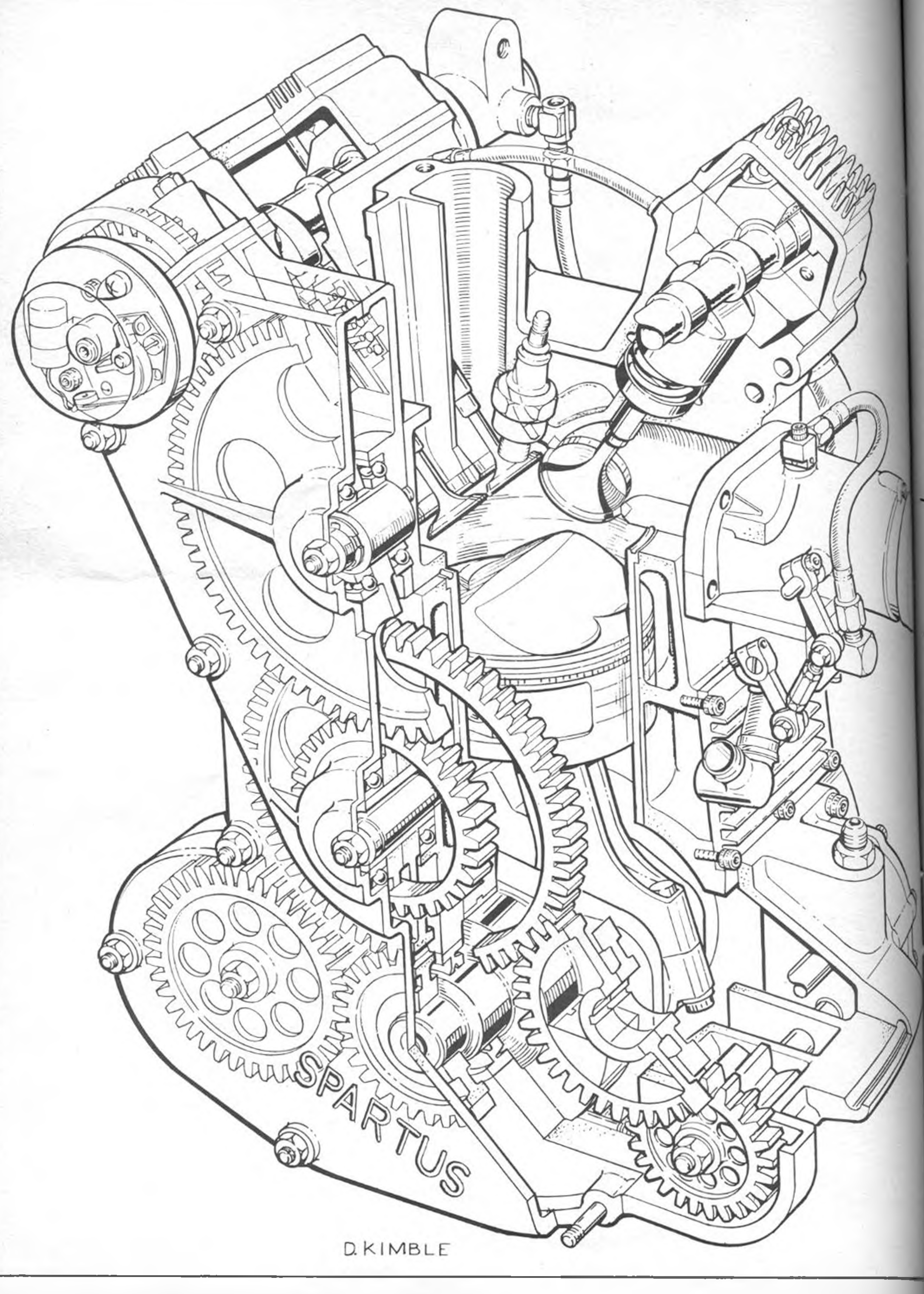
SPARTUS
D. KIMBLE

Don't Count The Thumper Out

FOUR VALVES, FUEL INJECTION AND 60 HP PUT THE SPARTUS SINGLE BACK IN THE RUNNING WITH THE CURRENT BATCH OF MULTI'S. IT'S **ONE** OF A KIND, **SINGULAR**LY TERRIFIC, **THUMP**THING ELSE!

BY TONY MURPHY

Ideas are formulated in many ways. A conversation at a cocktail party, a bull session at a race meeting or the old-fashioned bench racing that takes place any time two or more motorcycle enthusiasts get together. Lots of great ideas get passed back and forth —lots of bad ones too—but often a seemingly insignificant remark can be the spark that sets one to thinking about a particular subject area. Such is the case with our "project." A good friend remarked that "four-stroke singles are dead." Immediately put on the defensive due to a fondness for single-cylinder machines, the only possible reply was the point blank question, "Why?"

Reasons don't come readily to mind. True, the single was for a long time prominent on the street as well as the race track. Then, "poof," it was gone. BSA, Norton, Matchless, AJS and Velocette were all popular and certainly had more than their share of race victories. Manufacturers like Benelli, Ducati, Morini, Mondial, Moto Guzzi, Gilera and NSU fielded extremely competitive singles in international racing. In the United States, BSA singles were virtually unbeatable on the dirt tracks. Then manufacturers all but stopped building them. The single did indeed wane but not from old age. It was factory genocide.

