snapped off in order to ensure smoother flow without problems; if it was that bad to begin with, the idle screw wasn't doing anything anyway. Reinstallation is straightforward, note that the throttle slide has a notch in it which must be aligned with a ridge in the carb.

There's a single jet at the end of the jet holder, and Bing jets are replacements. The jet can be changed without removing the belt.

The idle screw is wedged in between the intake and the float bowl, at an awkward angle. If yours still works (the throttle slide is not damaged), make sure you open the throttle *before*adjusting the idle screw. *Do not* adjust the idle while the engine is running - that's how the throttle slide gets damaged. Open the throttle, make an adjustment, and close the throttle.

If you want to put a different carb on this machine, you'll need to fabricate an intake. I believe the intake from an HS-50 will work to start with, though there are surely others that could be easily fitted. You need something that angles forward and out at about 45 degrees, then add some pipe to the end of that. Now you can run a clamp mount! Wooo hooo!

Drive belt

The correct replacement drive belt is a 390-5M-19. That's a High Torque Drive (HTD) belt with a 5mm tooth pitch, 390mm around, 78 teeth, 19mm wide. The belts sold as replacements are T5-390-18, regular timing belts. The rounded tooth shape of the HTD belt is correct; HTD belts can transmit much more power than regular timing belts.

The belt is supposed to be extremely tight, and it's difficult to get on and off. The Batavus factory documentation below says you're supposed to remove the clutch cover and rear gear wheel at the same time, with the belt, and that installation is the reverse. This is, ahem, *wrong.*

Removal

Remove the starter plate / belt guide from the outside of the clutch cover. Note the two tiny Phillips screws - replace these with Allen head bolts, or risk stripping them or snapping them off. I believe the size is M3, but double check at the hardware store. Once the belt guide is off, you should be able to walk the belt off by pushing the edge of it out while you turn the gears. An older, worn belt will come off pretty easily, but a new belt may require some effort. If you've got one of those urethane belts, it's probably got steel wire in it. Be careful not to stick yourself with an errant wire, and take special care not to get your fingers pinched in between the belt and the gear.

Installation

Remove the large rear gear. There's a single nut that holds it on. Right behind that nut is a lock washer and a flat washer. The gear is loose on the shaft, and there's a woodruff key in the shaft. Don't lose it. Behind the gear, there should be one or more 14mm washers, acting as spacers on the shaft. Note that when the nut is tightened all the way down, it's actually tightened against the shoulder on the shaft, *not* against the gear. The gear may have some lateral play, and that's fine, as long as it doesn't have so much lateral play that it can be pushed back far enough that it jams against the clutch housing. Check this while you have the belt off. If it can move back enough to jam, you're going to need to get additional washers, and you'll need *exactly* the right thickness, because if it's too thick, the gear will jam on the outside against the belt guide. (Specific measurement forthcoming.)

Warning: watch your fingers!

Put the shim washers, woodruff key, and gear back on. Put the flat washer and lock washer on the end of the shaft, and thread the nut on a couple of turns, so that the rear gear can slide way out. Now, put the new belt around the large gear, so that about a third of it hangs over the edge. This should be just enough so that you can start to turn it on to the front gear. Hold the belt on the rear gear with your left hand, and turn the top side of the belt onto the front gear with your right. Turn the rear gear clockwise with your left hand while you're guiding/forcing the belt over the front gear. It might take a few tries before you get the hang of it, but it'll go on there.

Once the belt is securely around both gears, it'll need to be walked all the way on. Push down and in, hard, on the outside of the belt on the top, between the two gears. While you're doing this, turn the large gear clockwise again. Keep pushing, keep turning, and the belt will slowly walk its way on to the gears.

After the belt is all the way on the rear gear, tighten the nut on the end of the shaft a turn or so. Now the rear gear is in a little bit more. Push the belt, and walk it on some more, making sure you do at least an entire revolution of the belt before you go back to tighten the nut again. Alternate these two procedures until the belt is all the way on. Make sure the belt is well on the front gear before remounting the belt guide.

