Batavus M48 Tech Notes

SPARK PLUG SPECS

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 ignition, is 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 the piston and other engine parts. 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 of the 20- and 25mph engines is a Bosh W240T1 with Champion L81 as an equivalent. The spark plug gap should be 0.20 inches. Always check this as there are similar spark plugs with a gap of 0.28 inches, which is too large for a magneto ignition. Always use the prescribed spark plug to prevent difficulties.

READING SPARK PLUGS

There are five different appearances of the spark plug, which help indicate the condition of the engine. The first appearance is if the electrode is grayish yellow-brown, which indicates that the engine is in good condition and the heat range of the spark plug is correct.

The second is a velvet-like dull, black deposit on the electrode, which can be caused by too large of a jet, a shortage of air (caused by a pinched intake tube or clogged intake filter), too large of a gap on the spark plug, or too cold of a spark plug. The jet needed for the 30mph engine during the break-in period is jet number 58; after the break-in period, replace it with a 56. For the 25mph engine during break-in, use a 54, thereafter use a 52. For the 20mph engine, use a 52 jet for break in, and use a 50 afterwards.

The third is a spark plug with a greasy, black carbon oily deposit on the electrode. This can be caused by too much oil in the fuel/oil mixture or a worn out cylinder or piston rings. In order to prevent the carbonization of the cylinder ports and exhaust, Batavus has specially-developed two-stroke oil. From the very start, the fuel mixture should be 2%, which means 2.6 fluid ounces of oil to one gallon of gasoline. The Batavus pillow pack contains 2.6 fluid ounces of oil plus 0.7 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 ring rap is larger than 0.020 inches, then the cylinder bore or the piston rings are too worn. To determine whether the cylinder bore or the piston rings are too worn, take a new piston ring and put it in the cylinder bore and measure the gap again. If it is still larger than 0.020 inches, then the cylinder bore is worn out. You will have to replace the cylinder, or re-bore and re-hone it. If you re-hone and re-bore it, it will have to be done in such a way that the diameter of the cylinder (after re-honing) is between 40.245mm and 40.255mm. After re-honing, the cylinder must be fitted with an oversize piston.

The fourth is a spark plug with melting pearls and a deposit consisting of lead components on the electrode. This can be caused by too small of a jet, a leaky spark plug, or an improperly tightened spark plug. 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. As mentioned previously, after the break-in period, normally the jet must be replaced by a jet two numbers smaller than initially installed. However, it is possible that even this jet is too small. To determine this,

simply ride the moped at top speed for three or four miles to ensure the engine reaches its working temperature. Close the throttle partially. If the bike is apt to go faster, then the jet is too small and will have to be replaced with the original size jet.

The fifth appearance is a glassy pearl between the electrode and ceramic insulator. This formation may be caused by a dirty air filter, a cutoff intake tube, no intake tube, or no dirt shield. The cylinder head is made of aluminum because this material has good heat abstraction. In order not to disturb the heat flow from the cylinder and the cylinder head, do not use a gasket or any seal between the cylinder and the cylinder head, because the cylinder will run too hot, causing seizure of the piston.

