

Chapter 3

Tools

The tools supplied with the bike are adequate for 90% of maintenance and repairs. The other 10% requires a small collection of standard mechanic's tools and a few special tools that are peculiar to mopeds.

WRENCHES

Mopeds are built on the IS, or metric, standard. No American tool will exactly match a metric bolt or nut. Half-inch and 9/16-inch wrenches will turn 12 and 14-mm bolts, but the fit is sloppy and invites butchering the bolt head and your knuckles. The first priority is to invest in a set of metric wrenches.

Open-end and Box-end Wrenches

There are three basic wrench varieties—open-end, box-end, and socket (Fig. 3-1). If you are on a budget, the open and box-end wrenches in the bike's tool kit will carry you a long way, but these wrenches tend to be crudely finished and wear quickly. Open-end wrenches are more essential than box-ends, since fuel fittings and the like cannot be worked on with a 360 degree jaw. And open-ends are faster to use. However—and this is a minor point—open-end wrenches tend to wear and distort in heavy use. A really tight fastener will spring one. Box-end wrenches are stronger and less liable to

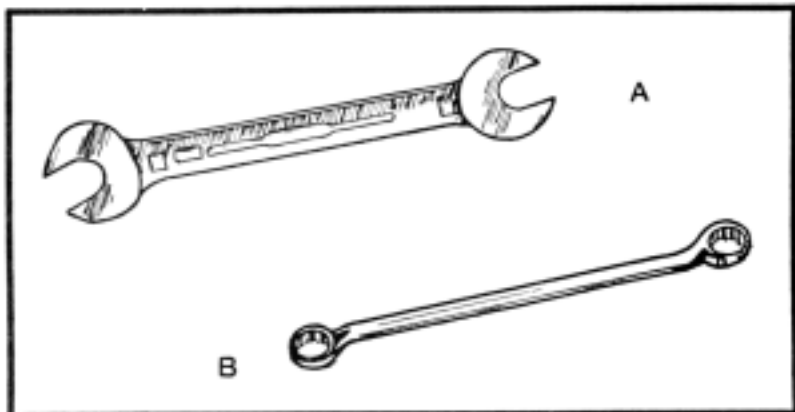


Fig. 3-1. Open-end wrenches are the most basic (view A), but need to be shortstopped by box-ends (view B).

round bolt faces, and are the second choice after a 4 to 19-mm set of open-ends.

The third choice, one that is a luxury for most Saturday-afternoon mechanics, is a set of combination wrenches in the same 4 to 19-mm span (Fig. 3-2). These wrenches have an open-end jaw on one side and a closed-end on the other. Both jaw sizes are the same. The idea is to use the open end to rapidly run the threads and the closed end for initial loosening or final tightening. Combination wrenches are expensive, since you must purchase one wrench for each bolt size and because these wrenches will not do anything that open and box-end wrenches will not do.

Socket Wrenches

Some nuts and bolts are positioned so that access is from above—the sides of the fastener are masked by other parts. The only wrench that will work under these circumstances is a socket.

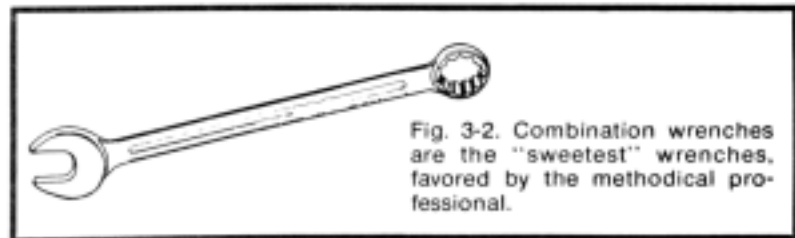


Fig. 3-2. Combination wrenches are the "sweetest" wrenches, favored by the methodical professional.

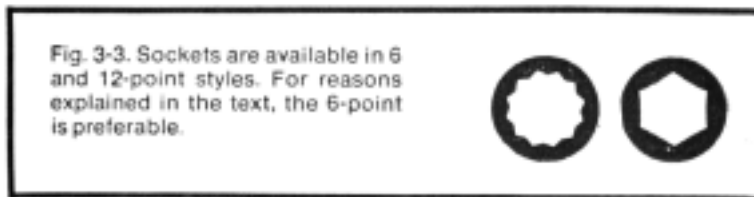


Fig. 3-3. Sockets are available in 6 and 12-point styles. For reasons explained in the text, the 6-point is preferable.

It is cheaper and less frustrating to purchase a complete set of sockets at one fell swoop. While there is a trend to standardize metric fasteners in even sizes on motor vehicles, not all moped manufacturers follow this convention. You will encounter some odd-numbered sizes, and will need sockets from 7mm to 19 mm in 1-mm increments. If possible, specify 6-point, as opposed to 12-point, jaws (Fig. 3-3). Six-point sockets exert a stronger grip, especially if the fastener is worn and rounded, and last much longer than the 12-point variety. The standard length, or reach, is adequate for everything except the spark plug which requires a 5/8-inch deep-well socket (Fig. 3-4). The popular 3/8-inch square-drive—this is the size of the hole in the back of the socket—is the best choice for small engine work. Quarter-inch drive tools are a little fragile and are not built to give the leverage; half-inch drive tools are heavy and get in their own way on moped castings.

Ratchet Handles

A simple T-handle driver is all that you need, at least in the beginning. Later you will want to invest in a ratchet handle, sometimes called a ratchet wrench. Ratchet handles come in a variety of shapes, sizes, and finishes. Each mechanic has his favorite brand, with some 70% choosing S-K.

The primary advantage of the S-K handle is its close-acting ratchet, made possible by the use of

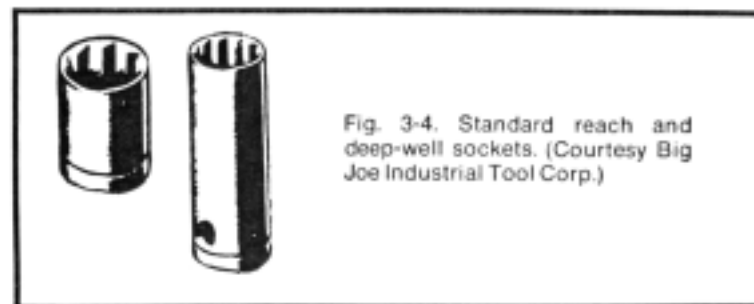


Fig. 3-4. Standard reach and deep-well sockets. (Courtesy Big Joe Industrial Tool Corp.)

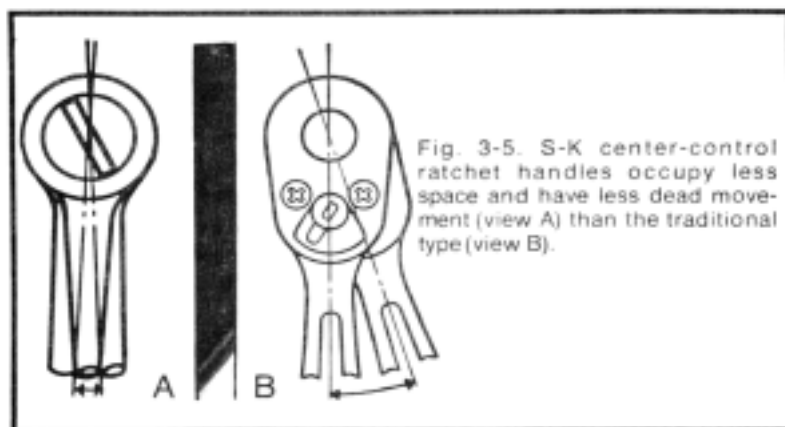


Fig. 3-5. S-K center-control ratchet handles occupy less space and have less dead movement (view A) than the traditional type (view B).

aircraft-quality steel in the ratchet wheels and pawls. Cheaper wrenches must have large gear teeth for strength; consequently, there is 10-20 degrees of dead movement at the handle before the ratchet engages (Fig. 3-5). The S-K tool requires no more than 9 degrees of dead movement and as little as 5.1 degrees.

Some mechanics prefer Snap-on tools, which are about the most expensive, and are surely the best finished, on the market. The Snap-on "Ferret" series handles require 18 degrees of handle movement between engagement points. Sears Craftsman ratchets have as little as 4 degrees of dead movement, but—with all apologies to Sears—are somewhat sloppy in action and finish. The real advantage of Craftsman tools and the reason why many amateurs and more than a few professionals are loyal to them is the warranty. Craftsman socket handles have an unlimited unconditional warranty which includes the ratchet mechanism. No other manufacturer gives such complete buyer protection.

TORQUE WRENCHES

The bane of beginning mechanics is stripped or pulled-out threads. Most of the fasteners you are dealing with on a moped are threaded into aluminum, and aluminum is not a forgiving metal. Run the fastener in crooked and the threads will cross and strip. Draw down the fastener too hard, and the threads will pull out.

Working mechanics do not have this problem. They avoid cross-threading by running the fastener in at least three turns

by hand, before picking up a wrench. Spark plugs might get four or five turns, since the threads on the spark-plug port are subject to wear. And professionals have educated hands that sense how tight is enough. Without being conscious of it, the mechanic takes into account the diameter of the fastener, its threaded depth, the metal it threads into, and the length of the wrench handle. He stops tightening well short of that soft feeling that means the threads have begun to crumple. If this point is reached, the threads have been compromised, but will generally hold. Continued turning will strip the fastener.

A torque wrench indicates how much twisting force, or torque, is being applied to the fastener. It is a very good substitute for professional experience, and it must be used on critical fasteners. No mechanic, however competent, can consistently sense the difference between 8 ft-lb and 10 ft-lb. Some engine components can and the difference may be catastrophic.

There are many types of torque-indicating wrenches, each with advantages in particular applications. An amateur and most professionals are best served by a deflecting-beam wrench (Fig. 3-6). It is the simplest and least expensive, requiring no maintenance over its life span of several million cycles. The principle may not be entirely obvious from the drawing: force acting on the handle can turn the fastener or it can bend the beam. Initially the fastener threads easily, and the beam hardly bends. As the fastener is tightened it resists movement, and this resistance is read on the dial as torque. The dial is secured to the beam and deflects with it; the pointer is attached to the drive end of the wrench and remains straight.

There is some confusion about the units of torque. Torque is a measure of twisting force, expressed in units of weight, acting through a bar whose length is expressed as a unit of

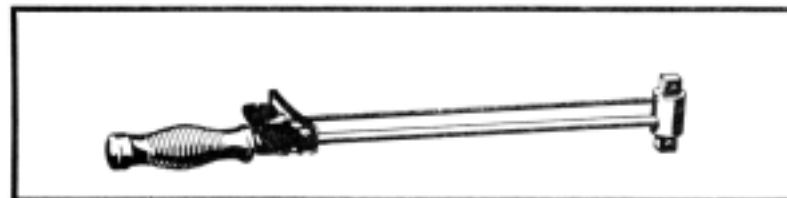


Fig. 3-6. This Fichtel & Sachs torque wrench is calibrated in mkg, and can be ordered from factory headquarters in Dorval, Quebec.

distance. In our system we use pounds as the unit of force and inches or feet as the unit of distance. Larger wrenches, intended for general automotive work, are calibrated in feet; smaller-capacity wrenches, of the kind that would be used on mopeds, are calibrated in inches. In Americanized shop manuals, specification sheets, and mechanic's conversation, torque is described as so many inch-pounds or foot-pounds. Engineers and the scientific community sometimes reverse the notation and say pound-inches or pound-feet. As far as this book is concerned, either term is okay. In the discussion of torque and horsepower in the previous chapter, the pound-foot was used since this is the way dyno gauges read.

Mopeds are built on the metric standard; inch-lb and ft-lb specifications are a courtesy extended to the American mechanic by some manufacturers. The traditional metric unit of torque is kilogram-meters, abbreviated kgm or, for scientific notation, mkg. However, by a recently passed law, West German torque specifications are published in Newton-meters, or Nm. Other European countries are expected to follow suit.

Torque specifications may be in four basic units: inch-lb, ft-lb, kgm, and Nm. The relationship between these units can be summarized:

TO CONVERT	MULTIPLY BY
in-lb to ft-lb	0.0833
in-lb to kgm	0.0115
in-lb to Nm	0.133
ft-lb to in-lb	12
ft-lb to kgm	0.138
ft-lb to Nm	1.36
kgm to in-lb	86.8
kgm to ft-lb	7.23
kgm to Nm	9.8
Nm to in-lb	8.85
Nm to ft-lb	0.738
Nm to kgm	0.102

Purchase a wrench with a 0-150 in-lb (0-2.0 kgm, 0-20 Nm) range. Most moped specifications fall in the middle of this range, where the wrench is most accurate. The wrench should be stored away from other tools, since the pointer and the plastic "floating" handle are fragile. If the pointer should be

damaged, the wrench can be recalibrated by bending the pointer so zero torque is indicated under no load.

Factory torque specifications assume that the nuts, bolts, and other fasteners to be torqued are like-new and lubricated. Damaged threads or threads filled with rust and carbon will give wildly inaccurate torque readings since the wrench cannot distinguish between friction and tension on the fastener. Both are read as resistance to turning.

A common shop practice is to clean threads with a power-driven wheel. A light brushing probably doesn't hurt anything; heavy brushing, of the sort required to remove carbon, dulls the threads and makes a torque wrench useless. If the fastener is carbon-impacted or rusted, soak it in carburetor cleaner and brush it by hand.

In addition, the threads and the underside of bolt heads and nuts should be lubricated. Motor oil is most often used, and is generally adequate, but for best results, purchase a small tin of antiseize compound.