Clutch housing

The clutch housing is held on by a circlip. Between the circlip and the housing, there are two thin shim washers. If the circlip is old, it may have lost its tension. Replace it so that your clutch doesn't fly off while you're riding.

The clutch housing slides right off the shaft. There is a needle bearing pressed into the clutch housing, marked Torrington C DE200-071 (replacement spec forthcoming, looks like a 12x18x20mm unmounted needle bearing. Possibly two 12x18x10.) Inside the clutch, the clutch disc floats freely between the clutch plates. When you put the clutch housing back on, you'll need to line up the notches on the outside of the housing with the notches in the clutch disc, as well as lift the clutch disc up a little bit so it's centered. There is also a little metal rectangle with a slot in it. This goes over one of the clutch disc fingers, as a leaf spring. If you're replacing the clutch disc, there are six bolts behind the clutch cover that need to come off. (I haven't done this yet, so I can't say any more than that.)

Clutch housing alignment

Before you install the belt, check the lateral play of the clutch housing. The factory documentation advises that there should be between 0.2mm and 0.5mm of lateral play of the clutch housing on the crankshaft. That's not very much, and if the clutch is worn, there will be too much slop there. If this is the case, the front pulley will be pulled out of alignment by the drive belt, causing the clutch to turn the engine when it should be freewheeling. You might be able to get a belt on it, but the engine will not run.

Remove the circlip from the outside of the crankshaft. Underneath that, there will be one or more shim washers. The crankshaft is 12mm in diameter, and shim washers can be gotten from McMaster in various sizes, down to 0.1mm. Put on more shims than you think you'll need, then put the circlip back on. If the clutch tries to turn the engine over *without* the belt on, you've got too many shims. Remove a 0.1mm shim and try again. Continue doing this until the clutch freewheels without the belt installed.

If, after performing this procedure, the clutch housing is still out of alignment with a belt installed, the clutch bearing is at fault. The bearing can be pressed out and back in with a large C-clamp and some 3/8" sockets chosen for their diameter. New replacement bearings for this application are non-existent; you'll have to find a machine shop that's willing to make one. *Grease or regrease the clutch bearing before putting everything together!*

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TECHNICAL SCHOOL FOR BATAVUS SERVICE TECHNICIANS
CONCERNING THE LAURA MOTOREN M-56 ENGINE

M-56 ENGINE

The spark plug is an important part of the engine. Two temperatures are very important for the spark plug. First, the temperature at which the spark plug burns itself clean is about 930 degrees. The second temperature, which causes spontaneous ignitions is about 1650 degrees. The temperature mentioned first must always be reached in order to get a clean spark plug. The second temperature should never be reached to prevent damage of, for instance, the piston. For that reason, the spark plug has a very specific heat range which has been determined by means of extensive thermal research. The specification for the spark plug is Bosch W175T1, or Champion L85 as an equivalent. The spark plug gap should be .020". Always check this as there are similar spark plugs with a gap of .028", which is too large for a magneto ignition. Always use the prescribed spark plug to prevent difficulties. There are five different appearances of the spark plug, which help to indicate the condition of the engine. The first appearance is if the electrodes are grayish yellow-brown. The second is a velvet-like, dull, black deposit on the electrodes. The third is a spark plug with a greasy, black carbon, oily deposit on the electrodes. The fourth is a spark plug with melting pearls and a deposit consisting of lead components on the electrodes. The fifth, and last, appearance is a glassy pearl between the electrodes. Now, let's discuss each of these five appearances of the spark plug and their relation to the condition of the engine. The first appearance is the electrodes being grayish yellow-brown. This being the case, the engine is in good condition; the heat range of the spark plug is correct. The second appearance is a velvet-like, dull, black deposit on the electrodes. This deposit could be caused by: a jet too large; a shortage of air, caused by a clogged intake filter; too large a gap on the electrodes; or a spark plug of a too-cold type, causing a heat range too high. The jet needed for the 25 - and 30-mph engines is jet number 56. For the 20-mph engine, use jet number 46. The third possible appearance is a spark plug with a greasy, black carbon, oily deposit on the electrodes. This deposit may be caused by too much oil in the mixture, or a worn-out cylinder or piston rings. In order to prevent carbonization of the cylinder ports and exhaust muffler, Batavus has a specially developed two-stroke oil. From the very start,