CYLINDER INFO, MATERIALS, PORTS, AND CLEARANCES

The cylinder can be made of aluminum or cast iron. The cylinder for this engine is cast iron. It has three advantages over an aluminum cylinder. The first advantage is that cast iron has very good dry-running properties. Secondly, the cast iron muffles vibrations and noise better than aluminum. The third advantage is that a cast-iron cylinder can be re-machined and re-honed. However, cast iron does have two disadvantages when compared with aluminum. First, the expansion of aluminum is about twice that of cast iron. Second the parts of a cast-iron cylinder are less accurate than those of an aluminum one. Now let's discuss those disadvantages in detail. First, the expansion of aluminum is about twice that of cast iron. If appropriate measures are not taken, a large piston clearance is necessary. So to minimize the piston clearance, the Laura Motoren piston is made of a very special material. It is an aluminum alloy of which 23% is silicon, which ensures less expansion. A characteristic of this special alloy is that is much harder than normal piston aluminum, thus insuring that the wrist pin bore will not wear out. In addition, the piston is shaped in a very special way. The configuration of the piston is adapted to every different temperature. Due to the special nature of this piston, use only original Laura Motoren pistons top prevent seizure of the piston or loss of power. Should the piston ever require replacing, be sure that the arrow on the piston bottom points in the direction of the exhaust port on the cylinder. Now, the second disadvantage of cast iron is that the ports of a cast iron cylinder are less accurate than the ports of an aluminum one. Occasionally this causes the distance between the top of the exhaust port and the top of the intake port to be too small. If a cross-section of the cylinder was made and then opened, this is how it would be. On both sides there is a transfer port, and in the middle, the exhaust port. The dimensions of the ports are very important. Equally important is the exhaust port. Should this distance be too small, it causes loss of power. In this case, to obtain the proper distance, simply dismount the cylinder and put it in a vise. Take a flat file and file the top side of the exhaust port. This will give an increase in power. For the 25mph and 30mph engines, the distance must be between 0.090 inches and 0.130 inches. For the 20mph engine, the distance must be between 0.90 inches and 0.100 inches. Do not make the distance much larger than recommended because there will be a loss of power in the lower RPMs.

TAKING APART THE CLUTCH

Remove the starter leaf spring along with the dirt shield underneath the crankcase. Then take off the v-belt. The v-belt for the 25- and 30-mph engine is the same, but it is different for the 20mph engine. Then loosen and remove the nuts of the clutch. Remove the locking plate, the end plate, and clutch plate. Remove leaf spring fitted on one of the cams of the clutch plate. Take off the pressure plate. Flatten the tab washer. Take the special tool to block the clutch. Use a 17mm socket and loosen and remove the nut on the crankshaft. Fits the same special too with two of the small nuts and pull the clutch off the crankshaft. On the clutch hub is a coil spring filled with 31 steel balls. The diameter of this spring is smaller than the diameter of the hub on which the spring is fitted, meaning that the spring is pre-stressed on the hub. The coil springs for the M48 and M56 engines are not interchangeable. The M48 coil spring bears a rod marking. Not that the spring hub, the pressure plate, and the end plate are

connected with the crankshaft. However, the clutch housing and the clutch lining are not connected to the crankshaft. The clutch lining is via the cams connected with the clutch housing.

HOW THE CLUTCH MECHANISM WORKS

Upon starting the engine, pull the start lever which bends the starter leaf spring, thereby engaging all parts, the end plate, clutch lining, and pressure plate. When beginning to pedal, the v-belt will move, forcing the clutch housing to turn. When the clutch housing rotates, 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 this hub 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 lining, 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 will increase. At a certain number of revolutions, the centrifugal forces 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, thereby pushing the pressure plate, clutch lining, and end plate together. If there is sufficient friction, the pressure plate and end plate rotate the clutch lining within them. Since the cutch lining is connected via the cam with the clutch housing, then the clutch housing will turn and the v-belt will move, thus propelling the moped. On top of the clutch housing is a plain steel washer on the crankshaft. On top of that washer is a disc washer with the concave side pointing away from the engine. This position is very important because, if the disc washer is reversed, the clutch will stick. On top of that disc washer is a smaller, plain steel washer. It is used only for the 25 and 30mph engines; it is not used for the 20mph engine. In the clutch housing is a needle bearing. On the engine side, there is a seal which is part of the bearing. On the other side is a separate seal. Should it ever be necessary to replace that needle bearing, press only on the side with the inscription, because that side is heat treated and it is thicker. Pressing on the other side will damage the needle bearing. Press the needle bearing into the housing, being sure that the distance from the inner side of the clutch hub to the outside of the needle bearing is 25.5mm to 25.6mm, or 1.0039” to 1.0079”. This dimension may be measured with calipers.

REMOVING THE FLYWHEEL/STATOR

Take the special tool to block the flywheel. Take a 17mm socket and loosen and remove the nut of the flywheel. Use the flywheel extractor to pull the flywheel from the crankshaft while blocking the flywheel with the special tool. Inside the flywheel, there are four coils fitted on the stator. A 22-watt coil is for the headlamp, the ten-watt coil is for the brake light, and a 5watt coil for the tail light. A second 10-watt coil acts as the primary high-tension coil. When removing the stator, do not pull the wires by means of the stator because it will damage the connection of the wires. Pull only the wires themselves. This is facilitated by providing the wires with oil.

