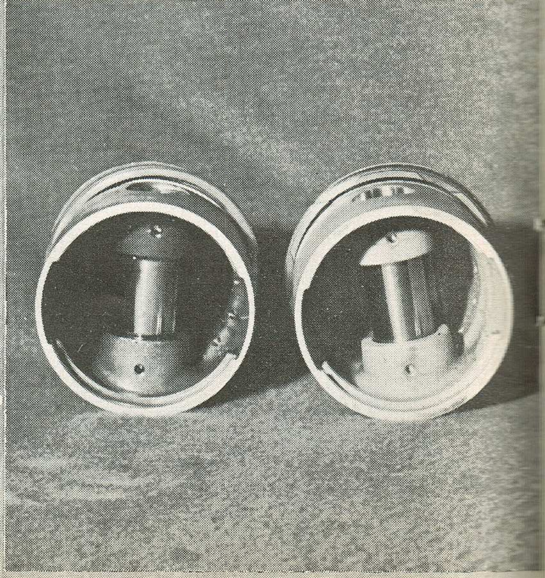
SCI builds an MGA TWIN CAM for competition

The potential was there — all it needed was coaxing. Here is how it was done.

by John Christy



LEFT — New type of piston is seen at right. Rings are closer together and there are no vent holes visible. In the SCI MG the top chrome ring was replaced with an iron ring similar to second and third units. RIGHT — Pins are palm-push fit at room temperature. Large ridges visible can be cut for balance.

SUBSCRIBERS and regular SCI readers who were with us for the October and December, 1958, issues will remember a certain black MG Twin Cam, New York license number 6N 3298. This particular MG was one of the first Twin Cam cars off the boat and it had, from the moment of its landing, anything but a life of tender loving care.

For the October issue it was tested as delivered. The results, while good were not terribly impressive. Performance was on the order of that of a Stage 4 MGA but with more docility than is found in the stage-tuned rocker box car. In short, a good car but no class F winner.

In the December issue we told how we attempted to improve the raceability of the car without going into the engine. In brief we stiffened up the suspension in front, changed the Dunlop Roadspeed tires for Dunlop R-3 racing rubber and removed about 80 of the 150-plus legally removable pounds of weight. Lap times around the Lime Rock Park course dropped from 1:20 to 1:18.5. For the earlier October issue runs we had already experimented with gears, dropping the original 4.3 to 1 rear end in favor of 4.55 to 1 final drive gears, one of three standard sets available with the car. Also installed at that time was the optional close-ratio gearbox with ratios of 2.45, 1.62, 1.27 and 1.00 to 1 respectively in first, second, third and fourth. As we said, all these little things added up to about two seconds worth of lap time. At this point we could pursue this tack no further without actual body and chassis modifications that would have nullified the "production" status of the automobile.

The obvious succeeding step was to check out the engine. There isn't a true production power plant in the world that is perfect — the exigencies of a production line won't permit the hand fitting and careful tool setting that must be used if the final product is to fit the designers plans perfectly in all respects. For that matter, many racing enignes are built up and then carefully torn down and reassembled before ever appearing on the race course.

It was obvious by this time that this particular MG was no exception. In the first place it had been well and truly pushed from the start and it was now showing the strain of many fast laps and acceleration runs. Power was very obviously down, oil consumption was up, water temperature stayed high, it pinged piteously at any but the lowest ignition setting and it "ran on" like a berserk diesel. It would still turn 7000 revs without clattering but there just didn't seem to be any power coming through the flywheel. It didn't have the willingness that two cams, nearly 10 to 1 compression and 1600 cc's would lead one to believe was there. In short, it was a very unhappy, unhealthy engine.

The one problem here was that the car was not the property of SCI. It belonged to Hambro Automotive Corporation, the importers of all BMC products in the U.S. A call to Hambro management elicited the necessary permission to delve into the engine with two provisions. First the car must remain a legal production machine and second, that the results must not be listed as official recommendations of either Hambro or of the MG Car Company. The first provision was already part of the plan and the second was absolutely standard procedure in any case.