the fuel mixture should be two percent, which means 2.5 fluid ounces of oil to one U.S. gallon regular gasoline, or one Batavus pillow pack to each gallon gasoline. The Batavus pillow pack contains 2.5 fluid ounces of oil plus 7 fluid ounces of a special additive, which prevents carbonization and corrosion. Use only regular gasoline. To determine whether the cylinder or piston rings are worn out, remove the piston rings, put them in the cylinder bore, and measure the piston ring gap. If the gap is larger than .028", then the cylinder bore or the piston rings are worn too much. Due to the unique nickasil coating used on the Laura Motoren cylinder, it is virtually impossible to wear out this cylinder bore. To determine whether the piston rings or the cylinder bore is worn, put a new piston ring in the cylinder bore, and measure the gap again. If it is still larger than .028", then the cylinder bore is worn out. You will have to replace the cylinder. The fourth possible appearance of the spark plug is finding melting pearls and a deposit consisting of lead components on the electrodes. This can be caused by a jet too small, a leaky spark plug, or a spark plug not properly tightened. This problem could also exist when the heat range of the plug is too low, which indicates a too-warm plug. A spark plug of a warm type has a large insulator base and absorbs considerable heat. A spark plug of a cold type has a small insulator base and absorbs a minimal amount of heat. The fifth possible appearance of a spark plug is the formation of the glassy pearl between the electrodes. This formation may be caused by a dirty air filter. The M-56 engine differs from the M-48 engine in the sense that it has an aluminum gasket between the cylinder and the cylinder head. This gasket is needed to ensure that the cylinder head will be sealed correctly. The cylinder head nuts should be torqued in a crosswise pattern with 6.5 foot-pounds. The cylinder head gasket can be reused as long as it is not damaged or scratched. If it must be replaced, use only an original Laura Motoren aluminum gasket. By using any other gasket, you'll disturb the heat conduction from the cylinder into the cylinder head, causing an overheated cylinder, thereby causing seizuring of the piston. As you probably know, an aluminum cylinder can have different types of lined bores. As this requires a large piston clearance, the poorest quality lining is a cast iron or steel sleeve. Another possibility is having a chromium coating in the bore. There is no finer coating than the nickasil coating used on the Laura Motoren cylinder. A nickasil coating in the bore of the cylinder offers three very important advantages as compared to a chromium coated cylinder. First, a nickasil coating offers greater resistance against wear. Secondly, it's a lot softer than a chromium coating. And third, and most important, is that it's heat conduction is many times greater than that of chromium. Now, let's discuss in more detail how a nickasil coating in the bore of the cylinder offers three very important advantages as compared to a chromium coated cylinder. As we've al-