CARB/INTAKE REMOVAL AND TROUBLESHOOTING

After removing the ignition, remove the intake silencer. On the inside of the intake silencer is the intake filter. The filter must always be clean. Clean it with gasoline, rub it with oil, and reinstall it. If the filter is not clean, the mixture will be too rich and the engine will run in four stroke, causing poor performance and vibrations. Also, dirt could get into the engine, thereby fouling the spark plug and causing damaged to certain parts, such as the piston. Loosen the clamping screw of the carburetor and remove the carburetor from the manifold. The choke valve is located on the front side of the carburetor housing. Be sure that the choke valve is in such a position that the intake opening of the carburetor is totally open. If the choke cable is too short, the choke valve will stay in a certain position, partially covering the intake

opening, thereby forcing the mixture to be too rich. By pulling the choke lever, the choke valve will almost totally cover the carburetor opening. This leaves a very small hole, making the mixture very rich, thus making it possible to start the engine if it is cold. Located in the cover of the float chamber is the banjo bolt. Inside it is a very small strainer. Sometimes the strainer becomes clogged by dirt in the gasoline. If so, simply clean the strainer in gasoline and refit it. There is a plastic float inside the chamber. It is possible that these plastic floats leak. To determine this, hold the float against the light. A leaky float will have gasoline on the inside. When remounting the float, be sure that the pointed side of the needle is up, that it matches correctly the guide n the bottom and the orifice in the cover. To determine a proper fit, shake the carburetor, and you should hear the float moving freely inside the float chamber. There is a small hole in the float chamber cover, which is to vent air. This hole must always be open. On the bottom of the carburetor is the jet and jet holder. To remove these, use a 9mm wrench. After removing them, the jet and jet holder can be taken apart. Hold the jet holder with a 9mm wrench or put it in a vise, then use a small screwdriver to remove the jet. Inside the carburetor housing is the throttle valve. The throttle valve for the 20- and 25mph engines is the same, but there is a different throttle valve fitted in the carburetor for the 30mph engine. Upon opening the gas grip, the throttle valve will move to the top of the chamber. This increases the intake opening of the carburetor, giving it more mixture, thereby making the engine run faster. It is possible that the throttle valve may stick in the housing. Should this happen, simply take a piece of emery paper and polish it, making certain that it moves very smoothly in the carburetor housing. On top of the carburetor 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, thereby increasing 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 and decreasing the idling speed.

REED VALVE INFORMATION/CHECKING

Remove the manifold, loosening the two screws with a 10mm wrench. In front of the manifold is a reed valve. There are several ways to control a two-stroke engine. The engines can be piston controlled, rotary valve controlled, or reed valve controlled. We chose the reed valve as it is independent of the number of revolutions of the crankshaft, thus giving a better filling of the cylinder than any other system, especially in lower RPMs. If the piston ascends, the volume of the crankcase will increase, causing the pressure in the crankcase to decrease. This opens the reeds allowing the gasses to go into the crankcase. When the piston descends, the pressure in the crankcase increases, thereby closing the reeds. Better cylinder filling means better performance. To determine if the reed valve is in good condition, place the top side in the mouth and try to breathe. For a reed valve to be in good condition inhaling must be very easy; exhaling must be impossible. It cannot be checked by blowing on the other side.

SPLITTING THE CASE/CRANKSHAFT INFO

Before dismounting the crankcase, note that the bores in the crankcase are smaller than the outer diameter of the ball bearings. This prevents the bearings from turning around in the crank housing after the engine achieves its working temperature. As mentioned previously, the expansion of the aluminum of the crankcase is nearly twice as much as the expansion of the steel ball bearings. If the bores of the of crankcase were exactly the same as the outer diameter of the ball bearings, the ball bearings would turn around in the crankcase, thus damaging the crankcase. The crankcase must be heated up to 212 degrees before dismantling, to prevent damaging the bores. To be certain that the temperature has been reached, drop some water on the crankcase. 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 the bending of the webs. Put the special plate on a vise, using a dolly to