Aluminum castings can easily distort in assembly. Bolts should be drawn down together, if possible, to stress all areas of the casting equally. If there are only two bolts, as in the case of a carburetor flange, tighten one a few turns, then the other. Work in this criss-cross fashion until the bolts are snugged; then if you have the specs, finish the job with a torque wrench. Head bolts are tightened in the same manner, moving from one an other across the long axis (Fig. 3-7). Go through the sequence in three increments: 1/3 torque, 2/3 torque, full torque. All torque-limit specifications available at this writing are included in Chapter 6.

SCREWDRIVERS

American screwdrivers fit metric screws reasonably well, although you may want to file the screwdriver that you use for

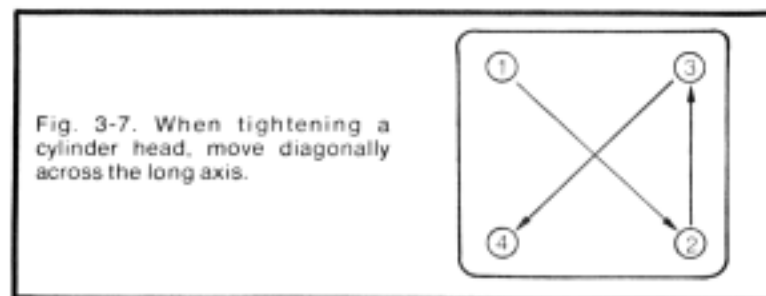


Fig. 3-7. When tightening a cylinder head, move diagonally across the long axis.

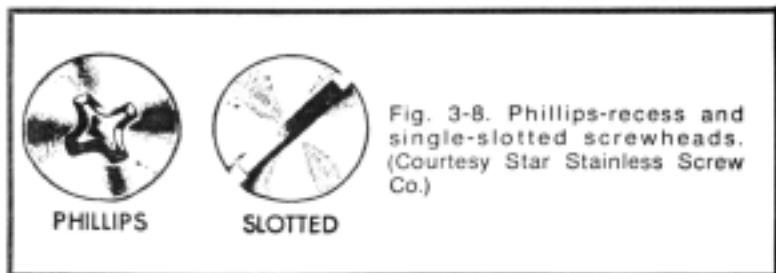


Fig. 3-8. Phillips-recess and single-slotted screwheads. (Courtesy Star Stainless Screw Co.)

point adjustments to an accurate fit. A butchered point screw is a frustration.

Some manufacturers use Phillips, or cross-slot, screws to hold the major castings (Fig. 3-8). While this approach simplifies manufacturing—Phillips screws can be run in with automatic drivers—and gives the bike a clean look, it causes headaches for the mechanic. The screws get tighter as the machine is run and removal with an ordinary screwdriver is



Fig. 3-9. A K-D impact driver.

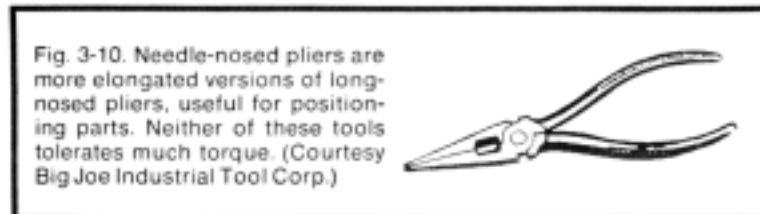


Fig. 3-10. Needle-nosed pliers are more elongated versions of long-nosed pliers, useful for positioning parts. Neither of these tools tolerates much torque. (Courtesy Big Joe Industrial Tool Corp.)

almost impossible. Sometimes the screws can be shocked loose with a hammer blow on the end of the driver. One may be reduced to turning the screws crabwise with a small chisel which, of course, ruins them.

The solution to this and other vexing fastener problems is an impact driver (Fig. 3-9). The bit is positioned in the screw slot and the tool given a healthy wallop with a hammer. The bit is forced deeper into the slot and, thanks to an internal cam, rotates. No Phillips screw with any kind of slot left is proof against an impact driver.

PLIERS

Ordinary slip-joint pliers, the kind that most people keep in a kitchen drawer, are adequate for most jobs. Long-nosed pliers are convenient for holding small parts, and the needle-nosed variety is even more so (Fig. 3-10). The best source of either is an electronics supply house.

Vise-Grip Pliers

Vise-Grip is a trade name applied to a group of plier-like tools (Fig. 3-11). The bolt adjusts an internal toggle to the approximate jaw size needed; squeezing the handles generates a force of some two tons for the 8-inch size and correspondingly more for larger tools. Vise-Grips have no specific use on a moped—you should not be in a situation that requires two tons of force—but they have scores of miscellaneous uses. The tool can be mounted in the vise to hold

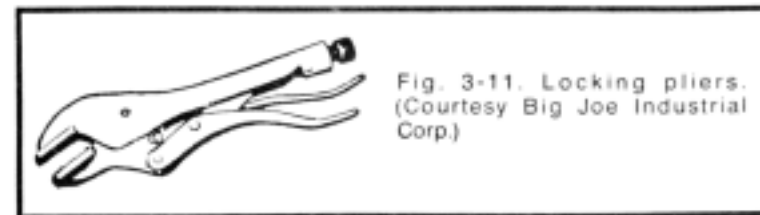


Fig. 3-11. Locking pliers. (Courtesy Big Joe Industrial Corp.)



Fig. 3-12. A K-D combination snapping tool. The snapping assortment is inch standard and of no use on metric equipment.

irregularly shaped parts, used as a clamp to secure parts during assembly, and can generate leverage on other tools. The central use, and the reason these tools have displaced water pump pliers in most mechanic's tool boxes, is to remove rusted and battered fasteners.

Purchase the original Vise-Grip or a tool of comparable quality. Cheap locking pliers are worse than useless, since the force generated by the handles merely warps the jaws.

But a word of caution: pliers are not wrenches and should not be used on bolts with good heads. Using Vise-Grips or other pliers on a fastener is an admission that the fastener is already damaged and must be replaced.

Snapping Pliers

Snappings are used to secure the piston pin to the piston and may be found on clutch and transmission components. There are two types of snaprings, normally requiring separate plier-like tools. The K-D tool shown in Fig. 3-12 handles both inside and outside snaprings, expanding one and squeezing the other. The combination tool is no more expensive than the others, although it does take up more space in the tool box.

Of course, more people disassemble mopeds than have snapping tools. A knife blade in concert with a small screwdriver usually does the trick, but there is danger of damage to the parts. Damage to the snapping is of no consequence, since a careful mechanic discards them—particularly those on the piston pin—each time they are disturbed, but damage to the mounting surfaces can cause a loose or difficult fit.

HAMMERS

Hammers are strong medicine, particularly on white-metal castings, but strong medicine has its place. A carpenter's claw hammer is better than nothing, but the balance and the distance of the face from the handle is wrong for mechanical work. It is much better to purchase a machinist's, or ball-peen, hammer. The 8-ounce weight is about right.

A few precautions can prevent most embarrassments and minimize the danger of injury:

- Wear safety glasses. I realize that a mechanic may be laughed at if he dons safety glasses when he uses a hammer. But many who didn't wish they had.
- Keep the hammer clean. A greasy handle or face can cause injury to yourself or to the machine.
- A hammer requires some minor maintenance. In dry weather you may have to soak the hickory handle in water to swell the grain. Replace the handle at the first sign of a crack. And replace the head if it begins to peel and chip. Hammer heads are surface-hardened by a dose of carbon at the foundry, but the inner metal is as soft as pig iron: once the surface is compromised, it will throw chips.
- Use a hammer with discretion. Do not strike soft metal castings with a steel hammer.
- If it doesn't move, find out why. Be slow to apply more force.

A mallet is needed to separate crankcase halves. The traditional favorite is made of rolled rawhide, but these are getting expensive, and you may have to settle for plastic or, at the worst, hard rubber. But do not attempt any serious, elbow-deep, engine work without a mallet.

Cutting Tools

We think of saws, files, and chisels as construction tools, rather than as repair tools. There are times, however, when nicks and gouges have to be smoothed out and allegedly interchangeable parts must be custom-fitted.

Hacksaws

As long as the frame is rigid, the most important part of a hacksaw is the blade. For precision work, use a 12-inch "all-hard" blade, such as the tungsten high-speed steel blade made by Disston. This blade is brittle and will snap if you force the saw or allow the blade to work loose in the frame. Disston Super Safe blades are flexible—so flexible in fact that they can be tied in knots without breaking—but their cut tends to wander.

Files

File technology was old when the pyramids were built, and there is a lot to learn about the subject. Basically, files are classified in terms of their cut, pitch (number of teeth to the inch), shape, and length. Some of these factors are interrelated. For example, the pitch number drops as the length of the file blank increases. A 4-inch file has more teeth to the inch than the same style in the 12-inch length. In other words, smooth work requires a short file.

The cut refers to the way the teeth are milled. If formed by a single pass of the cutter, the teeth are in parallel rows and the file is classified as single-cut. A second pass, diagonal to the first, produces a double-cut file. The teeth have a diamond shape, falling off from a point in the center. Single-cut files are slow, but leave a smooth surface; double-cut files rip the metal.

Tooth size or pitch is described in general terms as fine (smooth) cut, medium (second) cut, and bastard. As explained in the previous paragraph, the pitch is related to the length. A 12-inch fine-cut has larger teeth—leaving a coarser work surface—than a 4-inch bastard.

For general cutting and sharpening, use a flat mill bastard in the 8-inch length (Fig. 3-13).^{*} A rattail of about the same length is useful on curved surfaces and doubles as a poor



Fig. 3-13. If you buy only one file, make it a mill bastard. (Courtesy American Saw & Mfg. Co.)

man's reamer. Do not make the error of purchasing one of the round files meant for sharpening saw blades. A true rattail is tapered and has double-cut teeth for rapid material removal.

Purchase name-brand files, with the maker's logo stamped on the tang. Unmarked files are factory seconds and give disappointing results, since most rejects have faulty heat-treating.

A file will give years of service if you observe these rules:

- Always use a handle, for the control and protection it offers.
- Cut on the forward stroke, lifting the file off the work on the back stroke.
- Cut dry, without oil.
- Keep the teeth clean with a filecard. A filecard looks like a wire brush with a burr haircut. An ordinary wire brush or power-driven wheel will dull the teeth.
- If you keep your files in the toolbox, protect them with plastic sleeves.

GAUGES

When you begin to work on engines, it is satisfying enough to get the things running, but as a mechanic gets more experience, he takes a longer view. Not only is the engine supposed to run—that is expected—it's supposed to stay together for a long time. A real engine man goes beyond these considerations. The engine must not only run and stay together, but it must perform better than it did the day it left the factory. He begins where the factory finished.

At the heart of engine work is precision measurement. Inside and outside micrometers, dial indicators, vernier calipers, and gauge blocks to keep the instruments accurate are what distinguish the engine man from the ordinary, however-talented, mechanic. The mechanic can estimate piston-to-cylinder clearance accurately by wobbling the piston with his fingers; a thumbnail nail dragged across a bearing journal gives him some indication of its finish. But the engine

^{*}This is the standard file in the metal-working trades. The adjective "mill" is a carry over from the past, when these files were used primarily to sharpen circular mill saws.

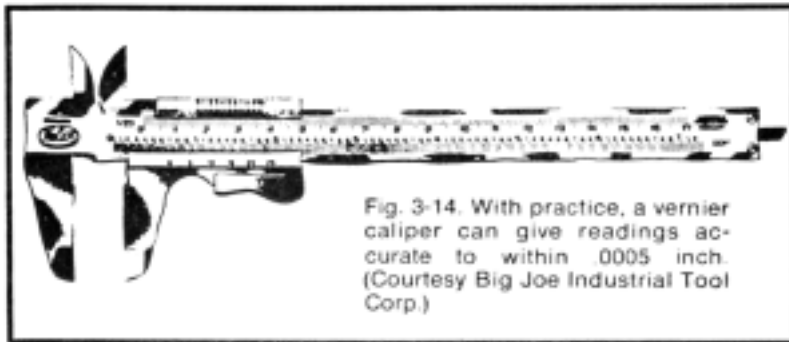


Fig. 3-14. With practice, a vernier caliper can give readings accurate to within .0005 inch. (Courtesy Big Joe Industrial Tool Corp.)

man starts where the mechanic finishes. His touch provides the clue that reveals an imperfectly-fitted part; his instruments enable him to fit it to a ten-thousandth.

The beginning mechanic has little experience to guide him and less in the way of precision gauges. In this book I will describe, as well as I can, the correct feel for bearing clearances, piston fits, and the like. But if you really want to build the engine right, invest in a vernier caliper (Fig. 3-14). You can purchase a fairly good one for about \$30, and with practice will be able to take readings accurate to 0.0005 inch. The instrument may be used as inside and outside calipers, and doubles as a depth gauge.

Feeler Gauges

Feeler gauges are indispensable. The gauge shown in Fig. 3-15 combines two types of feeler gauge into a single tool. The round wire gauges are used to measure spark plug gap, since spark-plug electrodes wear rounded and the gauge must conform if it's to give honest readings. The flat leaves are used to set ignition point gap and measure clearances between machined parts.

Most moped manufacturers have been considerate enough to translate their metric specs into the inch system. Metric feeler gauges are available, but you can use inch gauges if you remember that 1 mm equals 0.04 inch. Say, for example, that the specification calls for a contact point gap of 0.3 mm. Multiplying 0.3 by 0.04 gives 0.012 inch.