ready mentioned, the first advantage is that a nickasil coating offers a much greater resistance against wear. The second advantage of the nickasil coating is its characteristic of being a lot softer than the chromium coating, even though it has a higher resistance against wear. Therefore, normal cast iron piston rings can be used in a nickasil cylinder. This is impossible with a chromium-coated cylinder. Inasmuch as the chromium surface is too hard for the use of normal cast iron piston rings, it is necessary to use piston rings of an expensive alloy when using a chromium-coated cylinder. The third, and most important advantage is that the heat conduction of nickasil is many times greater than the heat conduction of chromium. This makes it possible to have a very small piston clearance. The piston clearance in the Laura Motoren engine is a maximum .015 mm, or .0006". Nickasil is an alloy of nickel, potassium, and silicon. Nickasil is the European term for this advanced coating. Please note that on the bottom of the piston and on the top surface of the cylinder, there is a letter. Should it ever be necessary to replace one, or both, of the parts, be certain that both the parts assembled are marked with the same letter. There are six different letters, A thru F. The configuration of the piston is adapted to every different temperature. The M-56 engine has an aluminum cylinder, making it cooler than the cast-iron cylinder of the M-48. Because of the different expansion qualities and the conductivity of the M-56 aluminum cylinder in comparison to the M-48 cast-iron cylinder, the configuration of the two pistons is different. And for this same reason, the piston material is different. So both pistons are not interchangeable; and they must be separated very carefully. Only the piston rings of both the M-56 and the M-48 pistons are exactly the same. The ports in the cylinder base gasket are symmetrical so the gasket cannot be fitted in the wrong way. Remove the intake silencer, lifting the tab and removing the air intake silencer cover. Remove the intake filter. If the foam of the intake filter is clogged, clean it in gasoline and refit it while it is dry. It does not need to be oiled. Then remove the starter leaf spring. The primary drive is realized by means of a tooth belt. This is a synthetic rubber tooth belt, with steel wires imbedded in it to make it extremely durable. It cannot be damaged by normal usage. However, if it is moved over sharp edges or rubbed against the thrust disc and this disc is scratched, the tooth belt will be damaged in a very short period of time. Also, if it is bent in half, it will be damaged. But, under normal circumstances, it cannot be broken To remove the tooth wheel, block the drive shaft with a 13 mm open-end wrench. Loosen and remove the nut with a 17 mm close-end wrench. Then remove both philips screws in the thrust disc. The philips screws are self-tapping; therefore, there are no screw threads in the clutch housing. Remove the circlips by means of the circlips pliers. Don't open them more than necessary for the circlips will lose their elasticity, and most likely will not fit properly thereafter. Dismount

the three parts: clutch housing, tooth wheel and tooth belt simultaneously because the tooth belt cannot withstand movement over sharp edges. There is a riveted lining inside the clutch housing which makes it easier to crank the engine. This lining should not require replacement. There is also a needle bearing inside the clutch housing. Should it be necessary to replace the needle bearing, press only on the side with the inscription because that side is heat treated and it is thicker. Should pressure be exerted on the opposite side, the needle bearing will be damaged. Block the crankshaft with the special tool and a 19 mm close-end wrench, removing only every other screw. Then block the clutch with the clutch steady tool, removing the nut from the crankshaft with the special tool and a 19 mm close-end wrench. Take the clutch extractor, fitting the bolts on the clutch assembly, and then pull the clutch assembly off the crankshaft. The coil spring inside the hub is 15 mm longer than the coil spring of the M-48, and for that reason, the coil springs are not interchangeable. The M-48 coil spring bears a red marking. The diameter of this spring is smaller than the diameter of its seat on the hub. This means the spring is prestressed on the hub. Notice that the spring hub, pressure plate and end plate are connected with the crankshaft; that the parts, clutch housing and clutch plate are not connected to the crankshaft. The clutch plate is via the cams connected with the clutch housing. When starting the engine, pull the start lever, which bends the starter leaf spring, and thereby pushes all parts, end plate, clutch plate and pressure plate together. When beginning to pedal, the tooth belt moves, forcing the clutch housing to turn. If the clutch housing turns, the clutch plate will turn. When there is sufficient friction between the clutch plate, end plate, and pressure plate, then these parts will turn. Therefore, the spring hub will turn and since it is connected with the crankshaft, the crankshaft will turn. This sequence of events starts the engine. By releasing the starter lever, the crankshaft will revolve, but the end plate, clutch plate and pressure plate will not remain engaged, thus causing the engine not to move the moped. By opening the gas grip, revolutions of the crankshaft increase. At a certain number of revolutions, the centrifugal force of the steel balls in the spring will be sufficient to force the spring to the outside. When the spring moves to the outside, it will move along the sloping side of the spring hub, forcing it to the left, therefore pushing the pressure plate, clutch plate, and end plate together. If there is sufficient friction, the pressure plate and end plate will rotate the clutch plate with them. Since the clutch plate is connected via the cams with the clutch housing, the clutch housing will rotate and the tooth belt will move, thus propelling the moped. If an M-48 coil spring is fitted on the M-56 clutch, the spring will be prestressed too much. This means that the clutch will be engaged at a number of revolutions higher than the number of revolutions at which the torque is at a maximum, thus causing poor acceleration of the moped. The clutch clearance can be measured between the end plate

