

PSSST! WANNA BUY A 12 HORSE MINI ENDURO

No?
Well, how's about
building one, then?

It's hard to believe but Larry Shoemaker swears on a stack of shop manuals that he can get 12 hp from a 5 hp Yamaha Mini-Enduro. He could be right! We watched the magic being performed and had a chance to test out the result. Some of Southern California's top Mini-Enduro racers got to ride the Shoemaker-prepared machine and all reported that it was faster, more powerful, than their own. Since our story is about power and not handling, we also set up some impromptu drag races and the results confirmed their impressions.

Who is Larry Shoemaker? Larry is the easy-going, though efficient, service manager at International Motorcycle, Inc., Canoga Park, California. IMI is one of the leading Yamaha dealers in the Southern California area and Larry is hung up on making machines go fast. We spent the best part of two days in the IMI service shop and it is obvious that hop-up work is a large part of their business. It works like this. Larry does the experimenting, using the shop dynamometer and field testing, draws up the specs for each engine, and then trains his mechanics to do the work under his supervision.

We were planning a Mini-Enduro hop-up article and asked Ron Henricksen, who runs the races at Indian Dunes, to steer us to a likely source. Ron said that machines prepared by Larry had been quietly winning consistently, although IMI does not field a team of its own. So, the next thing we know, Larry was laying this 12 horse figure on us. To say the least, we were skeptical. While we have not dyno-tested the Mini-Enduro IMI prepared for us, we are less skept-

tical now, since we have seen it blow off some of the fastest Mini-Enduros around.

And the surprising thing about all this is the relatively small amount of work done to the engine. We saw the job being done by Jim Hartel, one of Larry's mechanics, and it would appear that none of it is beyond the scope for the efficient "dad mechanic." Some good shop tools would be necessary, particularly a hand grinder, and some of the work would probably have to be done by professionals. Despite Jim's experience, he worked on the project for a little over a day, pausing for our questions and photographs.

The amateur, therefore, can expect to spend a week on the job, or even longer, depending on how far he goes with the job. There is one very important element in the hop-up procedure that probably cannot be done by the home mechanic and that involves building a good expansion chamber. This is critical. Having tried a stock muffler with the hopped-up engine, we know that a large part of the power increase comes from the expansion chamber.

Larry Shoemaker says that most Mini-Enduro expansion chambers on the market have the exhaust pipe too short, resulting in good high end performance but very little on the low end. Also, he says, the volume of the chamber is usually too big. He has designed a chamber to match the engine modifications and this is being sold by IMI for \$32.95.

Also, Larry didn't design the hop-up procedures for the Mini-Enduro just because he likes the machine. His company is in the business of perform-

ing modifications on a commercial basis and anybody who wants a 12 horse Mini-Enduro can ship off the engine to IMI (address and prices at the end of this story). On the other hand, some people may want a completely new M-E ready to run, with the modifications done from scratch and that, too, IMI will supply.

We mention this because it is somewhat unusual for a company doing hop-up work commercially to reveal their secrets. We asked Larry about this and he said they decided to cooperate with MiniCycle on this project because they didn't feel that riders should have the competitive edge simply because they had the money to pay for the work. It was fine if somebody wanted the work done professionally; in other words, with no mistakes. But anybody who had the initiative to do their own work should be given the opportunity. This is an attitude we find refreshing.

There is still the question of the expansion chamber but there is no way around the purchase of this item. A serious Mini-Enduro racer just has to have one.

With the preliminaries out of the way, we watched as Jim Hartel prepared to go to work. First step was to raise the bike up on the hydraulic lift. Since it is unlikely that the home mechanic will have one of these devices, it is recommended that the engine be removed from the frame. Our engine was new but if the engine to be worked on has been used at all, it should be thoroughly cleaned, and we mean thoroughly, before work commences.

A large working area on the bench should be cleared and one corner of the garage should have a clean sheet of cardboard on which to lay the parts, in the proper sequence, as they come off the engine.

The machine Jim modified for us was the MX version but the version with lights is basically the same except, of course, it will be necessary to remove the lights, battery and all unnecessary items. Any racing machine should be as light as possible and, for this reason, the Auto Lube system should also be removed.

Begin by removing the carburetor housing cover on the right front of the engine. This is held by four Phillips head screws. Start the job correctly by laying the cover with the screws on the "parts board" at the top left hand corner. Subsequently, all parts will be laid on this board as they come off the engine,

arranged in order of disassembly. The rubber plug in front of the housing is removed and a screwdriver inserted to release the carburetor clamp. The fuel lines and throttle cable are disconnected, leaving the clamps on the lines, but it is not necessary to remove the hoses from the housing (the fuel pet-cock on the tank should, of course, be closed). Slide the carb off and put it on the parts board.

