



LIGHTWEIGHT WEAPON

With time, effort and money you can duplicate the light weight and super performance of the 'works' machines.

by Barry Watkins

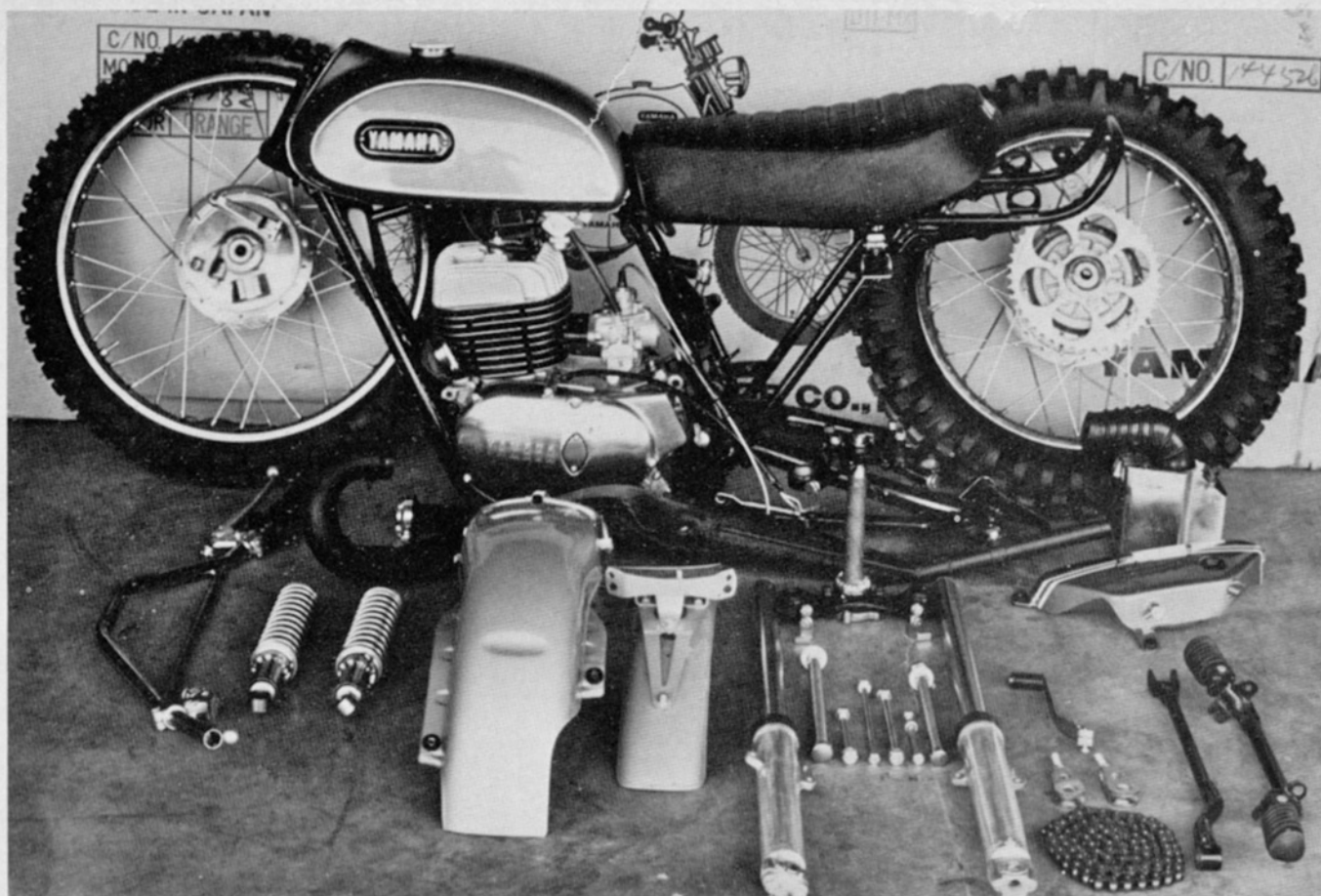
Many hours of the last two years have been spent dreaming how to build a sub-200-pound motocrosser. My dreams were encouraged by an article I read about the 'works' Suzuki of Joel Robert. Dry weight was a claimed 182 pounds. I couldn't believe it, but I sure wanted to. In November of 1970, I saw the bike at Bay Mare at the Inter Am. I was awed.

The machine was flawless. Attention to detail was what made it so light. It was hard for me to sleep after seeing that bike. I hoped Suzuki would come out with a production version of the prototype weighing around 200 pounds, so I was disappointed with the 400 Suzuki. Actual weight is in excess of 240 pounds. I could not understand why Suzuki spent all the

time and money reducing the weight of the prototype, and then came out with a production version 60 pounds heavier.

In the early months of 1971 I saw the Jones family, Don, Gary and DeWayne, who were racing Yamaha's prototype, the 250 YZ. A very impressive machine, and it only weighed about 195 pounds. It was quick; as quick if not quicker than many of the stock European 400's. I had heard that Don Jones was one of the key people involved in developing the YZ.

I had begun my research prepara-



The project began with a stock Yamaha DT1 MX out of the crate. Every piece was weighed to the ounce. Total dry weight was 246 pounds. Completed project weighed 52 pounds less.

tions. My guidelines were as follows:

1. Reduce the unsprung weight as much as possible without a loss in reliability. Every expert I've talked to said this is one of the most important factors of good handling. The light unsprung weight allows the tires to roll over the terrain as fast as possible.

2. Reduce the weight on top of the bike to the lowest practical figure, i.e., handlebars, gas tank, seat and fenders. The center of gravity is lowered, making the bike easier to handle through the corners. Someone told me that removing one pound from the top of the bike is like removing five pounds from the bottom.

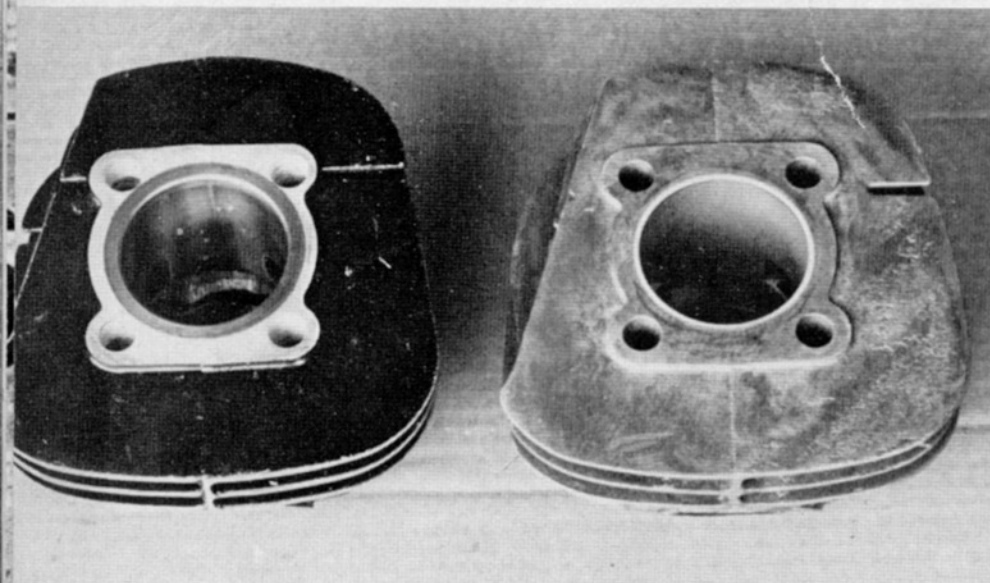
3. Reduce the remaining parts of the bike to the lowest possible weight without sacrificing reliability. There was practically no area of the bike that escaped the weight reduction program, but the reliability factor was most important. The bike isn't worth two cents if it's always breaking. DNF's don't pay. Most of the products I used are as good if not better than anything on the market, and at the same time they're lighter. You'll be



amazed how much less stress the whole bike will be under when you remove 50 pounds. Parts last longer.

4. Make the bike as easy to build as possible. You will see that about 90% of the project is a simple bolt-together procedure. A few brackets here and there have to be welded and

Some essential items for the project include a baby scale, Yamaha service manual, hand grinder kit, silicone seal and a Webco stand to hold the bike upright.



The 1969 GYT Kit aluminum cylinder(right) weighs two pounds less than the standard Yamaha cylinder (left). The GYT Kit cylinder has a chromed barrel, instead of cast iron liner.

