BRITISH LEYLAND TRIUMPH

COMPETITION PREPARATION MANUAL

TR-4-4A

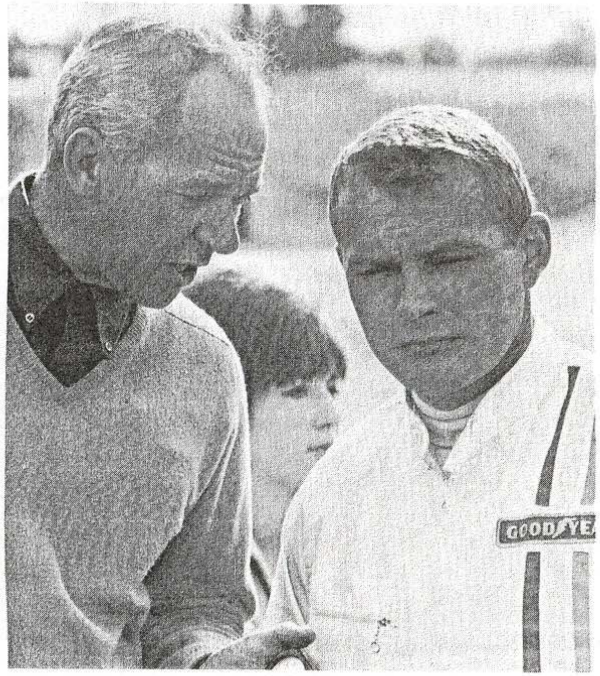
4th EDITION

TRIUMPH TR-4

COMPETITION PREPARATION

by **R. W. KASTNER**

It is the policy of the British Leyland Motors Inc. Competition Departments, both in England and the U.S., to constantly seek improvements in performance. As new or revised technical data becomes available, supplements will be made available for this book.



R. W. Kastner discusses lap times with Triumph champion Bob Tullius. "Kas", a veteran West Coast competitor in his TR-3 until 1961, took on the job of Triumph Competitions Manager for the United States and the modifications in this book have been developed and thoroughly tested under his supervision. This book is the result of years of experience in, on and under Triumph cars and the procedures described are the only way to reliable peak performance in your TR.

FOREWORD

The sport of road racing production cars has evolved, as a necessary requirement for success, into an expensive exercise in the tuner's art. Those in the British Leyland Competition Department fully appreciate that racing is costly, and try always therefore to develop track-proven 'tuning' procedures around existing engine and chassis components. Generally, it is less costly to modify existing parts than to purchase special racing items, such as crankshafts, connecting rods, and the like. It is possible for us to follow this policy, and for you to employ it with success due to the very high quality material used in all Triumph automobiles. In short, there is sufficient margin of strength to permit modification without loss of reliability.

It must of course be accepted that failures in highly-stressed parts will occur, but obviously this is an inescapable factor in racing.

This book is for those who want that "little bit more", and are prepared to live with the consequences. We should caution that the recommendations given will be of little value if general preparation of the automobile is faulty. The best of 'speed secrets' is useless unless supported by meticulous basic assembly.

It must be emphasized that the contents of this book, while they tell you how to achieve the best performance from your car, do not cover all of the modifications necessary to meet the Sports Car Club of America rules. Items such as roll bars, fire extinguishers, oil catch tanks, etc., should be installed according to the SCCA General Competition Rules.

We wish you the very best of 'racing luck' . . . (a factor that should be minimized) . . . with your Triumph. Now let's get on with it. . . .

CRANKSHAFT

In the past we have recommended that the crankshaft be nitrate hardened to preserve the bearing surfaces of the throws, should a small piece of dirt or metal be forced through the system.

As it is now permissible under SCCA regulations to use an optional oil radiator on both the TR-3 and the TR-4, quite frankly further hardening from standard is not necessary, although it will of course provide additional protection.

Crack detect the crankshaft to be certain that you have a perfect unit, and of course check to see that the main and connecting rod journals are perfect. Do not accept any out-of-round condition.