Round gauges are less subject to error than flat ones, which is why some mechanics use them whenever they can. A flat gauge must be held dead parallel with the parts measured, while a round gauge can move in one plane without affecting

the reading. There should be a slight drag as the gauge is moved between the parts. The feel of zero clearance cannot be described in a book, but you can learn to recognize it with practice. The ignition points are a good teaching aid, particularly if the points are new and the contact faces are square. Set the gap to specification. Now insert the next smallest leaf between them. It should move with an almost-imperceptible resistance, indicating that both sides of the leaf are in light contact. Then try the leaf on the wide side of the specification. It should be in solid contact with the points.

Compression Gauges

A compression gauge is used to diagnose piston ring and cylinder bore wear (Fig. 3-16). The gauge fitting screws into or is held over the spark plug port, and registers peak compression as the engine is cranked. One-shot readings are not as useful as a carefully recorded series of readings taken once or twice a year. In a new or rebuilt engine, compression will usually be low for the first few hundred miles and climb steadily as the rings seat. It will remain on a plateau for many miles, and then gradually fall off as wear takes its toll. The rings should be renewed at the falloff point. New rings should reach and hold the original compression plateau, once they are broken in. If the rings leak, soon after installation, the cylinder bore or piston is worn and should be replaced.

SUPPLIES

Engine and drive-train maintenance and repair requires a variety of solvents, sealers, and lubricants.

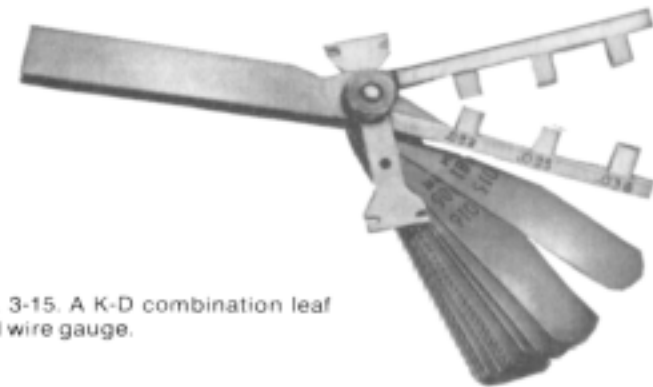


Fig. 3-15. A K-D combination leaf and wire gauge.

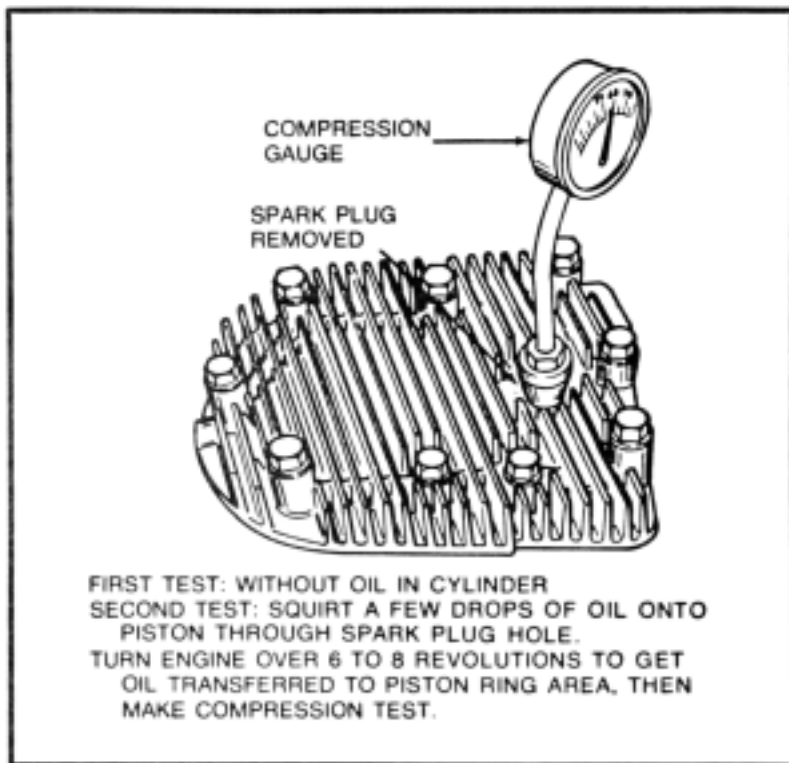


Fig. 3-16. A compression gauge is a good diagnostic instrument.

Solvents

The first priority is a general-purpose solvent. One of the best solvents, available if you're lucky enough to work where it is used, is trichlorethylene. Stoddard's is the brand name of another good solvent, and one that is easier to find than trichlorethylene. The third, and most economical, choice is kerosene. But do not, under any circumstance, use gasoline as a solvent. Gasoline boils at room temperature and below. The vapor is heavier than air, and moves out in long, ground-hugging streamers. These streamers act as fuses. In one case on record, an open container of gasoline was ignited by a welding torch 162 feet away. When mixed with the proper proportion of air, gasoline is more explosive than an equal weight of TNT.

The pungent, burnt-candy odor you detect around motorcycle shops and airplane hangers is Gunk, one of the

most efficient degreasers known. When mixed with kerosene, Gunk turns grease and oil into soap. The disadvantages of Gunk are that it must be flushed with water—a problem around electrical equipment—and that it discolors paint.

Gunk Hydroseal is a favorite of aircraft mechanics, who use it to dissolve carbon deposits inside engines and on cylinder fins. Cylinder fins can also be brightened with oven cleaner, but test the cleaner on an unobtrusive part of the head before you spray the whole surface.

There are special carburetor cleaners, but most are sold in five-gallon cans for professional use. Gunk Carburetor Cleaner is available from most automotive stores in pints; one pint should do about a hundred moped carburetors. Perhaps the best solution is to purchase a spray can of Berkebile 2 + 2 Gum Cutter. The spray product is more potent (and expensive) than the 2 + 2 in pints. If nothing else is handy, you can clean most carburetors with lacquer thinner.

Mufflers eventually clog up and must be dismantled for cleaning. The job is easier if you submerge the muffler in a warm solution of water and caustic soda. Be careful when you are handling caustic—it does to flesh what it does to carbon. Nor are the fumes particularly wholesome. And caustic cannot be used on aluminum, only steel and cast iron.

Engine work produces large amounts of waste, and you should have a good supply of rags on hand. Cotton shop towels are best, but any lint-free, natural-fiber cloth is adequate. Somehow, old T-shirts are traditional around a shop. Some mechanics use heavy paper towels available from parts stores. Ordinary paper towels are better than nothing, and much better than dirty rags.

Lubricants

You will need several lubricants. Chassis lube is a bit heavy for wheel bearings and suspension swing arms, but it is inexpensive. Most shops use it, but specially refined and formulated greases such as Lubriplate are better choices and can add to the life of the machine.

If you run synthetic oil, use it as an assembly lube. If not, preoil the parts with SE-grade motor oil from a major refiner. Some petroleum-based motor oil is fortified with additives; fortified oil is the choice for use as an assembly lube. Or you may purchase an additive from a Big Three auto

dealer—Chrysler, Ford, and General Motors offer well-tested additives under their own parts numbers.

Torque specifications can be more accurately met if you dab antiseize lubricant on the threads. This extreme-pressure lubricant is available in small cans from the larger automotive supply houses. Penetrating oil is useful on machines that are heavily weathered. Various chain oils are available, some of them containing exotic metals such as molybdenum, and others that spray on as a bubbling froth. Industrial chain users, the experts in this field, say that motor oil is okay, so long as the chain stays wetted. Silicon lubricants protect rubber and plastic parts and, should the need arise, can be sprayed on the magneto and spark plug leads to draw water out of the insulation.

Sealants

Gasket sealants are insurance against leaks and, used with moderation, add security to a repair job. The old favorite was 3M Weatherstripping Adhesive, affectionately known as "Yellow Death." It works very well, but is sensitive to heat and cannot be used on head gaskets or exhaust systems.

The current favorite, at least on the eastern Pennsylvania sprint car circuits, is Permatex Silicon ("Blue Stuff"). To use, spread a thin coat of Blue Stuff on both sides of the gasket and bolt it up immediately before the silicon has a chance to cure. The engine can be started upon assembly. Blue Stuff tends to harden in the tube after opening, but its shelf life can be extended to a year or more if it's stored in the refrigerator.

SPECIAL TOOLS

Figure 3-17 illustrates the complete tool set for the Sachs 505/1-series engine. Some of these tools are specific to the Sachs and will work on no other bike; a number of them, including the piston pin extractor (1), the clutch holding wrench (9), and the tachometer (12), can be used on other makes. Other tools in this series can be fabricated with a little ingenuity and patience; a few are European equivalents of familiar American mechanic's tools and can be purchased locally. The flywheel puller as well as clutch pullers for other engines can often be purchased at bicycle shops—the same tools are used to remove cotterless bicycle cranks.

ODDS AND ENDS

Collect several half-foot lengths of two-by-four to use as supports for precision parts. Machined surfaces such as the head gasket surface or the parting line on the crankcase halves should be placed on the supports, not directly on the bench. A brass rod 5 or 6 inches long and 5/8 or 3/4 inch in diameter protects steel parts from direct hammer blows. If you have a vise, you should fashion jaw covers from brass or copper sheets. Cut the covers slightly larger than the jaws and crimp the ends.



Fig. 3-17. Sachs factory tools include piston pin extractor 1, several sleeves 2, 3, 4, 5, a timing gauge 6, flywheel puller 7, offset wrench 8, clutch holder 9, flywheel holder 10, intermediate plate 11, tachometer 12, sprocket puller 13, bearing puller 14, and bearing puller adaptors 15 and 16.

Several repair operations take advantage of aluminum's rapid expansion when heated. You can use a propane torch for this, but a light touch is necessary. Too much heat or heat focused in one spot will distort the casting beyond repair. A safer method, and one that almost always can be substituted for a torch, is to heat with an electric hot plate. Where the shape of the parts prevents direct contact, you can use oil and rags as the medium. Heat the oil, keeping the temperature below 200 degrees F, pour it over rags wrapped around the casting.

Discarded ice trays and clean food tins make good cleaning containers. Kitchen brushes can be used to scrub parts, but a mechanic's brush is cheaper in the long run; specify the type with nylon bristles.

Chapter 4

Fuel System

The fuel system is—after the electrical system—the most complex and least understood system on a moped. In addition, there is an element of personal danger involved, a danger that is usually underestimated by anyone who has not been in the vicinity of a fuel tank explosion. Some repair operations involve dribbling gasoline from open fuel lines and carburetor float bowls. Do not spill fuel on a hot engine or, God forbid, on an engine that is running. Work in the open, well away from water heaters, cigarettes, and other sources of ignition. Do not crank an engine that is wetted with fuel; sparking at the contact points can easily start a fire.

The fuel system has these components:

- Filler cap
- Tank
- Fuel valve
- Fuel line(s)
- Carburetor
- Air filter
- Reed valve (Batavus and Peugeot)
- Fuel pump (Velosolex)

FILLER CAP

The filler cap should be fuel-tight, whether the tank is full or almost dry. Leaks mean that the cap gasket or entire cap

must be replaced. Particularly in dusty environments, it is possible for the vent to clog. The engine will run for a few minutes and quit when the fuel level drops and tank pressure becomes less than atmospheric pressure.

FUEL TANK

The tank may be integral with the frame or detachable. Columbia and Motorbecane integral tanks bear frame loads and, from an engineering viewpoint, are elegant: one part has the function of two. On the other hand, should the tank be damaged, one has the option of making a difficult repair or purchasing a new frame.

Contamination

The major problem with the fuel system, the ultimate cause of more than 90% of difficulties, is contamination. Fuel may contaminate spontaneously with age. Some of the hydrocarbons in gasoline oxidize and settle out as varnish and gum. Besides being difficult to ignite, stale gasoline attacks metal and plastics.

Some water is present in all gasoline because of condensation. As water content increases, the fuel turns gray and, in time, globules of greasy water settle out at the bottom of the tank. Water rusts the steel tank and corrodes the aluminum parts in the carburetor. Rust and aluminum oxide particles eventually detach and score the piston, leaving tiny vertical scratches. Large amounts of water may make the engine hard or impossible to start and can freeze off the fuel line in cold weather.

Dirt and sand can enter by way of a faulty air filter, air leaks between the filter and cylinder, and through careless fuel handling. The piston rings may take on a satiny finish, as if they were lapped (as indeed they were). The piston will show thousands of fine vertical scratches and, in severe cases, the chromium bore will be affected.

Rust is the number one contaminant. If you suspect rust in the fuel—the condition of the piston or an examination of the residue in the carburetor will provide confirmation—drain the tank and inspect its interior with a small flashlight. Turn the light on before you put it over the filler neck and off after you take it away, since the spark at the switch contacts may be enough to ignite the vapors. Another, and safer, way is to

secure a piece of white rag to a wood dowel or brass rod and swab the floor of the tank. If rust is present, the rag will show it.

There are several things you can do about rust:

- Ignore it and attack the symptom by splicing a miniature filter into the fuel line. These filters are available from auto parts houses.
- Attempt to clean the tank.
- Purchase a new tank.

A severely rusted tank should be replaced, since the tank has been weakened and will almost certainly develop leaks. Minor rust can be contained with an inline filter and by keeping the fuel level above the rust line. The filter will catch most rust particles that float free and the oil in the fuel should prevent further rusting. Tanks that appear sound but are thick with rust can sometimes be salvaged by chemical cleaning. However, a word of caution: some detachable tanks are crimped together over a layer of plastic sealant. Bendix and other potent cleaners attack the sealant, leaving you with a more serious problem than before, one that is almost impossible to correct without replacing the tank. If the tank appears safe, and it would be wise to consult your dealer on this matter, remove the fuel valve, plug the hole, and carefully pour carburetor cleaner into the tank until the rusted area is covered. A half-hour soak should be enough, since carburetor cleaner is quite potent, dissolving paint and fingers about as readily as rust and carbon.