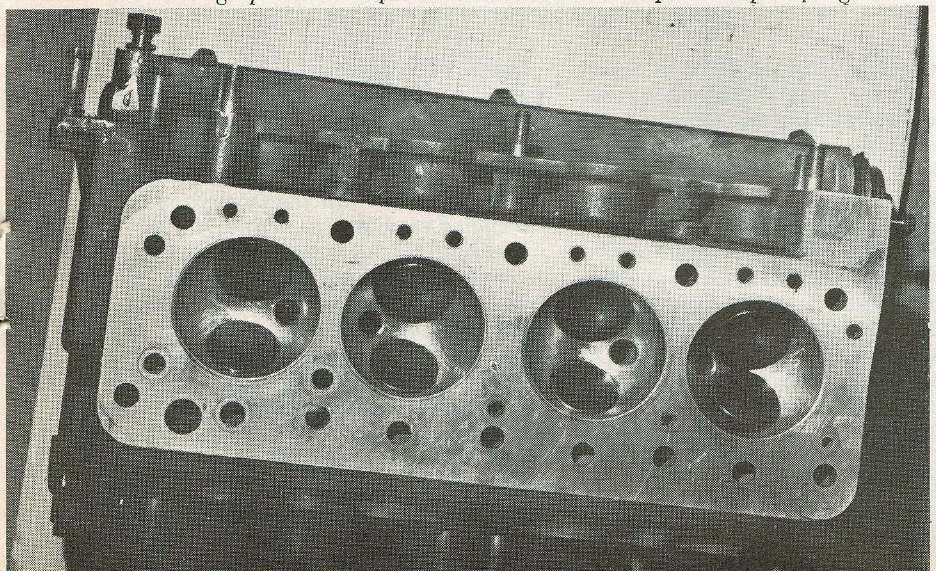
The car was then taken to Imported and Domestic Service, Ridgefield, Connecticut where master mechanic Joe Virag makes good machinery better. Virag had already reworked a Sprite for SCI with considerable success so we were familiar with his brand of craftsmanship. DOHC equipment is also a specialty of the house. The obvious first move was to pull the engine, a task more easily talked about than accomplished. We were to learn many things about MG's new road-eater and the engine pulling lesson was the first. The Twin Cam engine is not only wider than its rocker-arm cousin across the head, but there is considerably more girth at the bottom. The result was that the increased size of the cast alloy sump hits the front cross member when an attempt is made to remove the engine in the normal way. Either one of two alternate procedures must be used; the gearbox can be unshipped from its mounts and slid back carefully, or the sump can be removed. Of the two, the sump removal tends to be more tedious but, in the long run, easier. In any case one doesn't just unbolt the engine and lift. The long, tuned exhaust system must also be dismounted in either instance.

Next, the engine was mounted on an engine stand and all manifolding was removed as were the two angular cam covers. Here the dissassembly was halted and a degree wheel was mounted on the crank nose. Every cam lobe and every valve was then checked out.

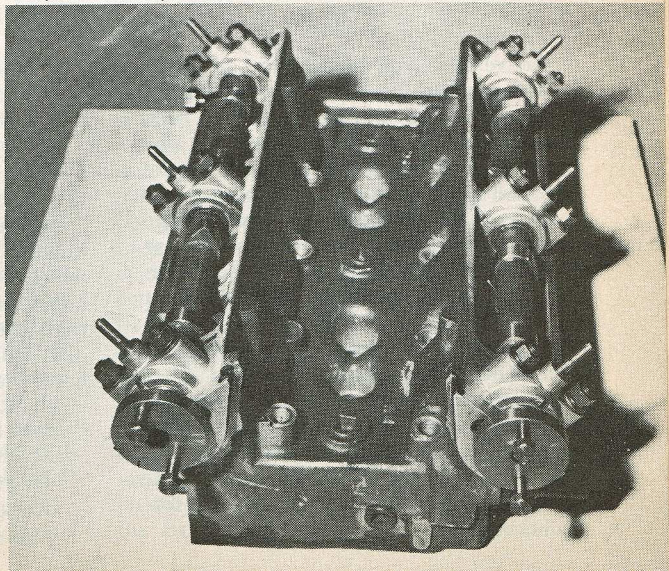
At this point and because of what follows it is only fair to point out that this particular car was one of the first 40 produced in a pilot run. The engine was not put together at Abingdon but was run through the production line at BMC's huge Engines Branch plant. The pilot run, we understand was a check to see if it was feasible to produce the Twin Cam in quantity on a production line.