EVERYTHING BUT POWER

A comprehensive list of the pro's and con's of the single-cylinder design will find but one major reason for its extinction. In its latest form it did not offer the engine performance that could be had from engines with two or more cylinders. However, in nearly every other area of design that has proven important to building a complete competitive machine, the single stands tall. It can be narrower and can therefore be mounted lower in its frame for better handling and less frontal area. It can be smaller and lighter for better braking and acceleration. It can be less complicated and therefore less expensive to produce and easier to tune.

A single suffers only from lower total engine performance. The multi's definitely have the edge, but the gap can be narrowed considerably by attention to the chassis and suspension. In Europe, Manx Nortons are obsolete but because of a fine chassis, they are still in the hunt on race courses which have a premium on handling rather than horsepower. Good Nortons develop 50 hp and weigh more than 300 pounds, and yet snap at the heels of 60-plus-hp multi's that weigh approximately the same. On the fast circuits they are out of business strictly because they lack the ability to accelerate or match the top speed of their rivals. With more horsepower and less weight it would be another story.

So why not do just that? We could build a 500cc four-stroke single that develops over 60 hp and house it in a good-handling package that weighs in at around 260 pounds. Why not? For one thing, it is too expensive. For another thing, Mr. Petersen is in the publishing business, not the motorcycle business. So that's out. But there is an alternative, and that's what we decided to do. We would put our collective thoughts together and design one we thought could do the job.

FROM WHERE THE ENGINE

Then the real head-scratching began. Before any chassis configuration could be finalized, the size and shape of the power unit had to be decided. Once we had that, the whole machine could be laid out. It became THE big decision, since every other component's design would be affected by it. Thought was given to borrowing some of the internal components of an existing high-performance automotive engine and building a single-cylinder structure around them. The whole project began to take on the seriousness that would be connected with actually building a real engine. No pie-in-the-sky, far-out design approaches; just proven ideas that would create a practical design as well as adequate performance.

It was quite feasible that one-eighth of a super-hot Ford or Chevrolet could be expected to put out approximately one-eighth the power of the actual engine. After all, the better V-8's are developing gobs of torque and doing it reliably at 8000 rpm and more with pushrods. One could easily borrow their crankshaft dimensions, buy their rods, pistons and valve gear and build them into a single-cylinder configuration. The final displacement would be a problem since bore and stroke ratios would have to be juggled, and with them some of the power potential might be lost.

It was frustrating. No matter how you looked at it, it was still just daydreaming — nothing more than a bench racing session justified by the fact that it might be an interesting story to write, if not read. It lacked realism. It was an illusion that unintentionally would be critical of manufacturers who have built singles, and

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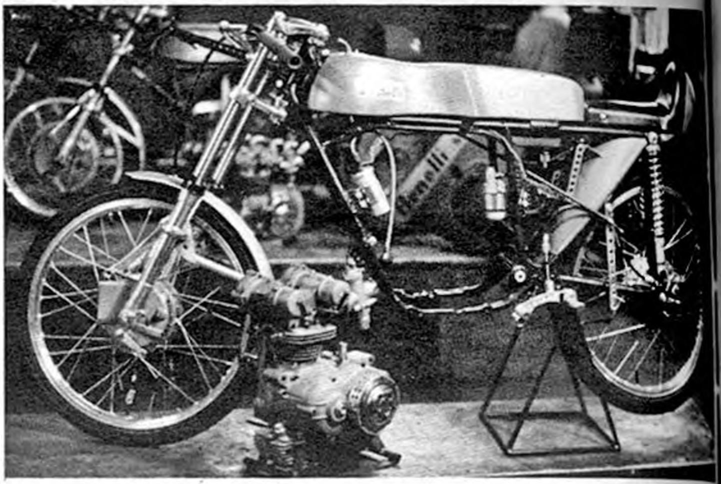

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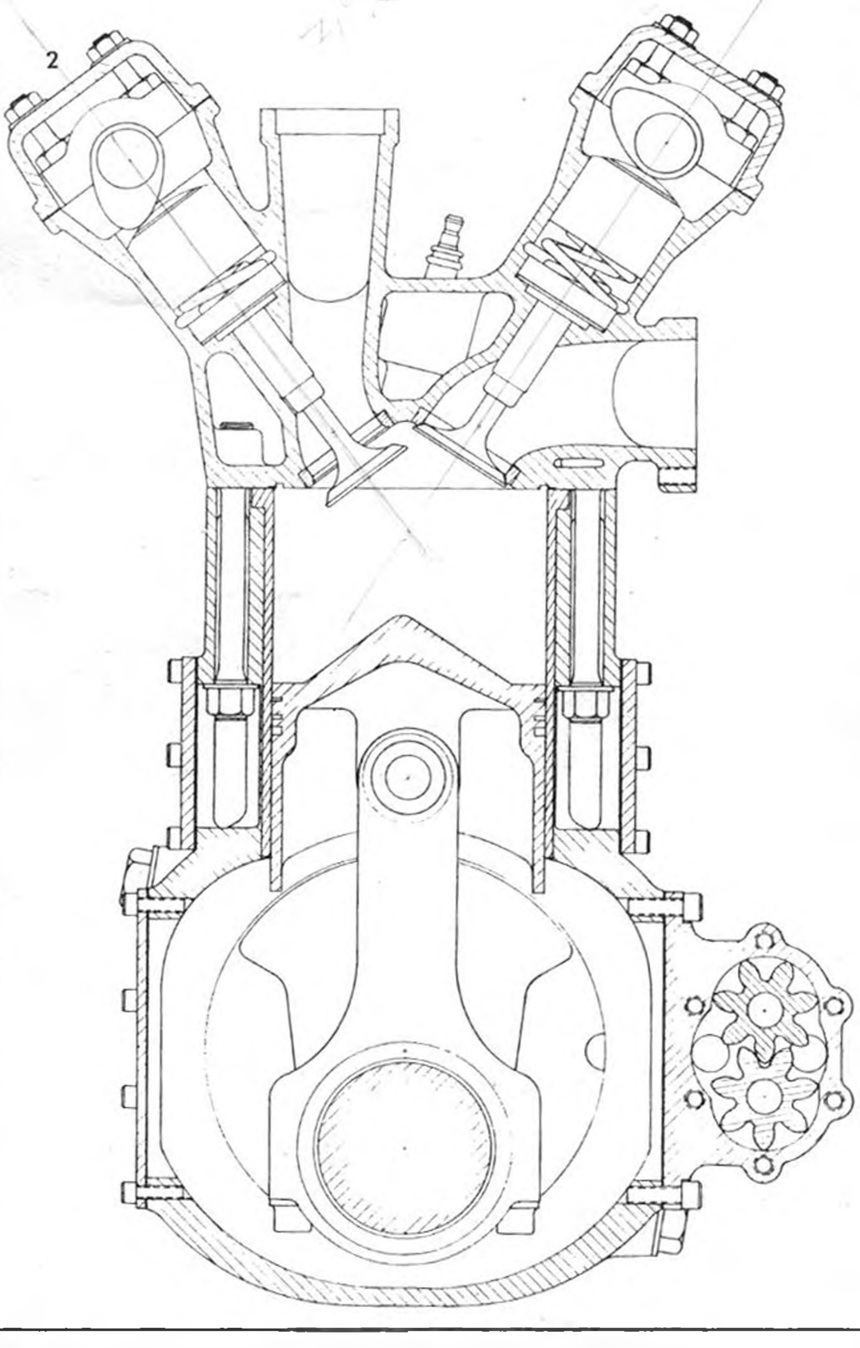