and the clutch plate, or between the pressure plate and the clutch plate. This clearance has to be a minimum of 0.5 mm or .020". On the clutch lining is a small leaf spring, which prevents noise while the engine is idling, and does not interfere with the function of the clutch. The leaf spring must be fitted on one of the cams of the lining. On the crankcase side, there is a felt ring on the clutch hub, which keeps the grease inside the oil seal and ensures a better seal. Dismount the Woodruff key in the shaft and take off the plain steel washer and the second washer, which has one side tapered. This washer should always be fitted in such a way that the tapered side points in the direction of the engine, thus keeping the circlips inside the groove of the shaft. Take off the circlips of the drive shaft with a screwdriver. Dispose of the circlips as it's been stretched and has lost too much of its elasticity. Remove the carburetor. Notice that the bolt on top of the flange is mounted from the outside to the inside of the engine. Note the placement of the insulation and undulated washers. The carburetor for the 20-mph engine is carburetor type H8, having an opening of 8 mm and a jet size of 46. The carburetor for the 25- and 30-mph engines is a carburetor type H12, having a 12 mm opening and a jet number of 56. Remove the plastic cover of the throttle valve and choke piston chamber. The choke differs from the M-48 carburetor. In the M-56 carburetor, there is a choke piston rather than a choke valve. This choke piston gives the engine a richer mixture by providing more gasoline when pulling the choke lever. On the M-48 carburetor, the air is shut off, making a richer mixture. On the M-56 choke piston, there are two o-rings, manufactured out of synthetics. This ensures that the o-rings won't swell when they come into contact with gasoline. The uppermost o-ring seals in the air; the lower one seals the mixture as long as the choke lever is not pulled. If the choke piston is refitted, it must be done in a rectilinear fashion, thus preventing the o-rings from being damaged. Should the choke cable require replacing, remove the little screw in the choke piston and slide the cable through the opening. On the float chamber cover are the same banjo bolt and strainer as used on the M-48 carburetor. The strainer can be clogged, and if so, clean it in gasoline and refit it on the banjo bolt. The float inside the float chamber is exactly the same plastic float as used in the M-48 carburetor. By holding the float against the light, one can determine the presence of gasoline and, if so, it will have to be replaced. The float chamber covers are identical with the exception that there is no air vent on the M-56 float chamber cover. On the M-56 carburetor the air vent is inside the float chamber, connected to the outside via an opening in the flange of the carburetor. When removing the float, be sure that the pointed side of the needle is up, that it matches the guide in the bottom and the orifice in the cover correctly. To determine a proper fit, shake the carburetor and you will hear the float moving freely inside the float chamber. On the bottom of the carburetor is the jet and jet holder. To remove the