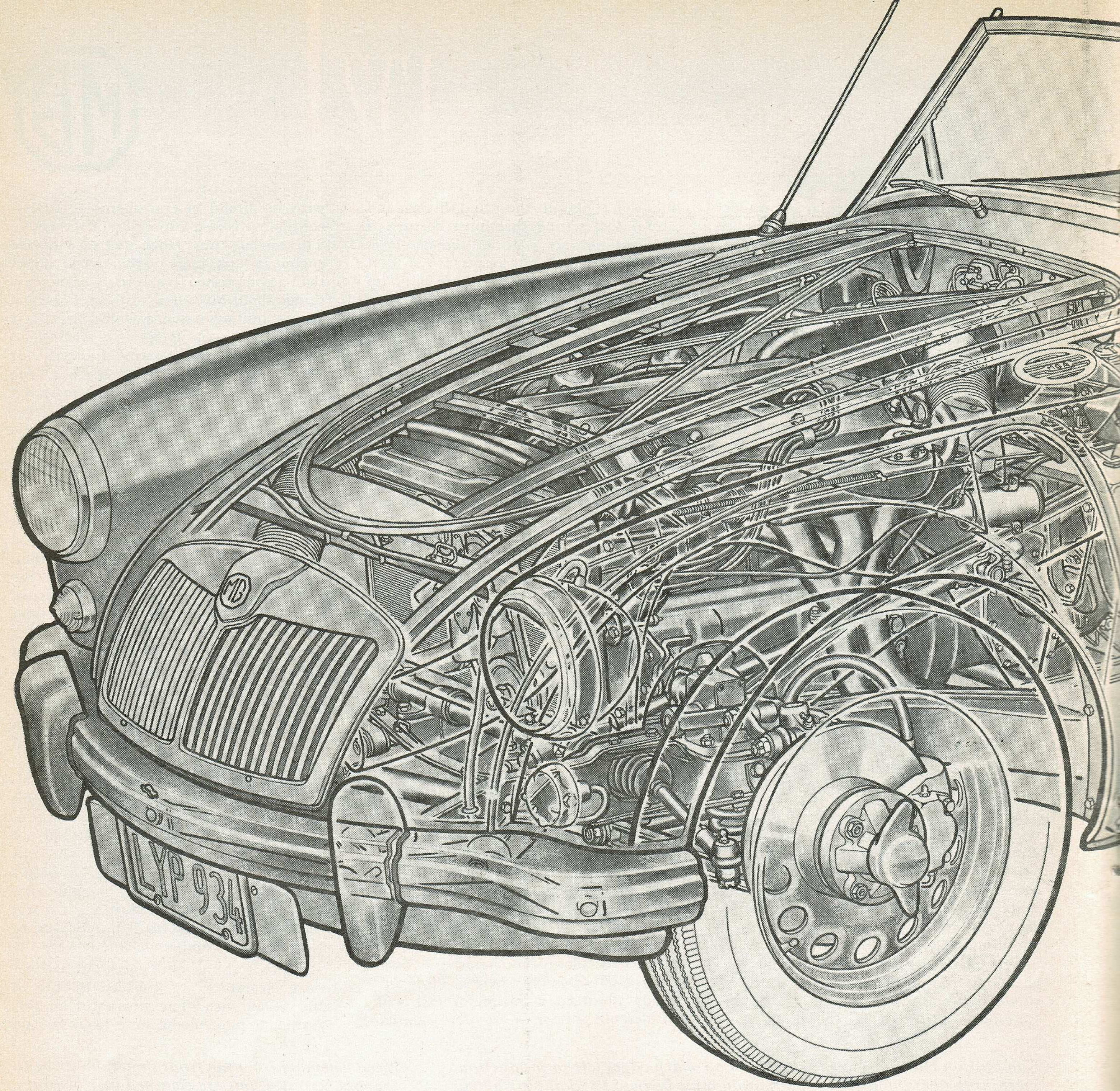
But back to the valve check-out. Correct valve clearances are specified as .018 to .019 of an inch. The clearances on this particular pilot model were from .016 on

Combustion chambers were relieved of all sharp edges left in production machining operations. Special attention must be paid to sparkplug holes.



Head assembly from the front shows the straightforward layout. Cams are clamped in 3 bearings.





one valve to .021 on another and all points in between for the rest. The cam timing also gave a clue to why we hadn't been getting the power we had expected. The intake cam checked out at four degrees late and the exhaust cam proved to be seven degrees early. In other words the intake valves were opening and closing later in the cycle and the exhaust valves were operating much too soon. The net result was that most of the fire was going out the exhaust instead of pushing the pistons down like it should.