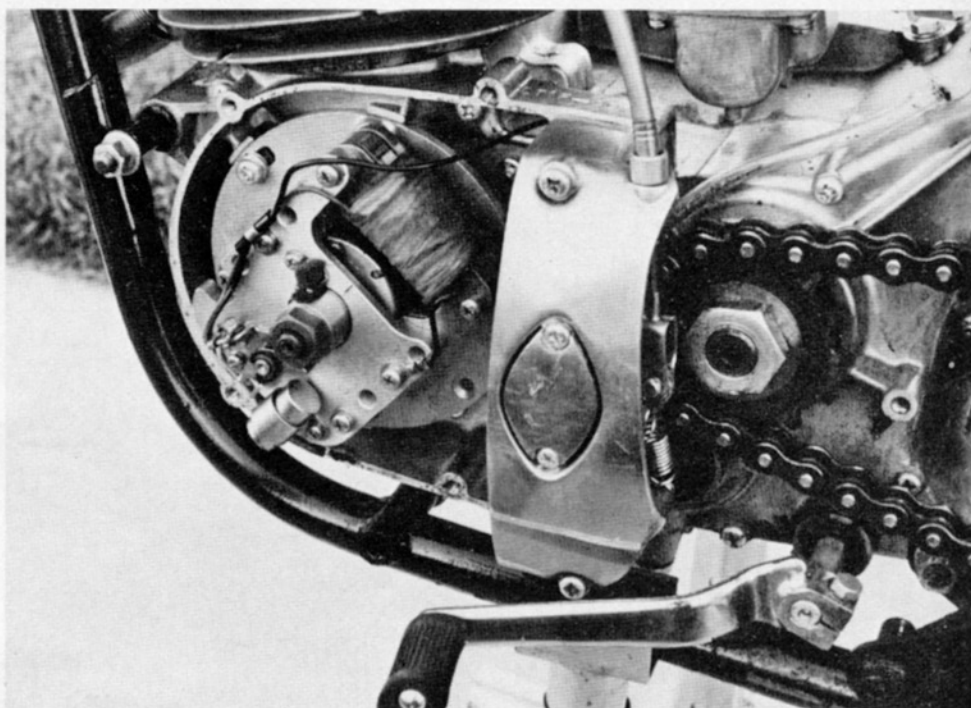
drilled, but no serious problems were encountered. It's easy to build, but it does require time to do a good job. Take your time, so you'll be proud of the result.

The cost of the machine varies. Alternates have been given in different price categories. If you can't afford the most expensive option, buy what you can afford. The weights are given for almost all parts used.

You don't have to build the entire machine. If you only purchase the Champion frame and bolt your DT1 parts to it, you'll have an excellent handling machine. If you own something besides a Yamaha, the same principles and products can most likely be incorporated with your make and model. You'll realize after finishing the article that a great number of parts were used—practically from A to Z. That was how I arrived at its name: the *Yamaha AZ*.

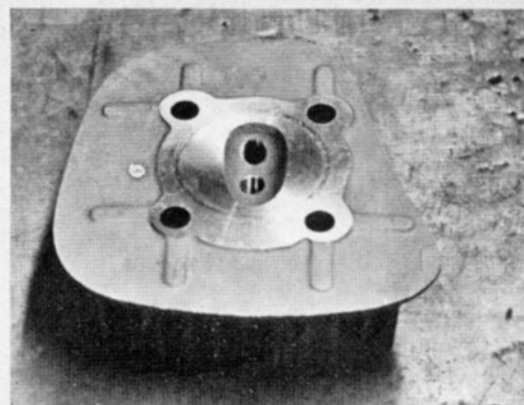
The article got its big push when I called Bob Braverman and discussed the possibilities of building a sub 200-pound motocrosser. He said he had made several attempts at it, and it was difficult to do without using special castings for engine cases, etc. I asked if I brought him a bike under 200 pounds, built primarily with over the counter items, could we do a feature article so *Cycle Guide* readers could build a similar Yamaha project bike? He said it would be a good idea, since nobody had done a do-it-yourself version of a sub 200-pounder. His comment of the difficulty challenged me, and I was off.

I called Yamaha International for



Special machining allowed the installation of this light weight Kawasaki rotor magneto and stator plate. Reduced weight of the crankshaft allows quicker revving of the engine.

advice, since I was impressed with their YZ. Terry Tiernan and Dennis Mahan were most cooperative and helpful. Much of their information is passed on in this article. Dennis explained in detail what materials and methods had been used to reduce weight on their machines. He emphatically recommended two people to do most of the special work: Don Jones of *Hacienda Heights, California*, to build the engine, and Jack Davis of the *City of Industry, California*, to do any necessary machine work. Don has a reputation of building almost un-



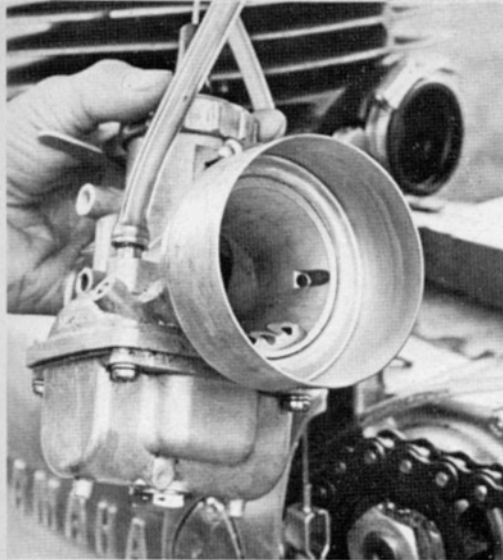
The special head by Don Jones utilizes two spark plugs operated by separate coils. Higher compression improves low end torque while the trench improves top end flow.

beatable engines, and I can testify to that. Jack Davis is one of the best machinists I've ever met. Yamaha uses his services for special work on their race bikes. His work is absolutely flawless.

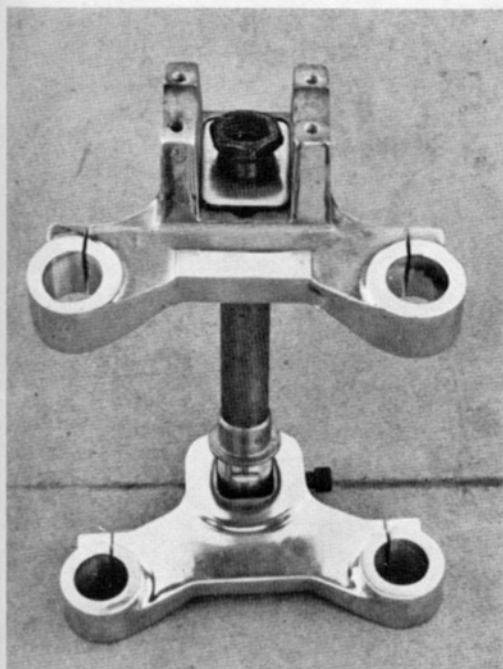
Doug Schwerma was the man who provided the super light exceptional handling Champion frame.

I weighed some of the competitive 250 motocross machines offered for sale, and their dry weights are as follows:

MODEL	POUNDS
MAICO T5	231
CZ	242
OSSA STILETTO	244
HUSKY	234
BULTACO PURSANG	239
MONTESSA CAPPRA	242
YAMAHA DTIMX	246



The adaptor fitting by K&N Engineering is essential to allow the 34mm Mikuni road racing carburetor to breathe adequately throughout the entire RPM range.



Don Jones manufactures these five way adjustable triple clamps for Yamahas, to vary the steering for different types of competition. Weight is only 5 3/4 pounds.

You can see that any bike weighing 194 pounds is 37 pounds lighter than the next lightest entry. With everything else equal, the lighter bike will handle better, accelerate quicker, stop faster and have less stress and strain on the component parts, so it will last longer.

The article has been outlined with segregations of categories for easier reading. It should also make it easier to refer to different areas of the bike when ordering parts. So read on to



The Champion motocross frame is constructed entirely of chrome moly tubing. Extremely strong, with a proven geometry for excellent handling, it weighs only 17 pounds.

see how you can build the unique Yamaha AZ.

FRAME

Yamaha's standard frame leaves a lot to be desired. First of all, it's heavy. Pound for pound, Oriental steel tubing does not have the strength and rigidity of chrome moly, so the wall thickness must be thicker and heavier to make the frame rigid. The Yamaha frame is also too high, resulting in a top heavy feeling when you lay it over in the corners. You can lower the frame to make it a fine handler, but it's still heavy.

I surveyed quite a few frame kits on the market and found at least three that were excellent units. I chose Doug Schwerma's Champion frame. It is extremely light and very rigid. The pieces fit beautifully and the welds are perfect. It is flawlessly made of chrome moly 4130 tubing. All welds are heliarc'd with a P&H solid state welder using 4130 welding rod. Filler rod is used so that a convex weld is built up for additional strength. The frame and swing arm sell for about \$350. Geometry is almost identical to the Maico, with a 54-inch wheel base, steering head angle of 28 1/2 degrees, and 5 inches of trail. The Champion frame weighs 17 pounds, which is 11 pounds less than the

Yamaha unit. If you only purchased the frame kit and bolted your stock Yamaha components to it, you would have a very rewarding improvement.