Disconnect the oil pump cable and oil feeder line (put a bolt in the end to prevent oil leaking). Remove the oil

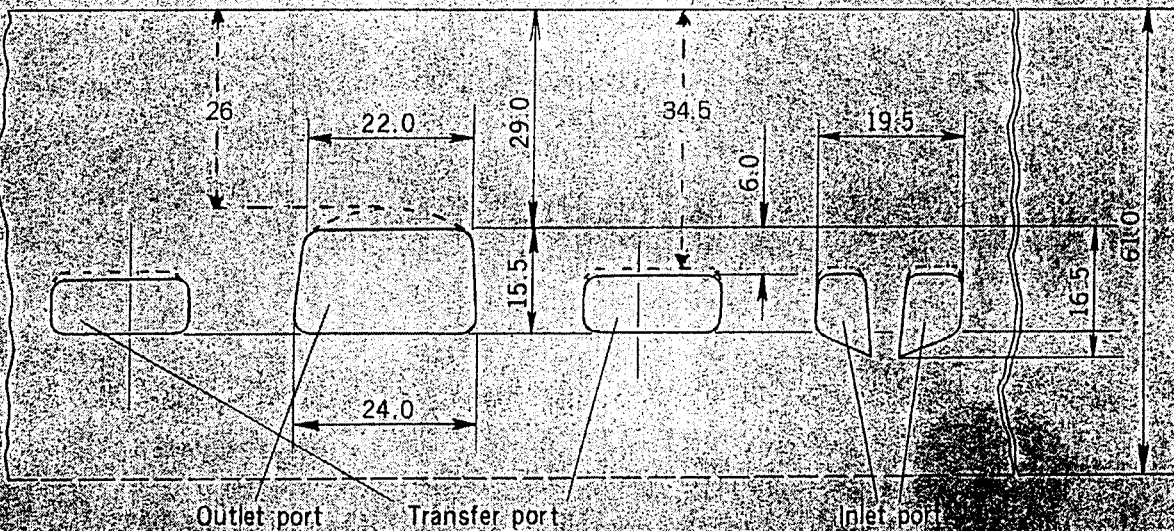
pump by unscrewing the two Phillips head screws. The oil pump will no longer be required but it is a good idea to save the Auto Lube system in case you later sell the machine to somebody who wants it. Remove the oil tank from the frame, drain all the oil, wrap the Auto Lube system in an oily rag, box it and file.

Drain the oil from the gearcase. The muffler and chain will have been removed in taking the engine out of the frame. Remove the gear change lever and the kick starter. Remove the

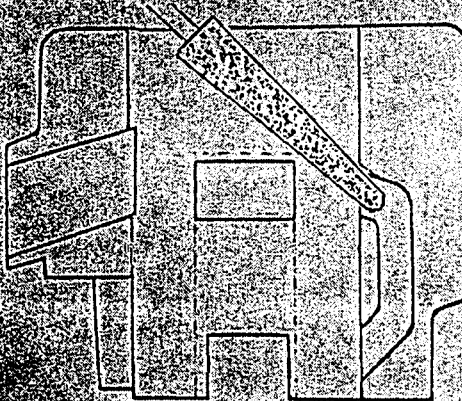
Phillips screws holding the covers on both sides of the engine. (Remember to place the covers, with their respective screws, on the parts board.) There are rubber O-rings on the carb mount and the oil inlet, these should be removed and carefully preserved.

The clutch is then removed and care should be taken that the pressure plate springs do not cause the screws to go flying. With the pressure plate off, take out the push rod located in the center of the nut. Flatten the lock washer with a screwdriver or cold chisel. Yamaha has

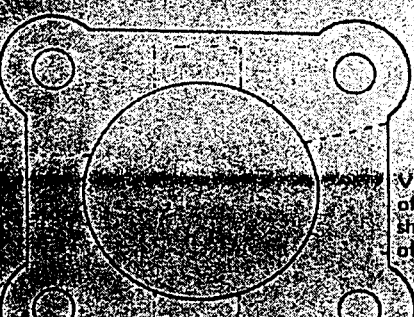
THREE PORT CYLINDER, EXPLODED VIEW



Exploded view of port layout on the Yamaha Mini-Enduro shows the extent of the modification work. Dotted lines indicate the amount of metal removed.



A thin grinding bit is needed to reach into the transfer ports and inlet port to avoid doing damage to the cylinder.



View from the top of the cylinder showing the location of the ports.