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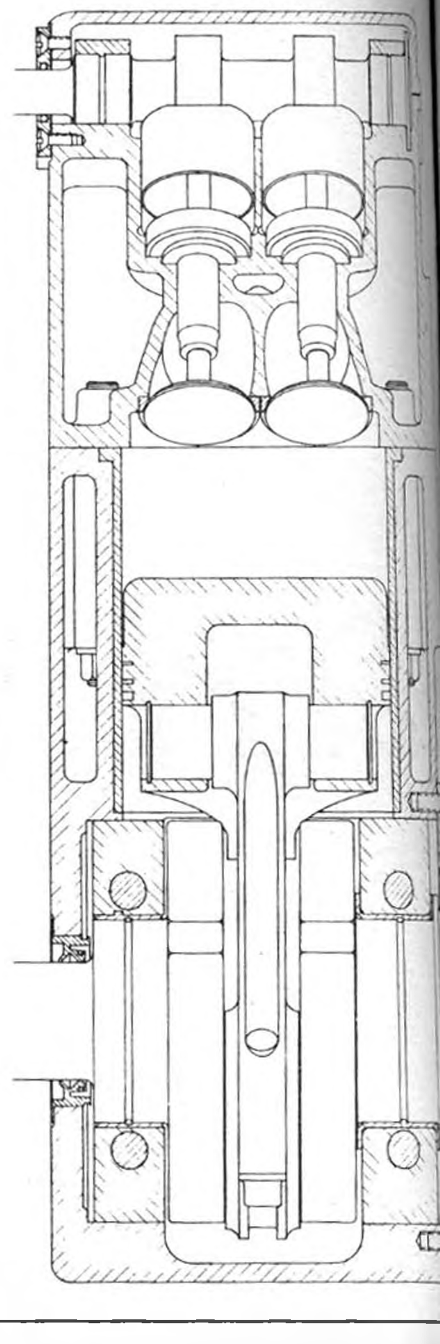


yet it would never prove its worth—except on paper. No, it wouldn't be fair. If we were to build a better single-cylinder engine to power a racing machine, we had better build it or forget the whole thing. Or we had better find one that had already been built. That's just what we did.

THE "SPARTUS" SINGLE

Dubbed "Spartus" by its builders, it was not really new. In fact, we had seen it before, and if the truth were known, it might have subconsciously had an influence on wanting to build the ultimate single in the first place. Art Sparks and Tim Witham were responsible for building the engine. Both men have illustrious backgrounds in the high-performance business, particularly with the world-famous S&W valve spring covered elsewhere in this book.

In the early Sixties they undertook to build an all-new Indianapolis race car powered by their own six-cylinder engine. For test reasons they built a 500cc single-cylinder. It ran — still does — ran well. Initial running produced over 60 hp, and refinements to camshaft timing and the many other variables that contribute to ultimate performance held hopes of perhaps another 8 or 10 on top of that. But we won't count on that. We had found our 60-plus-hp single. We could touch it, listen to it run and—best of all—we could build our motorcycle around it.

Bearing in mind that it was never intended for a motorcycle, there are a few things that are less than ideal for this use. Leaving that till later, let's look at the things that it has going for it. It is small by 500cc single-cylinder standards, being some 5 inches shorter than a Norton Manx or BSA Gold Star. It weighs about the same, but could have been considerably lighter if it had been designed as an air-cooled rather than water-cooled engine. Adding to its weight are the relatively bulky innards designed large on purpose for use in an engine that was ultimately to be supercharged. But a plus is that extra strength is also extra life, making the engine able to withstand hard use for sustained periods.