ENGINE

Most of you probably won't believe how fast my bike is. I'm not afraid to race any of the European 400's. It has more torque and acceleration than I ever dreamed possible in a 250. And the powerband. It starts coming on very low and keeps pulling stronger and stronger. Don Jones really outdid himself on building it.

Don showed me how to remove 6 1/2 pounds from my engine. Weight before changing parts was 70 pounds (without oil) and 63 1/2 pounds after remodeling. I found he knew quite a bit about this weight reducing game. It seemed like everything he wanted was lighter. The following is a list of parts that were changed, with comparative before and after weights:

	Before	After	Difference
Carburetor	2-2/16 lb.	1-5/16 lb.	13/16 lb.
Magneto assembly	5-6/16 lb.	3-1/16 lb.	2-5/16 lb.
Cylinder	8-8/16 lb.	6-6/16 lb.	2-2/16 lb.
Kick start lever	1-7/16 lb.	1-3/16 lb.	4/16 lb.
Cylinder head	3 lb.	2-13/16 lb.	3/16 lb.
Gears	2-6/16 lb.	2-4/16 lb.	2/16 lb.
Oil injection	12/16 lb.	0 lb.	12/16 lb.
Total	23-9/16 lb.	17 lb.	6-9/16 lb.

CARBURETOR

Don advised me to use the 34mm Mikuni road racing carb because the engine will need the extra fuel. That unit weighs less than the stock MX carb. Don modified the spray bar and jetted the carb.

MAGNETO

Don's magneto recommendation produces acceleration that you won't



The Yamaha AT1 hub (right) was the lightest motocross unit available. The Rickman magnesium unit (left) is two pounds heavier, but stronger. Baroni MX rims and Dunlop tires are secured with stainless steel spokes.

believe. The new unit consists of a rotating magnet and stator plate assembly from a Kawasaki. Basically, the unit removes about 2½ pounds of inertia weight from the crankshaft, which allows it to rev up much faster—an unbelievable difference. Jack Davis of Davis Machine Company in the City of Industry, Calif., is responsible for its installation. Contact him and he can tell you which unit to order and will also machine the stator plate for assembly. Don't attempt this modification unless you know what you're doing, because it requires professional assistance.

CYLINDER

We used a 1969 GYT kit aluminum cylinder with a hard chrome liner instead of the standard cylinder with the cast iron liner. I was happy to lose 2-2/16 pounds in the process of getting a better cylinder. The all aluminum unit allows a much closer tolerance between the piston and cylinder due to the equal expansion of the identical metals.

Don's porting of the barrel was something else. The hardest part was waiting for him to have time to port it, but it was worth waiting for.

KICK STARTER LEVER

I didn't change levers for the weight difference, but because the stock lever rubbed my shin raw where the

Champion frame is narrower than the DT1. You can use either a CT1 lever or the folding kick starter from the 350 street Yamaha. Both of these are lighter.

CYLINDER HEAD

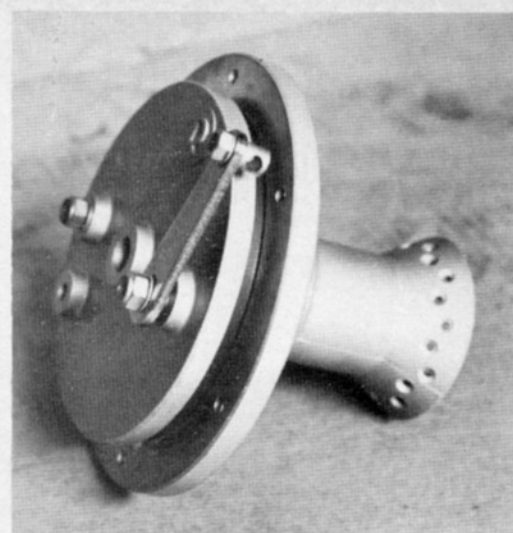
The weight difference was not worth the purchase of a new head, but the performance of the head was. Don Jones has designed a special head for the DT1 that improves both low and top end performance. The increased compression helps low end torque, and the trench in the head improves flow at the top end. The feature I really like is the two spark plug holes which can be used in conjunction with Don's dimmer switch. The switch has two wires leading to two coils. One coil supplies the juice to the front spark plug, which is the hotter of the two. The other coil juices the rear plug, which is colder. The dimmer switch allows a choice of heat range by switching from one plug to the other, depending on the situation. You can use the warm plug for plunking around and the cold plug for those long straights. The dimmer switch has a kill button, which is something every bike needs.

Don can supply the cylinder head and spark plug switch kit.

GEARS

Every competitive racing engine should be equipped with straight cut gears. The weight differential is not nearly as important as the longevity it gives an engine. Side thrust on the main bearings is eliminated, which allows the bearings to operate freely.

Horsepower gain is probably small, but the engine's lower end will last longer. You will notice a definite in-



The Rickman aluminum rear hub weighs only 5¾ pounds, but you eliminate almost a half pound by cutting out the excess aluminum between the sprocket bolt holes.

crease in noise, however. Straight cut gears are available from most Yamaha dealers and you'll save 2/16 of a pound using them.

Champion spark plugs with the palladium tips were used.

FRONT END

A comparison of the before and after weights of the front end is very interesting. They are as follows:

Item	Weight Before	Weight After	Weight with Alternate
Rim, hub, & spokes	14-4/16 lb.	11-6/16 lb.	10-1/16 lb.
Rim lock	3/16 lb.		
Tube	1-2/16 lb.	1-2/16 lb.	1-2/16 lb.
Tire	7-8/16 lb.	7-8/16 lb.	7-8/16 lb.
Total	23-1/16 lb.	20 lb.	18-11/16 lb.
Difference		3-1/16 lb.	4-6/16 lb.

Closer examination of the component parts yields the following information:

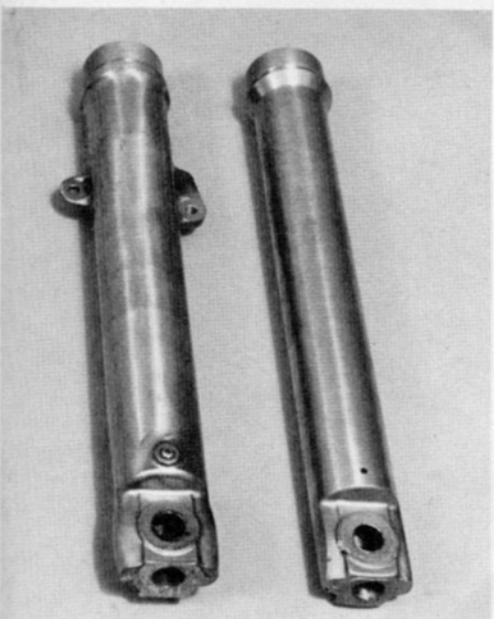
HUBS:

The lightest hub on the market that will hold up to the punishment of motocross is the Yamaha AT1 hub. It weighs a mere 3-1/16 pounds including backing plate, bearings and brake shoes. The only problem with this hub is with a heavy rider such as myself, the brakes will not quite do the job. If you're a light weight rider, this is a great way to go and it's impossible to beat the price. It's a real bargain. Jack Davis machined two bearing shells so the DT1 bearings and axle will fit the AT1 hub. It's also necessary to machine a spacer for the inside of the hub.

The hub I prefer is the 500 Rickman magnesium unit which sells for about \$92. The complete hub and backing plate weighs only 4-10/16 pounds. The brakes work better than any I've



The completed front end is light and strong. The custom torque arm must be fabricated after the slider legs are turned down. The Rickman magnesium brake really works.



Custom machining removed 12 ounces of unsprung weight from the 1971 Yamaha fork slider leg (right) without impairing the strength. The standard unit is on the left.

ever used. It will just about lift the rear end off the ground under hard braking. It's relatively expensive, but it's super strong. The brake drum was machined by Jack Davis so it provides total contact with the brake shoes.

RIMS

The standard Yamaha front steel rim is pretty tough, but you can elimi-

nate 14/16 of a pound by utilizing a Borrani alloy rim. The fact that they will dent before they break makes them more suitable for my purposes. Make sure you order the new motocross version of the Borrani rims, as the former street rims they produced will not hold up in the rough.

TIRES

Several manufacturers produce excellent tires that have good traction under varied types of terrain. The Dunlop 2.75x21" tire that is standard equipment on the DT1 MX is the lightest I found. It only weighs 7-8/16 pounds. The 3.00x21" Dunlop weighs 8-8/16 pounds, and can be used in instances where a wider tire is preferred. Desert riders may prefer a 19" tire. Comparative weights of various tires on the market are as follows:

Dunlop 2.75x21"	7-8/16 lbs.
Dunlop 3.00x21"	8-8/16 lbs.
Mitsuboski 3.00x21"	8
Avon 3.00x21"	8-12/16 lbs.
Pirelli 3.00x21"	10-4/16 lbs.