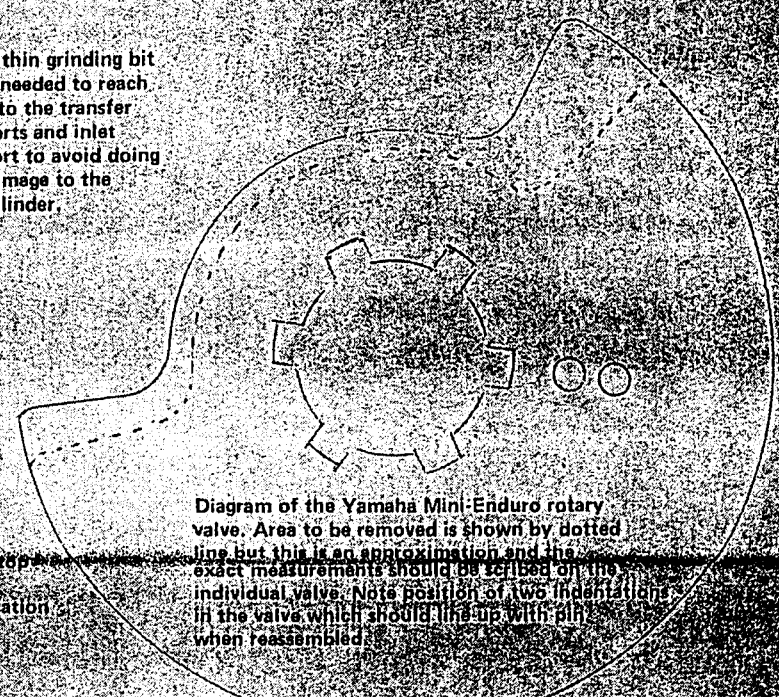


Diagram of the Yamaha Mini-Enduro rotary valve. Area to be removed is shown by dotted line but this is an approximation and the exact measurements should be scribed on the individual valve. Note position of two indentations in the valve which should line up with pin when reassembled.

a special clutch holding tool and this provides the easiest method of removing the retaining nut. However, if this is not available several layers of rag can be rolled between the primary gears until the clutch shaft is locked tight. Whether the special tool or the rag method is used, it is a good idea to also loosen the primary drive gear lock nut at the same time. With the retaining nut removed, the entire clutch assembly, including the driven primary gear, should slide off. For safekeeping, also remove the kick pinion gear and the gear retaining collar, found on the shaft back of the driven primary gear.

Take off the already-loosened primary drive gear lock nut. The primary drive gear can be forced off the shaft by using two screwdrivers beneath it and gently prying up. The rotary valve cover is now exposed and ready to remove except that the shift lever mechanism is in the way. That is why you removed the cover on the left side. Go to this side and locate the shift lever shaft and remove the circlip and washer. Now slide out the change mechanism on the right side, trying to maintain the return spring, around the right side of the shaft, in place. Now remove the rotary valve cover, avoiding damage to the shaft seals and the O-ring in the lip of the cover.

Examine the rotary valve set-up before you remove the valve. Note that there are two indentations in the fiber valve in line with the locating pin in the shaft. Now remove the valve. Go to the other side of the case and remove the drive sprocket, flattening the bent edge of the lock washer first and holding the shaft steady by wrapping a short length of chain around the sprocket.

Remove the cylinder head and cylinder, loosening the head bolts slightly in rotation to prevent a warp from setting in. First job in the modification procedure is to take the cylinder to your Yamaha dealer and have them check the cylinder for wear. If there is any doubt at all that things are not snug, have the cylinder rebored and honed. Oversize pistons are available in 0.25 and 0.50mm. If it is necessary to re bore the cylinder it will probably be necessary to replace the top-end needle bearings and pin.

Now the modification process begins. The main purpose is to help this little asthmatic engine breathe more freely. First, the rotary valve. This has to be modified to allow the "window" to stay

work is included for guidance but the amount to be removed should be measured on *your* rotary valve. The specifications are: remove 11mm (if you don't have metric measurements, this is .4331" or a shade over 4/10") from the leading edge; 6mm (or .2362" or a shade under 1/4") from the trailing edge; and 2.5mm (or .0984" or nearly 1/10") from the inner diameter.

The fiber rotary valve is extremely tough and a fine-stone grinding wheel will greatly assist in this work. It can be done with a good file but this is the hard way. Carefully radius all the edges slightly with emery paper. If the work on the rotary valve appears too hard, The Fun 'n Fast metal valve conforms almost exactly to these specifications and can be obtained for \$8.85 from Fun 'n Fast, 18143 Napa Ave., Northridge, Calif. 91324.

Next take the rotary valve cover and open up the inlet hole about one millimeter. Jim Hartel did this work with a metal cutting bit on a hand grinder but this requires considerable skill since if too much metal is removed the inlet hole will not have enough strength to carry the carb. We suggest going to a good machine shop for this work.

While you're there, take your engine head with you and have them mill it 60 thousandths, making sure that the milled area is perfectly flat. Before the milling is done, examine the "squish" area in the combustion chamber and try to remember the configuration. After the milling is done, it is necessary to get approximately same geometry on the outer circumference of the squish area. Put the head and cylinder together and scribe onto the head the inside circumference of the cylinder. This line is the outer limit of your work on the squish area and must not be exceeded. At the same time it must be carefully followed.

Use a small diameter grinding stone or fine cutting tool in a hand grinder and do the work in long sections, working down gradually to the correct shape. The purpose of this work is to make sure the piston does not strike the head due to the reduction in clearance from the head mill job. Later, when the porting work on the cylinder is completed, the top end of the engine is reassembled without the head gasket and the engine turned over by hand. If the piston clears the head without the gasket, you are okay. Any slight stretch of the con rod under high rpm will be compensated for. There should be no

Place the cover back on its pins and look through the inlet hole. It is likely that the hole through the crankcase will appear to be off-center. Scribe the true line from the valve cover inlet onto the crankcase. It is necessary to open up the hole in the crankcase to match the valve cover hole. If care is exercised, this work can be done without splitting the crankcase halves. This is a tough job so we recommend taking care.