INTERNAL CONSTRUCTION

The crankcase assembly and cylinder barrel are cast in one unit, so it is probably better described as a block. A spigoted liner is pressed in from the top, and during initial tests several bore/stroke ratios were tried in the same basic casting by using different liners, crankshaft and rod lengths. The present dimensions measure 3¾ inches for the bore and 2¾ for the stroke (95mm x 70mm).

Advantages of this type of construction are many. Normal motorcycle practice is to split the crankcases into two halves, either left and right or top and bottom, and then bolt them together around the crankshaft itself. The Spartus design allows the crankshaft to be inserted in a single robust structure that, because it more closely resembles a sphere, does not require the weighty beefing of separate cases. Overall weight can therefore be lowered with no sacrifice in strength.

The timing side of the crankcases, which in our installation will be the right-hand side, has an opening just large enough for an oil seal on the 1-inch diameter shaft. Large aluminum bearing housings are interference fitted in the crankcase casting and support the crankshaft on both sides in automotive babbitt inserts. The main bearing housings and the crankshaft are inserted through a larger opening on the drive side. Rod and piston are fitted through the cylinder bore; car style.

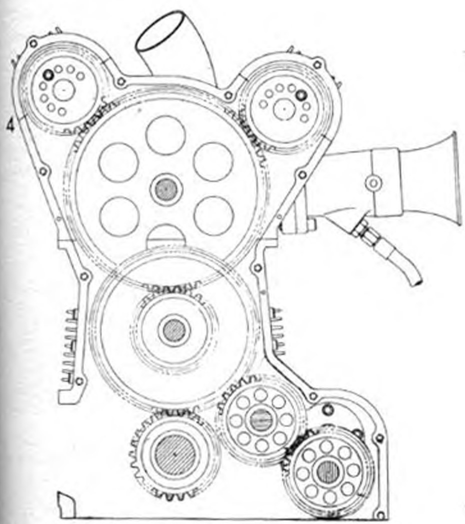
Split connecting rod is supported on a 2¼-inch automotive-type insert. It is an H-pattern Carrillo high-performance automotive item that has proven nearly indestructible in high-revving car engines.

Oiling is handled by a gear pump driven by the crankshaft and mounted on the front side of the engine at crankshaft center height. Since the intent was to have the cylinders in an opposed position (a la Porsche), the location of the oil pump would have placed it at the lowest point on the engine. In this way the oil would drain down into the pump and assist scavenging. In our application the pump is a little too high to benefit from the call of gravity, and some suitable modifications in this area might prove necessary. It could be done easily with a remote oil supply and would work efficiently no matter where the location.

MORE CRANKCASE VOLUME

On the opposite side of the engine from the oil pump, the photographs show a small fabricated tower. Initial testing showed that the lack of enough crankcase volume was causing a pumping effect, and the addition of some more volume was accomplished by using this small plenum chamber. Because its function is merely to provide more crankcase area, it could take whatever shape became necessary to cater to space requirements of other components.

The crankshaft itself is machined from 5140 steel, has main bearing journals 2¾ inches in diameter and is the same shape as an automotive crank throw with a small 5½-inch diameter at its widest point. An outside flywheel 8 inches in diameter is attached to the drive end of the crank by six 5/16-inch dowels. Whatever drive method is employed then connects on the outside of the flywheel and is held in place by a 1⅜-inch bolt threaded into the center of the shaft.