jet from the jet holder, block the jet holder with a 9 mm wrench, removing the jet with a small screwdriver. On top of the carburetor, there is an idling speed adjusting screw. By screwing it into the housing, the throttle valve moves to the top of the housing, increasing the carburetor opening, thus increasing the idling speed. By screwing it out of the housing, the spring will move the throttle valve to the bottom of the carburetor, decreasing the carburetor opening, thus decreasing the idling speed. On the flange of the carburetor, there is a minute protrusion, which ensures that the carburetor is sealed correctly. This protrusion is impressed in the gasket, making it necessary to always use a new gasket. If the gasket is reused, the impression probably shifted, causing the carburetor to leak. Although the outside contours of the carburetor gasket and the reed valve gasket are exactly the same, the inside openings differ. Therefore, if the reed valve gasket is inadvertently fitted on the carburetor housing, the groove which provides the flow of gasoline for the choke will not be sealed. Underneath the carburetor gasket, there is an insulation flange, a gasket, and a reed valve gasket. The reed valve gasket and the reed valve are exactly the same as in the M-48 engine. Block the flywheel with the special tool and remove the nut with a 13 mm wrench, pulling the flywheel off the crankshaft with the flywheel extractor. Inside the flywheel are two coils fitted on the stator. One fifteen-watt coil is the primary high-tension coil and also the coil which charges the brake light. It can also be used to charge the battery if a turn signal set is mounted. A second 27-watt coil charges the head lamp and the tail-light. To facilitate repairs on the ignition, all wires are connected with screws, rather than being soldered. Underneath the stator is a felt ring, which keeps the grease in the oil seal and ensures a better seal. Block the chain wheel on the drive shaft with a chain wrench and remove the nut with a 19 mm close-end wrench. Take off the tab washer and remove the chain wheel. Next remove the fill and drain plug and drain the oil. Remove the screws from the crankcase. Before taking the crankcase apart, heat it around the crankshaft and all around the housing up to 212 degrees. Drop some water on the crankcase. If the water evaporates immediately, it has reached the prescribed temperature at which the crankcase my be taken apart without damaging the bores. Inside the crankcase on the clutch side is a ratchet wheel assembly, which replaces the free wheel in the rear wheel. This design has three very important advantages. First of all, the free wheel is totally covered and protected against dirt. Secondly, the free wheel runs in oil, thus ensuring a longer life. Thirdly, only one chain to the rear wheel is needed. To remove the ratchet wheel, a special tool is needed to block it. Remove the chain sprocket with a chain wrench. Put the special tool on the ratchet wheel, and then put the special tool in a vise. Inside the gearbox are the drive and lay shafts, both of which have diagonal teeth. Underneath the ratchet wheel is one plain steel washer, which causes less friction, thus

diminishing the loss of power. On top of the ratchet wheel is another plain steel washer, which also prevents loss of power. Underneath the drive shaft are two steel washers, essential to prevent friction on the aluminum gearbox housing. If a bearing must be replaced, use the extractor. The extractor clamps are interchangeable and thus suitable for every bearing. When removing the ball bearings of the crankshaft, protect the screw threads with a special tool. When remounting the bearings, support the crankshaft with the special plate, to prevent bending of the webbs. Put the special plate on a vise, using a dolly to remount the bearings in the proper position. Due to our advanced technology, it is possible to machine the crankshaft with a very high accuracy. The bore for the big-end bearing is honed with a tolerance of a maximum .003 mm, or .0001", and the size of the deviation is a maximum of .001 mm, or .0004". This accuracy cannot be realized by grinding the bore. The described manner of machining the connecting rod allows a very small radial clearance of the big-end bearing, which is .012 mm, or .0005". Previously, grinding was the accepted machining of the bore. Since Laura Motoren began honing the bore, we have manufactured nearly 800,000 crankshafts and haven't had even one damaged big-end bearing. Because the accuracy is so high and the clearance is so small, it is virtually impossible to replace a connecting rod since very highly refined instruments and tools are required. Should it ever be necessary to replace a connecting rod, replace the complete crankshaft. Should the bearings on the drive and lay shafts need to be replaced, use the suitable extractor clamps. Support the shaft with a dolly and use another dolly to place the bearing on the lay and/or drive shafts in the proper position. It is not necessary to heat the bearings. Should it be necessary to replace the needle bearing in the crankcase housing, do it so that the needle bearing is depressed approximately 0.5 mm from the gearbox surface. Press only on the side of the needle bearing where the inscription is, because that side is heat treated and it is thicker. Pressing on the other side will damage the needle bearing. Should it be necessary to replace the oil seals, use the special tools to be certain that the oil seals won't be damaged and that they will be fitted in the right position. Before remounting the engine, provide the seals of the crankshaft with heat-resistant grease. Use the special tool to protect the oil seal on the lay shaft from being damaged. Then put the lay shaft in the crankcase part, ignition side, after having first reheated the crankcase to 212 degrees. Don't forget the two shims on the drive shaft. Remember to use the steel washer underneath the ratchet wheel. Turn the ratchet wheel quickly counterclockwise to fit it into the layshaft. Remember to fit the steel washer on top of the ratchet wheel. Fit the crankshaft with the ignition side into the crankcase. Take the special tools to protect the oil seal of the lay and drive shafts. Then fit the crankcase gasket. Then fit the crankcase part, on the clutch side, after having first reheated the crankcase up to 212 degrees. After