Micro-polishing of the journals to an amount not to exceed .001″ is recommended, but again is not mandatory. The additional .001″ will aid the bearing lubrication. If you find it necessary to have the crankshaft re-ground to the next undersize (not to exceed .011″), have the additional .001″ included in the dimension to be ground . . . that is, instead of grinding the crankshaft to .010″ undersize, grind to .011″ undersize.

Although we have not had any personal experience of bearing problems with a larger undersize than the amount of .011″, I do not recommend further grinding for the simple reason that a bearing of thicker dimension must be used, and the more material on the bearing, the more difficult it is for heat transfer. Needless to say, further grinding of the crankshaft is quite acceptable for minor competition or street use.

Check the end float of the crankshaft, and adjust as necessary according to the workshop manual for a final fit of .004″ to .006″. Balance the crankshaft. Fit the front pulley and hub extension, and balance this pulley assembly.

Polishing or shot peening the crankshaft is good practice so that possible fracture marks are removed.

Although there are any number of connecting rod and main bearing insert-type bearings available for the Triumph, the best results over a prolonged test period have been achieved with the standard factory fitting. We therefore recommend that you do not change from the type normally furnished as standard production.

CYLINDER BLOCK

The cylinder block is fitted almost as stock with a few minor changes and labor operations.

First clean the entire block very carefully. If you have the block professionally cleaned or 'boiled out', you can expect that the camshaft bearings will be damaged by the caustic cleaners, and replacement will be necessary. Leave the replacement of these bearings to a professional man in a reputable machine shop.

Check the cam follower sections of the block to be certain there is not a residue of slag or grit, as these are the points where heavy materials will accumulate. Check the oil drain holes from the cam follower sections to be certain they are free. Inspect the camshaft end plug. This plug must be very tight or oil will be lost from the rear camshaft bearing, and a heavy oil loss will result. We have found that sealing this plug into position with an epoxy glue is good insurance for a permanent seal.

Remove all paint in the area around the plug, and scrub the plug and lip of the block with a stiff steel brush. This will lightly etch the surface, and provide a good surface for the glue.

Inspect the cylinder head stud holes in the top surface of the block. Look for cracks emanating from the stud holes. Cracks of this type can usually be easily repaired by a cylinder block repair shop at minor cost.

If an amount of over .125″ is milled from the cylinder head face, and the competition exhaust system is fitted, occasionally there is interference with the top edge of the block on the manifold side. File or grind off the edge of the block at approximately a 45-degree angle, so that the header assembly will fit flush up without touching the block. Test fit the system without a manifold gasket installed. When you are certain there is no interference, fitting of the gaskets will give you additional clearance, thus eliminating ANY possibility of fouling the block edge.

Inspect the surface in the block that seals the bottom of the liners. UNDER NO CONDITION CAN ANY ROUGH EDGES OR ROUGH SURFACE BE TOLERATED.

Fit the special figure '8' gaskets WITHOUT CEMENT, and push the sleeves into place. You can now check to see that the sleeves stand proud of the cylinder block the required amount of .003″ to .005″. If you wish to paint the engine use a non-reflective black paint.

If you are fitting a new cylinder block make certain that you follow the workshop manual installation instructions when fitting the rear crankshaft seal. This must be done correctly, or undoubtedly you will have a severe oil leak. Be certain to pack the rear main bearing cap with the felt rope as shown in the workshop manual. This rope must be DRIVEN into the bearing cap, not just laid in without compression.

The best method is to make up a driver from 3/8″ malleable steel, that will just fit easily into the bearing cap hole. Cut the felt rope into sections approximately 1″ long and soak in gasket cement. Push in one piece of the rope and force it home with the steel driver. Install the next piece, and continue with this process until the hole is filled to the bottom surface of the block. Trim off the excess with a razor blade. The gasket cement will squeeze out around the main bearing cap. This excess must be wiped away. Lacquer thinner is a very good cutting agent for clean-up work with gasket cement.

CONNECTING RODS

The connecting rods should first be crack detected to make certain of their fitness for further use. Assuming the rods pass inspection, the lightening process can be undertaken. The very first instruction for lightening is DON'T BE TOO EAGER. Considerable metal can be removed, but it must be from the correct portions of the rod. Careful attention must be paid to this detail.