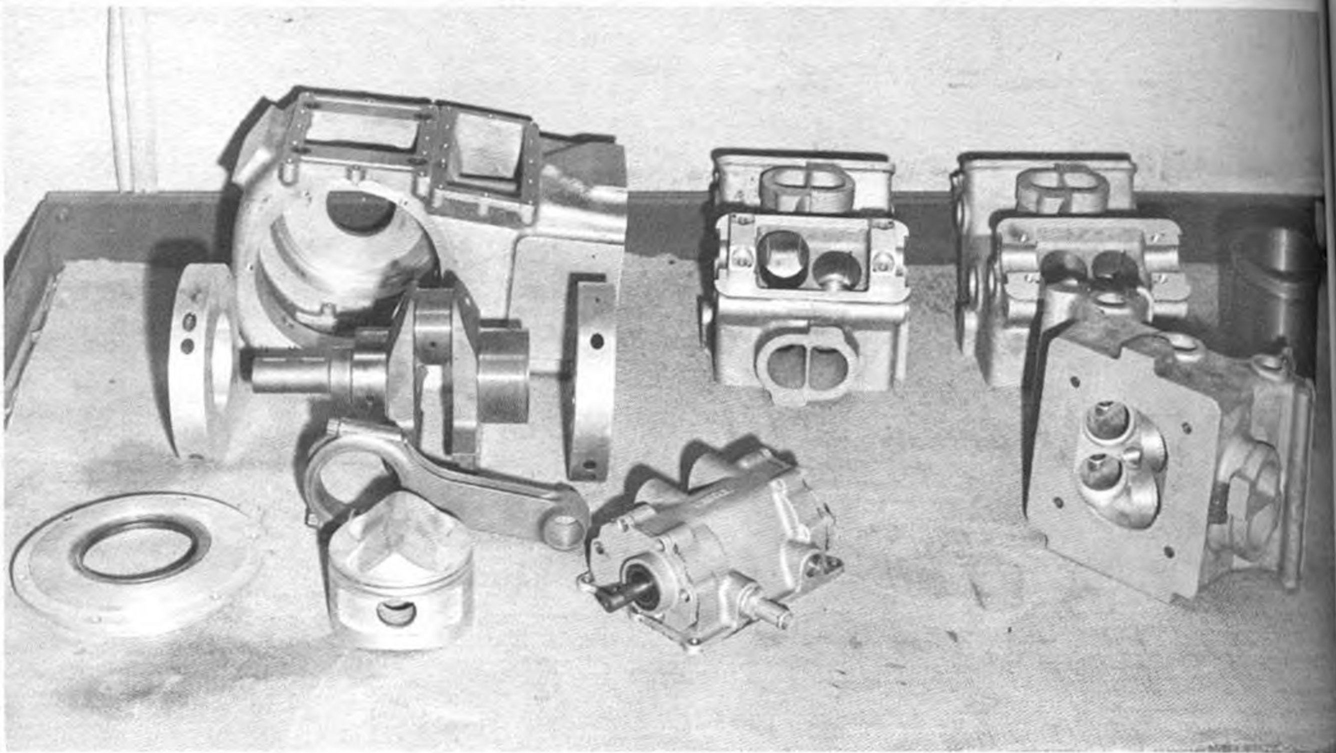


1. Feasibility of using a single-cylinder engine to develop a multi is not new. In addition to the automotive companies, two-wheel manufacturers find it the easy way to go. This little single was built to test ideas for World Champion four-cylinder Benelli.

2. A sectional side view, right side, of the Spartus single, reveals the construction of the unusual crankcases and rugged simplicity of the internal components. The overall height of the engine is a very short 17 inches.

3. Sectioned fore and aft, the narrowness is impressive. Note the huge, car-type main bearings supported in large-diameter alloy housings pressed into the case. The holes above and below the main bearings are for through-bolts that add to the total rigidity.

4. Gear-driven camshafts have vernier timing adjustment. Oil pump is driven from intermediate gear at reduced speed. Water pump could be driven from same gear on the other side of the engine or worked externally by the drive belt.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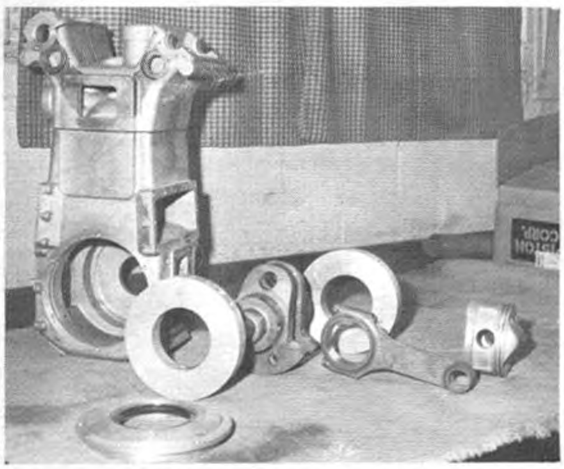
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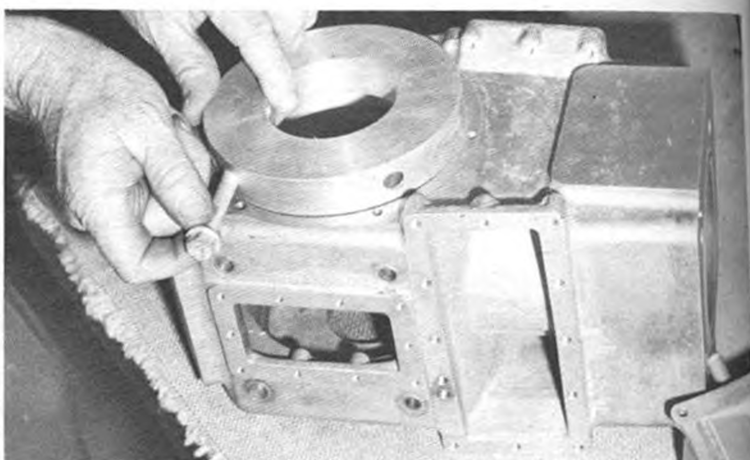
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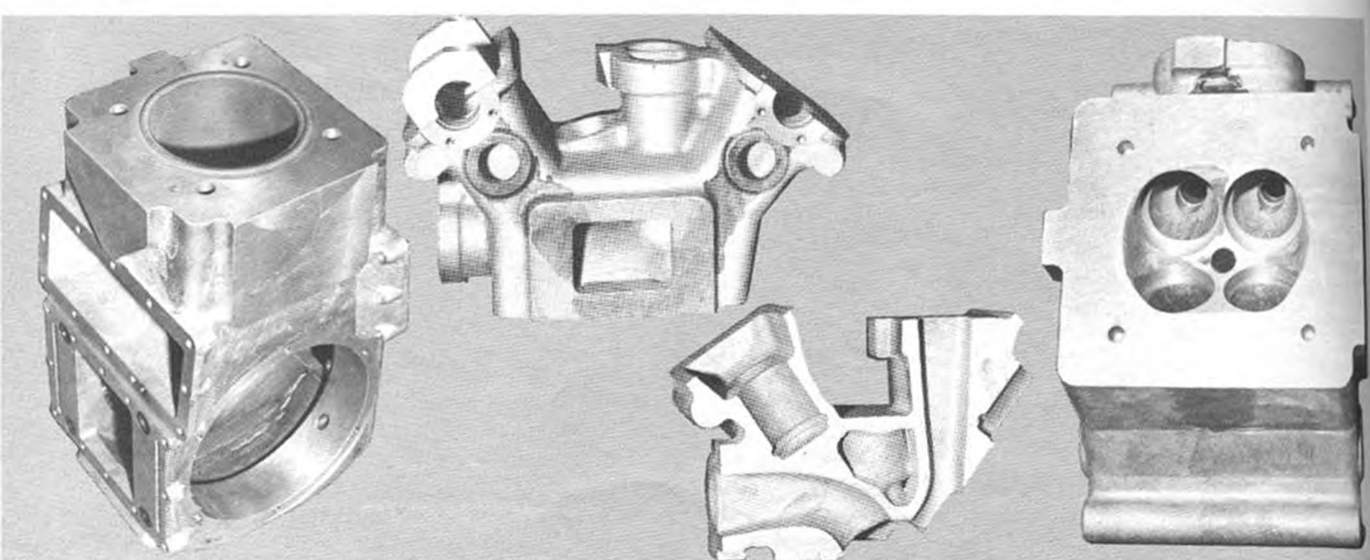
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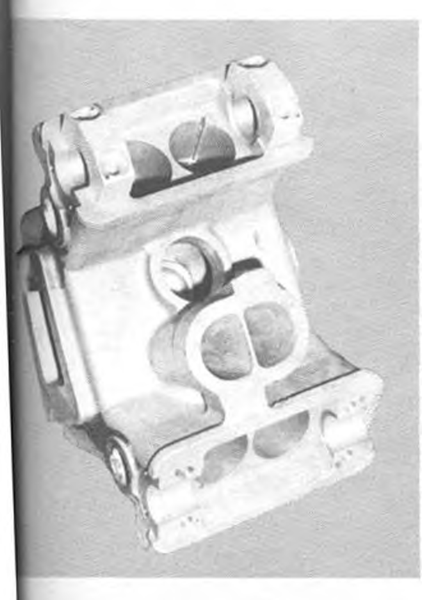
Don't Count The Thumper Out