When you purchase your tires and tubes, take your scale along and weigh all the tires in the store, because the exact same type of tires vary as much as 12 oz. each. Triumph Motorcycle Corporation, the west coast distributor for Dunlop tires, let me go through their warehouse. We weighed over 100 tires before I was confident that the lightest ones had been selected.

TUBES

Dunlop's 2.75x21" tube is the lightest one I found on the market. Quality is excellent and I would recommend it for motocross. Desert fans may be better off buying a super

heavy duty tube. They hold up better against the rocks and cactus.

RIM LOCKS

Yamaha makes a light weight rubber rim lock that weighs 3/16 of a pound. This is a small amount of weight, but can be safely eliminated by taking a cold chisel and making little nicks on the inside of the rims that grip the tire. Space them about one inch apart.

SPOKES

Spokes are such a vital part of any dirt motorcycle that it would be foolish to use inferior items. A set of spokes and nipples weigh anywhere from 1 1/2 to 2 1/2 pounds. I made more than a casual survey of spokes, and two distributors seem to have especially good products. North American Imports distribute excellent stainless steel spokes which stretch very little and break very rarely. Buchanan's in Monterey Park, Calif., manufacture their own spokes which are also excellent. I'm a nit picker about how my rims are spoked, so J and J Cycle in Westminster, Calif., were requested to do the work. They made sure the rims were perfectly true and rotating in a circle and with no side wobble.

FRONT FORKS AND TRIPLE CLAMPS

I used what is considered by many people one of the finest front forks on the market. Don't laugh, but the 1971 Yamaha DT1 MX front forks with the aluminum lower legs are excellent. Yamaha has made tremendous progress with their forks in the last year. If you have 1970 or earlier forks, I would strongly recommend replacing the damping body with the

Continued on page 96

FOUL WEATHER GEAR

HANDCRAFTED IN ENGLAND BY TT LEATHERS



Webco introduces an all new, two-piece foul weather suit. Smart in appearance, rugged, yet light and comfortable. 100% waterproof waxed cotton of highest quality and craftsmanship. Designed by top European riders to meet the needs of the most demanding enthusiast. Available in four colors: Charcoal, Brick Red, Denim Blue and Verde Green; and in five sizes: extra small (32-34), small (34-36), medium (38-40), large (42-44), and extra large (46-48).



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LIGHTWEIGHT WEAPON

Continued

Patrick and Bowers unit distributed by Doug Schwerma or Webco. Then the earlier forks work super. It should be noted that the 1970 and earlier forks with the steel lower legs weigh about 4 pounds more than the 1971 aluminum units.

Jack Davis performed a nifty little trick on my slider legs. He machined the legs down to just a little over Yamaha 'works' specifications. Total wall thickness is 0.200 inches. That saved me almost 3/4 of a pound on each leg, and the units are still very strong. The YZ Yamaha has been through more than 3,000 miles of desert and motocross racing with slider legs a lot thinner than mine, without a failure. The best part of this modification is that the weight loss is placed in the unsprung category. If you perform this modification, a brake torque arm bracket will have to be made.

Triple clamps are another area where we can lose some weight. Standard Yamaha triple clamps weigh exactly 7 pounds. You can eliminate 12/16 of a pound by simply removing the steering damper. You don't need it. The geometry of Schwerma's frame was designed for Yamaha clamps, so you're safe in using them.

Don Jones invented a set of triple clamps which are five way adjustable. You can put the front end really out, a little out, normal, in a little, and in a lot. These clamps allow a motorcycle to be more versatile. The complete triple clamp setup weighs only 5-1/16 pounds, or 8/16 less than the stripped Yamaha clamps. These clamps are available through Don Jones.

Using the lightest combination, the comparison is as follows:

	Before	After
Fork Tubes complete (both)	14-8/16 lb.	13 lb.
Triple Clamps	7 lb.	5-12/16 lb.
Oil	12/16 lb.	12/16 lb.
Total	22-4/16 lb.	19-8/16 lb.
Net difference	2-3/4 lb.	

A complete set of Ceriani forks and triple clamps (with oil) weigh 22-1/2 pounds. You can see that Yamaha has kept the weight of their stock units down, and with a little attention you can lower that weight even more.

AXLE

Jack Davis bored my front axle to the same specifications as the Yamaha YZ. Weight before was 3/4 lb.; after it was 1/2. Once again, a small detail, but helpful, since it's unsprung weight.

To be continued next month

LIGHTWEIGHT WEAPON

Quick and fast, this custom Yamaha Motocrosser can be duplicated by the racer who wants to win.



PART 2

by Barry Watkins

REAR END

You can really save a bundle of weight at the rear end. Let's look at the before and after weights and then see how we got there.

REAR HUB

The stock DT1 hub has an excellent brake but the complete unit is very heavy. For about \$52 you can buy a Rickman aluminum hub from their 250 motocrosser that weighs 5-14/16 pounds or 4-9/16 less than the DT1 hub. I removed 13/16 of a pound by drilling the brake shoes, backing plate and machining part of the heavy bead between the sprocket holes. Total overall weight of my complete hub was 5-1/16 pounds. To the best of my knowledge, the Rickman hub is at least 2 pounds

lighter than any other hub on the market. If you use the brakes severely, you may want to buy a magnesium hub from a 500 Rickman. They weigh about 7-7/16 pounds, and have more effective brake shoes, but cost quite a bit more. Maico also makes an excellent rear hub which weighs 7-1/2 pounds. If you choose this unit I recommend having Wheelsmith Engineering in Santa Ana, Calif., supply the floating back-

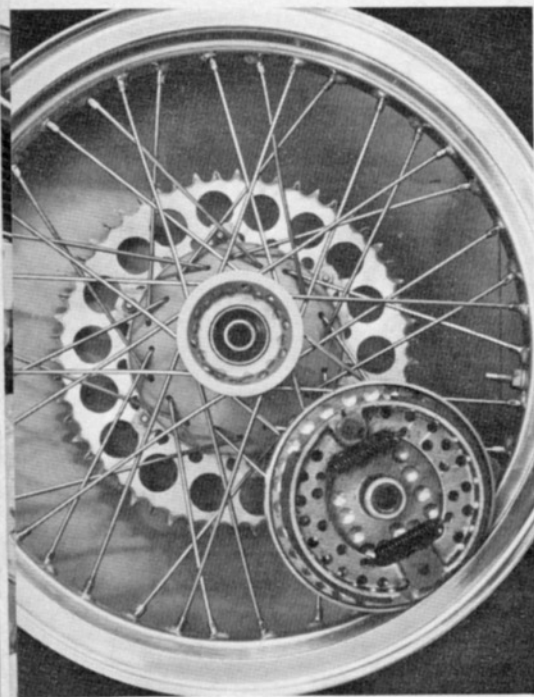
ing plate which will make the combination almost unbeatable.

Jack Davis machined both front and rear brake drums to insure 100% contact upon application of the brakes.

RIMS

Yamaha's steel rims are comparatively light at 5-5/16 pounds. Steel rims are normally better for desert use, but motocrossers should switch

	Before	After	Difference
Hub (complete)	10-7/16 lb.	5-1/16 lb.	5-6/16 lb.
Rim	5-5/16 lb.	5 lb.	5/16 lb.
Spokes and Nipples	2-8/16 lb.	2-4/16 lb.	4/16 lb.
Rim Locks	8/16 (two) lb.	4/16 (one) lb.	4/16 lb.
Sprocket and Bolts	2-4/16 lb.	15/16 lb.	1-5/16 lb.
Spindle, Nuts and Washers	1-2/16 lb.	1-0/16 lb.	2/16 lb.
Tire	12-8/16 lb.	10-8/16 lb.	2 lb.
Tube	1-14/16 lb.	1-6/16 lb.	8/16 lb.
Shock Absorbers	7-8/16 lb.	7-8/16 lb.	—
Swing Arm (with bushings)	8-12/16 lb.	6-2/16 lb.	2-10/16 lb.
Swing Arm Bolt	1-1/16 lb.	8/16 lb.	9/16 lb.
Chain Adjusters	8/16 lb.	4/16 lb.	4/16 lb.
Brake Torque Arms	1-2/16 lb.	9/16 lb.	9/16 lb.
Total	55-7/16 lb.	41-5/16 lb.	14-2/16 lb.



The brake shoes and backing plate of the Rickman rear brake have been drilled to reduce weight, and the aluminum sprocket has been lightened by using a hole saw.

to an alloy rim. My Borrani weighs 5.0 pounds. Their major disadvantage is the large trench that seems to accumulate mud, which increases unsprung weight, but they are stronger than most steel rims.

SPOKES AND NIPPLES

Stainless steel spokes are the strongest, although not the lightest. Spokes are not the place to lose weight. They take too much pounding. North American Imports in Mojave, California, or Buchanan's in Monterey Park, California, should be able to meet any of your spoke requirements.