With fresh masking tape, carefully tape off the bearings around the crank shaft and any other areas that could be contaminated with metal shavings. This cannot be stressed too much. Jim Hartel, who comes expensive, spent about 15 minutes doing this. Take a clean rag and thoroughly rub in clean grease. Stuff this down between the con rod and the crank case inlet hole blocking off the hole completely. Now go to work with a fine cutting bit in the hand grinder, carefully opening up the crankcase hole to the scribe line.

You will find that the metal shavings will stick to the grease-soaked rag on the inside of the crankcase. Hook the rag with a sharp point (making sure you don't push it back) and gently pull the rag through the hole, bringing all the shavings with it.

The carb is next. Completely disassemble the carb (this is a good time to thoroughly clean it), leaving the body free of parts. The venturi of the carb should be bored out from 16mm to about 17mm. This is a job that is best done on the lathe of a machine shop to ensure a straight-through and parallel bore. When reassembling the carb, replace the stock No. 86 main jet with a No. 90. The next step up is a No. 94 but the optimum would probably be a No. 92, if it was available. The needle should be raised to the fourth notch from the top. Normal setting for the air screw is back out 1 1/2 turns but with this modification start at 3/4 turn and adjust as necessary. Some juggling with jet sizes, needle positions and the air screw may be necessary to get the modified engine running properly and further adjustments will probably be necessary as the engine seats in properly.

We asked Jim about the possibility of running an exotic fuel mixture, such as nitro, in the modified engine. He indicated that Larry Shoemaker had not gone this route since they were as much concerned about simplicity, as going fast. If the Mini-Enduro owner decided to go

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to an exotic mixture it would be necessary to enlarge the passages and jet sizes in the carb but the end result would probably be even more power, if the job was done correctly.

Everybody has their own idea of fuel mixture but the one recommended by Larry is a 30:1 mix of Texaco premium and VBA oil. In the initial stages of run-in, a slightly richer oil mix would be recommended.

Porting of the cylinder came next. The amazing thing about the modification of this engine is the small changes neces-

for the amateur mechanic because the cast iron cylinder is tough and the porting can only be tackled with good cutting bits in a good hand grinder.

Clean the inside bore of the cylinder and scribe a mark over the exhaust port 26mm (1.0236") from the top of the cylinder. Scribe a similar mark over the top of the transfer and inlet ports 34.5mm (1.3578") from the top of the cylinder. Probably the transfer ports will be close to the scribe mark, leaving only a clean-up operation to bring them up to specs. The scribe marks should be very light and a metal dye will help make them clearer.

Block the cylinder firmly but carefully

cylinder skirt) in a vise, using thickly padded rags for cushioning. Put a drop light so that illumination shines up the barrel without blinding the mechanic. Go to work cutting out the exhaust port in the shape shown on our exploded view of the porting arrangement.

Imagine the exhaust gases as a flowing river and make the exit path as easy and natural as possible. Take the metal cutting all the way back to the mount for the expansion chamber but do not take too much metal off the mount otherwise it will be weakened. When you are satisfied the shape is right, carefully polish the port with emery paper in a mandrel. There should be no rough spots to cause an eddy in the exhaust gases.

Getting at the transfer and intake ports is somewhat more difficult. The angle of the grinder (not a cutting tool as the amount to be removed is too small) must be carefully controlled to avoid damage to the cylinder walls (see illustration). From the illustration it will be seen that it is near-impossible to get inside the intake port to clean up the casting marks and the transfer ports are nearly as difficult. In point of fact, Jim did not attempt this while modifying our engine but this was largely due to the time involved. The home mechanic may try flexible files and rattail files. Perhaps one of the small hobby grinders with flexible drives might help and a trip to a sand-blaster might clean up the passages, although this will not remove the nubs. Also, care must be taken not to file or grind out hollow spots from the walls of the passages so that the inside volume changes.

Whenever any removal of material has taken place during these modifications, the new corners should be carefully radiused. This is most important, as a single sharp corner can seriously damage the engine. The radiusing should not be extreme, usually a fine emery cloth is sufficient but it should be possible to rub a finger over the corner without scratching the skin.

Depending on the use that the modified Mini-Enduro is put to, gearing changes will probably be in order. Jim dropped the PTO sprocket one tooth from 13 to 12, with the rather light Indian Dunes mini track in mind. However, in our field testing of the machine we clocked it at almost 60 mph and this is too fast for close track racing. We could have gotten even better acceleration times with a smaller PTO sprocket.

PART TWO OF THIS STORY WILL BE CARRIED IN THE FOLLOWING ISSUE.