Leaks

Tank leaks may be caused by impact damage, faulty welds, and severe rust. If rust is the problem, the only practical cure is to replace the tank. Other leaks can usually be sealed with *Produit D'Obturation*, better known as Peugeot part No. 69158. To use it:

- With a piece of chalk, mark the leak site.
- Disconnect the fuel line and, if possible, remove the tank from the frame.
- Drain the tank completely, tilting it in the direction of the fuel valve.
- Blow out any fuel that remains with compressed air.

- Close the valve and pour one quart of trichlorethylene into the tank. Do not use kerosene or any other petroleum-based solvent.
- Shake the tank vigorously for several minutes.
- Drain and collect the solvent for reuse.
- Remove the fuel valve.
- Thoroughly dry the inside of the tank with compressed air.
- Position the tank so that the leak is at the lowest point.
- Pour a 30-cc bottle of *Produit d'Obturation* into the tank. This sealant has a shelf life of six months. If the bottle is not full, the sealant has undergone a chemical change and will not work.
- Allow 48 hours for the sealant to cure. Do not move the tank during this period.

Alternately, the tank can be sent out for welding. This is not a job for a beginner, for even the most vigorous cleaning does not eliminate the risk of explosion. At a minimum, the tank should be flushed with live steam for 30 minutes and flooded with carbon monoxide during the welding operation.

FUEL VALVE

Figure 4-1 illustrates a three-position fuel valve. The longer of the two inlet pipes opens in the *on* or *run* position; the shorter pipe comes the flow when the valve is turned to *reserve*. This particular assembly has its filter screen downstream of the valve; the more common moped practice is to mount the screen over the inlet pipes. Motobecane fuel valves are mounted on the side of the carburetor; other machines have their valves threaded on a nipple on the tank.

The valve should be removed once a year for cleaning. Drain the tank and undo the valve union nut. Some of these nuts are double-threaded; that is, the lower, or valve-side, threads are left-handed; the upper, tank-side, threads are right-handed and so are simultaneously disengaged by turning the union nut counterclockwise. Soak the valve assembly in solvent and work the lever through all three positions. Then blow the mechanism out with compressed air.

FUEL LINE(S)

After several years of service, the fuel line may grow brittle and develop cracks, particularly at the ends.

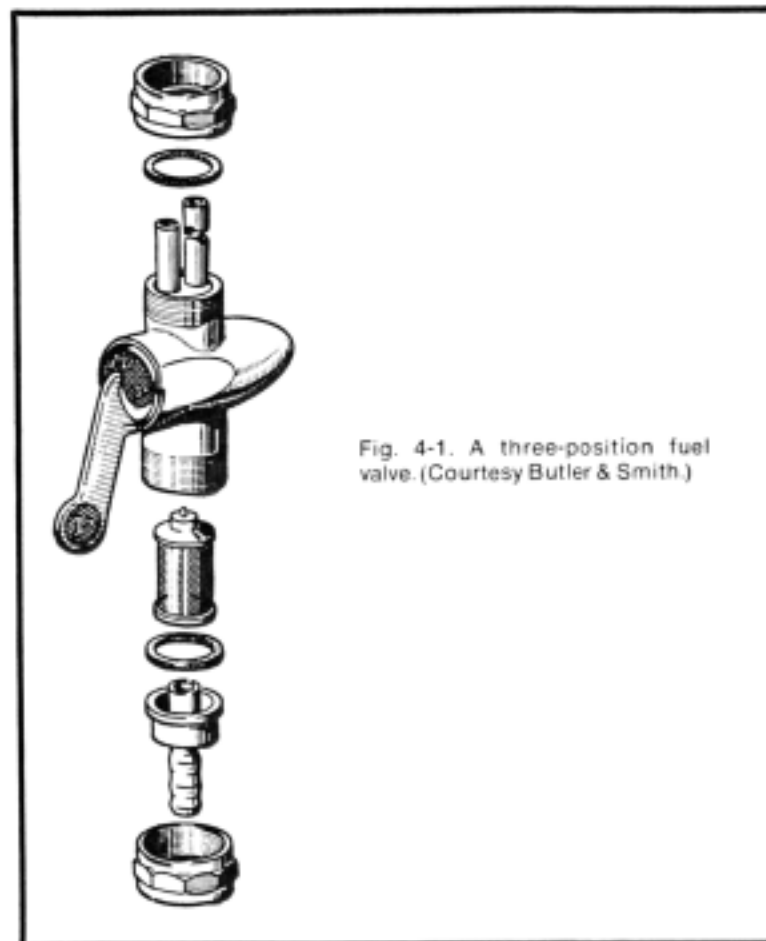


Fig. 4-1. A three-position fuel valve. (Courtesy Butler & Smith.)

Quarter-inch fuel line (the size refers to the inside diameter) can sometimes be purchased at auto parts stores. It should not be confused with vacuum or windshield-washer hose, neither of which are fuel-proof. Motorcycle dealers stock clear neoprene hose and clamps. Neoprene slowly deteriorates in sunlight, but is preferred by motorcyclists who want a positive indication that fuel is reaching the carburetor.

CARBURETORS

Moped carburetors are simple instruments, designed for ease of maintenance. There is nothing mysterious about them, but their principles of operation are less than obvious. Some

theory is needed, if only to troubleshoot the instrument intelligently.

How They Work

The central principle of all carburetors, moped or automotive, is pressure differential. The weight of the atmosphere presses down on the earth's surface with a force of 14.7 pounds per square inch. During the intake stroke the engine generates a partial vacuum, where pressure is less than atmospheric, in the cylinder. The carburetor provides the route between engine induced vacuum and atmospheric pressure, and the pressure imbalance forces air (and thereby, fuel) through the carburetor and into the engine.

A carburetor has three functions. It atomizes the fuel into a fine spray, regulates engine speed on demand from the rider, and adjusts the mixture strength for different operating conditions. I'll talk about each of these functions in subsequent paragraphs.

Liquid gasoline burns slowly and inefficiently. To drive the piston, the fuel must be converted into a vapor, so that each hydrocarbon molecule is surrounded by oxygen molecules. Atomization, the process of breaking the fuel into tiny droplets, is the first step toward vaporization. Once atomized droplets enter the engine, they absorb heat and boil off into vapor.

Moped carburetors use a piston slide throttle (Fig. 4-2, part No. 18), connected to the twistgrip by means of a Bowden cable. Withdrawing the piston from the bore allows more air and fuel to pass, and at idle the piston closes the bore almost completely. The coil spring, part No. 17, forces the piston down, closing the throttle, when the tension on the control cable is relaxed. Without the spring, the throttle could stick open, since cables are flexible and don't "push" well. In addition to regulating the amount of air and fuel, piston slide throttles have a second and sometimes third function, discussed later.

The most demanding job the carburetor has is adjusting the strength of the mixture according to the engine's needs. At cruise, an engine is happiest on a mixture of about 16 parts of air to 1 part of gasoline. At high speed the mixture should be slightly richer, in the range of 14 or 15 to 1: the additional fuel is needed to overcome mechanical friction and to cool the

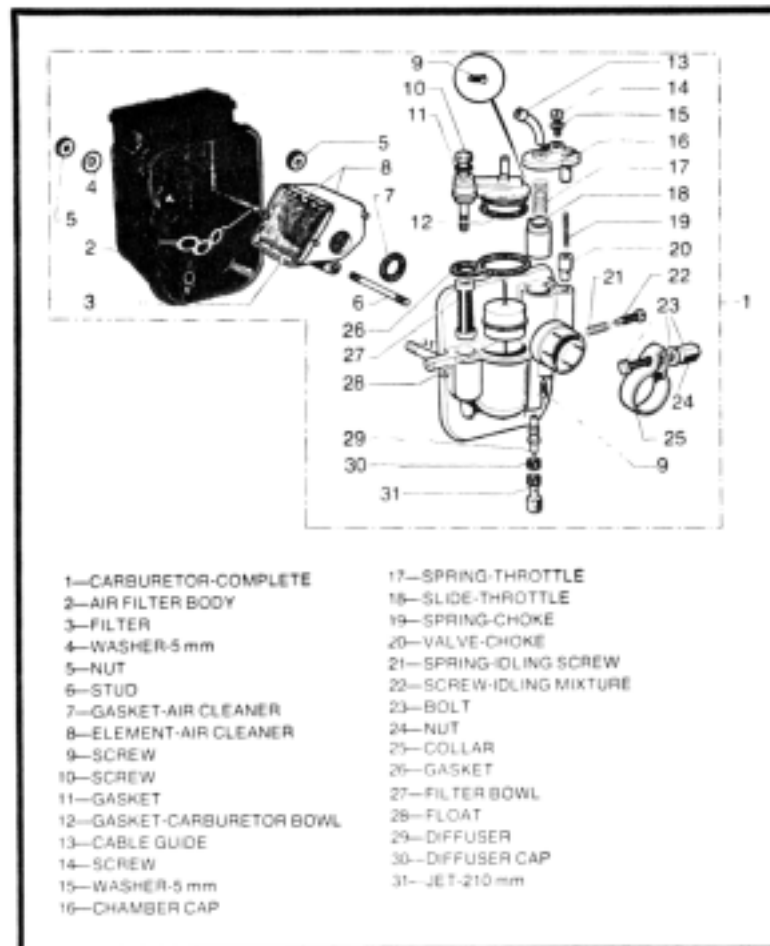


Fig. 4-2. The Motobecane carburetor, developed specifically for moped service.

piston. At very low speeds the engine again needs a rich mixture to persuade it to run at all, since the cylinder is not very well scavenged, and the incoming charge is diluted by exhaust gases from the last cycle. Idle mixtures may be as rich as 8 or 9 to 1. Cold starting, when the fuel tends to condense back into a liquid, requires very rich mixtures on the order of 4 or even 3 to 1.

The carburetor makes these changes automatically, with no attention from the operator except for starting. This is what gives some complexity to even the simplest carburetor.

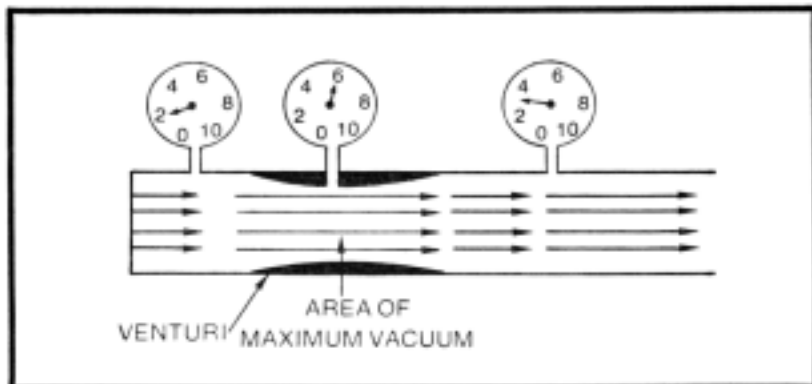


Fig. 4-3. Venturi action. The vacuum gauges read in inches of mercury.

Venturi

Although there is a pressure differential between the carburetor and the cylinder, it is not always sufficient to draw fuel into the engine. Help takes the form of a venturi, or vacuum generator. A venturi is a restriction in the carburetor bore; it may be streamlined as shown in Fig. 4-3 or it may be quite blunt.

Since just as much air enters the carburetor bore as leaves it, the velocity of the air at the venturi increases over its entry velocity. The boost in air speed helps atomize the fuel, whipping it into a fine mist, but the major benefit is that this velocity increase is "purchased" at the expense of pressure. The pressure of the air stream in the venturi section drops, encouraging fuel to flow into the bore.

Moped carburetors are a little different than those on typical automobiles and American small engines. Instead of forming the venturi as a *fixed* restriction or bulge in the sides of the casting, moped designers follow European practice and use a piston to form a *variable* venturi (Fig. 4-4).

At low speeds the piston masks off most of the carburetor bore, and the area of the venturi—the distance between the lower edge of the bore and the bottom of the piston—is small. Consequently, the air stream moves at high velocity, assuring a good vacuum draw. As the throttle piston retracts, the engine turns faster, and flow velocity is maintained by the increased air intake to the engine.

At full throttle the venturi effect no longer exists, since the piston is withdrawn completely from the carburetor bore, but

some vacuum is generated by the bore itself. You can demonstrate the principle involved by cutting the ends off a cigar wrapper and blowing through it. The wrapper will collapse because the pressure of the moving air stream in the wrapper is less than atmospheric pressure.

Main Jet

In carburetor terminology, a jet is an orifice through which fuel flows. Jets are carefully calibrated so that only a preset amount of fuel flows through them at a given vacuum.

Most of the fuel consumed by the engine passes through the main jet circuit. The circuit is fed from the float bowl and discharges at the vacuum zone created by the venturi. The main jet is inserted at some point in the circuit; it may be just under the carburetor bore or it may be at some distance from the discharge point. In Fig. 4-2 the main jet is shown as No. 31; in Fig. 4-5 it's No. 17. Jets' numbering corresponds to their ability to pass fuel. Unfortunately there is no universal code; each manufacturer has a system of his own. In most cases, the higher the number the larger, more free-flowing, the jet.