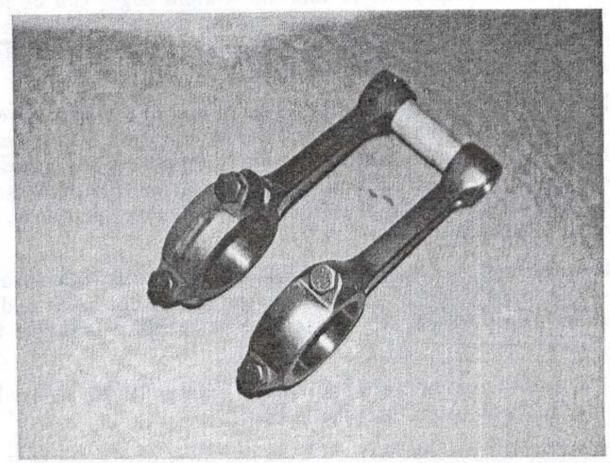


Figure 1

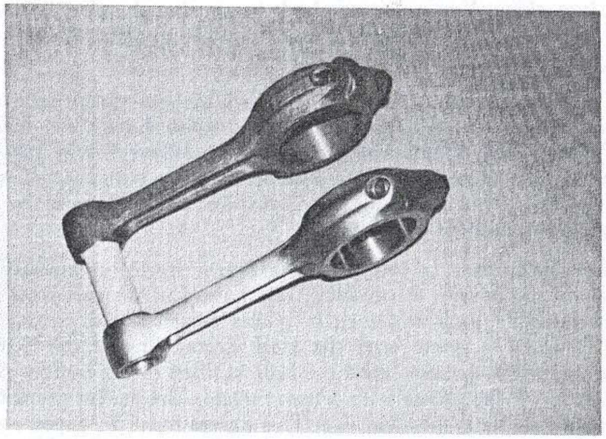


Figure 2

Approximately 75 per cent of the stiffening rib can be removed from the bottom of the connecting rod. Note Figure 1. The stiffening rib over the top of the big end can be reduced approximately 50 per cent as shown in Figure 2. Further weight reduction can be achieved by grinding off the flashing marks left from the original casting along the entire length of the connecting rod. When removing this flashing, shape the beam of the rod so that the face has a slight curve, with the high portion in the center of the face. Smooth up the edges of the beam with a file so that the straight edges can be maintained. Do not bother to polish into the actual 'eye' of the rod. Very little metal can be removed as the 'eye' is drilled for oil supply to the wrist pin. There is the possibility of grinding through in this area.

Material can be removed from the small end of the rod. Here again try to maintain a curve in the metal so that the high portion is in the center, with the sides sloping off to the bushing opening. Do not do any grinding on the small end unless the wrist pin bushings are in place. This work is preferably done with the old bushing in place, then after all other operations, have them replaced and honed to fit.

The connecting rod can be polished out very well with an abrasive of *the type* known as 'Craytex'. Brown Craytex is for high finish and green for fast cutting. These wheels are inexpensive and readily available from most large hardware stores.

Final polishing is up to the individual. High polishing always looks very impressive, but is no better than shot peening.

Fit new small end bushes and have the wrist pins fitted to a very easy one thumb press at room temperature (68 degrees). Have the connecting rods aligned at your local machine shop. Balance the rods, then shot peen.

If you are polishing you must balance as you go, as after final polishing you will disturb the finish if additional material has to be removed to maintain the correct balance. Remember to balance before shot peening.

Fit new connecting rod bolts. Neglect in checking the bolts and in fitting, has cost many engines in the past, and I'm sure will be a factor in future 'blow-ups' by those who are not careful in preparation.

Make certain that the threaded portions of the connecting rods are clean, dry, and the thread smooth with no high spots. Test each rod. Make certain that the clean, dry, new bolt can be run into almost full distance without the aid of hand tools. These quick checks can save you an engine.

Run the bolts up evenly. Try a test if you wish to see what happens. Using an old rod, pull up one bolt to full torque, then TRY to install the other bolt. Try one bolt half-way in and pull up the other side. You will note the loose side will immediately be tight and require a wrench. This misfit will scrub the threads of both the bolt and the connecting rod and make a point of possible failure.