remount the bearings in the proper position. It is not necessary to heat the bearings. 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 0.003mm, or 0.0001 inches, and is the size of the deviation is a maximum of 0.001mm or 0.00004 inches. 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 bearings, which is 0.12mm or 0.0005 inches. 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 you have to replace the oil seals, use the special tools to be certain that the seals will not be damaged and that they will be fitted in the right position. To determine the need to replace the oil seals, remove the carburetor from the engine. Put the piston in top dead center and be sure all ports in the cylinder are closed. Then blow some smoke in the manifold. If the smoke leaks out of the seals, then obviously they must be replaced. The first symptom of a leak is that the engine is very hard to start. Secondly, if it starts, it will idle at very high RPMs.

REASSEMBLING THE ENGINE

Now that the engine is completely dismantled, let's discuss rebuilding the engine. Begin with the crankcase part on the clutch side. In this part are two dowel pins which provide a fixed base for the gasket. To allow the gasket to stick, put some oil in the crankcase surface. Put the other crankshaft with the clutch side into this crankcase part. Take the other crankcase part and fit both the crankcase parts together. Before reassembling the crankcase parts, they must be heated up to 212 degrees. Tighten the six crankcase screws. After the crankcase has cooled off and shrunk sufficiently, re-tighten the screws. Cut the crankcase gasket so that it matches exactly the crankcase surface on both sides. Fit the cylinder base gasket. Do be certain it is fitted in the right way, not covering the ports, as this would cause a loss of power. The cylinder bore is tapered, which allows one to pinch the piston rings with the fingers. Slide the cylinder over the piston. Be sure that the piston ring gap is properly located around the little pegs in the piston grooves. Fit the cylinder head, never using a gasket or any seal. Then put a flat washer and a spring washer underneath the cylinder head nuts. Fit the cylinder head nut and tighten them crosswise. Torque the nuts with 8.7 toot pounds. Before fitting the clutch housing on the crankshaft, use the special tool that prevents the oil seal from being damaged while fitting it. Fit the plain steel washer, being certain that is well centered on the crankshaft. Fit the disc washer on the concave side pointing away from the engine. For the 25 and 30mph engines, use the second smaller plain steel washer and fit it on the crankshaft. Fit the spring hub on the crankshaft. Fit the tab washer, being certain that it is inside the gap of the hub. Use the nut of the smaller thickness. Block the clutch with the special tool Take a 17mm socket and tighten the nut properly. Bend the tab washer against of the of the flat sides of the nut to prevent the nut from loosening. Fit the pressure plate. Fit the leaf spring on one of the cams of the cutch plate. This leaf spring prevents noise while the engine is idling. It does not interfere with the function of the clutch. Fit the spring between the pressure plate and end plate. Then fit the end plate, being sure that it is well-located in the gaps of the clutch hub. Fir the locking plate, and put on every bolt and undulated washer. Tighten the nuts. Check the clutch clearance. 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 must be a minimum of 0.20". Put the wires through the grommet; this is facilitated by oiling them first. Fit the stator on the crankcase, being certain not to pinch the wires between the stator and the crankcase. There are four magnets 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 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 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 between 0.14 inches and 0.18 inches,** thus ensuring that the points will open in the exact same position that the inducted voltage is at a maximum. 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.