tightening the screws of the crankcase, and the crankcase has cooled off and shrunk, retighten the screws. Cut the crankcase gasket so it matches exactly the crankcase surface to prevent damaging of the cylinder base gasket. Fit the chain sprocket and don't forget the small locking plate on the inside. Fit it by hand, because after starting the engine once, it will be tightened sufficiently. To mount the circlips on the drive shaft, use the special tool consisting of two parts. Put the one part with the cone pointing away from the engine on the shaft. Put the circlips on the cone and fit the other part of the special tool, knocking the circlips into position. Fit the washer with the tapered side pointing to the engine, mount the plain steel washer, and mount the Woodruff key. Before mounting the clutch and the tooth belt drive, first mount the reed valve and the carburetor. Mount it in this sequence: gasket, reed valve, gasket, insulation flange, gasket, then carburetor. Mount the bolt on the top side of the carburetor from the outside to the inside, in this order: bolt, insulation washer, filter bracket, then undulated washer underneath the nut. Fit on the carburetor stud, in this sequence: the insulation washer, the undulated washer, and the nut. Mount the clutch assembly, not forgetting the undulated washer underneath the crankshaft nut, which prevents that nut from loosening. Also fit the felt ring. Torque the nut with 36 foot-pounds. To tighten the nut, block the clutch assembly with the special tool and tighten the nut with the special tool and a 19 mm close-end wrench. Remember to mount the three screws from the clutch assembly. Mount simultaneously the clutch housing, the tooth wheel, and the tooth belt. Move them on the shaft until the clutch housing is very near the clutch plate or lining. Then fit the leaf spring on one of the cams of the clutch plate and guide the clutch plate so that the cams are matching the gaps of the clutch housing. On top of the tooth wheel, mount the larger flat washer and be sure that it is well-centered on the drive shaft. Fit the smaller flat washer, then the spring washer, then the nut. Block the drive shaft with a 13 mm open-end wrench and tighten the nut with a 17 mm close-end wrench. Fit the circlips on the crankshaft, pushing the clutch housing in the direction of the crankcase. Measure the distance between the bottom of the clutch housing and the top of the crankshaft. Pull the clutch housing against the circlips and measure this distance again. The difference between these two measurements has to be regulated between .008" and .020". To achieve that, use as many shims as needed. The shims are available in gauges of .020" to .032". Check to be sure that the guiding surface of the starter disc is not damaged. Mount the disc with two philips screws to the clutch housing. Mount the cylinder base gasket and the cylinder. Pinch the piston rings and be certain that the locating pins are inside the piston ring gap. Check the cylinder head gasket for scratches. Fit the cylinder head gasket and cylinder head. Underneath the cylinder stud nuts, mount a flat steel washer and a spring washer. Torque the nuts with 6.5 foot-pounds. Tighten the cylinder nuts crosswise. Fit the felt ring on