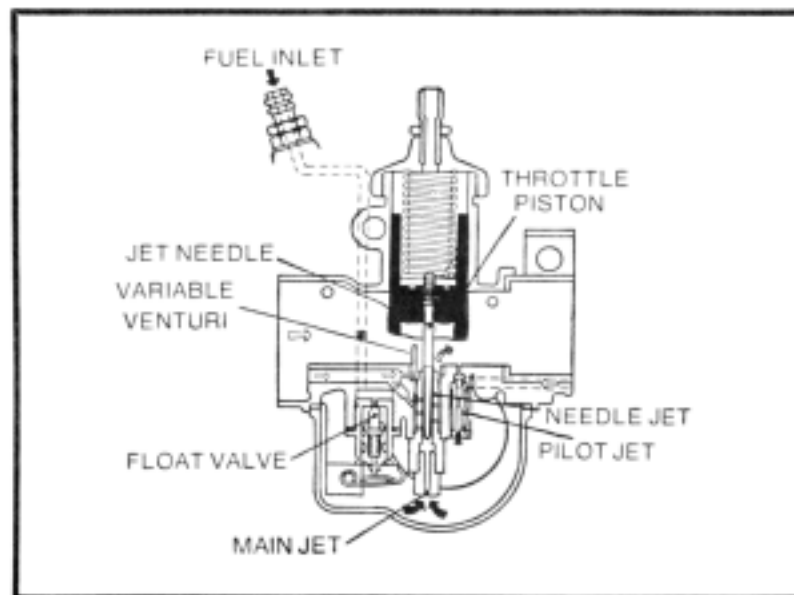


Fig. 4-4. At half throttle, the position and diameter of the needle determines fuel flow through the needle jet.

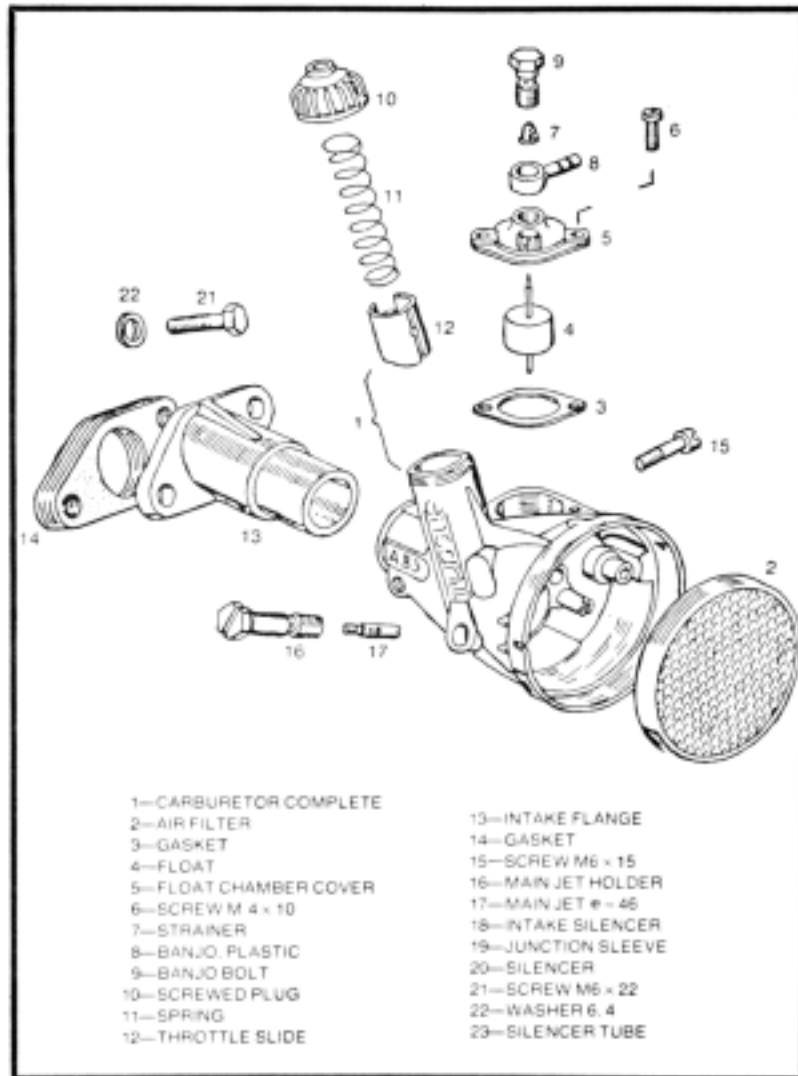


Fig. 4-5. The Encarvi carburetor and silencer as fitted to Tomos bikes.

Bing, Dell'Orto, Jikov, and other carburetors have a feature borrowed from motorcycles: flow through the high-speed circuit is, in part, controlled by throttle position. A tapered needle on the end of the piston moves up and down in the discharge nozzle which in this configuration becomes the needle jet. At low speeds, the piston is low in the bore and the

thickest part of the needle almost fills the jet (Fig. 4-4). Very little fuel flows. As the piston retracts, the needle lifts out of the jet, progressively uncovering it. At full throttle the needle is almost completely withdrawn and maximum fuel flows. This arrangement provides a richer mixture at high speed and, because the position of the needle is adjustable, gives another opportunity for the carburetor tuner. Needle jet hardware is shown in Figs. 4-6 and 4-7.

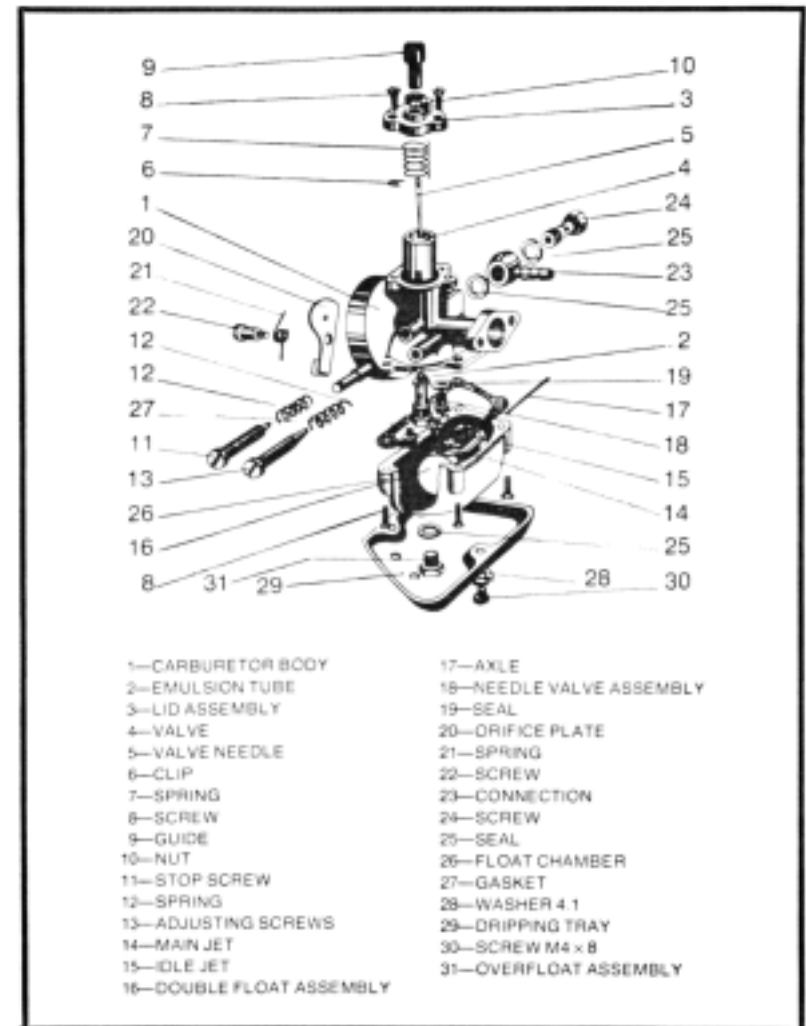


Fig. 4-6. The Jikov carburetor, used on Jawa bikes.

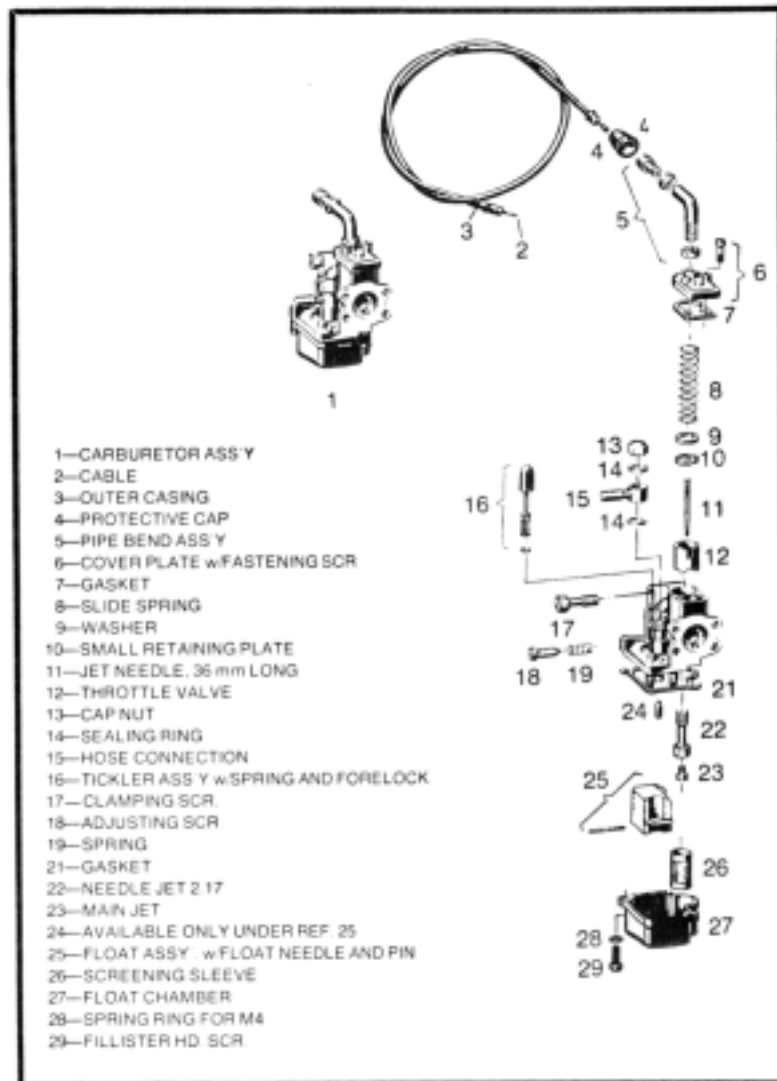


Fig. 4-7. Bing is a famous name in German carburetors, found on such prestige products as the BMW motorcycle. This example is used on the Columbia bike.

Low-Speed Circuit

The low-speed circuit discharges just aft of the throttle piston. This auxiliary circuit is necessary because air flow becomes erratic over the main jet as the piston is lowered. Friction losses increase and, at some point while the engine is

still running, air through the venturi reaches supersonic velocities. The main jet is caught in series of pressure waves and fuel delivery is unreliable.

Figure 4-8 shows a low-speed circuit typical of several moped carburetors. Note the way the throttle needle completely fills the needle jet, denying fuel from that source until the throttle is approximately one-third open. At low speeds the engine runs on fuel supplied by the low-speed, or pilot, jet.

The term "pilot jet" is a new one here and means that the low-speed mixture control is by way of an air screw. For reasons explained presently, some air is admitted to the jets before the fuel is discharged. This means that the low-speed mixture can be regulated by controlling the flow of fuel or the amount of air premixed in the fuel prior to discharge. Tightening the air screw (on the lower right of Fig. 4-8)

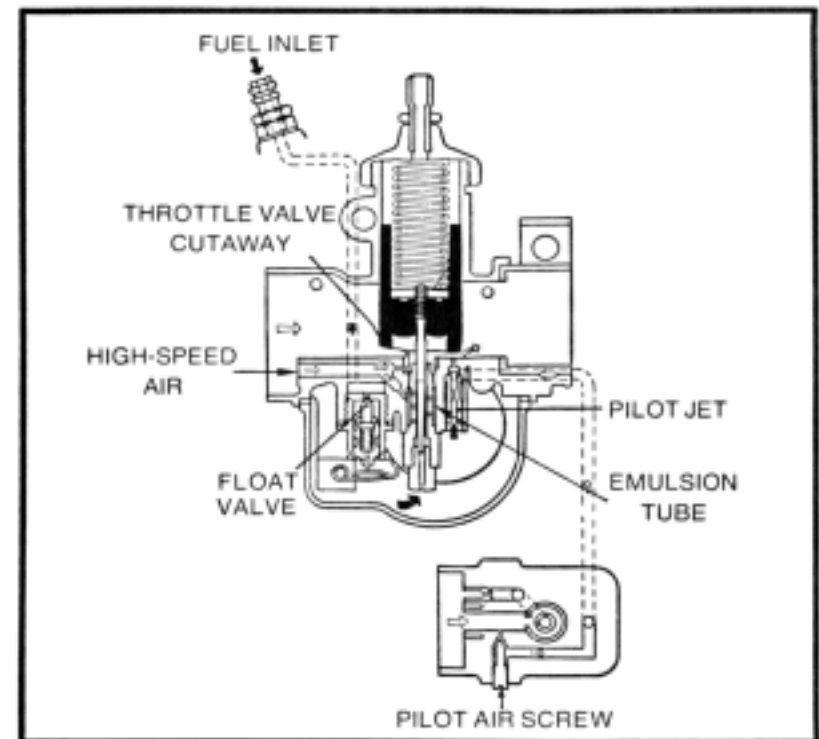


Fig. 4-8. The low-speed circuit is controlled, in this case, by a pilot air screw.

reduces the amount of air without affecting the amount of fuel flow. Consequently the mixture goes richer. Turning the needle out has the opposite effect.