1. Just how serious the Spartus effort was, is evidenced by the number of components prepared for a test engine. Several cylinder head configurations were tried, as well as different bore/stroke ratios. Then testing was stopped.

2. This is the order in which the major components go together. In our application this would be the left side of the engine with the head turned around to place the intake up front. Relationship of bearing housings to crankcase can clearly be seen.

3. Extreme rigidity can be understood when one realizes that those bearing housings are an interference fit in the cases, and the through-bolts lock them in place. Note water passage around cylinder.

4. Partially machined castings and cylinder head section give a further clue to the potential of the Spartus as a single-cylinder racing engine. Far from being a back-yard special, it was designed and built by individuals that knew from experience what was needed.



camshaft bearings are identical at both ends. So if you had noticed that the intake side seemed to be jumping around from illustration to illustration, there's your answer.

The need to do this was brought about in the search for a mounting position in the chassis. If it were to be mounted vertically, the exhaust pipe would come up through the gas tank. Either that or the pipe must make an extremely sharp bend and then resemble a serpentine in its progress toward the rear of the machine. If the engine were laid horizontally, it would require that the engine be mounted far enough back from the front wheel to allow pipe clearance. Then the pipe would still require some tricky bends and there would not be much room for a transmission behind the prone engine. Furthermore if this was to be a fire-breathing model lighter than the competition, it would require more weight on the front wheel to keep it from continually being airborne than either of those layouts permitted. There was only one choice left.

The crankcase portion of the engine carries quite a bit of weight so it should be just as close to the front wheel as possible. This we did, and then rotated the engine around the crankshaft center some 30° to the point where it gave adequate clearance to the transmission mounted behind and gave the exhaust pipe a relatively bend-free path rearward. The intake system then fits snugly under the gas tank and is protected from disturbing air by a combination of the frame steering head and appropriately placed ducting drawing air from above the gas tank and behind the forks.

FUEL INJECTION

Initially tested with fuel injection, this would be retained for the present to be replaced by carburetion if it became necessary.

So far, so good. To this point there can be no argument with the fact that such a configuration, using an existing engine is feasible. Based on the performance figures of the engine, it is probably the most potent 500cc single ever manufactured considering only the 60-plus power of its mildly tuned state. With more power, who knows how much, it would certainly be a competitive machine in many types of racing. So let's go on as though we were part of a serious effort to make it into a raceworthy machine. What's next?

Before we actually put a chassis around the motor, we need some means of delivering that power. It would be nice to adapt a gear-driven transmission but, alas, that would require some means of permanently attaching the engine to the transmission housing. This would require a common casting which would make the whole assembly an in-unit affair beyond our facilities. The only alternative is to chain-drive an existing transmission by means of a sprocket mounted on the outside flywheel.

There is really only one available transmission that would be suitable, and that is the AMC four-speed unit as fitted to the current batch of Norton Commandos. Any Norton or late-model Matchless owner will tell you they are indestructible, but there are even more important reasons. The basic transmission is identical to those used in the Manx Norton and G-50 Matchless and therefore has close-ratio gears available. In addition, there are sets of five- and six-speed gears made to replace the original four speeds with no changes to the actual gear cases. With high horsepower outputs come narrow power ranges; with narrow power ranges four speeds are just not enough to get the job done. Five would be minimum —six would be ideal.

With the dimensions of both the engine and transmission, we can now set about bolting them together and putting a chassis around them. Engine plates which bolt to both sides of the transmission housing and then to the engine itself are simple enough to fabricate. There are several suitable places to attach to the engine; the water jacket covers and plenum chamber mount are robust enough to attach a specially made cover with mounting points for the engine plates, but even if they weren't, some handy surgery with a heliarc could provide mounts that would be up to the job.

THE CHASSIS

As outlined elsewhere in this book, a flex-free frame is the heart of good handling. The forks and rear swing arm must be equally as rugged so that there is no deflection at all. Add to this a proven overall geometry and weight distribution, and you should have a good-handling package, especially after minor adjustments here and there.