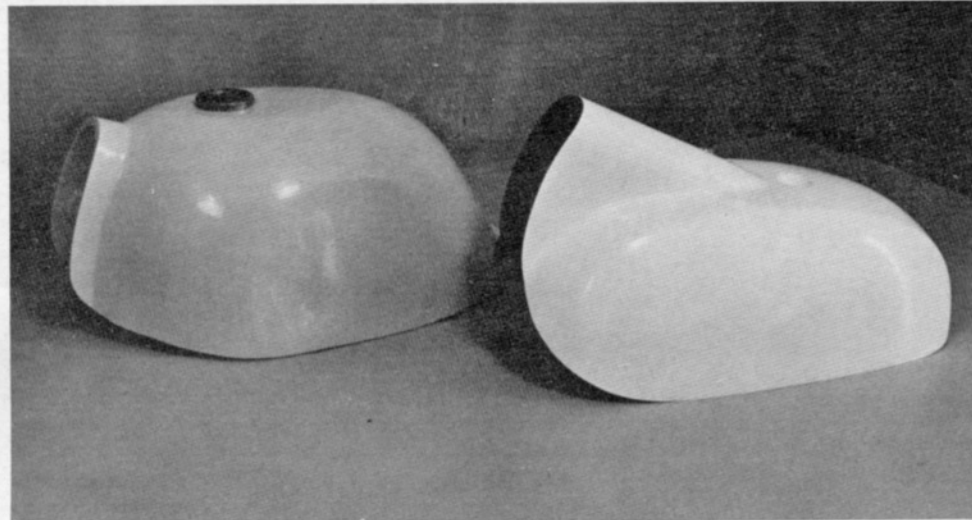
RIM LOCKS

Although a small detail, it's still worthy of mention. Two Yamaha rim locks weigh 8/16 of a pound. Use one rim lock with Lubri-Tech Tire Mounting Compound and they'll never slip. Another way is to use sheet metal screws in the side of the rims that anchor into the tire. Tire changing time is increased, however, with the rim screws.

SPROCKET and BOLT

Circle Industries, South El Monte, California, the world's largest manufacturer of sprockets, make about any type of sprocket you need. My 54T sprocket weighed 1-6/16 pounds, but boring holes removed 8/16 of a pound, yielding a weight of 14/16 of a pound.

Standard Rickman bolts with self-



A wide variety of accessory tanks are available, and their weights vary widely, so take your scale along. Pictured here are the Pacer tank (left) and Doug Schwerma's design.

locking nuts were used to mount the sprocket to the hub.

SPINDLE

Yamaha's axles had to be replaced with a Rickman axle to fit the bearing diameter. Weight loss was 2/16 of a pound. I decided not to bore a hole through the rear axle because it will be taking much more punishment than the front.

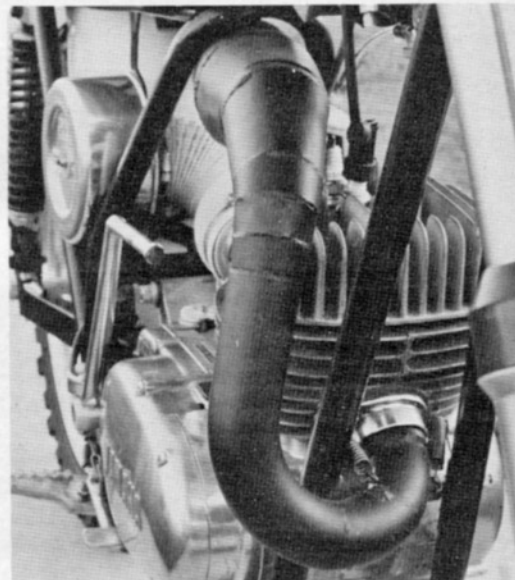
TIRES

Yamaha standard equipment is a Dunlop 4.00x18" Sports Stud, which is an excellent tire for all around dirt riding conditions. Its weight is about the same as most of the competitors at 12-1/2 pounds. Dunlop also manufactures a K:88, 4.60x18" tire which weighs two pounds less than anything on the market at 10-1/2 pounds. They vary in weight, so take your scales along and weigh all of them you can. This particular tire provides good traction on dry ground and unbelievable traction in moist or wet soil. Other tires I considered weighed as follows:

Dunlop K:88	4.60x18	10-8/16 lbs.
Dunlop	4.00x18	12-8/16 lbs.
Inour	4.00x18	12-2/16 lbs.
Irc	4.00x18	12-4/16 lbs.
Nitto	4.00x18	15-8/16 lbs.
Barum Desert Special	4.50x18	16-8/16 lbs.

TUBES

The Dunlop tube that was standard equipment weighed 1-14/16 pounds, but another one on a dealer's shelf weighed only 1-6/16 pounds. It was surprising that the same tube



The custom Bassani exhaust pipe fits neatly between the engine and frame and exits at the left rear side. High performance and light weight combine with being out of the way.

would vary as much as a half pound. Weights of comparative tubes were as follows:

Dunlop	4.00x18	1-6/16 lbs.
Nitto	4.00x18	1-6/16 lbs.
IRC	4.00x18	1-12/16 lbs.

SHOCK ABSORBERS

Sorry, I can't recommend any weight loss here. This is one place to get the best unit, no matter what it weighs. Koni is the best unit. A pair of Konis, with springs, weighs 7-1/2 pounds, the same as standard Yamaha units. Their damping can be adjusted and the spring tension is also adjustable. Webco (Venice, California) is the western distributor for Koni



This Titan Racing quick turn throttle is the hot setup for motocross. It opens the big carburetors with only 55 degrees of throttle turn, which is slightly more than $\frac{1}{8}$.

Shocks. Girling 70-pound springs were used.

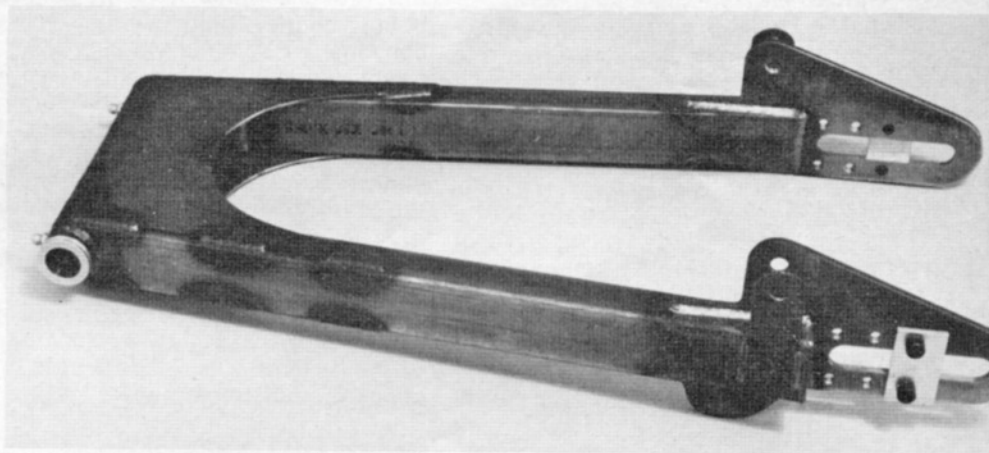
SWING ARM AND SWING ARM BOLT

The Champion frame is equipped with one of the finest swing arms I've ever seen. Special bronze bushings which Doug Schwerma distributes are installed in conjunction with grease fittings, which decrease swing arm maintenance. The unit is built from chrome moly and is as rigid as any I've compared. I especially prefer Doug's method of rear axle adjustment utilizing Bultaco axle cams, which makes chain adjustment super quick and simple. As a bonus, the Bultaco cams weigh $\frac{4}{16}$ of a pound less than the Yamaha units.

Doug's swing arm uses an earlier model 12mm DT1 swing arm bolt which is $\frac{9}{16}$ of a pound lighter than the late model bolt, and it's plenty strong.

BRAKE TORQUE ARM

I fabricated an aluminum torque arm from bar stock purchased from the scrap pile of a local metal wholesaler. The chain guide is also made of aluminum sheet stock. Be sure to flare the edges toward the outside so the chain won't catch the chain guide and break it. I copied Yamaha's prototype with the adjustable roller at the

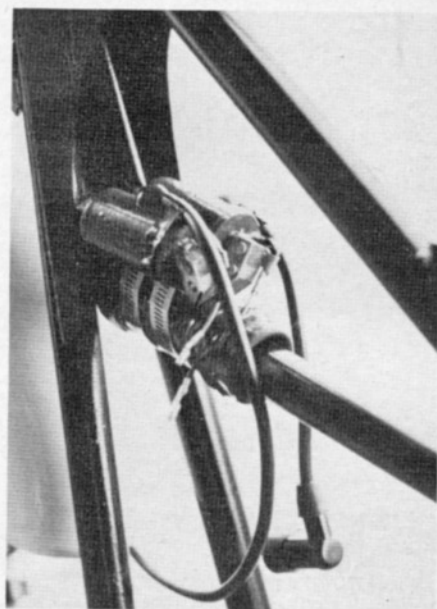


The Champion chrome moly swing arm is light and strong, utilizing special bronze bushings for rigidity and grease fittings for easy maintenance. Axle adjustment is a full three inches.

bottom of the chain guide. Incorporating that feature allows chain tension adjustment without altering the wheelbase. My aluminum torque arm and chain guide weigh $\frac{9}{16}$ of a pound compared with Yamaha's $1\frac{2}{16}$ pounds, a saving of $\frac{9}{16}$ of a pound.