Lesson number two. If you have one of the early series Twin Cam units and are not getting the wallop you should, set the cams by use of a degree wheel and depending on the camshaft numbers use the following figures:

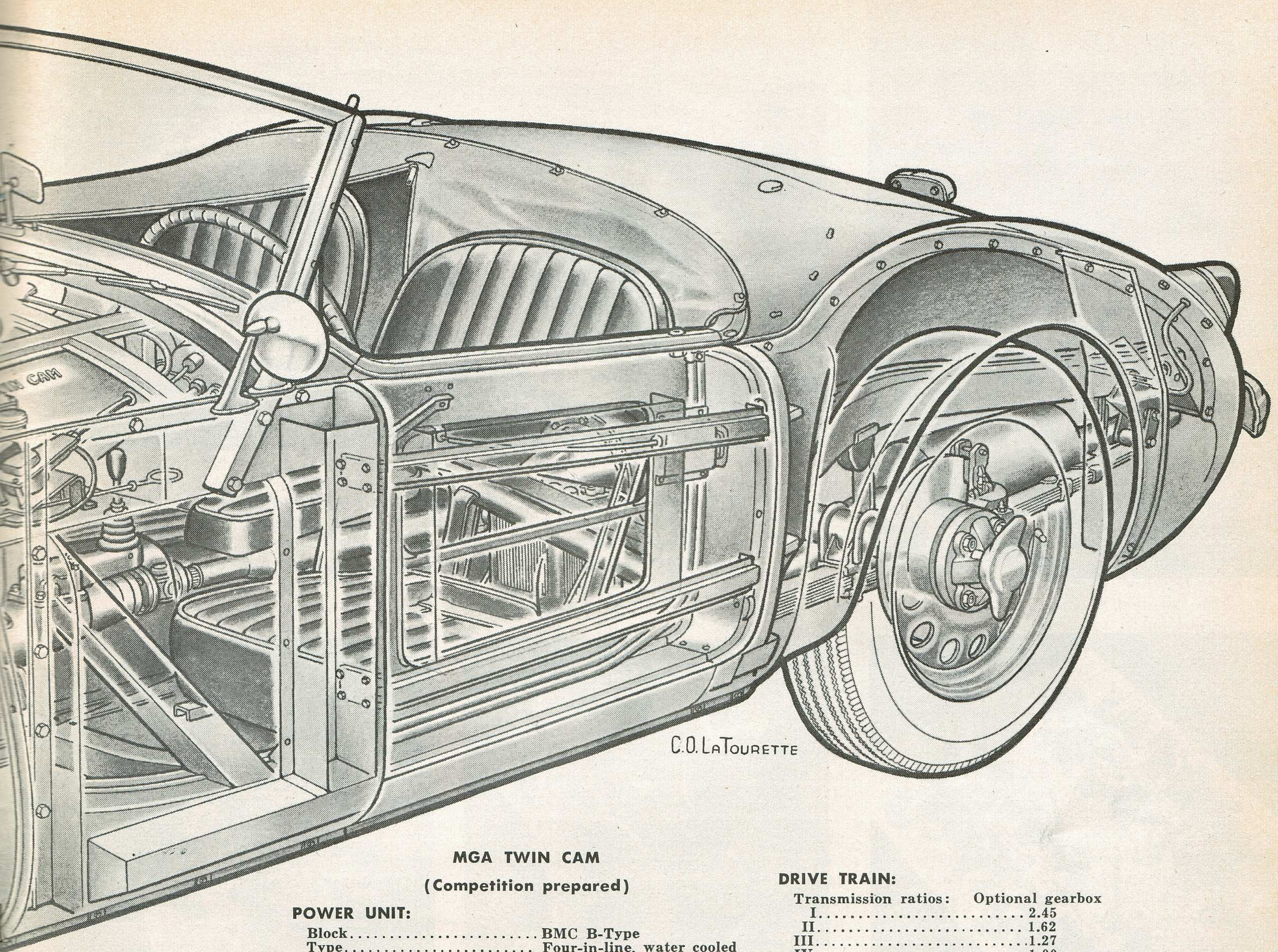
Intake opens 20 degrees BTDC
Intake closes 50 degrees ABDC
Exhaust opens 50 degrees BBDC
Exhaust closes 20 degrees ATDC

In addition to the above, the first production run Twin Cam engines had cams which degree out at 280 degrees with the same lift and slightly milder acceleration than the 250° units. Check yours with a dial indicator and degree wheel. If you have the 280° cams the timing is:

Intake opens:	35 degrees BTDC
Intake closes:	65 degrees ABDC
Exhaust opens:	65 degrees BBDC
Exhaust closes:	35 degrees ATDC

After, and only after, all the valve data was gathered, dismantling proceeded by the book. The cam sprockets were unbolted and slid forward into their locks and the cams lifted. Piece by piece in strict accordance with the factory manual the engine came apart.