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PSSST! WANNA BUY A 12 HORSE MINI ENDURO

Part II correct buttoning-up procedure

Reassembly should be no problem if all the parts were laid out on the parts sheet in their proper order and with the fasteners located with each component. However, there is one major provision: all the parts should be thoroughly clean and all the gaskets should be in sound shape. The parts that have been modified should be double-washed in solvent, washing off in one container of solvent and rinsing in another. Metal chips or grinding dust will quickly ruin the engine. Jim had the advantage of a constant-flow filtered parts washer and compressed air to blow everything dry and clean. However, your parts should be no less clean, no matter what it takes. As the job progressed in the IMI shop a spray can of metal cleaner was used constantly and liberally, always with clean rags to wipe out offending particles.

There are a couple of points to watch for in the reassembly. The oil pump is driven by a nylon gear on the inside of the right hand clutch cover. This and the shaft to which it is attached must be removed since the oil pump is no longer in use and the shaft gets its lubrication from the oil pump. If the shaft is left in place it is liable to gall and stick. The hole in the clutch cover through which the shaft passes is then blocked off by a special cover available through Yamaha dealers, using a gasket. The inlet hole for the oil injection system on the rotary valve cover is plugged with a screw. The boss for this inlet hole and the carburetor mounting boss must have the sealing O-rings that were taken off in disassembly and if they are damaged, they should be replaced.

When installing the head, a new gasket should be used. Torque down the head bolts to 10 ft/lbs of torque gradually, working in a criss-cross pattern. Incidentally, the compression ratio has been raised by the head milling but no overheating problems have resulted.

When reinstalling the carb, keep the oil pump cable in place, hooked into the cable stop. This will serve to fill the hole leading into the housing and it is not necessary to disconnect it. Just roll up the end of the inner cable so that it does not interfere with anything.

The clutch is reassembled with Yamaha DT-1 clutch springs replacing the stock units. This is so that the clutch will not slip under the greater power being turned out by the modified engine. For the same reason, it is probably best to install new clutch plates. The clutch is installed in the order shown in the accompanying illustration. The clutch retaining nut and the primary drive shaft nut should be tightened at the same time using either the special clutch holding tool or a rag jammed between the gears to hold them. When installing the rotary valve cover, thoroughly grease the oil seal so that it slides on without damage. Also check the O-ring in the lip, if it is stretched or broken, replace it. It is also advisable to use a non-setting sealer, such as that sold by Yamaha, on the O-ring and on the lips of the cases on both sides of the engine.

When the engine is assembled, and if the IMI expansion chamber is to be used, place the engine in the frame and

Continued on page 62

1) On the inside of the clutch cover will be found the oil pump drive gear and shaft. Gear is removed by releasing circlip.

2) Oil pump shaft retainer pin is removed with slim punch.

3) Oil shaft passage cover and gasket, purchased from Yamaha dealer. Note that flat side of cover goes to the top, it will leak the other way round.

4) After reinstalling the clutch cover, the oil inlet passage is blocked with a bolt and washer. Note plate over oil pump driver shaft bearing just below.

5) Showing special adapter for the recommended sock type foam air filter. Note oil pump cable still in place, mainly to block up the entry hole; the filled in hole through which the oil feeder line once passed; and the carb free air vent tucked into the bolt hole at the rear.

6) The finished and modified Mini Enduro does look a little bit, but it is far superior riding a smaller tank and 12HP would be installed and the suspension worked over.

Problems in the riding: this is one of our improved 12HP Mini Enduro. From left: Ward on his unbeatable 51-70 right behind him is Chad McQueen on his Mini Enduro in an honorable position and then comes Brian Conrad on one of the best local Mini Enduros. These positions run through the series of races, so the Mini Enduro has been a consistent performer.

IMI MODIFICATION PRICE LIST

| | |
|---|---------|
| Port and polish cylinder | \$25.00 |
| Mill and reshape head | \$10.50 |
| Bore and modify carb | \$20.00 |
| Cut rotary valve | \$3.00 |
| Enlarge and polish valve housing | \$4.50 |
| Set timing | \$10.50 |
| Labor to repair and replace necessary parts for customer's engine | \$26.00 |
| Gaskets | \$2.60 |
| Expansion chamber | \$32.85 |
| Sock type air cleaner | \$8.95 |
| Heavy-duty clutch springs | \$1.87 |

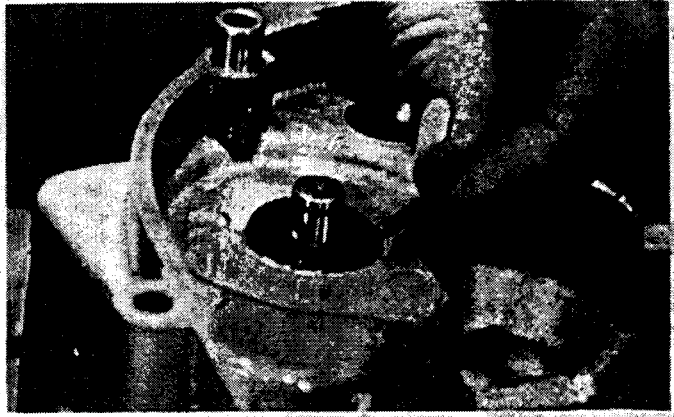
Complete modified Yamaha JT2-MX with tax and off-road license \$512.70