REAR END SUMMARY

When you weigh the before and after, there is a difference of a whopping $14\frac{2}{16}$ pounds, and it's almost all unsprung weight. This change alone allows the bike to handle far



Two coils mounted to the frame provide juice to the two spark plugs, one hot and one cold, but not simultaneously. Handlebar mounted dimmer switch selects coil for power.

better, especially in the rough stuff at high speed.

SEATS, TANKS & FENDERS

This is the portion of the bike that should be dictated by your personal tastes. That's why several seat, tank and fender combinations are shown: to give you a styling choice. You will never fully appreciate your bike unless you like its looks. You may be surprised to know that eight to ten pounds can be lost in this category. Listed below are the before and after weights:

	Before	After	Difference
Gas tank (with petcock)	6-7/16	3-7/16	3.0
Seat	6-7/16	3-3/16	3-4/16
Front fender	1-6/16	1-2/16	4/16
Rear fender	4-4/16	1-3/16	3-1/16
Total	18-8/16	8-15/16	9-9/16

I used a YZ prototype fiberglass tank made by Gary Jones at his fi-



The Rickman Hodaka brake assembly and cable mounts easily to the Champion foot peg bracket. The Champion foot pegs are a copy of the latest Bultaco design.

berglass shop in the City of Industry, Calif. There are several other manufacturers that produce seat, tank, and rear fenders that weigh about the same as mine. Doug Schwerma distributes a fiberglass tank that looks just like a Montesa, and it only weighs 4-8/16 pounds. They are designed to carry the gas lower on the frame than any tank I've seen.

Rahm Engineering in Redondo Beach, Calif., makes several styles of tank, seat and fender combinations from a very durable plastic. You can order the entire tank, seat and fender and with only minor modifications bolt the unit to the Champion frame. Their entire assembly weighs only 9 pounds. They manufacture many types of front and rear plastic fenders in several colors.

Preston Petty manufactures probably the most durable fenders. They never seem to break, especially when coupled with WheelSmith Engineering's aluminum fender bracket.

The removal of nine pounds from the top of the bike makes a big difference in being able to comfortably lean it over in the turns. My bike is so light, it feels like a mini-bike.

In summary of the seat, tank and fender category, select the style you like and go from there.

EXPANSION CHAMBER

Yamaha put enough steel in my stock expansion chamber to sink a battleship. Total weight was 7-11/16 pounds. The performance of the pipe is hard to beat, however.

Doug Schwerma can supply you with a pipe that comes on from the very bottom to within about 300 RPM's of the Yamaha MX pipe. It



There are a number of plastic and fiberglass front fenders for sale. The Preston Petty front fender pictured here is one of the unbreakable types on the market.

neatly tucks under the tank and seat and exits by the rear shock. His pipe weighed 4-4/16 pounds.

Bassani Manufacturing (Anaheim, Calif.) said they could route the expansion chamber under the seat and end it under the rear fender on the inside of the frame. I didn't believe it, but said they could try if they would copy the '71 Yamaha MX pipe specs. I came back the next night to see if they had started on it yet. After staring at my bike for about five seconds, I noticed the pipe was finished. It had almost completely disappeared under the seat and fender. I couldn't believe it. A beautiful job and it only weighed 3-11/16 pounds, or about half the original MX pipe. Bassani also manufactures quiet pipes which don't seem to hurt performance at all. I use one of their silencers and love it. It sure keeps the neighbors happy.

MISCELLANEOUS

This is the category that all the other important little details fall into. You'll never get under 200 pounds without some detail here. A listing of the remaining parts is as follows:

	Before	After	Difference
Expansion chamber	7-11/16	3-11/16	4.0
Handlebars	2.0	1.0	1.0
Clutch & brake cables	13/16	8/16	5/16
Chain	3-4/16	3-4/16	0
Air box and filter	1-13/16	1-13/16	0
Oil tank	2.0	0	2.0
Foot pegs	2-7/16	1-7/16	1.0
Brake pedal assembly	1-5/16	5/16	1.0
Skid plate	1-3/16	0	1-3/16
Kick stand assembly	1-6/16	0	1-6/16
Total	23-14/16	12	11-14/16

HANDLEBARS

Tom Kelsey of Titanium Racing Products in Agoura, Calif., helped reduce the weight of my handlebars by one pound. Yamaha bars weigh 2 pounds (which is comparatively light) and Kelsey's bars are one pound. The bars were so light I almost



K&N Engineering manufactures this special air cleaner assembly which does not restrict the air flow into the big 34mm Mikuni road racing carburetor.

threw them over my shoulder the first time I picked them up. They cost about \$35.

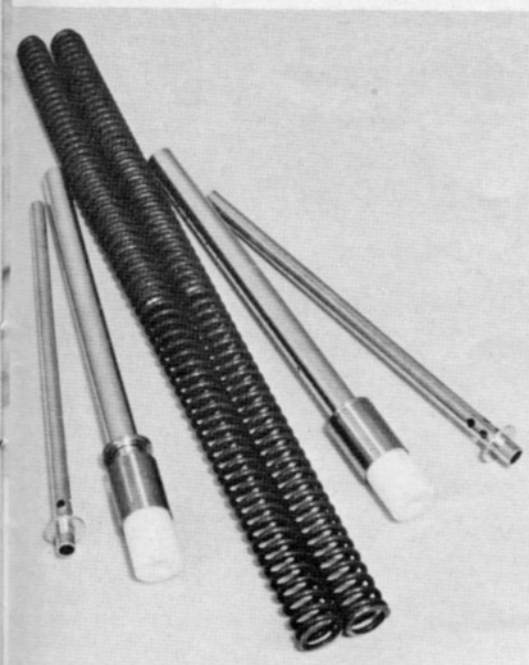
If you can't afford Titanium bars, the next lightest choice would be chrome moly. K&N Engineering in Riverside, Calif., or Webco in Venice, Calif., both make super strong light weight bars.

I prefer light handlebars. The less weight at the top of the bike to throw around on a long moto saves your muscles that much more. I used a Titan Racing quick turn throttle. It's the only one on the market that will fully open a 34mm Mikuni in 55 degrees. It saves being caught in an awkward position of a locked wrist trying to shut the throttle off.

If you use a carb of 32mm or less, Grizzly sells a Tomaselli quick turn throttle that works great, but it will not open the larger carbs.

AIR BOX AND AIR FILTER

K & N Engineering provided one of the most efficient air cleaner combinations I've seen. My 34mm road racing Mikuni must be able to breathe a tremendous amount of air without any restriction. Their air filter is probably the only one on the market that



The Patrick and Bowers fork damping kit greatly improves the performance of pre 1971 Yamaha forks. Kits are distributed by Doug Schwerma and Webco.

doesn't restrict air flow. The three-inch flexible hose leading to the adaptor on the carburetor allows a large volume of air to reach the mixing chamber. That air cleaner has a lot to do with the outstanding performance of the engine.

This was one of the few places on

the bike where I could not save any weight, but I made a big performance gain.

OIL TANK

Toss that steel can away because you don't need it. Pre-mix your gas and oil and you'll drop two pounds in the process. Remember to plug up the oiler hole in the barrel or you'll have air leak and a blown engine.

FOOT PEGS

You can drop another pound by using Doug Schwerma's foot peg setup. They look like Bultaco pegs utilizing strong corrugated steel. Boots don't slip off in the mud.

BRAKE PEDAL ASSEMBLY

You can buy a Rickman Hodaka brake cable and pedal from Steen's in Alhambra, Calif., that is probably the best setup. Mount it to the forward bolt hole in the foot peg bracket and save one pound in the process.

SKID PLATE

The need for a skid plate will be determined by the type of riding you do. Most motocross riders will eliminate a skid plate, but desert and enduro riders may prefer to use one. Yamaha's skid plate weighs 1-3/16 pounds, but an aluminum one should weigh about half that.

KICK STAND

Probably every bike should have this 1-6/16 pound item. Here again, if you ride where there are a lot of kick stands provided by nature, you may want to eliminate this item. Use your own discretion.



To contact the people who have their products mentioned in this article, the following list should be helpful. They are listed according to who did what.