SETTING THE TIMING

Now we will discuss how to adjust the ignition. The contact breaker gap is between 0.14 and 0.18 inches. Fit the flywheel, putting the flat washer on the crankshaft first, then the tooth washer underneath the nut. Fit the nut and block the flywheel with the special tool. Tighten the nut with a 17mm socket. 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, which is 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 0.071 and 0.87 inches for all engines.** The advance can be changed by turning the stator after loosening the three 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, turn the stator counterclockwise. Then take a new gasket and fit it on the reed valve, then fit the reed valve in the crankcase. Take another new gasket and fit it on the manifold Fit the manifold on the housing, using the two screws. Tighten the screws to be sure that the manifold is sealed. Fit the carburetor on the manifold and tighten the clamping screw. Fit the filter with the rubber seal, clamping on the intake silencer. Be sure to use the rubber seal. Before fitting the starter leaf spring and the dirt shield, fit the v-belt on the clutch housing. Before fitting the dirt shield, be sure that the little distance bushings are in the dirt shield. This prevents damage of the dirt shield. The dirt shield is attached with three screws. Two of them are longer than the third. Be certain that the two longer screws are used on the side where the starter leaf spring is located. Check the clearance between the starter leaf spring and the copper thrust piece. This clearance should be between 0.20” and 0.39”. If this clearance is too small, bend the starter leaf spring while it is fitted on the crankcase. But if this distance is too large, remove the starter leaf spring, put it in a vice, bending it in such a way that the clearance is what it should be. Provide the thrust piece with grease of any kind. Never let the moped be driven without the dirt shield. Fit the spark plug and connect the high-tension lead. Now the engine is ready to be used.

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TECHNICAL SCHOOL FOR BATAVUS SERVICE TECHNICIANS
CONCERNING THE LAURA MOTOREN M-48 ENGINE

M-48 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 of the 20- and 25-mph engines is a Bosch W175T1 or Champion L85 as an equivalent. And for the 30-mph engine, a Bosch W240T1 with Champion L81 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 pinched intake tube or 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 30-mph engine during the break-in period is jet number 58; after the break-in period, replace it with jet number 56. For the 25-mph

engine, during the break-in period, use jet number 54; thereafter, use jet number 52. For the 20-mph engine, utilize jet number 52 for the break-in period; afterwards, jet number 50. 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-stroked oil. From the very start, the fuel mixture should be 2%, 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 .020", then the cylinder bore or the piston rings are worn too much. To determine whether the cylinder bore or the piston rings are worn out, take a new piston ring, put it in the cylinder bore and measure the gap again. If it is still larger than .020", then the cylinder bore is worn out. You will have to replace the cylinder, or re-bore and re-hone it. If you re-hone and re-bore it, it will have to be done in such a way that the diameter of the cylinder (after rehoning), is between 40.245 mm and 40.255 mm. Unfortunately, the inch measurement would not be accurate enough. After rehoning, the cylinder must be fitted with an oversize piston. 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. As mentioned previously, after the break-in period, normally the jet must be replaced by a jet two numbers smaller than initially installed. However, it is possible that even this jet is too small. To determine this, simply ride the moped at top speed for three or four miles to ensure the engine reaching its working temperature. Close the gas grip partially. If the bike is apt to go faster, then the jet is too small and will have to be replaced with the original size jet. The fifth possible appearance of a spark plug is the formation of a glassy pearl between the electrodes. This formation may be caused by a dirty air filter, a cutoff intake tube, no intake tube, or no dirt shield. The cylinder head is made of aluminum because this material has good heat abstraction. In order not to disturb the heat flow from the cylinder and the cylinder head, do not use a gasket or any seal between the cylinder and the