Not all moped carburetors employ a pilot air screw; many adjust the low-speed mixture by means of a fuel-regulating screw. The term "pilot" is no longer applicable, and we speak of a low-speed jet and a fuel-regulating screw. The two screws look alike, although you will generally find a pilot air screw to be blunter and thicker than a fuel-regulating screw. The adjustment procedure is the reverse: tightening the fuel-regulating screw sends the mixture lean.

Air Bleeds

Fuel in both the high- and low-speed circuits is mixed with air before it enters the carburetor bore. The low-speed air bleed may be adjustable or not, as discussed under the previous head; the high-speed air bleed is, for practical purposes, fixed. Air enters the high-speed circuit from a port at the carburetor mouth, flows through a passage under the bore, and mixes with the fuel at some point between the main jet and the discharge nozzle.

Figure 4-8 illustrates the typical arrangement. Mixing takes place in a part generally called the emulsion tube, although the same part goes by several names, including main jet holder and diffuser. At any rate, the emulsion tube is identified by one or more cross-drilled holes in its side. Air enters the fuel column through these holes; should the holes clog, the high-speed mixture goes rich.

There are three reasons for air bleeds:

- An emulsion of gasoline and air atomizes better than fuel in the liquid state.
- Because each bubble has its own surface tension, emulsified fuel tends to stay put in the passages. Raw fuel would drop away from the jets when the throttle opened suddenly and vacuum momentarily disappeared. The engine would go lean under acceleration.
- Again because of surface tension, an emulsion is less likely to siphon into the crankcase.

Float

The Bing float is made of nitrogenated plastic, a foam-like substance that is lighter than gasoline. Gurtner carburetors

use a hollow plastic cylinder as the float. The Jikov, a sophisticated design that was developed from the firm's motorcycle carburetors, employs a brass pontoon float.

Once fuel in the bowl reaches a predetermined level, the float closes the inlet valve (Fig. 4-9). This valve is generally known as the needle and seat assembly. The needle is usually made of chrome steel and may be acted on remotely as shown in Fig. 4-9, or may be attached to the float without any intermediary mechanism. The latter arrangement is illustrated back in Figs. 4-2 and 4-5. The seat is usually made of brass and, except on the most rudimentary carburetors, is replaceable.

The roof of the float chamber is vented to keep the fuel at atmospheric pressure. Where there is a float adjustment, this adjustment must be made with the greatest accuracy, for the distance the float moves before the needle closes determines the level of fuel inside the carburetor. All things equal, the higher the fuel level, the richer the mixture.

Cold Start Provisions

The engine needs a very rich mixture during cold starts. The traditional way to provide this is with a choke plate mounted on the mouth of the carburetor bore. The part described as an "orifice plate" (No. 20 in Fig. 4-6) is, in American terminology, a choke plate. When the choke is

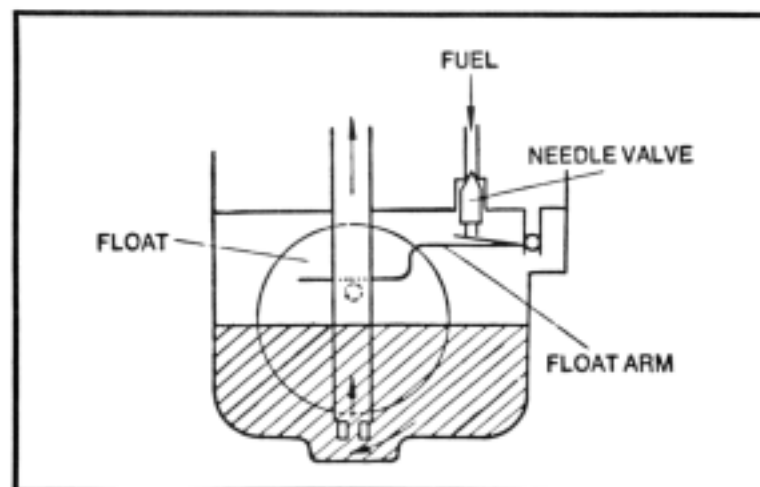


Fig. 4-9. A typical float and remote needle. (Courtesy U.S. Suzuki.)

athwart the bore, the engine pulls against it, creating a vacuum along the whole length of the intake passage. Both the main and low-speed jets flow.

French designers, in the best automotive and motorcycle tradition, use a starting jet, of which the Motobecane carburetor is typical (Fig. 4-2). Two fuel passages leave the floor of the float bowl; the upper passage supplies the main and low-speed jets, the lower passage runs under the carburetor and up to the choke valve, (No. 20). The valve is normally kept closed by the spring (No. 19). When raised, the valve allows fuel to flow to a discharge orifice in the aft part of the carburetor bore.

In addition to a choke or a starting jet, some carburetors feature what is quaintly called a "float tickler". The Bing, shown in Fig. 4-7, has this feature. Depressing the tickler sinks the float, flooding the jets for an extremely rich mixture. The tickler should be used with discretion and only on the coldest days.

TROUBLESHOOTING

Hard starting, "flat spots" during acceleration, misfiring, and loss of power are all symptoms of carburetor ailments—but are more likely to originate in the ignition system. Check the ignition system, giving particular attention to the spark plug and contact points, engine compression, and the exhaust ports and muffler before you turn to the carburetor. By the same token, resist the temptation to adjust the carburetor. Once in adjustment, it should remain there for many thousands of miles.

No Fuel

The prime symptom of no fuel is a dry spark plug nose after repeated cranking. If the engine is running when this condition occurs, it will miss, cough, pick up again, and finally stop.

First ascertain that fuel is getting to the carburetor. Momentarily disconnect the line at the carburetor end. If there is no fuel present, the diagnosis is an empty tank, a clogged fuel valve, line, or air vent in the filler cap.

If fuel is present, remove the float bowl to determine if fuel has passed the inlet needle and seat. If the bowl is dry, the inlet needle is hung in the seat or the inlet screen is clogged.

Fuel in the bowl and none—after persistent cranking—in the engine is a more serious affair. There are five possibilities; in order of frequency of occurrence they are:

- A clogged high-speed fuel circuit, usually stopped at the main jet.
- A massive air leak between the venturi and the engine cylinder.
- Less than 60 psi of cylinder compression.
- Broken or sprung reed valves (Peugeot).
- Leaking crankcase seals.

As a temporary repair, stoppages can be cleared by blowing through the high-speed circuit at the main jet. The jet is accessible with the float bowl removed. A broomstraw may be used if the stoppage is stubborn, but do not introduce wire into the jet or emulsion tube. A scratch on these parts is enough to upset calibration. At the first opportunity, disassemble and chemically clean the carburetor.

See that the intake pipe is secured to the carburetor and to the cylinder. An air leak serious enough to short-circuit engine vacuum implies loose hold-down bolts. Reed-valve and seal work is detailed in Chapter 6.

Flooding

A flooded engine is one whose mixture is too rich to ignite. A gasoline-soaked spark plug tip is the first visible symptom, but one that occurs relatively late in a hot engine: a fairly large amount of fuel must pass unignited through the engine before cooling the metal enough to condense the charge on the spark plug tip. Fuel evaporates upon contact with hot metal; if the vapor concentration in the chamber is greater than 6%, the mixture may be totally vaporized but still refuse to ignite. You may see a wisp of vapor curling out of the spark plug port as you remove the plug. Too much choke during cold starts and any choke during hot starts will flood the engine, making starting difficult or impossible. Once an engine's flooded, continued cranking adds to the problem.

Assuming for the moment that the carburetor is not at fault, there are several ways to clear a flooded engine. Minor flooding can sometimes be corrected by partially disengaging the spark-plug cable boot from the plug, leaving about a quarter-inch air gap between the cable terminal and the spark

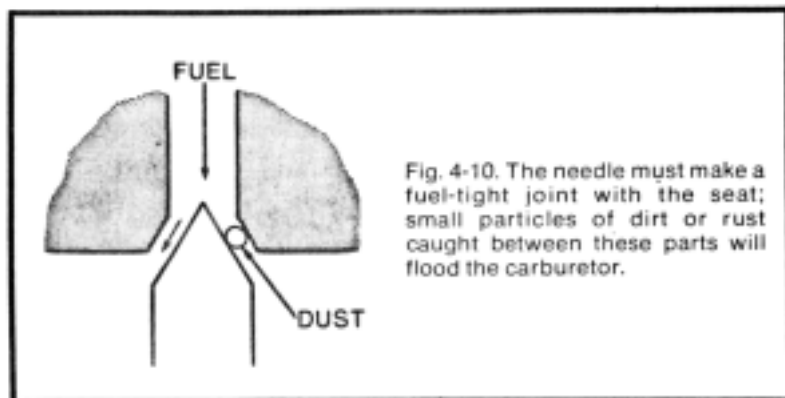


Fig. 4-10. The needle must make a fuel-tight joint with the seat; small particles of dirt or rust caught between these parts will flood the carburetor.

plug terminal. The spark will have to jump this gap before it gets to the spark plug. The ignition coil delivers only as much voltage as it has to; the air gap between the cable and spark-plug terminals increases the voltage output. With luck, the increase will be enough to ignite the over-rich mixture.

If this does not work, remove the spark plug and replace it with a known-good one. This procedure eliminates the spark plug as the cause of flooding and, unless the cylinder is sopping wet, may get the engine started. If you do not have an extra spark plug, dry the original with a cigarette lighter or match.

Severe flooding—when the chamber and crankcase are puddled with raw fuel—takes time to correct. One approach is to let the bike sit for an hour or so to give the fuel time to evaporate. Be sure to turn the fuel valve off. If you're in a hurry, you can drain the carburetor float bowl and try to dry the engine by cranking. Have a fresh spark plug ready when you open the fuel tap for the starting attempt. Compressed air introduced at the spark plug port speeds drying, particularly if the piston is brought down past the transfer ports.

Persistent flooding with the throttle wide open and the choke off means a problem with the carburetor's internal fuel-regulating mechanism. In severe cases, fuel dribbles from the carburetor mouth when the air cleaner is detached.

The needle and seat assembly is the usual culprit. The needle may be held off its seat by a particle of dirt (Fig. 4-10), or the needle may be worn so it no longer makes a fuel-tight seal with the seat. Dirt can sometimes be dislodged by giving the carburetor a sharp rap; a surer method is to drop the float bowl and turn on the fuel for a second or two. The rush of

gasoline over the needle will clear it. A worn needle and seat should be replaced even if this means purchasing a new float bowl cover and float too. Fortunately, most carburetors have removable needles and seats. All that's required for the repair is a large screwdriver, ground to fit the slot in the seat, and the requisite parts. Use a new gasket and tighten the new seat firmly in the float bowl cover. You may wish to coat the threads with gas-proof sealant as further security.

Steel needles and brass seats can be temporarily repaired by lapping. Dip the tip of the needle in fine-grade valve grinding compound and rotate it in the seat with your fingers. Replenish the compound as needed, turning the needle so the full circumference is lapped. Wash off all traces of the compound with solvent—any that you miss will enter the engine and continue to lap there—and assemble the carburetor for test. Repeat the process until the valve stops leaking.

Some carburetors have an adjustable float. If the float rises too high in the chamber before it closes the needle against the seat, the engine will run rich and may flood. But the float will not spontaneously get out of whack; this condition can occur only if someone has changed the factory setting. See the "Overhaul" section in this chapter for further details.

Another possibility, one that is almost always confined to hollow floats, is leakage. Shake the float vigorously; if enough fuel is present to disable it, its weight will be felt and, in brass floats, heard. Since repairs are impractical and, at best, short-term affairs, the best bet is to replace the float.

Finally, there is a very remote chance that the float is binding, particularly if the float works off a pivot. Carefully examine the float and the sides of the chamber for wear marks; correct by making small bending adjustments to the pivot.

Rich Running

An over-rich mixture costs power, fuel, and spark plugs. The symptoms of this malady are:

- Black carbon deposits on the spark plug nose.
- Acrid exhaust odor which may be accompanied by black droppings from the exhaust pipe.
- Four-stroking. The exhaust note becomes irregular as the engine misses a beat and fires with almost a double charge on the next revolution.

If these symptoms persist across the rpm band, suspect a restriction in the air supply. Test the bike with the air filter element removed; if the problem disappears, the filter element is clogged and should be renewed. Puch and a few other bikes use a remote element, connected to the carburetor by a flexible hose; the hose may be pinched shut.

Dell'Orto carburetors have fixed jets. Others have an adjustment screw located on the outboard side of the carburetor, about midway along its length. Four-stroking at low speeds can be corrected by turning this screw counterclockwise if it is a pilot air screw and clockwise if it regulates the fuel flow. With the engine running, move the screw out one-eighth turn or less. Allow a few seconds for the adjustment to be felt; repeat until four-stroking stops. It may be necessary to increase the idle speed slightly, an operation that is described under "Adjustments."

Rich running at high throttle settings can be corrected by lowering the tapered needle in the throttle piston one notch. If a needle is not used, it may be necessary to insert the next-smaller main jet. However, you should remember that jet changing—particularly when it produces a leaner mixture—is not something one does casually. The jet that came in the carburetor should be approximately correct. The major exception to this rule is if the machine is operated at high altitude: in this circumstance, a smaller jet will correct the overly-rich mixture by matching the fuel delivery with the reduced oxygen content of the air, but it will not restore sea-level power.