The bearings, both rods and mains, were in fair shape, all things considered, but were worn enough to be replaced and so set aside. The crank was absolutely unscored and brightly clean which attests to the quality of material that goes into the Twin Cam when the pounding this engine took is remembered. The big, sturdy rods were checked and proved unflawed and in perfect alignment. This last item is important. In rebuilding any engine, especially if competition is the goal, any and



MGA TWIN CAM

(Competition prepared)

POWER UNIT:

Block	BMC B-Type
Type	Four-in-line, water cooled
Head	MG DOHC, Hemispherical chambers
Chamber volume	86.6 cc
Valve arrangement	2 per cylinder, 90° inclination
Compression ratio	9.9 to 1
Bore	2.995 ins
Stroke	3.5 ins
Valve seat angle	45° intake and exhaust
Valve size	1.59 ins intake, 1.44 ins exh.
Cams	250° duration (280° early series) AHH580
Lift	.375
Tappets	Cup-type, shim adjusted
Connecting rods	MG, full-floating wrist pins
Pistons	Mowog, aluminum, solid skirt
Total clearance	.0075
Rings	3 iron compression, 1 oil
Intake manifold	Log type, 2 inlet, 4 outlet
Carburetion	S.U. Type H-6 1¾ in
Needles	OA-6
Jets	.10 (2.54 mm)
Flywheel	MG, (steel)

DRIVE TRAIN:

Transmission ratios:	Optional gearbox
I	2.45
II	1.62
III	1.27
IV	1.00
Final drive	4.55

RUNNING GEAR:

Shock absorbers	Stock, lever & piston, Castrol R oil
Front suspension	Stock, coil springs
Rear suspension	Semi-elliptic leaf springs
Brakes	Dunlop quick-change disc, competition pads
Wheels	Steel disc, knock-off
Tires	Dunlop R-3 (Alternate R-5)

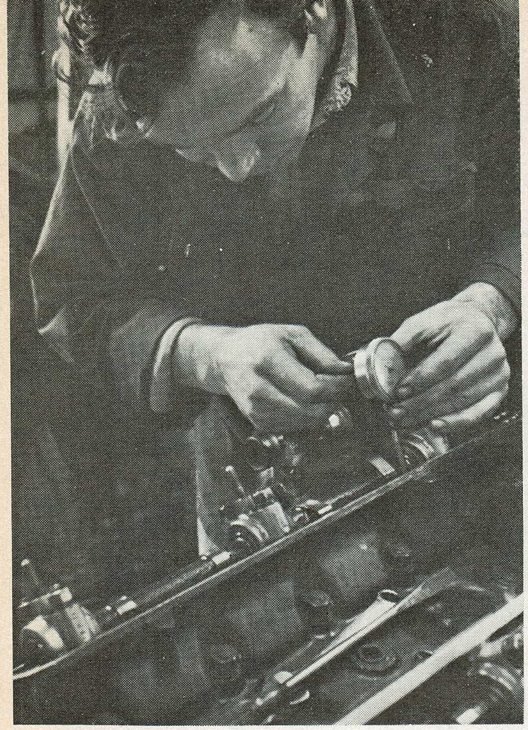
GENERAL:

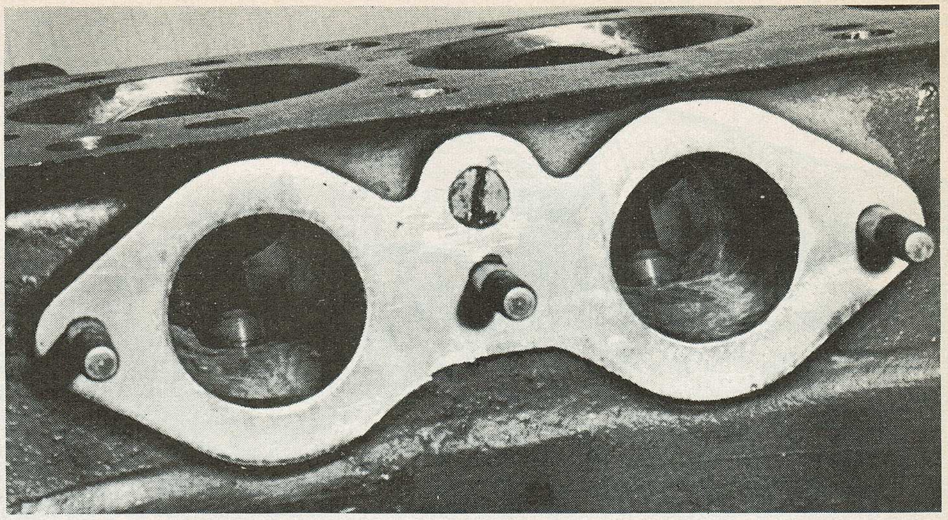
Length	156 ins
Width	58 ins
Height	50 ins
Weight	2000 lbs without top, windshield, bumpers, rugs and heater
Weight distribution F/R	51/49

all rods should be checked for flaws and set in perfect alignment. One bad rod can wipe out the whole engine in less time than it takes to tell about it, and it can do it with no warning whatsoever.