cylinder head, because the cylinder will run too hot, causing seizuring of the piston. The cylinder can be made of aluminum or cast iron. The cylinder for this engine is cast iron. It has three advantages over an aluminum cylinder. The first advantage is that cast iron has very good dry-running properties. Secondly, the cast iron muffles vibrations and noise better than aluminum. The third advantage is that a cast-iron cylinder can be remachined and rehoned. However, cast iron does have two disadvantages when compared with aluminum. First, the expansion of aluminum is about twice that of cast iron. Second, the parts of a cast-iron cylinder are less accurate than those of an aluminum one. Now let's discuss these two disadvantages in detail. First, the expansion of aluminum is about twice that of cast iron. If appropriate measures are not taken, a large piston clearance is necessary. So to minimize the piston clearance, the Laura Motoren piston is made of a very special material. It is an aluminum alloy of which 23% is silicon, which ensures less expansion. A characteristic of this special alloy is that it's much harder than normal piston aluminum, thus ensuring that the wrist pin bore will not wear out. In addition, the piston is shaped in a very special way. The configuration of the piston is adapted to every different temperature. Due to the special nature of this piston, use only original Laura Motoren pistons to prevent seizuring of the piston or loss of power. Should the piston ever require replacing, be sure that the arrow on the piston bottom points in the direction of the exhaust port of the cylinder. Now, the second disadvantage of cast iron is that the ports of a cast-iron cylinder are less accurate than the ports of an aluminum one. Occasionally this causes the distance between the top of the exhaust port and the top of the intake port to be too small. If a cross-section of the cylinder was made and then opened, this is how it would be. On both sides there is a transfer port, and in the middle, the exhaust port. The dimensions of the ports are very important. Equally important is the distance between the top of the transfer port and the top of the exhaust port. Should this distance be too small, it causes loss of power. In this case, to obtain the proper distance, simply dismount the cylinder and put it in a vise. Take a flat file and file the top side of the exhaust port. This will give an increase in power. For the 25-mph and 30-mph engines the distance must be between .090" and .130". For the 20-mph engine, the distance must be between .090" and .100". Do not make the distance much larger than recommended because there will be a loss of power in the lower RPMS. Remove the starter leaf spring along with the dirt shield underneath the crankcase. Then take off the v-belt. The v-belt for the 25- and 30-mph engines is the same, but it is different for the 20-mph engine. Then loosen and remove the nuts of the clutch. Remove the locking plate, the end plate, and clutch plate. Remove the leaf spring fitted on one of the cams of the clutch plate. Take off the pressure plate.

Flatten the tab washer. Take the special tool to block the clutch. Use a 17 mm socket and loosen and remove the nut on the crankshaft. Fit the same special tool with two of the small nuts and pull the clutch off the crankshaft. On the clutch hub is a coil spring filled with 31 steel balls. The diameter of this spring is smaller than the diameter of the hub on which the spring is fitted, meaning that the spring is pre-stressed on the hub. The coil springs for the M-48 and M-56 engines are not interchangeable. The M-48 coil spring bears a red marking. Note that the spring hub, the pressure plate, and the end plate are connected with the crankshaft. However, the clutch housing and the clutch lining are not connected with the crankshaft. The clutch lining is via the cams connected with the clutch housing. Upon starting the engine, pull the start lever, which bends the starter leaf spring, thereby engaging all parts, the end plate, clutch lining, and pressure plate. When beginning to pedal, the v-belt will move, forcing the clutch housing to turn. When the clutch housing rotates, 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 this hub 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 lining, 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 will increase. At a certain number of revolutions, the centrifugal forces 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, thereby pushing the pressure plate, clutch lining, and end plate together. If there is sufficient friction, the pressure plate and end plate rotate the clutch lining with them. Since the clutch lining is connected via the cams with the clutch housing, then the clutch housing will turn and the v-belt will move, thus propelling the moped. On top of the clutch housing is a plain steel washer on the crankshaft. On top of that plain steel washer is a disc washer with the concave side pointing away from the engine. This position is very important because, if the disc washer is reversed, the clutch will stick. On top of that disc washer is a smaller, plain steel washer. It is used only for the 25- and 30-mph engines; it is not used for the 20-mph engine. In the clutch housing is a needle bearing. On the engine side, there is a seal which is a part of the bearing. On the other side is a separate seal. Should it ever be necessary to replace that needle bearing, press only on the side with the inscription, because that side is heat treated and it is thicker. Pressing on the other side will damage the needle bearing. Press the needle bearing into the housing, being sure that the distance from the inner side of the