The original concept of our little project had been to design a competitive single-cylinder engine and house it in a lightweight chassis that

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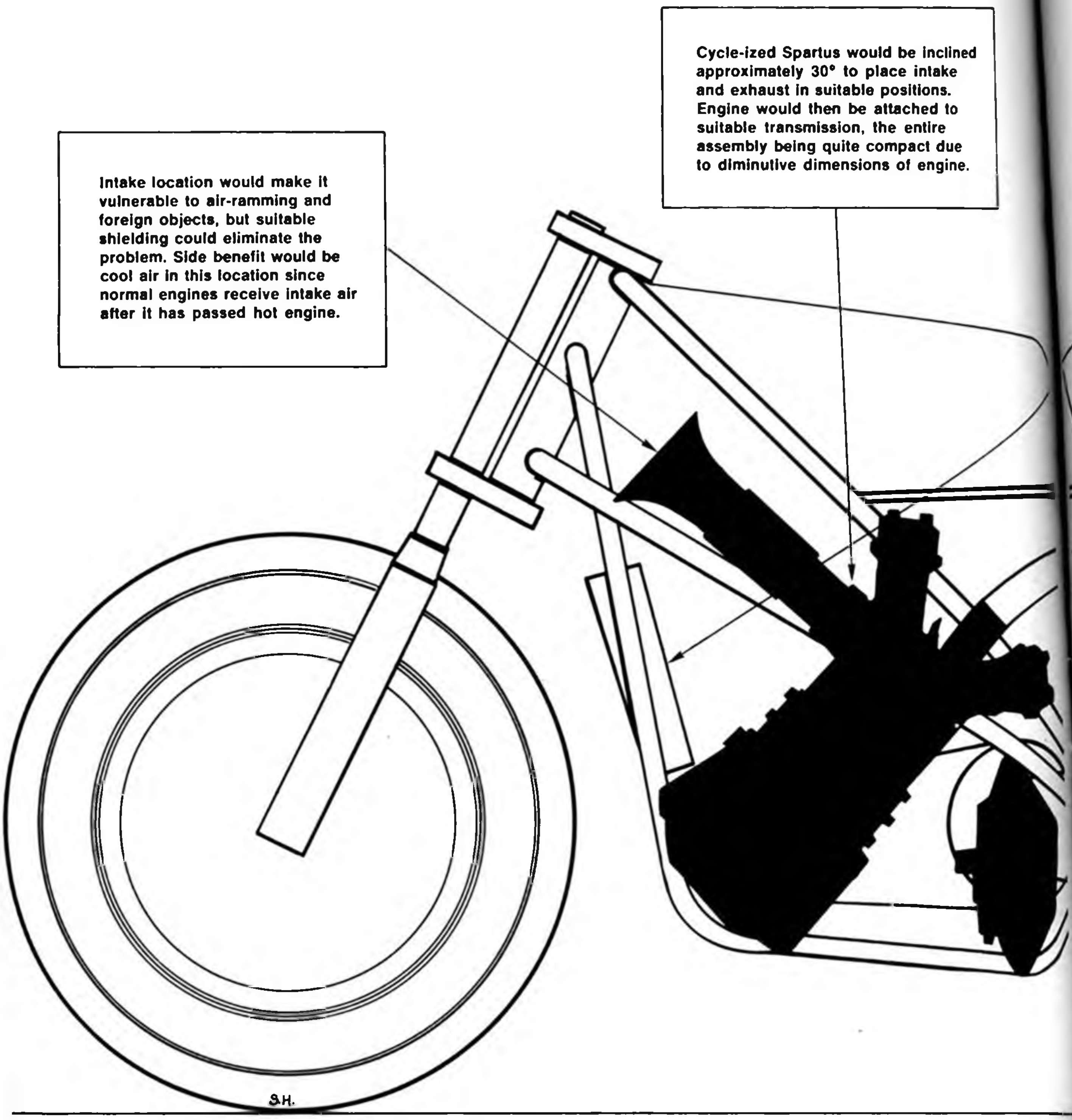
possessed superior handling qualities. Since it was only to be built on paper, some unique chassis concepts were at first envisioned since it is easy to speculate on what would be better than the current way of doing things. But our discovery of a "living" engine turned our thoughts away from speculation and toward genuine possibilities. Thoughts of exotic monocoque frames and new concepts in suspension were put aside in favor of a conventional design that would, were it really being built, eliminate the chassis experimentation that would surely be necessary. A conventional chassis could be made to handle as well, if not better than the competition. Besides, the powerplant could always be installed in a "trick" chassis at a later date.