BE CERTAIN that the flat surface under the head of each bolt is in complete contact with the rod cap and that the bolt is not seated on the small diameter radius between the bottom of the bolt head and the bolt shank.

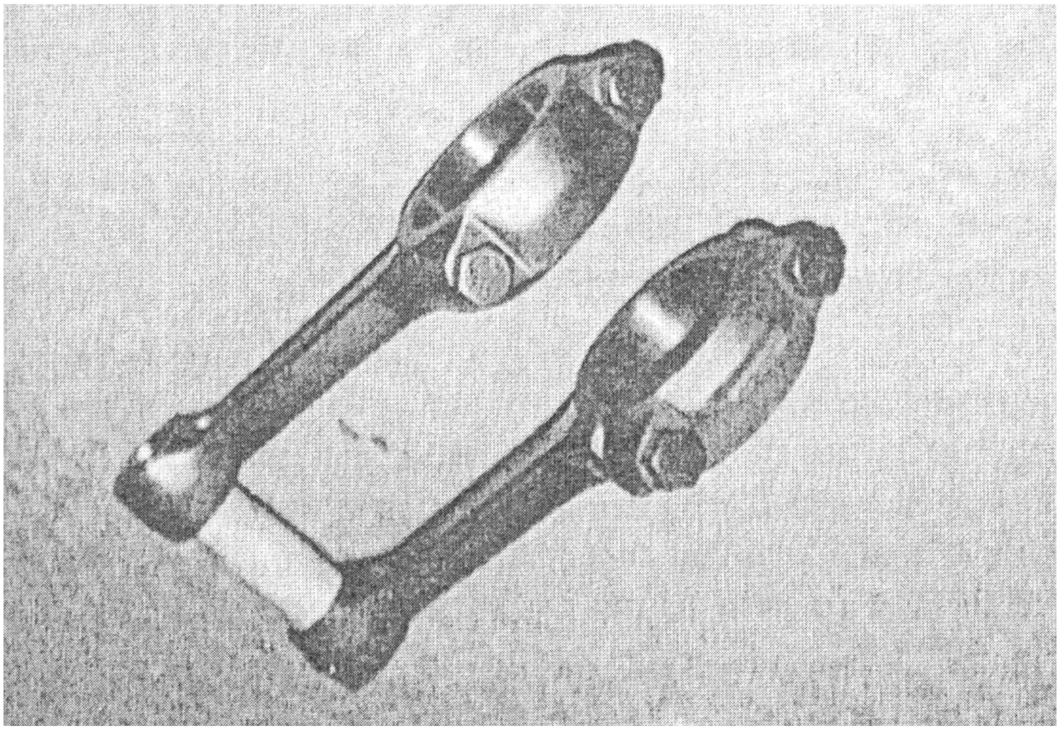
Needless to say do not use an air or electric impact wrench. Do your torquing to 80 ft./lbs. with a good torque wrench. DO NOT RE-USE THE LOCK TABS.