clutch hub to the outside of the needle bearing is 25.5 mm to 25.6 mm, or 1.0039" to 1.0079". This dimension may be measured with a nernier calipers. Take the special tool to block the flywheel. Take a 17 mm socket and loosen and remove the nut of the flywheel. Use the flywheel extractor to pull the flywheel from the crankshaft, while blocking the flywheel with the special tool. Inside the flywheel, there are four coils fitted on the stator. A 22-watt coil is for the headlamp, the ten-watt coil for the break light, and a five-watt coil for the tail-light. A second ten-watt coil acts as the primary high-tension coil. When removing the stator, do not pull the wires by means of the stator because it will damage the connection of the wires. Pull only the wires themselves. This is facilitated by providing the wires with oil. After removing the ignition, remove the intake silencer. On the inside of the intake silencer is the intake filter. The filter must always be clean. Clean it with gasoline, rub it with oil and reinstall it. If the filter is not clean, the mixture will be too rich and the engine will run in four stroke, causing poor performance and vibrations. Also, dirt could get into the engine, thereby fouling the spark plug and causing damage to certain parts, such as the piston. Loosen the clamping screw of the carburetor and remove the carburetor from the manifold. The choke valve is located on the front side of the carburetor housing. Be sure that the choke valve is in such a position that the intake opening of the carburetor is totally open. If the choke cable is too short, the choke valve will stay in a certain position, partly covering the intake opening, thereby forcing the mixture to be too rich. By pulling the choke lever, the choke valve will almost totally cover the carburetor opening. This leaves a very small hole, making the mixture very rich, thus making it possible to start the engine if it is cold. Located in the cover of the float chamber is the banjo bolt. Inside it is a very small strainer. Sometimes the strainer becomes clogged by dirt being in the gasoline. If so, simply clean the strainer in gasoline and refit it. There is a plastic float inside the float chamber. It is possible for this float to leak. To determine this, hold the float against the light. A leaky float will have gasoline on the inside. When remounting the float, be sure that the pointed side of the needle is up, that it matches correctly the guide in the bottom and the orifice in the cover. To determine a proper fit, shake the carburetor, and you should hear the float moving freely inside the float chamber. There is a small hole in the float chamber cover, which is to vent air. This hole must always be open. On the bottom of the carburetor is the jet and jet holder. To remove these, use a 9 mm wrench. After removing them, the jet and jet holder can be taken apart. Hold the jet holder with a 9 mm wrench or put it in a vise, and then us a small screwdriver to remove the jet. Inside the carburetor housing is the throttle valve. The throttle valve for the 20- and 25-mph

engines is the same, but there is a different throttle valve fitted in the carburetor for the 30-mph engine. Upon opening the gas grip, the throttle valve will move to the top of the chamber. This increases the intake opening of the carburetor, giving it more mixture, thereby making the engine run faster. It is possible that the throttle valve may stick in the housing. Should this happen, simply take a piece of emery paper and polish it, making certain that it moves very smoothly in the carburetor housing. On top of the carburetor 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, thereby 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, thereby decreasing the idling speed. Remove the manifold, loosening the two screws with a 10 mm wrench. In front of the manifold is a reed valve. There are several ways to control a two-stroke engine. The engines can be piston-controlled, rotary-valve controlled, or reed-valve controlled. We chose the reed valve as it is independent of the number of revolutions of the crankshaft, thus giving a better filling of the cylinder than any other system, especially in lower RPMS. If the piston ascends, the volume of the crankcase will increase, causing the pressure in the crankcase to decrease. This opens the reeds allowing the gasses to go into the crankcase. When the piston descends, the pressure in the crankcase increases, thereby closing the reeds. Better cylinder filling means better performance. To determine if the reed valve is in good condition, place the top side in the mouth and try to breathe. For a reed valve to be in good condition, inhaling must be very easy; exhaling must be impossible. It cannot be checked by blowing on the other side. Before dismounting the crankcase, note that the bores in the crankcase are smaller than the outer diameter of the ball bearings. This prevents the bearing from turning around in the crank housing after the engine achieves its working temperature. As mentioned previously, the expansion of the aluminum of the crankcase is nearly twice as much as the expansion of the steel ball bearings. If the bores of the crankcase were exactly the same as the outer diameter of the ball bearings, the ball bearings would turn around in the crankcase, thus damaging the crankcase. The crankcase must be heated up to 212 degrees before dismantling, to prevent damaging the bores. To be certain that the temperature has been reached, drop some water on the crankcase. It should evaporate immediately. The crankshaft is located on the inside of the crankcase. 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. It is not necessary to heat the bearings. 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 00004". 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 bearings, 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 you have to replace the oil seals, use the special tools to be certain that the oil seals will not be damaged and that they will be fitted in the right position. To determine the need to replace the oil seals, remove the carburetor from the engine. Put the piston in top dead center to be sure that all ports in the cylinder are closed. Then blow some smoke in the manifold. If the smoke leaks out of the seals, then obviously they must be replaced. The first symptom of a leak is that the engine is very hard to start. Secondly, if it starts, it will idle at very high RPMS. Now that the engine is completely dismantled, let's discuss rebuilding the engine. Begin with the crankcase part on the clutch side. In this part are two dowel pins, which provide a fixed base for the gasket. To allow the gasket to stick, put some oil on the crankcase surface. Put the crankshaft with clutch side into this crankcase part. Take the other crankcase part, and fit both the crankcase parts together. Before reassembling the crankcase parts, they must be heated up to 212 degrees. Tighten the six crankcase screws. After the crankcase has cooled off and shrunk sufficiently, retighten the screws. Cut the crankcase gasket so that it matches exactly the crankcase surface on both sides. Fit the cylinder base gasket. Be certain it is fitted in the right way, not covering partly the ports in the crankcase, as this would cause a loss of power. The cylinder bore is tapered, which allows one to pinch the piston rings with the fingers. Slide the cylinder over the piston. Be sure that the piston ring gap is properly located around the little pegs in the piston grooves. Fit the cylinder head, never using a gasket or any seal. Then put a flat washer and a spring washer underneath the cylinder head nuts. Fit the cylinder head nuts and tighten them crosswise. Torque the nuts with 8.7 foot pounds. Before fitting the clutch housing on the crankshaft, use the special tool to prevent the oil seal from being damaged while fitting it. Fit the plain steel washer, being certain that it is well-centered on the crankshaft. Fit the disc washer with the concave side pointing away from the engine. For the 25- and 30-mph engines, use the second smaller plain steel washer and fit it on the crankshaft. Fit the spring hub on the crankshaft. Fit