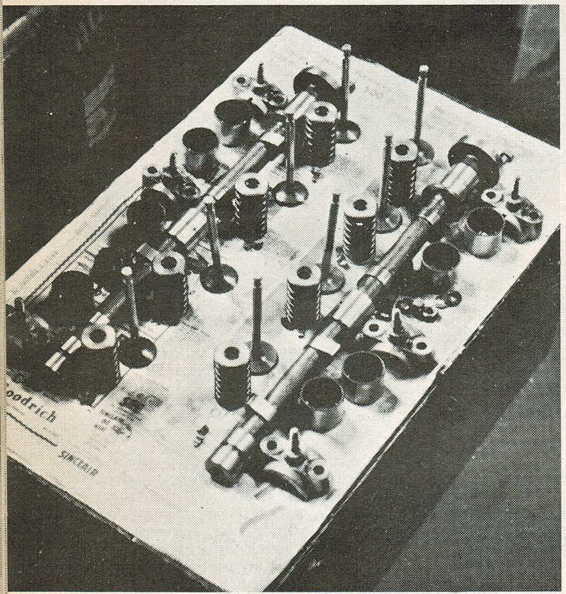
It was when we came to the pistons that we discovered just what had been going on inside this particular MG. The standard minimum clearance for pistons in the BMC B-Type engine block is .0035 of an inch. This is all very well in a passenger car engine that is to be broken in over thousands of miles and is meant to give years of service after that break-in. It is just sufficient clearance, tight but all right with *split skirt pistons* such as those used in the ordinary B-Type engine. But the Twin Cam is not an ordinary B-Type—the block is the same casting but that is about as far as it goes. The Twin Cam is equipped with sturdy *solid* skirt racing type pistons which have an expansion factor much greater than that of the split skirt type in which the split or slot takes up the swelling when the piston is hot. To further complicate matters the car had been run in with Castrol R #40. The combination of what amounted to virtually nil clearance on the hot pistons and the heavy racing oil left no room for oil on the cylinder walls. The result was a set of four badly scuffed racing pistons and, worse, a four-thousandths taper in the bore. The hard chrome top ring had acted like a cutting tool when pressed by the expanding piston on the oil-less wall and had chewed the upper bore out by over .004 of an inch. The wonder was that the tops hadn't been pulled right off the pistons. Strong stuff, these Mowog racing slugs.

The wear was too great to be cleaned out with a simple honing. The decision had to be made and it was. Virag bored the cylinders out an additional .020 of an inch and ordered a set of pistons for that oversize. Two cuts were made for each cylinder. First a rough cut to plus .019 was made and then a finish cut to bring the bore out .0085 of an inch further completed that particular hole. Between each cut for each cylinder the tools were dressed so that separate bores were absolutely accurate to the ability of the micrometer to measure. A fast hone in a diamond pattern finished the job. The new pistons are of the latest type with the oil vents behind

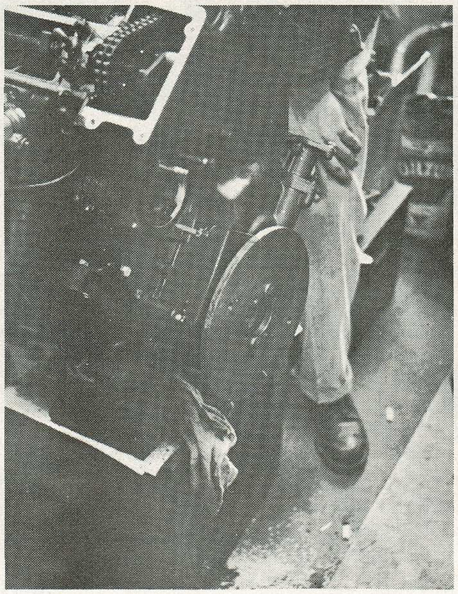




LEFT — Joe Virag checks out the valves with a dial indicator prior to disassembly of the engine. All timing was carefully checked during dismantling and assembly. ABOVE — Ports on exhaust side are huge and virtually straight through. No enlargement necessary but all ports were matched to manifolds and equalized in size.