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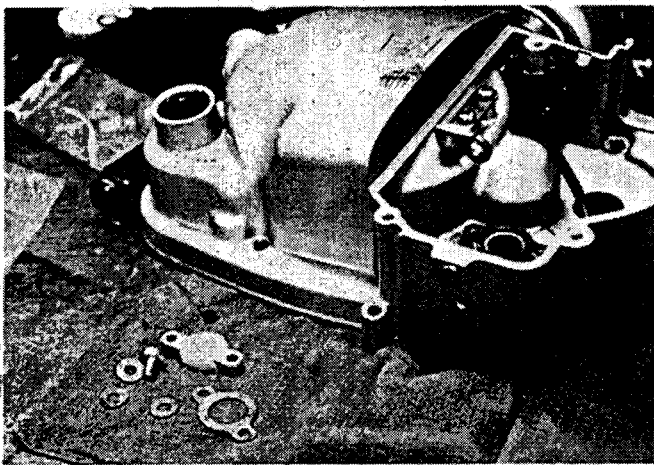
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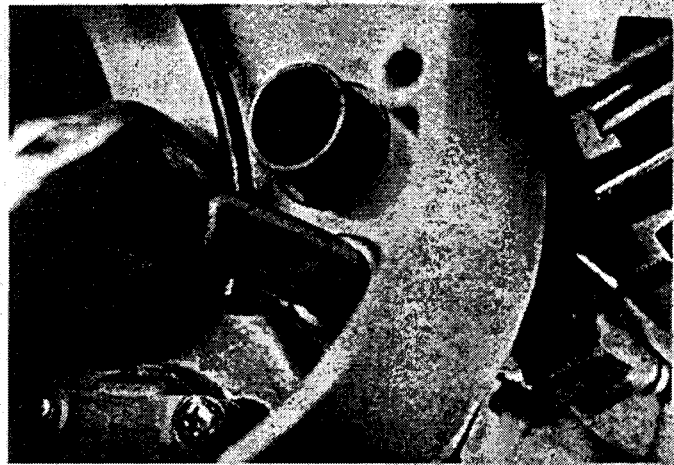
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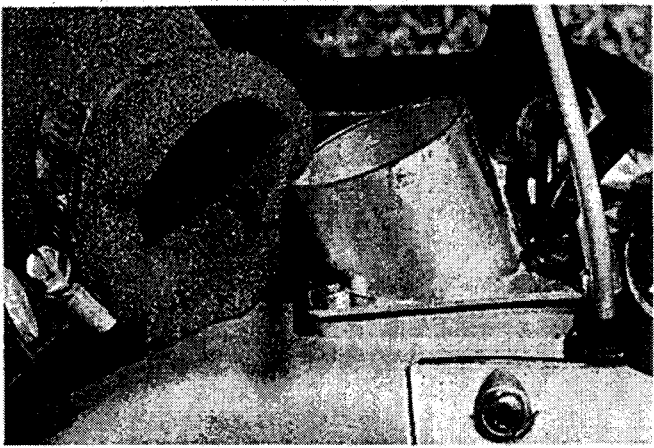
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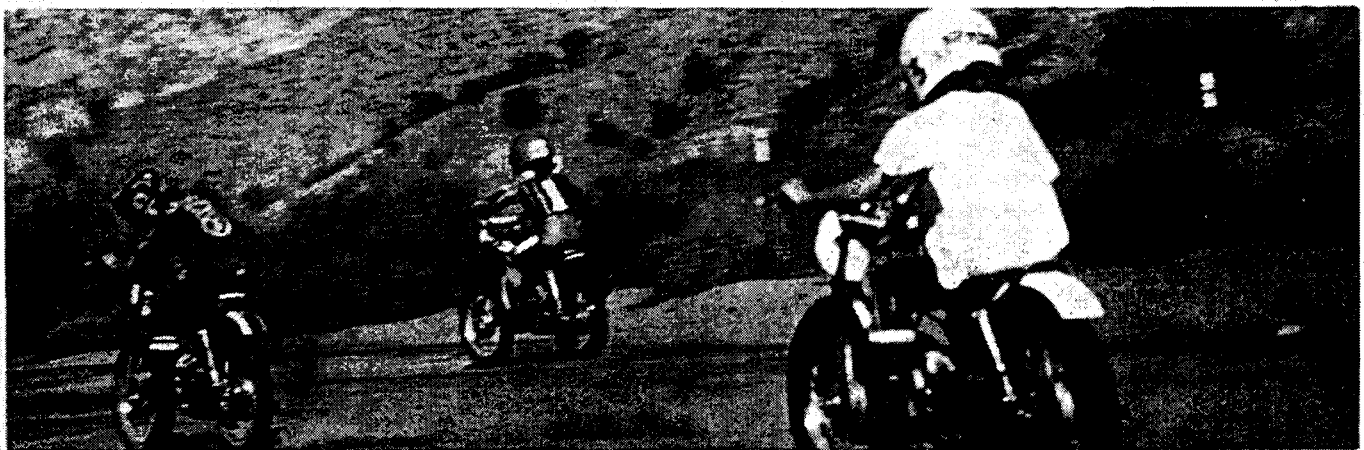
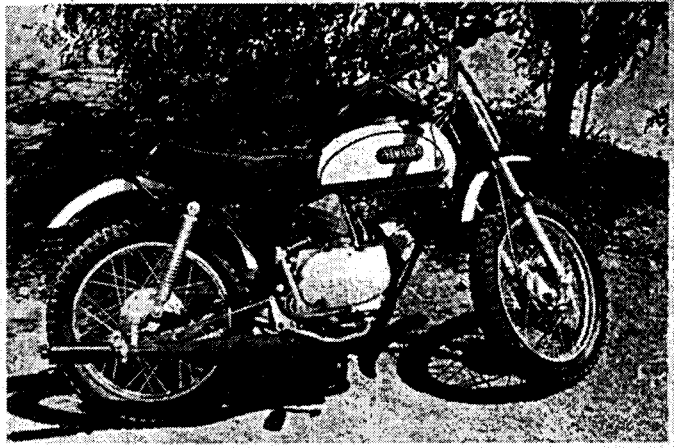
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PSSST PART 2