the tab washer, being certain that it is inside the gap of the hub. Use the nut of the smallest thickness. Block the clutch with the special tool. Take a 17mm socket and tighten the nut properly. Bend the tab washer against one of the flat sides of the nut to prevent the nut from loosening. Fit the pressure plate. Fit the leaf spring on one of the cams of the clutch plate. This leaf spring prevents noise while the engine is idling. It does not interfere with the funtion of the clutch. Fit the spring between the pressure plate and end plate. Then fit the end plate, being sure that it is well-located in the gaps of the clutch hub. Fit the locking plate, and put on every bolt and undulated washer. Tighten the nuts. Check the clutch clearance. 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 must be a minimum of .020". Put the wires through the grommet; this is facilitated by oiling them first. Fit the stator on the crankcase, being certain not to pinch the wires 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 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 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 between .014" and .018", thus ensuring that the points will open in the exact position that the inducted voltage is at a maximum. 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. Now we will discuss how to adjust the ignition. Fit the flywheel, putting the flat washer on the crankshaft first, and then the tooth washer underneath the nut. Fit the nut and block the flywheel with the special tool. Tighten the nut with a 17 mm socket. 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, which is 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 counter-clockwise 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 .071" and .087" for all engines. The advance can be changed by turning the stator after loosening the three 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 counter-clockwise. Then take a new gasket and fit it on the reed valve; fit the reed valve in the crankcase. Take another new gasket and fit it on the manifold. Fit the manifold on the housing, using the two screws. Tighten the screws to be sure that the manifold is sealed. Fit the carburetor on the manifold and tighten the clamping screw. Fit the filter with the rubber seal, clamping on the intake silencer. Be sure to use the rubber seal. Before fitting the starter leaf spring and the dirt shield, fit the v-belt on the clutch housing. Before fitting the dirt shield, be sure that the little distance bushings are in the dirt shield. This prevents damage of the dirt shield. The dirt shield is attached with three screws. Two of them are longer than the third one. Be certain that the two longer screws are used on the side where the starter leaf spring is located. Check the clearance between the starter leaf spring and the copper thrust piece. This clearance should be between .020" and .039" If this clearance is too small, bend the starter leaf spring while it is fitted on the crankcase. But if this distance is too large, remove the starter leaf spring, put it in a vise, bending it in such a way that the clearance is what it should be. Provide the thrust piece with grease of any kind. Never let the moped be driven without the dirt shield. Fit the spark plug and connect the high-tension lead. Now the engine is ready to be used.

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