the crankshaft. Fit the stator on the crankcase. Be certain that the wires are not pinched between the stator and the crankcase. There are four magnetos on the inside of the flywheel. They alternate in this manner: North Pole, South Pole; North Pole, South Pole. The primary high-tension coil on the stator is situated in the same manner. In a magneto, on the outside the magnetic flow goes from a North Pole to a South Pole and back again. Because the flywheel is turning the situation will change constantly. At a certain position, the field starts to be distorted; and later, at another position, the field changes its direction. In the period between these positions, the inducted voltage and current are at a maximum. If this current is suddenly cut off by opening the breaker points and unloading the condenser, the inducted voltage will increase up to 25,000 volts. The position in which the field starts to be distorted is given by the manufacturer of the magneto, called the rapture distance. This rupture distance can be changed by adjusting the breaker gap, a larger gap making the rapture distance smaller, and a smaller gap making the rupture distance larger. Adjust the contact breaker gap to .012", thus ensuring that the points will open in exactly the position that the inducted voltage is at a maximum. Because the flywheel of this ignition is small, it is difficult to adjust the breaker points if the flywheel is mounted on the crankshaft. Therefore, there is a special tool which makes it possible to set the points and adjust them without the flywheel fitted on the crankshaft. Check the gap with a feeler gauge. If the gap is not correct, loosen the connecting screw of the breaker points. Move the fixed part of the breaker points in the needed direction. Fit the flywheel, putting first the flat washer on the crankshaft and the tooth washer. Fit the nut and block the flywheel with the special tool. Tighten the nut with a 13 mm socket. Now let's discuss how to adjust the ignition. To adjust the ignition, use an ignition adjusting lamp, or better, a buzzer. Connect one of the wires of the buzzer with the blue wire of the ignition, being the cutoff wire. Connect the other buzzer wire to the ground, such as the cylinder head. Fit a dial gauge in the spark plug hole of the cylinder head. Turn the flywheel clockwise, that's the direction in which it rotates if the engine is running. The indicator of the dial gauge will turn. By continuing to turn the flywheel, the indicator of the dial gauge will stop and change its direction. At this point, the piston is in top dead center. Then turn the flywheel counterclockwise until the sound of the buzzer changes. This is the moment the breaker points close, which is the moment the spark ignites. The advance can be measured by counting the turns of the dial gauge. By counting the turns, it can be determined what the distance is between the bottom of the piston and top dead center at the moment the spark ignites. Then the advance has to be adjusted. It must be between .055" and .063" for the 25-mph engine. For the 20- and 30-mph engines it must be between .071" and .079". The advance can be changed by turning the stator after loosening the two

connecting screws. If the distance is too large, which means the spark is igniting too early, then turn the stator clockwise. If this distance is too small, which means the spark is igniting too late, then turn the stator counterclockwise. Then mount the chain wheel on the lay shaft. Note that the chain wheels are different for each engine: the 25- and 30-mph engines' chain wheels have 17 teeth, whereas, the 20- mph engine has 13. Remember to fit the tab washer underneath the nut. Be certain that the protrusion is inside the hole in the chain wheel. Tighten the nut and, while tightening, block the chain wheel with the chain wheel wrench. Then bend the tab washer against one of the flat sides of the nut. Hold the engine at a 45 degree angle, filling it with oil to the bottom side of the fill and drain opening. By doing this, the gearbox will be filled with approximately 80 cc's of oil. Use motor oil SAE 50 or gearbox oil SAE 80. After the break-in period of 500 miles, the oil should be drained, refilled with fresh oil, and then should never require another change. Mount the fill and drain plug. Mount the starter leaf spring in this sequence: coil spring, starter leaf spring, then the nut. The distance between the outside of the starter leaf spring and the edge of the crankcase must be regulated by the adjusting screw on the handlebar so that it is 1.89". This can be measured with a vernier calipers. After that, the starter leaf spring needs a second adjustment. This should be done with the nut of the starter leaf spring stud, so that the clearance between the starter leaf spring and the copper thrust piece is between .020" and .039". Then grease the copper thrust piece. Mount the intake silencer, and fit the filter. Now, the engine is ready to be mounted in the frame again.

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