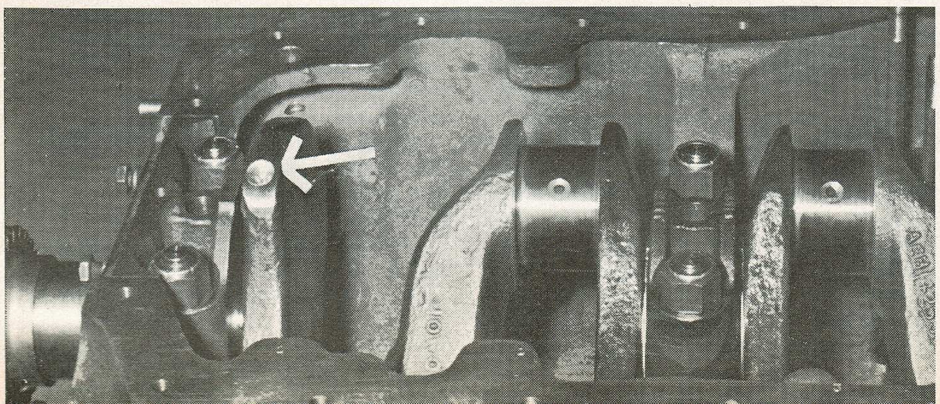
Valve, cam assembly broken down and laid out with all components separated.

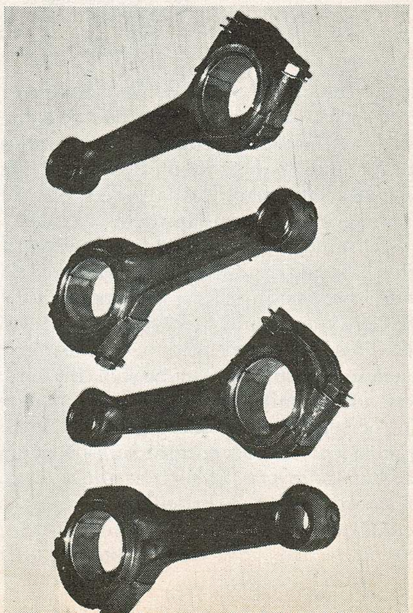


A degree wheel is a must if accurate valve timing is to be achieved on MG.

Dunlop racing tires accounted for almost a full second lap-time in tests.

BELOW — Dynamic balance tests of the sturdy crankshaft showed only one small balance drilling was needed (arrow). The same applied to flywheel and clutch. RIGHT — Short stiff rods are similar to those in Stage 4 MGA fitted with solid skirt pistons. Large bosses on caps and little end may be ground for balance.





the oil ring only and none in the piston wall. The rings are also spaced closer together on these later replacements for a better seal. The pistons were measured and found to be exactly on size and the bores — as outlined above — were then honed out carefully to give a skirt to wall clearance of .007 instead of the original .0035 of an inch. When fitted to the bore without rings the new pistons dropped through freely but with no sign of cocking or wobble — a perfect fit.

Next came the balancing act.

Each rod, piston and the bearings to go with that particular rod were carefully weighed and balanced against each other. The weights were marked down and the crank, flywheel and new clutch assembly were sent out for dynamic balancing. Only one small balance hole had to be drilled in each item but they *did* need the drilling. This balancing comes easy on the Twin Cam — or any MGA for that matter. The rods have large, meaty sections at the lower end of the caps and on the little ends so they can be slightly ground to gain the necessary end-for-end and overall balance. The pistons also have internal ridges at the bottom of the skirts from which metal can be carved if found necessary. In all cases it is vital that the bearings to be used in the final assembly be clamped in the rods when the weighing is done. It is also a good idea at this point to tamp the locating tang on each bearing shell into its recess in the rod big-end. These are *not* full floating bearings and must be well and securely located. The rods in the Twin Cam are virtually the same as the Stage Four rods for the MGA in that the wrist pins are of the full floating, push-fit type rather than the clamped pins found in the standard MGA and other B-Type engine units. These wristpins should be (and were in our case) an easy palm-push fit in both the rod and the piston at about 70 degree temperature, Fahrenheit. Location is by circlips in the piston at either end of the pin.

The crank, rods, pistons with rings and flywheel were then mounted in the bare block and cinched down to the various torque readings specified in the manual. A solid spin of the flywheel produced nearly six complete revolutions with no clicking noises. Although we had been afraid at first that there might be some piston noise with a cold engine due to the large clearances we had allowed there was none when the engine was later fired up. Thus while the clearances we had used were somewhat larger than those specified in the manual they were still within the range of silent running even using the Castrol R-20 with which the engine is being run-in.