Continued from page 47

scratch a mark on the bash plate in line with the centerline of the exhaust mount. There is some argument around Mini-Enduro enthusiasts as to whether a downswept or an upswept pipe is best. However, a glance at the illustration showing the grinding angle for the intake port will show that the exhaust on the other side of the cylinder exits downward. Larry feels that it is not advisable to change that direction so the IMI expansion chamber follows the downswept configuration. In line with Larry's "smooth-flow" thinking, no attempt has been made to route the exhaust pipe around the bash plate because this would create a sharp bend. So, to accommodate the smooth internal bend of the pipe it is necessary to bend the bash plate upward. Hacksaw a two-inch cut in the bash plate and bend the bash plate up, making a V-shaped indent.

Now install the engine in the frame, reconnecting the ignition wiring. The expansion chamber is mounted, using the gasket that came with the stock muffler. If a silencer is to be used, and we recommend this, cut off the stinger pipe so that it remains the same length

with the silencer. If a smaller PTO sprocket was installed, as recommended, don't forget to tighten the chain.

Finally we come to the air cleaner question. If the stock filter is used, everything we have done will be nearly useless. Larry recommends the foam rubber sock type of filter extending straight up from the manifold into the carb housing. If the sock type filter is used it will be necessary to buy an adapter that replaces the shaped rubber hose of the stock air filter. This adapter has provision for the stock rubber insert that guides the fuel line, air relief line and oil line into the carb housing. The air relief line to the carb should be retained, venting to free air. Since the oil line will no longer be in use it is necessary to block up this hole and Jim used a self-vulcanizing rubber solution to do this. The problem with these exposed foam rubber sock air filters is that they provide no protection from wet conditions. The trail rider should, then, give consideration to the Fun 'n Fast filter, although this is not quite so free-flowing as the sock air filter.

A final check of all fasteners should be made and the tank drained of gasoline. Refill the tank with the recommended mix. *Do not forget this.* Remember, from now on you have to use oil in the

gas. Fire it up and be prepared for a surprise. You will probably have to do some carburetor adjustments after the engine is thoroughly warm and this can be time consuming, taking the carb housing cover off and putting it back on. Nevertheless, you will not get an accurate reading unless the machine is properly buttoned up.

It is advisable to go to a colder plug. A Champion B-8HC is a good starting point but the slightly warmer B-7HC could also work. Check to make sure that the ignition timing is set to 2.3mm before top dead center.

We are not sure that the Shoemaker Mini-Enduro kicks out 12 horsepower but it is certainly one of the hottest Mini-Enduros around. The power band is broad, giving lots of torque at the low end and climbing very rapidly through the range. It is not particularly temperamental. Many high performance machines are powerful in a narrow range but dogs either side of it. The Shoemaker Mini-Enduro is not like this. Although it is designed for racing, the performance-minded non-competitor will also enjoy the machine. In fact, judging by our test engine that wasn't broken in when we got to ride it, we wouldn't hesitate to recommend it to the cow-trailer. □

Ready to Rough it



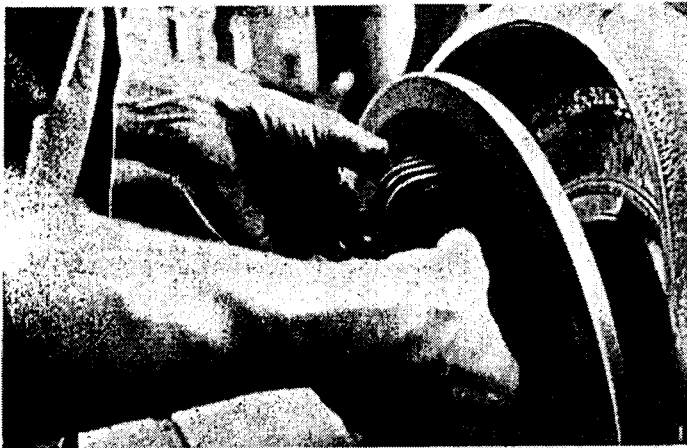
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HOLDER