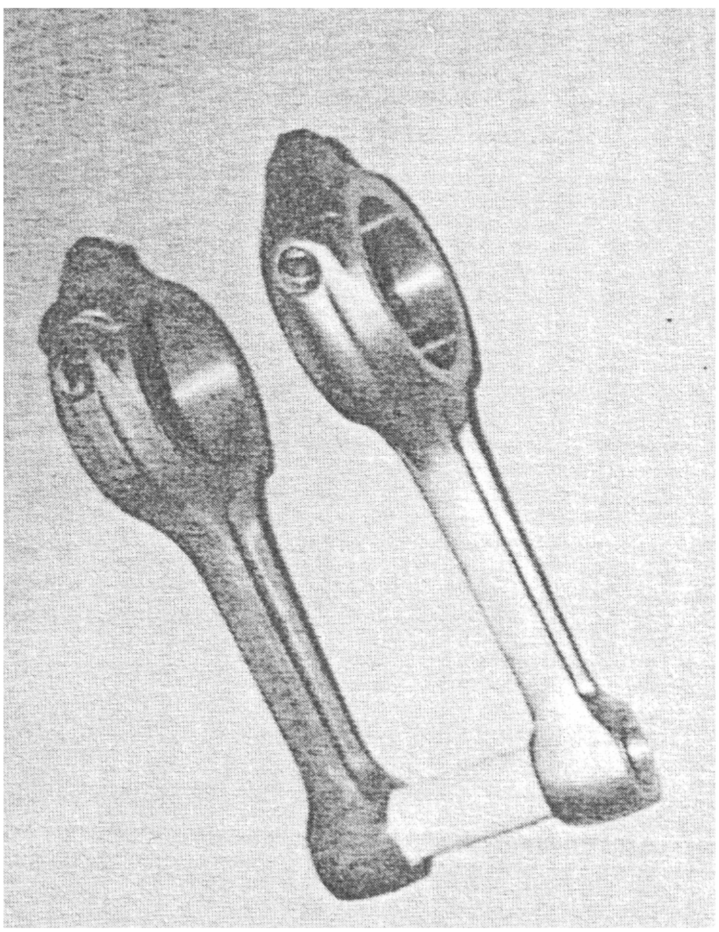
PISTONS

The standard factory furnished 86 mm pistons are of high quality, and will take the added pressures of racing and modification without complaint. Inasmuch as the current regulations for racing in the U.S. allow an overbore of 1.2 mm, it is advisable for those attacking the racing program with full force to install the overbore pistons and liners.

Again, as in other items used in the general repair of the engine, there are many different brands of oversize pistons. The majority of the testing on TR-4 engines by your author was accomplished with Hepolite brand pistons and liners fitted. These are very good units that generally will have the proper piston to wall clearance, and a good fit on the wrist pins. The liners are straight, without taper and have given very good service. Triumph does not service the TR engine with oversize pistons, so you must purchase these overbore items from a local source. Usually the Hepolite kit can be obtained through an imported car parts house, or may be ordered by your local Triumph Dealer's Parts Manager.

(In the remainder of this section any reference to pistons will signify Hepolite unless specifically noted).





The standard rings as fitted will serve very well, but have been found to be a little slow in seating. Due to the fact that racing engines are usually not given any great opportunity for breaking in, I recommend that you order Grant rings from the Grant Piston Ring Company. Be certain to specify 1/16″ compression rings, 5/32″ oil control rings with the bore size of 87 mm. Fit the expanders as supplied with the ring kit.

End gap the rings to .015″ to .020″. Be certain to stagger the ring end gaps on the piston. The end gap of the oil ring fits at the gap of the oil ring expander. The entire piston should be polished all over. This polishing will minimize drag of the skirt, and make it more difficult for carbon to adhere to the aluminum. Without a doubt you will burn more oil than with a street engine, and carbon build-up cannot be ignored.

The deck height (that height of the piston at TDC below the level of the top of the cylinder) on the Hepolite pistons is generally quite even. Therefore it will not be necessary to make more than a few thousandths correction to have a perfect set.

Check the wrist pin fit to a very easy one thumb press at room temperature, and fit up the pistons to the connecting rods. Slide the cylinder head into position on the block, (pistons, liners and figure '8' gaskets installed) and torque up the head to approximately 75 pounds. Remove the cylinder head and install sleeve hold downs. This operation will seat the sleeves and allow us to make a correct reading for top dead center, and related measuring of the piston heights.

Install the pistons with rings and torque the rods to the normal figure. Fit up a dial indicator so that you can read the point of top dead center from the crown of the number one piston. Using a depth micrometer, measure the distance from the top of the sleeve and the top of the piston. Record this figure for both numbers one and four. Repeat the procedure for TDC and make your measurement on numbers two and three. Record these measurements and be certain that you number each piston, so that an adjustment can be made to the correct piston.

Using the thin steel head gasket, the deck height should be a minimum of .012″.

Our test engines have run much less deck height than this amount, but there have been reports of pistons hitting the cylinder head when using a clearance less than this. Considering that the steel head gasket compressed is .020″, and with .012″ deck clearance, we now have a total of .032″ clearance between the crown of the piston and the cylinder head face. This measurement is made with the sleeve figure '8' gaskets installed. Bearing in mind that we will later equalize each of the combustion chambers, it is necessary that all of the piston deck heights be the same. Our purpose is to achieve equal compression in each cylinder.