During the wait for the necessary block components and the balancing operation the head and valves were given close attention. The inlet manifold showed the usual bumps, lumps and casting ridges found in any production casting and was cleaned up without hogging immediately, a process made easy by the short, very wide passages. When bolted to the head for checking it was found that the outlets at the mating surface were offset downward in relation to the inlet ports in the head so the ports were scribed and tapered to a perfect match. On other engines this offset could be up, down, right or left or even non-existent in some cases. In these cases not too much worry need result but if the offset is downward as in our case there is a problem since there is not too much metal in the bottom lip of the port. The angularity of the taper must be watched and controlled to avoid weakening this lower lip. The ports in the Twin Cam need not and should not be enlarged but they must be cleaned and matched one against the other. Some attempt at equalization is made at the factory but the speed of production line prevents really accurate port equalizing. The result is that in the non-machined portions no two ports are exactly alike as they should be if the potential inherent in the MG is to be realized.

Other than the port matching and cleaning the major work in the head is the relief of hot spots in the form of sharp edges left by machining and doming operations. The major source of trouble and the one that probably caused the running-on and preignition in our engine was the sparkplug area. Apparently the dome cutting was done after the plug inlet was drilled and threaded and the resulting knife edges made ideal glow points. Such faults as these are not necessarily the private property of MG Twin Cams but are found in many other marques as well and cause much of the running-on character that is usually associated with four cylinder engines tending to cause the mistaken impression that running on and preignition is one of the characteristics of the four-barrel. All such edges and the edges of the combustion chamber as well were rounded off in our Twin Cam. Where it once dingled, pinged and chugged on with the switch off it now runs smoothly and quietly under load and shuts off instantly with the key. Combustion now takes place when the sparkplug tells it to and not when the fuel and air are shoved up against some evilly glowing piece of metal.

The valves, which were found to be in good shape were lapped into place after the valve seats had been refaced and slightly narrowed and new guides installed, the old ones being just worn enough to warrant replacement. Each spring, both inner and outer, was checked against the others and all found to be within half a pound of each other fully compressed. After this the assemblies were installed at exactly the .018 of an inch clearance the book calls for.

Now came the tedious part. Virag is a nut on absolutely accurate valve timing. With his Offenhauser the job is made simpler since the cams are gear-driven but with most sports cars chains are used in the interests of silence and economy. The MG Twin Cam falls into this latter category and the chain is long indeed. The major problem is to keep enough tension on the chain so that it doesn't slip off the lower sprocket while the adjustments are made at the cam sprockets. Once the tensioner is backed all the way off or removed the chain is quite likely to skip a tooth and anything from three degrees on up can be lost. The main points to watch are contacts at each cam sprocket and at the half-speed shaft and the tension in between these points. The workshop manual gives the adjustment procedure in great detail and it would be repetitious to cover it here since the use of this manual is an absolute must for anyone delving into the innards of the Twin Cam. You can bumble through a rocker-head and make it run but the Twin Cam is not a rockerbox. Either a thorough course of instruction or meticulous use of the book and succeeding bulletins are as necessary as proper tools.

Next came the outside accessories. When the engine was first removed it was discovered that the generator bracket had cracked at the generator swivel point. The original bracket is made of bent flat stock and this form of breakage is not unique to the Twin Cam but is fairly common. A reinforcement plate was made, doubling the thickness of the bracket. The generator was then mounted and shim washers placed between the bracket and the mounting flanges on the generator so that tightening would not displace or strain either the flanges or the bracket.

The original carburetors, H-6, 1¾ inch S.U. instruments, were used in their standard trim with OA6 needles and 2.54 millimeter main jets. No richening was deemed necessary. The ignition distributor was equipped with new points, the springs of which have been changed metallurgically since the earlier models since it was found that the former metal tended to fatigue. The distributor on the Twin Cam is rather hard to get at, being down on the left side of the engine so the rubbing blocks on the points were run in for several hours on an ignition strobe machine. This imparts a high, hard polish and retards the tendency for these blocks to wear, which causes the points to open with a progressively shorter gap as time goes on.

What does all this do?

We've indicated that we have a smooth, virtually trouble-free engine. It also goes. As might be expected torque at the bottom end is low. At anything under about 3000 rpm the push is just not there. As the tach needle swings past 3500 rpm, though, you begin to realize just what this engine can do—it appears as though someone added two more cylinders. At one point, motoring happily along at 3600 rpm in third gear we saw a clear stretch of road ahead. Half a mile up was another car also motoring along at about 40 mph. A quarter of a mile ahead of him was a bend. Feeling that he'd be well around the bend before we got there we poked the throttle. We were on top of him, backing off and dragging brakes, before he got halfway to the curve!