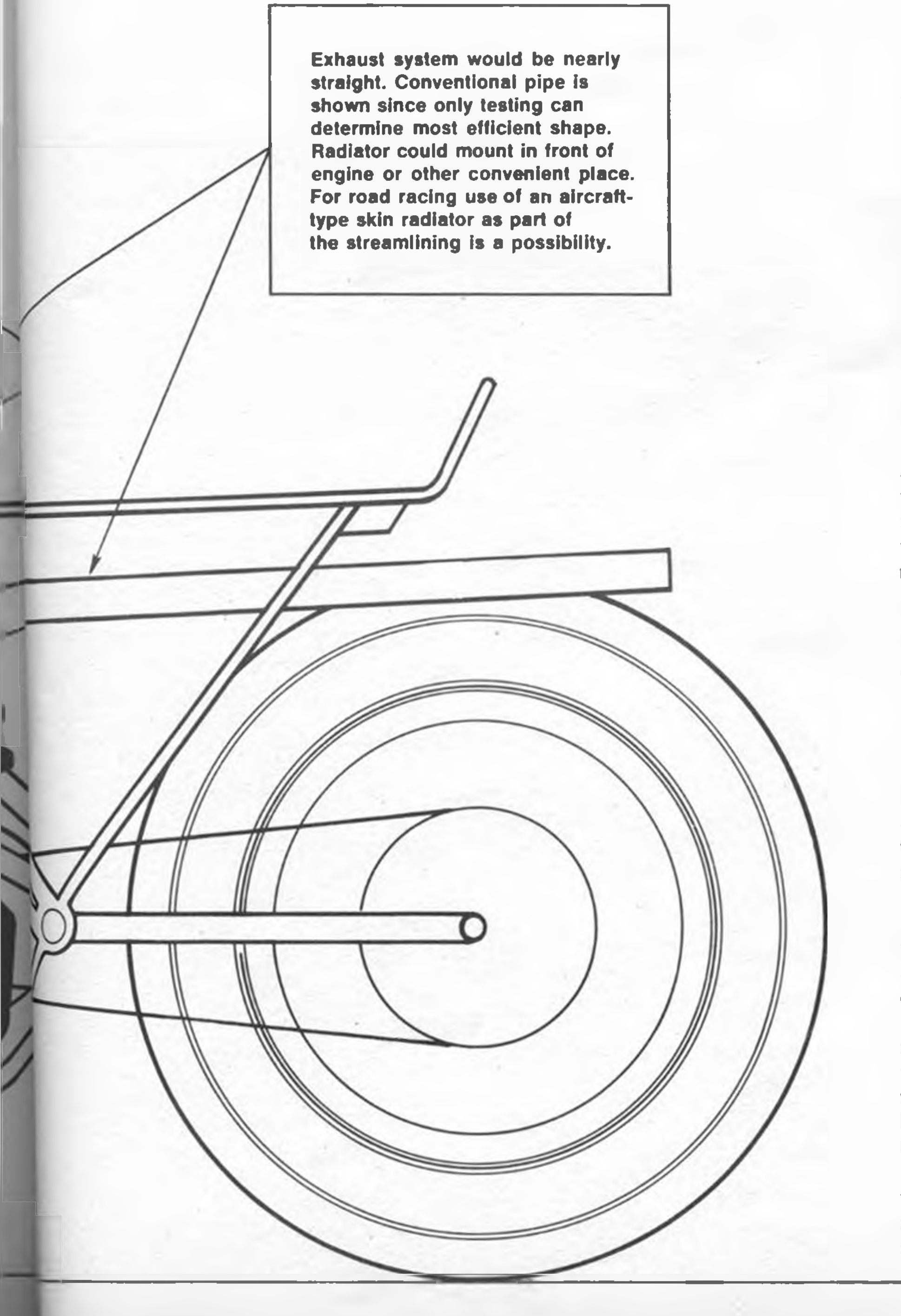
WHERE TO START?

Unhampered by a massive power unit, the length of the machine and the amount of ground clearance are really flexible. Mounting the engine as close as possible to the ground will



get the weight down low; the length of the wheelbase will affect the responsiveness of the steering. A figure of 50-52 inches was chosen for the wheelbase since the machine would be easier to maneuver. Machine for machine, the one with the shorter wheelbase will prescribe a given turning circle with less angle of lean. Smaller wheels have the same effect on the turning circle, so we have opted to use 16-inch tires mounted on lightweight cast magnesium wheels. The combination of short wheelbase and small wheels, together with the low overall weight of the machine should make it extremely easy to handle on tight courses and in traffic situations.

Sixteen-inch wheels have other advantages. The relationship of the center of gravity of the mass of the machine and the contact patch of the front tire can be advantageous to braking. There is some mechanical advantage that should actually improve braking power, if not stopping power—a factor that is determined solely by the contact area of the tire. To benefit from this, the tires are of larger-than-normal section, being close to a 4.00 size. This larger size, combined with the fact that the machine does not have to be leaned over as far as its longer, larger-wheeled competition, places more rubber on the road during cornering. Conceivably, this would leave the rider with more left when the other fellows are on the ragged edge, and perhaps with a slightly modified riding technique the machine could be cornered faster than the competition when riding on its ragged edge.



FUTURE PROJECTS

So we have the wheelbase, wheel and tire size and a general idea of the machine's ultimate configuration. The engine/transmission will fit within those dimensions, so it remains only to hook it all together with a suitable tubing and hang forks at the front and a swing arm at the rear. We won't go into the chassis in detail, since as we have already stated it would be of conventional design for the purpose of testing the engine's performance. At this time we wish only to prove the feasibility of using this existing engine within the confines of a motorcycle chassis. If it were to work as well as predictions indicate, then a major effort could be aimed at building an equally advanced chassis that would further raise the competitiveness of the whole unit with the existing 500cc racing machines.

Not coincidentally, we have a chassis project in the back of our heads, the concept of which we feel is long overdue in the two-wheeled world. A full technical report is scheduled to run in the next (Winter) issue of *Motorcycle Sport Quarterly*. Initially, the designs are aimed at eliminating all that is wrong with existing chassis and suspension systems and replacing them with a concept unaffected by motorcycle tradition.

By now you may have guessed that it is of the monocoque type so popular with car manufacturers. That it is, although it is unlike any of the past efforts of machines such as the Ariel Leader and the 250cc Ossa road racer. It is a true monocoque chassis which performs all of the needed functions of a two-wheeled vehicle, but not in a conventional manner. If that interests you, tune us in in about three months and we'll try and convince you that it is the basis of the motorcycle of the future, both on the street and the race track. •