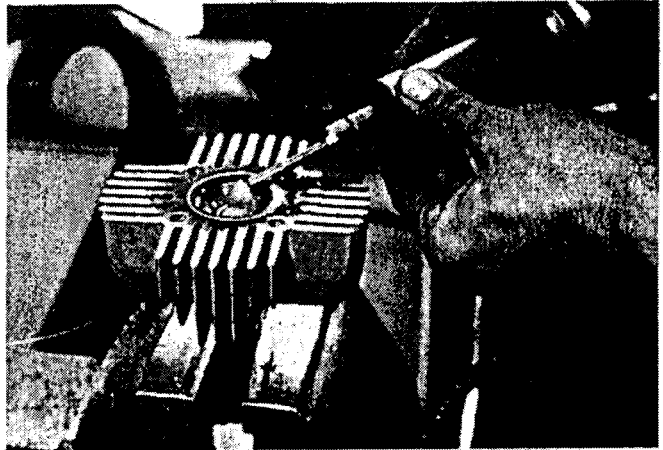
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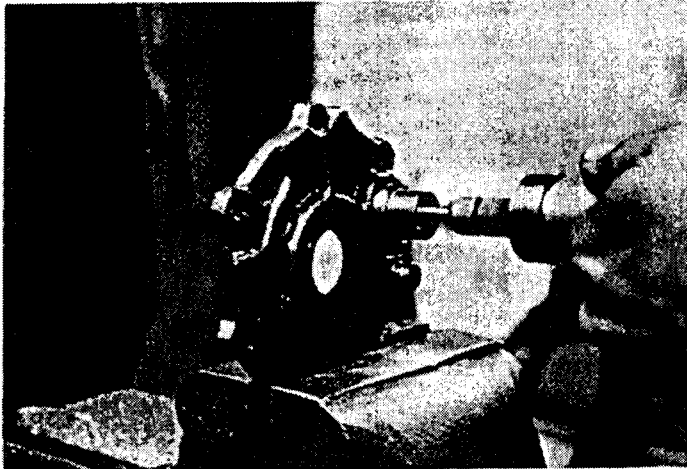
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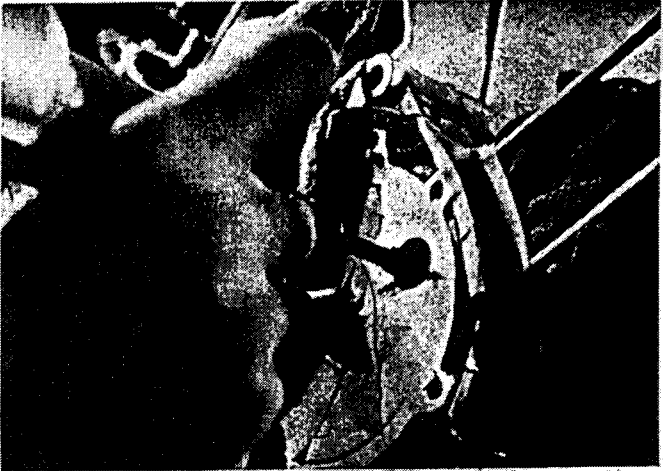
1.



2.



3.



4.

1. Milling the head. There are various machining methods for doing this. A super-flat grinding wheel and hand-lapping were used here.

2. After the head is milled, the squish area in the combustion chamber has to be reshaped to avoid the piston striking it.

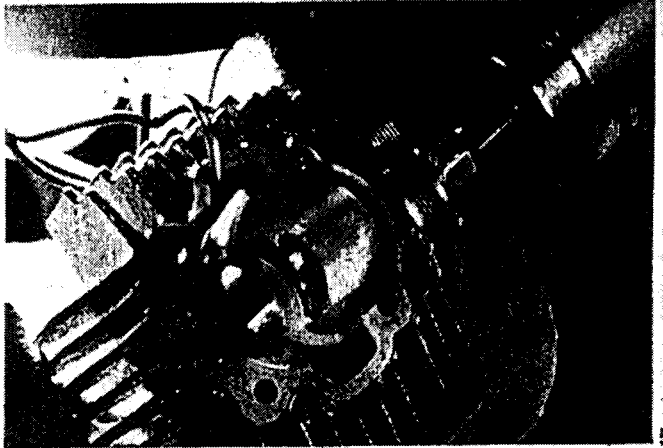
3. The inside diameter of the mounting boss for the carb has to be milled out about one millimeter to match throat of the bored carb.

4. Reshaping the intake port in the crankcase. Note rag stuffed inside to prevent fouling by metal shavings (see text).

5. Shaping, raising and polishing the exhaust port is the major part of the modification work.

6. Great care must be exercised when raising the transfer ports to prevent damage to the bore of the cylinder.

7. A lathe is used to bore out the throat of the carb, bringing it from 16mm to 17mm. The bore has to be clean but not, necessarily, polished.



5.