Lean Running

A gasoline-starved mixture burns hotter than a normal mixture and produces less usable power. The first symptom is a dull white spark-plug tip. As the condition progresses, the tip turns china-white and the side electrode shows blue temper marks. Very little carbon will be left in the cylinder; that which remains will be scorched grayish-white. The end product is piston destruction, either from a hole in the crown or a melted skirt.

Determine whether the carburetor is receiving enough fuel. Two types of fuel line are used: transparent neoprene and black rubber. A rubber line can be loosened at the carburetor with the engine stopped. Fuel should gush out as the line is

pulled toward the end of the barbed fitting. In a transparent line the fuel column can be seen. It should be solid, perhaps broken by an occasional small bubble. The usual site of fuel line obstructions is the screen at the fuel valve. Disassemble and clean it.

If adequate fuel seems to be getting to the carburetor, the next step is to remove the float bowl cover or float bowl, depending upon the construction of the carburetor. The bowl should be at least half full. If not, check the inlet screen and, if applicable, the float level adjustment. See that the inlet needle drops without binding or hesitation. Clean the needle and seat as required to restore its responsiveness.

Enough fuel to keep the float awash but a scarcity of fuel in the engine may mean a partial stoppage in the main jet or its feed circuit. Blow out the carburetor as described a few pages back under "No Fuel."

The fuel supply is only half the picture: there is also the possibility of air leakage between the carburetor venturi and the combustion chamber, particularly if the engine has many miles on it. Open the throttle piston cover; some covers are secured by small screws, others by a knurled ring. Carefully lift the throttle piston up and out. The piston is slotted and located by a pin or tab in the piston bore. Pull the piston straight up, clearing the needle jet without bending the needle in the process. Inspect the piston for scratches, wear marks, and carbon tracks that can mean air leakage between it and the bore. In some carburetors a severely worn piston will vibrate and rattle under load and at low speeds: the only cure is to purchase a new carburetor.

Install the piston dry, without lubricant. Align the slot and pin and center the needle over its jet. The piston should fall easily into the bore.

See that the carburetor is secure on the inlet pipe and that the pipe is fastened down hard on the cylinder head. Leakage at the head seems to be rather common on mopeds; it can be cured by coating the gasket with silicon sealant. A paper-thin coat is enough.

And, if worse comes to worst, there is always the possibility of crankcase seal failure. Fortunately this does not happen often; most seal failures occur early because of manufacturing error or very near the end of the engine's life, when the main bearing clearances have pounded out. See Chapter 6 for test and repair procedures.

Erratic Starting, Backfiring, Shutdowns in Extreme Cold.

Occurring separately, these symptoms mean ignition problems or water in the fuel. If they occur together, you can be sure that the fuel is water-logged. Drain the fuel system at the tank and the carburetor. It is a good idea to mix a few ounces of wood alcohol with the next load of fuel; the alcohol will absorb any moisture that remains.

OVERHAUL

Overhaul means cleaning, inspection, and replacement of worn parts. Berkebile 2 + 2 or lacquer thinner will dissolve soft gum and varnish; corrosion and calcified deposits can generally be removed with one of the commercial immersion-type metal cleaners.

Replace the needle and seat, if possible. As mentioned earlier, some moped carburetors have needles that are integral with the float and seats that are part of the float bowl cover. Others have a replaceable soft-tipped needle and pressed-in seat: when the seat wears the parent casting must be purchased.

If the throttle piston is excessively worn, the air will leak between it and the throttle bore. Most carburetors have high- and low-speed adjustments that can be used to compensate for this worn condition; however, extreme wear, signalled by 1/64 inch or so of clearance between the piston and bore, means that the carburetor should be replaced. The needle jet—the brass part that the throttle needle moves in—should not be in contact with the needle and, therefore, should not wear. Unfortunately this is not always the case. A small misalignment is enough to send the needle into the side of the jet. If this has happened, you will see wear marks on the needle, and both the needle and jet should be replaced. The low-speed adjustment screw should be replaced when it loses its profile (Fig. 4-11). Otherwise engine idle suffers.

Replace all soft gaskets and O-rings as a matter of course. Hard gaskets are washer-like affairs found on fuel-line fittings, and may be reused, if they are not grooved. Of course all nonmetallic gaskets should be removed before the carburetor is immersed in a chemical cleaner. Less potent cleaners, such as 2 + 2 Gum Cutter, do not have any immediate adverse effect on gaskets.

Removal

To dismantle the carburetor, first remove it from the engine. It is secured at three or four places:

- Air filter—on many bikes the filter is attached to the frame and connected to the carburetor by a flexible hose.
- Intake pipe—in some instances the pipe must be loosened at the engine end.
- Choke control—if a remote choke is fitted, remove the cable at the carburetor end.
- Throttle cable—disengage at the throttle piston.

The throttle cable mounts at the underside of the throttle piston. Remove the piston cover plate, the part that seals off the top of the piston bore (shown as No. 6 in Fig. 4-7). Most cover plates are secured by small screws; some of the older models used a knurled ring threaded over the top of the carburetor bore. Once the plate is free, carefully guide the piston up and out. Be particularly careful if the piston is fitted with a needle.

Turn the piston over and compress it against the return spring, so the cable end protrudes through the bottom of the piston. Move the free end of the cable through its disengagement slot and allow the piston to pull free of the cable. Bing carburetor needles are held in place by pressure

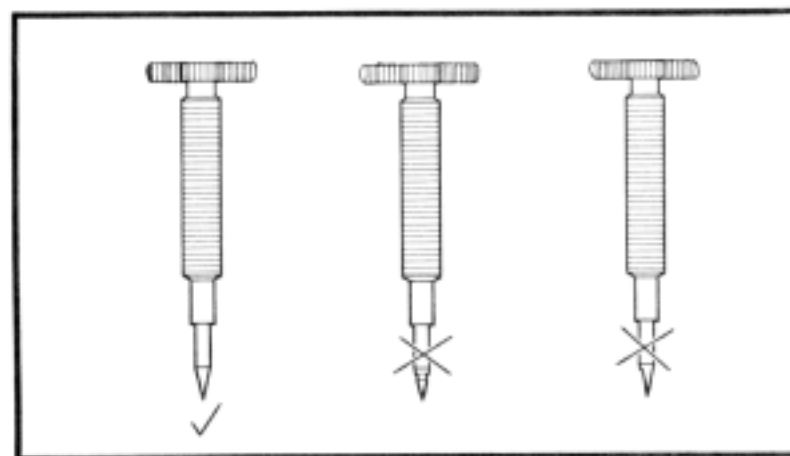


Fig. 4-11. Low-speed adjustment needles can wear out and produce an erratic idle.

from the return spring acting against a washer and retaining plate. These parts are shown as Nos. 9 and 10 in Fig. 4-7. Once the cable is released, the spring, needle, washer, and retaining plate are free (and easy to lose). Other needle-type carburetors secure the needle with a spring clip: the needle remains in place until the clip is removed. Regardless of the attachment method, note the position of the needle for assembly reference. Typically there are four grooves around the upper end of the needle, and the factory pins the needle at the third groove from the top.

Wipe off the piston with a paper towel or lintless rag soaked in solvent. Vertical scratches on the piston flanks mean that dirt is entering the system from a faulty air filter or a leaking cover gasket. Some discoloration on the bottom of the piston is more or less normal; heavy carbon deposits may indicate an out-of-adjustment carburetor, perhaps aggravated by long periods at idle.

Inspect as much of the control cable as you can see for frayed, broken, or splayed wires. Replacing the inner core of the cable is usually sufficient for repair; long-term wear, however, can damage the outer sheath. If the throttle binds after a new core has been lubricated and installed, replace both parts of the cable. In any event, the twist grip will have to be partly disassembled. Figure 4-12 shows a typical example.

Lubricate the twist grip threads and the inner cable core. Dab Vaseline on your index finger and thumb and draw the cable core between them. A thin coat of Vaseline on the grip threads and on the sleeve bearing is sufficient.

At this point we are ready to disassemble the carburetor. Clean the outside surfaces as a general sanitation measure—dirt on the outside of the casting will invariably find its way to the internal (critical) parts.

Disassembly

1. Remove the float bowl or float-bowl cover. The Motobecane carburetor in Fig. 4-2 and the Encarvi in Fig. 4-4 have float-bowl covers; other designs illustrated in this chapter have demountable float bowls.
2. Remove and discard the float bowl gasket.
3. Disengage the float. A typical pivot pin is shown as No. 17 in Fig. 4-6. Once it is withdrawn, the float and inlet needle can be lifted free. Other carburetors, such as

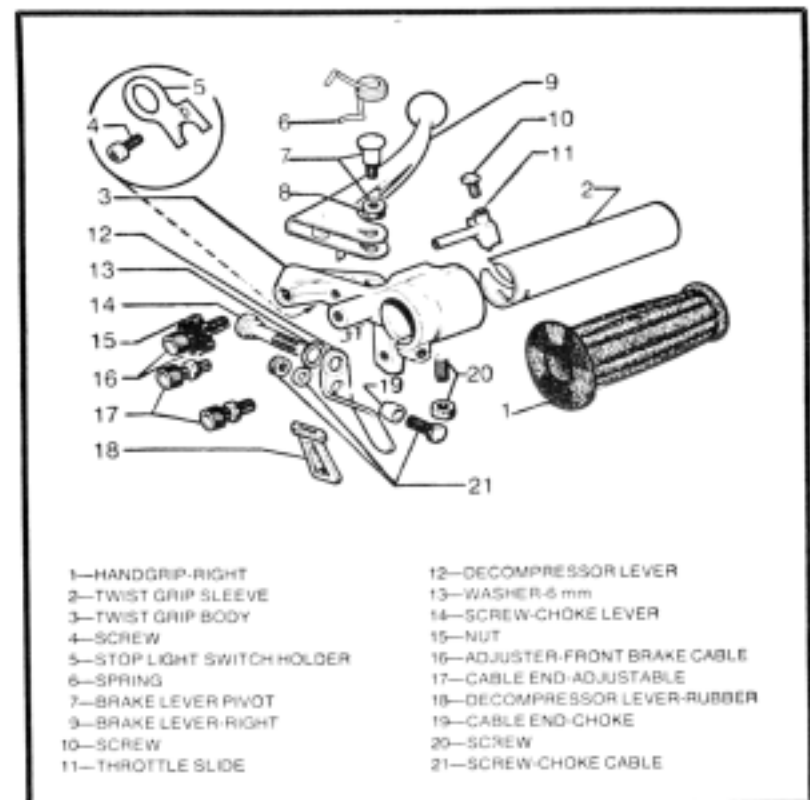


Fig. 4-12. Motobecane twist grip and control cable.

- those used by Peugeot, Motobecane, and Tomos have unsecured floats.
4. Take a close look at the inlet seat. If the seat is slotted for a screwdriver, remove it and the gasket on the underside. Bing and few other carburetors do not have replaceable seats. (More exactly, the seats are not replaceable unless you purchase the entire float bowl cover.)
 5. Unscrew the main jet, using a screwdriver ground to mate precisely with the slots in the jet. Motobecane and Tomos carburetors have the main jet outside the float bowl for accessibility. The jet is turned with a box-end wrench.
 6. Withdraw the emulsion tube, located in the passage above the main jet. On some carburetors the tube is

held in place by the main jet. A sharp rap on the casting is enough to dislodge it once the jet is removed. Other designs have the emulsion tube threaded into the casting; it is withdrawn with a screwdriver or a small wrench.

- Count the turns required to seat the low-speed needle; this is the preliminary adjustment. Now back the needle out and inspect its tip for wear and distortion. Replace if necessary.
- Some fuel-line fittings are integral with the carburetor body; others are secured by a gasketed banjo nut. If you are dealing with a banjo fitting, note the position of the inlet pipe before disassembly.
- Remove the starting jet from Peugeot and Motobecane carburetors.

It is not necessary to dismantle the carburetor further. Some internal passages are sealed after manufacture with soft plugs or lead shot. In the unlikely event that these passages are clogged—and you can get an idea of their condition from the cleanliness of the parts that are visible—obtain replacement plugs before you disturb the originals. Moped dealers may not be much help and it's likely you will have to fabricate: large plugs from brass sheet and smaller ones from BB shot or brass rod. Seal the plugs with 24-hour epoxy.

Immerse the metallic parts in carburetor cleaner for 20-30 minutes. A very dirty carburetor will require a longer soak, but do not park the carburetor in the cleaner and forget it. Eventually the cleaner attacks the castings, leaching the soft metals and leaving you with a porous metal sponge. Once the carburetor appears clean, dip the parts in solvent to neutralize the cleaner.

The most critical aspect of assembly is float adjustment of Bing, Jikov, and other carburetors that use a hinged float. The distance the float moves before it shuts the inlet valve determines the internal fuel level in the instrument. This level affects the air/fuel ratio, and is therefore very critical. Specifications for all moped carburetors are not available at this writing, but examination of a number of mopeds and discussions with factory mechanics has produced a working rule: unless specifications say otherwise, the float should be parallel with the roof of the float casting (Fig. 4-13). Assemble the needle, seat, float, and pivot pin. Invert the assembly and

sight between the float and casting. If the float is not parallel with the casting, make the correction by bending the tang, the torque-like projection between the float and the pin. Use needle-nosed pliers and do not use the inlet needle as a stop. That is, pull the float clear of the needle before you apply bending pressure. Steel needles can be damaged by forcing them into their seats; synthetic-tipped needles most certainly will be. Do not twist the float; it must be level and parallel.