Expansion Chamber

Bassani Mfg. (Darryl Bassani)
1164 C Fountain Way
Anaheim, Calif. (714) 630-1821

Handlebars

Titanium Race Products
(Tom Kelsey)
5606 Fairview Road
Agoura, Calif. 91301

Air Cleaner Assembly

K&N Engineering
(Ken Johnson)
2879 Main Street
Riverside, Calif.
(714) 682-8813

Brake Pedal Assembly, Front and Rear Hubs

Steen's Inc.
1635 W. Valley
Alhambra, Calif. (213) 289-4351

Baroni Rims, Tomaselli Levers and Quick Throttle

The Big Grizzly (Don Podesto)
812 So. Missouri
Waterford, Calif. (209) 522-7800

Sprockets

Circle Industries (Jim Oakes)
2536 Seamen
South El Monte, Calif.
(213) 686-1669

Dunlop Tires and Tubes

Triumph Motorcycle Corp.
2675 E. Huntington Drive
Duarte, Calif. (213) 359-3221

Koni Shock Absorbers

Webco, Inc.
Venice, Calif. (213) 870-7758

Quick Throttle

Titan Racing Inc. (Bill Oury)
24 El Sereno Dr.
Colorado Springs, Colorado

Engine Building, Triple Clamps, Cylinder Head, Tank

Don Jones
904 Aileron
City of Industry, Calif.

Seat, Tank and Fenders

Rahm Engineering (Dick Camp)
623 Mary Ann Dr.
Redondo Beach, Calif.
(213) 372-2266

Preston Petty Products
c/o Webco, Inc.

All Machine Work

Davis Machine Co. (Jack Davis)
904 Aileron
City of Industry, Calif.

Frame, Expansion Chamber, Tank

Cycle Services (Doug Schwerma)
1718 W. Winton
Hayward, Calif. (415) 782-3121

Paint

Charlie Tuna
Anaheim, Calif.



LIGHTWEIGHT WEAPON

Part 3

***A labor of love,
this motocrosser
is a dream
come true.***

by Barry Watkins

The Lightweight Weapon has been a lot of work, and time to work out the "bugs," but the effort has been worthwhile.

The AZ handles in a unique way. Steering is quick, but its super light weight makes it forgiving. The bike corners best when the rider is all the way forward in the seat. The relatively

steep fork angle allows for tight turns. It also slides well by using the throttle. Things happen a little quicker, however, because the engine revs up so quickly. The most important point on cornering the AZ is for the rider to be as far forward in the seat as possible. This is basically true for most motocross machines.



The outstanding handling feature is the speed at which it goes over bumpy ground. Whoop-de-dos and chuck holes are a breeze. Several factors contribute to its stability. Those '71 Yamaha forks are one of the finest units on the market. The Koni rear shocks (which are set at the lightest spring and damping setting) fully complement the front. The bike has no tendency to pitch the rider fore and aft, or to have the rear end come around sideways.

Starts are fun. The quickest technique is revving the engine and popping the clutch. It literally jumps off the line.

I've drag raced just about everything on two wheels. Out of maybe 20 acceleration tests against the more popular 250 machines, nothing has beat it. There have been only two bigger motocross machines that have shut the AZ down—a Maico and a 380CZ. Both of those bikes were fast, but they were within spitting distance at the end of a fifth gear straightaway.

The first day of testing was completed with knowledge gained and a list of improvements to be made. The gas tank fell off because the tie down strap broke. It slid on the gravel for 50 feet and destroyed Charlie Tuna's beautiful paint job. Charlie gratefully volunteered to make it beautiful again. We welded a small bolt near

the upper part of the frame's top downtube (just below the steering head) and used a small "Z" bracket to hold the tank down. Haven't had any trouble with it since.

Another problem was the original rear hub. I bent a couple of axles because the narrow hub left too much distance between the hub and swing arm. The rear brake was also too weak.

Wheelsmith Engineering in Santa Ana, California, solved my brake problems with a Maico rear hub. Buchanan's in Monterey Park, California, spoked the hub. In two months of riding, not one spoke has had to be tightened.

On the rear, Wheelsmith installed their floating brake, which has been so successful on the Maicos they prepare for racing. We eliminated the cable actuator by using a rod setup similar to a Husky. The floating rear brake is a tremendous aid to stopping on bumpy surfaces. It keeps the suspension from locking up under severe braking, allowing it to do its job. Every serious competition motorcrosser should have one. Wheelsmith claims they can fabricate one to almost any motorcycle.

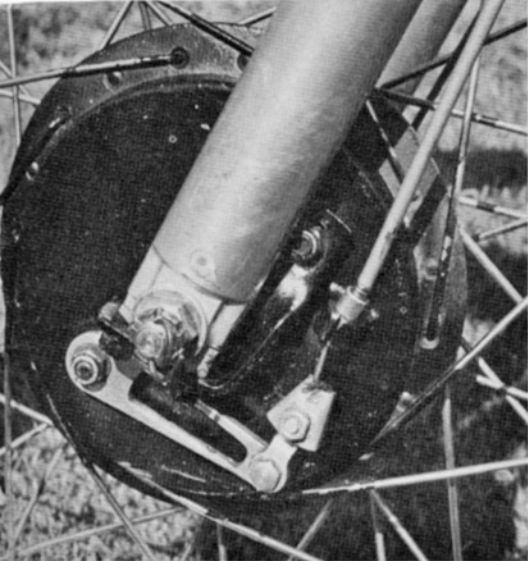
The Yamaha is noisy, so Bassani Manufacturing in Anaheim, California, made a quiet pipe for it. Bassani is dedicated to the "Less sound, more ground" concept.

The quiet pipe by Bassani really decreases the engine noise with no noticeable loss of power.

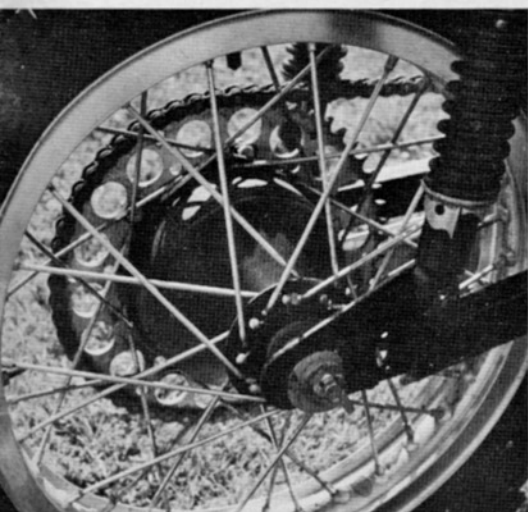
Before the CYCLE GUIDE staff got to ride the project bike, Don Jones spent two days helping me check everything out. That guy has been around for years and is one of THE authorities on motorcycles. The most obvious deficiency was the front brake torque arm. We ended up using Don's idea of a twisted piece of steel anchored to the studs in the fork sliders. It both looks and works better.

I called CYCLE GUIDE to schedule a testing date, and Swede Carlson said we could try out the new motocross course at Saddleback Park. I brought a Cheney Yamaha so that a comparison could be made between the two. Our attempts were ended after about ten minutes because an internal engine case screw backed out and was chopped off by the primary gears. It locked the engine up. It felt as though the transmission had shattered, but it turned out to be a small problem.

The second day of testing a week later also proved to be scary. After about ten minutes, Swede pushed the bike off the track with a loss of compression. He said the ring must be broken. We pulled the head off and found a broken head gasket. Ap-



The front brake is secured by a twisted steel bar which is bolted to the studs in the fork slider leg.



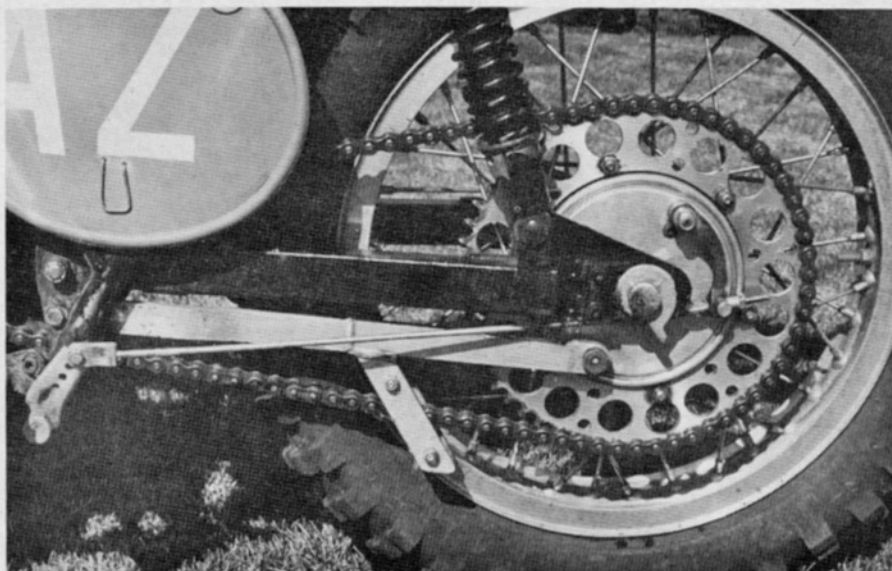
The heavy duty spokes by Buchanan have remained tight as a drum after two months of hard pounding.

parently I had put it on upside down, and an air leak caused overheating which destroyed the gasket. Luckily a spare gasket was in the tool box, so we fixed it and resumed testing. My first question to Swede was, "How does the acceleration and power compare to other 250's you have ridden?" Swede replied, "It is one of the two fastest 250's I have ever ridden." It will be better to let Swede give you his own unbiased opinion of the rest of the machine.