Run in the low-speed adjustment screw finger-tight and back it out the number of turns you counted during disassembly. Mount the spring, retaining clips, and other hardware on the back of the throttle piston. Compress the spring and snap the cable into place, passing its end through the piston. Make sure the piston is clean and insert it into the carburetor bore. A slot on the piston flank engages a screw and cast rib on the barrel. Push the piston home, being careful not

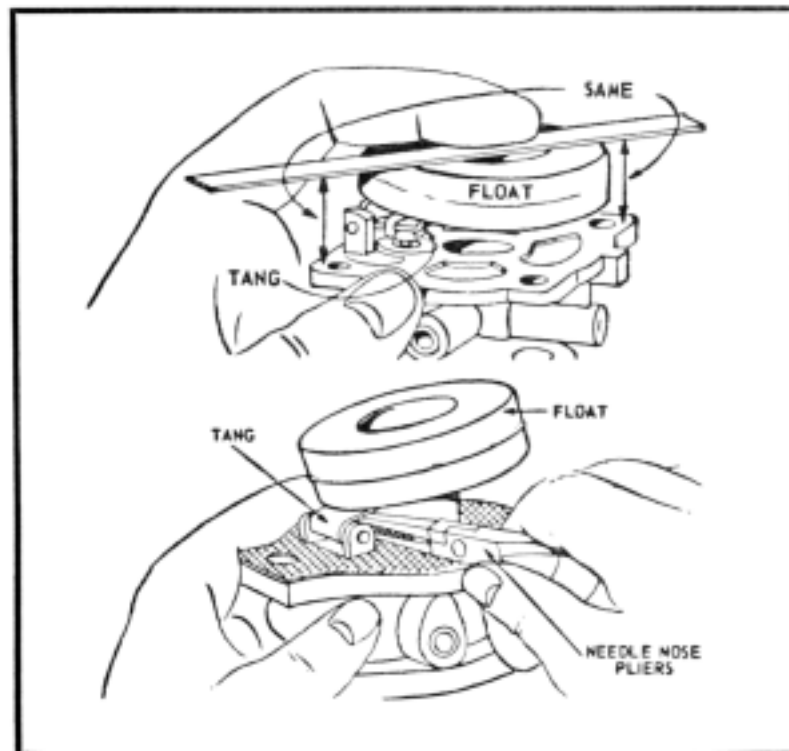


Fig. 4-13. Unless factory literature states otherwise, moped floats are set parallel with the casting.

to force it, since it is possible for the needle to hang on its jet. The piston is assembled dry, without lubricant.

Adjustment

The adjustment procedure is not as complex as it sounds. The first step is to identify the possibilities. All carburetors have some sort of idle rpm adjustment; most have a low-speed mixture adjustment; a few have a high-speed adjustment as well.

If the carburetor has	necessary adjustments are
no low-speed adjustment screw; no tapered throttle needle on the piston	idle rpm
knurled low-speed adjustment screw on the outside of the carburetor, just aft of the throttle piston.	idle rpm and low-speed mixture
knurled low-speed adjustment screw and tapered needle on the throttle piston. May have main jet options	idle rpm, low-speed mixture, and high-speed mixture

Idle RPM. This adjustment controls the height of the throttle piston, regulating the quantity of air and fuel entering the engine with the twist-grip released. If you turn back to the picture of the Bing carburetor in Fig. 4-7, you will see what is called the pipe bend assembly, referenced as No. 5. This assembly is capped with a hollow bolt and locknut. The bolt or,

more accurately, the barrel nut, is threaded. The control cable casing is moored at both ends, at the twist grip and at the barrel nut. Turning the barrel nut out puts a bend in the cable, making it effectively shorter: the piston rises and idle speed increases. Turning the nut clockwise lengthens the cable and lowers the piston. The locknut secures the adjustment.

A few motorcycle-bred carburetors, such as the Jikov shown in Fig. 4-6, have an idle rpm screw that bears against the lower edge of the piston. The barrel nut is still present, and is adjusted to give slack so that the distance the piston drops at idle is controlled solely by the screw. One or two designs have no idle-rpm adjustment at the carburetor; the cable is adjusted at the handlebar.

Low-Speed Mixture. When present, this adjustment takes the form of a knurled screw. Most moped carburetors follow European practice and have their low-speed mixture screws athwart the idle air bleed. This screw, called the pilot air screw, controls the amount of air mixed with the fuel. The Bing carburetor is one exception to this; their adjustment screws control the amount of fuel going into the low-speed circuit. The distinction between the two approaches is important: tightening a pilot air screw reduces the air flow and produces a richer mixture; tightening a fuel-control screw reduces the amount of fuel discharged and leans the mixture.

High-Speed Mixture. The position of the tapered needle controls the mixture between one-third and two-thirds throttle. Raising it in the piston puts a thinner section of the needle in the jet, which allows more fuel to pass, richening the mixture. Lowering the needle fills more of the jet, causing the mixture to go leaner. The factory setting—usually one notch rich—is correct for most bikes. The needle should be dropped a notch at high (over 2000 ft) altitudes and, if only as an experiment, raised a notch for extended full-throttle operation. Raising the compression ratio, removing intake and exhaust restrictions, polishing the head, and other modifications pretty well mandate a one-notch-richer mixture.

The main jet is removable in all carburetors, whether fitted with a needle or not. Under very unusual circumstances it may be necessary to replace the original jet with a different size. This is not a standard tuning procedure and is done only for high altitude operation or when the engine has been modified to give more power. Unfortunately, some moped

importers can't seem to stock even standard parts, let alone alternates, and you may have to write the manufacturer to get alternate jets.

On Motobecane and other designs that don't use a needle, the main jet determines mixture strength from approximately one-quarter to wide-open throttle.

Making the Adjustments

The symptoms of carburetor maladjustment are difficult to overlook. An excessively lean mixture bleaches the carbon deposits on the spark plug tip and may cause a flat spot on acceleration. An overly rich mixture soots over the spark plug tip and can induce four-stroking at low rpm. The exhaust beat skips and misses—da da BAM da da BAM. Also, once you've been around engines awhile, you'll be able to smell a rich mixture

I'll assume that your carburetor has the full panoply of adjustments and that you have lost track of the original settings. Install a new, correctly gapped spark plug and see that the air filter element is clean. Top up the tank with fresh premix, blended according to the manufacturer's instructions.

Lightly seat the low-speed mixture screw and back it out one and one-half turns. This should get the engine started. Allow the bike to idle for a few minutes, but not so long that you smell hot metal. Moped engines, even those with forced air circulation over the barrel, overheat when stationary.

Thread in the mixture screw about an eighth of a turn, and wait a few seconds for the mixture change to be felt. If the engine picks up speed, you're moving in the right direction; tighten the screw another small increment. If rpm drops, back the screw out an eighth of a turn past the original setting. Continue to chase rpm until you are satisfied that the engine is running at its peak for that rpm setting. The adjustment is usually broad: tiny changes will not have an obvious effect.

Snap the throttle open about a quarter-turn. The transition from idle should be smooth and effortless. If the engine hesitates, richen the mixture a smidgen. The idle may be less than perfect, but that is less important than the ability to pull strongly.

Now that the low-speed mixture is correct, it may be necessary to reduce idle rpm. Make this adjustment as described previously. The engine should be turning over

smartly, a few hundred rpm under clutch-in speed. An idle so slow you can almost count the revolutions may sound impressive, but it's harmful to the engine.

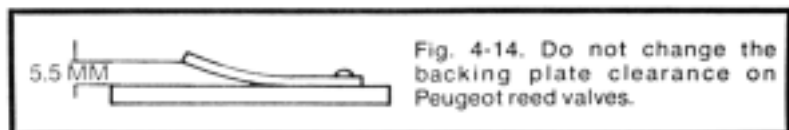
If the needle adjustment spec has been lost, begin one notch rich. Secure the typical four-groove needle at the second groove from the top. Take the bike out on the road and run it for a few minutes with the throttle between one-third and two-thirds open. Shut off the engine and brake to a stop. The spark plug tip should be brown—the color of coffee with a dash of cream—or tan. Lighter colors mean that the mixture is too lean; the needle should be raised a notch. Darker colors point to a surplus of fuel, and the needle should be lowered. Repeat the test after each change in needle position. With a two-cycle engine, err, if you must, on the dark side. About the worst a rich mixture can do is dirty the spark plug; a lean mixture may cook the piston.

The main jet controls fuel delivery from approximately one-third to full throttle in carburetors without the tapered needle and from two-thirds to full throttle in those with a metering needle. An oily and carbon-stained spark plug tip after a few minutes at full throttle may mean that the main jet is too large, or that the ignition system is missing at high speed, a condition often associated with the contact points.

By the same token, a lean mixture, one that bleaches the spark plug tip white, can mean that the main jet is too small, that the ignition is advanced beyond specification, or that there is an air leak in the induction tract. An air leak normally shows up at low speeds, but can be compensated for by adjustments. The main jet then becomes a kind of litmus test. That is, if you've unknowingly compensated for an air leak by richening the low-speed mixture, the air leak will be evident when the high-speed jet is in operation.

AIR FILTERS

Most carburetors are fitted with sponge-like polyurethane filters. Wire mesh or composition board filter elements are still encountered, but their use is a mark of obsolescence. Polyurethane filters' only required maintenance is cleaning in kerosene or hot water and detergent. Allow the filter to dry and reoil with no more than a teaspoon of engine oil. Knead the oil into the filter until it is completely wetted.



REED VALVES

Batavus and Peugeot engines use reed valves to contain the air/fuel mixture in the crankcase. The Peugeot valve has two reeds; Batavus has four arranged in a triangular housing for maximum efficiency. In the normal order of things, these valves should outlast the engine. When it does occur, failure is dramatic: the engine stops as if someone had turned off a switch. It will refuse to start and the spark plug will remain stubbornly dry after repeated cranking. If you are sensitive to the engine you may detect a change in the cranking sound.

The valve assembly is located on the side of the crankcase, usually under the inlet pipe. It is held by two capscrews and gasketed on both sides. Once these gaskets are disturbed, they should be replaced.

The reeds should be in full contact with the mounting plate or lie a hair's breadth above it. Peugeot reeds have a backing plate which should not be disturbed for any reason. The correct distance between the backing plate and the mounting plate (Fig. 4-14) is 5.5 mm—more will allow the reeds to open wider and quickly fatigue them. Treat the reeds gingerly, not touching them at all with your fingers. Look for cracks radiating out from the rivets and for deep pitting along the sealing faces. Using a small screwdriver, open the reeds only wide enough to see what their tips look like. If a reed is missing, it has been injected, and the engine must be torn down to determine the extent of damage.

FUEL PUMP (VELOSOLEX)

A fuel pump might seem out of place on a moped, but the Solex engine rides proud over the front wheel, where gravity-feed would be impractical. The pump contains a neoprene diaphragm and a plastic check ball. One side of the diaphragm is open to the crankcase and fluctuates with piston movement. Three lines connect to the pump body: the suction line provides fuel from the tank; the return line recycles fuel that is not used by the engine; and the output line connects the pump with the carburetor.

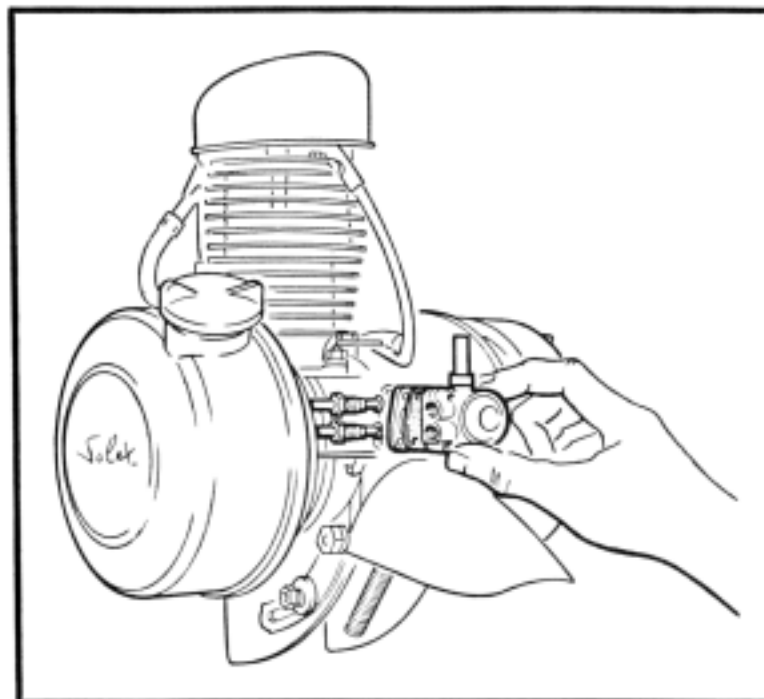


Fig. 4-15. Removing a Velosolex fuel pump.

Disassembly

Disconnect the fuel lines and remove the four pump hold-down bolts. Lift the pump off (Fig. 4-15). If the plastic seating piece remains on the crankcase, gently pry it free. Replace the diaphragm each time the pump is disturbed. Clean the parts in solvent.

Assembly

Place the plastic seating piece over the crankcase port with the concave, or dished, side out. Tap it over the port lug. Without dropping the ball out of its recess, install the pump body. Tighten the screws in a criss-cross pattern to bring the body down square against the crankcase. Connect the fuel lines, running the metal fittings in at least three full turns by hand before you put a wrench on them. Crank the engine a few times; fuel should appear at the discharge port. If everything is copacetic, connect the pump-to-carburetor hose.