I think he agreed on how the bike handled. It took him some time to get used to it. He felt more at ease on the Cheney at first. After about 45 minutes on the AZ, he started going pretty fast and started appreciating it.

One of the characteristics I least expected is the AZ's ability to get on top of sand and really haul. It doesn't get bogged down by sinking into the

Continued on page 100



Wheelsmith Engineering installed their floating brake setup with the Maico rear hub.



After all changes have been made, the total machine weight is 197 pounds.



CYCLE GUIDE TESTS

LIGHTWEIGHT WEAPON

Light weight, quick acceleration and good handling combine to produce a potent motocross package.

The future trend of motocross is already clearly visible. It began with Suzuki's domination of the 250cc world championship series in Grand Prix competition in 1970. With a machine weight of 40 to 50 pounds less than the competition, the Suzuki works bikes were just too quick in the

acceleration bursts that spell winning in motocross. Joel Robert and Sylvain Geboers, the top ranked factory riders, had the additional advantage of less machine weight to wrestle around the course, resulting in less rider fatigue in the latter stages of the long 40 minute motos. When they

finished the season first and second respectively, the other factories knew they would have to build lighter, quicker bikes, or forfeit any chance of victory in the prestigious championship series.

The winds of change are blowing also in the United States, which is after all the largest market for the European motocross machines. A southern California firm is developing titanium frames for Husqvarnas, which Lars Larsen has already campaigned with considerable success. In the recent U. S. Grand Prix, top ranked American John DeSoto's modified 400 Suzuki was clearly no match in either handling or power to Sylvain Geboer's factory 370 machine. The latest report is that John will soon receive his own 'works' 370, which should give him an edge over his American competition which will be tough to overcome. According to reports, the western U. S. Maico distributor is building some super light titanium frames for sponsored riders. Soon the thousands of avid American motocross racers who want to remain competitive will be demanding the opportunity to buy sub-200 pound production machines, and the first factory to answer that demand and supply the machine will reap large benefits from the market.

In the meantime, the other alternative for the choosy rider is to build his own machine, utilizing special components and considerable ingenuity. One who did just that was Cycle Guide contributor Barry Watkins, whose 194 pound Yamaha 'AZ' was featured on the cover of the October '71 issue. Like most of our readers, the hands of the staff itched to grab this unusual machine, to see if the ride lived up to the promise. On a sunny Saturday morning at the motocross course at Saddleback Park, we got our wish.

We met Barry shortly before 9:A.M., to allow us ample time to test to our heart's content, before they kicked us out at the end of the day. The next few hours were spent in vigorously wringing out the special project machine, after first taking an hour or so to get used to the handling.

Barry pointed out three changes that he had made to the machine since the completion of the published project. The long front brake anchor strap had been replaced with a short twisted steel bar. The original Rickman rear brake was replaced with a Maico unit, with the spoking done by Buchanan. Finally, the original Bassani expansion chamber was replaced

with another Bassani pipe incorporating an integral silencer, but retaining just about the same power characteristics as the original.

The starting drill on the modified Yamaha engine was simple. A combination two-way switch and kill button on the left handlebar controls the separate coils, leading to a hot plug and a cold plug in the head. The hot plug is used for starting. The engine starts easily with two or three kicks when cold, with no carburetor choke required. After about five minutes of warmup running, just flip the coil selector switch to the cold plug, and ride to your heart's content.

The relative position of the seat, foot pegs and handlebars is comfortable. The width and shape of the titanium bars was right on for the staff test rider. The first impression of the machine in motion

open the throttle. With the power on, the front end becomes very light, which is good for directional control over the rough stuff, providing the rear end is not snaky. The rear axle has been moved back about an inch from the original position, with the result that the tracking is very stable. When powering over uphill bumps or across whoop-de-dooos, the bike tracks in a straight line, with no tendency for the rear wheel to hop from side to side.

The handling in the corners is quick, perhaps too much so for many riders' tastes. The fork and steering head angle is 28½ degrees, with a resulting moderate amount of trail. When you turn the handlebars even slightly, things happen. But the relatively long wheelbase and low center of gravity compensate for this nicely, with the result that the bike is still stable in



is one of extreme lightness and maneuverability. The handling feels more like a lightweight trail bike, but with greater stability and control.

The very quick acceleration takes some getting used to. The bike is considerably quicker than any of the standard 250cc motocrossers for sale, mainly due to the lighter weight. The power comes on very strongly; in fact, the engine is somewhat pipey, but the bike is so light, it still has ample torque to squirt it ahead when you

turns, and not squirrely. Power on in the turns is required with this machine's combination of geometry and handling. With power applied to the rear wheel, you can lean over a lot farther than is possible with most machines, without the rear wheel showing any tendency to slide out. This hard cornering with the power on and the bike heeled over sharply took considerable getting used to, but once the rider was programmed, it was a pleasant experience. Booming into the corners, a light tap on the rear brake



and downshifting set you up for the turn. Then lay her over and power on, but not too enthusiastically. There is plenty of power on tap, and too much exuberance can cause you to lose control.

The light weight of the machine requires continual modification of the average rider's habits. Corners with a sharp switchback, normally requiring downshifting into first gear, can be powered through in second. Likewise, normal second gear turns can be negotiated in third, without any tendency for the bike to hesitate when the throttle is opened. The result is that you can zip past riders on heavier machines when coming out of corners. This is the kind of advantage that can allow a poorer rider to beat a better one, simply because he has quicker acceleration in the places where he can turn it on. By the same token, if two expert riders of about

equal ability are competing on machines of equal power, but one machine weighs 40 pounds less, that rider has a terrific advantage.

The shift throws of the Yamaha transmission are short and crisp. Clutchless shifting up and down was the rule of the day, with very few missed shift gears. The only exception was an occasional missed shift when changing from second to third, but it wasn't consistent enough to be bothersome. A really competitive racer might want to tear down the transmission to check it, though. The gear ratios are well suited to the highly modified engine's power band, giving a wider range of speed than could be utilized on the motocross course. We never got into fifth gear all day. The straight sections just weren't long enough.

Standing up from a sitting position was smooth and easy. The foot pegs

are right under your tailbone, allowing a straight shove with the thigh muscles. The Schwerma foot pegs, which are a copy of the 1971 Bultaco Pursang items, are real boot grabbers. In the opinion of the staff tester, they have the best configuration of any on the market.

The saddle was not thick and soft, but it still didn't feel hard while riding. The box stock 1971 Yamaha forks, in combination with the Koni shocks, gave superb suspension over the roughest adobe ground, of which southern California abounds. The narrow gas tank never got in the rider's way, yet it carried ample fuel for the longest moto. The major problem that occurred during our test was the head gasket that burned out, causing the loss of compression. Inspection revealed that it had been put in upside down. There is a knurled lip on one side of the Yamaha copper gasket which fits into a recessed ring in the head. If this lip is mistakenly placed downward against the top of the cylinder, as was the case with our test bike, the combustion will eat away on the gasket until it fails. We replaced the gasket with a new one, torqued the head bolts to 25 pounds, and ran the bike for 10 or 15 minutes. Then we let it cool for a half hour and re-torqued the bolts again to 25 pounds. No more problems.

From the point of view of both builder Barry Watkins and the Cycle Guide staff rider, the response of everybody, and we mean everybody, who saw the bike was gratifying. The first question from men and boys was always the same; "Isn't that the bike I read about in Cycle Guide magazine?" We would allow that indeed it was, and the inevitable bench racing session would follow. It was fortunate we had all day to ride, because the groups of friendly, interested enthusiasts spent a lot of time with us. We don't know if every rider in the United States reads Cycle Guide, but it looks like every motocrosser in California does. We appreciate it.

Our overall impression of the Yamaha 'AZ' is that it's a well thought out and executed design. Admittedly, it's expensive, but for the serious motocrosser who can't buy a factory 'works' machine, a project like this may be his only alternative. But whether you're interested enough to build your own or not, it's nice to know the components are available, in case you become dissatisfied with the production machines for sale.

—Swede Carlson.