The pistons are altered in height by facing off the top or crown surface in a lathe. After all corrections have been made and polishing completed, balance the pistons with the pins installed. You can expect the weight of the piston and pin (87 mm) to be approximately 1 lb 4 ounces. The sleeves may now be removed for a modification that will be described later.

Many, many tests were made with pop-up type pistons. All tests failed to give more power than the flat top type piston, even when resorting to a higher compression figure. The highest power reading was made with a compression 12.6 to 1. The pop-up pistons would not give the power at 12.6 compression, that was achieved at 11.2 with flat top pistons. The pop-up piston crown interferes with the flame path, and only through extensive testing was it possible to stop heavy detonation. This detonation did not occur with the flat top type piston.

Consequently, I cannot recommend the pop-up design due to the power loss experienced. This recommendation applies only to the Triumph engine, and should not be construed to cover all engine designs.

There are several brands of forged pistons on the market. Fitting this type of piston is expensive but worth the money. If you can afford more than double the normal piston price, investigate purchasing a set of forged flat tops. You can expect to pay approximately $25.00 each, and this price may not include pins or rings.

Due to the price of these forged pistons, the normal grade Hepolite as described previously, is used in all of the engine experimentation by Triumph's Competition Department. This enables the average owner/driver to relate his engine directly to those used in the Competition Department.

CYLINDER HEAD

There are any number of possibilities and manners of porting, and any number of compression ratios that can be achieved with the stock TR-3 or TR-4 cylinder head. We will describe the methods used to obtain the maximum horsepower on my test engines. Before work is started, it must be mentioned that there are three types of cylinder head of the high port variety in use on the TR-3 and TR-4. First we have the oldest type which has an intake port opening at the manifold face of 1⅝″, and 8.5 compression. This was normally fitted as standard to the TR-3.

We then have the TR-3B and early TR-4 cylinder head which was fitted to the S.U. carburetted engines. This cylinder head has the 1⅝″ intake ports at the manifold face, but was used on a larger bore diameter, and was part of the make-up of the 9 to 1 compression specification.

Finally, we have the latest type cylinder head which is fitted to the TR-4's having the new Stromberg carburetors. This cylinder head has 1½″ intake ports at the manifold face, is fitted with the later type exhaust valves which are more tulip shaped, 5/16″ bore exhaust guides, and a compression ratio of 9 to 1.

The first head we mentioned — that normally fitted as standard on the TR-3 — is a different casting than either of the other two types. It is necessary with this type head to check the clearance between the water outlet portion on the casting, and the water pump body after milling the cylinder head face.

The two later-type cylinder heads have a special 'flat' on the bottom of the water outlet of the head, and unless a great amount is milled (in excess of .140"), no interference will be found. Should you find interference as with the first cylinder head, correction can be made by removing metal primarily from the water pump casting. Some additional material can be removed from the bottom of the water outlet.

In our test engines compression figures ranging up to 13.4 have been accurately tested. The maximum power output without detonation has been achieved at 12.6 to 1. To reach this very high compression figure, a considerable amount of material must be removed from the cylinder head face, creating problems in spark plug cooling, etc. It is suggested therefore that you limit your compression figure to 11.7 to 1.

This compression figure can be obtained by milling approximately .150" from the cylinder head face, using the 87 mm pistons and liner kit in conjunction with the steel shim head gasket. The power loss between 12.6 and 11.7 is small, and it must be admitted some reliability is lost with the higher compression figure.

Those using the first cylinder head we mentioned — that fitted as standard to the TR-3 — must be extremely careful in milling the head face. This early type of cylinder head just will not allow the extreme milling that can be carried out on the two later types. Rather than having to cry about it later . . . I suggest you make the cut in careful stages, with inspection between mill cuts, and in this manner be certain that your particular cylinder head will accept the milling without breaking through into the water jacket, or weakening the 'squish' area around the combustion chamber to the point where it will collapse.

After the milling of the cylinder head, it will be found that the manifold gaskets will foul the top of the block. Cut approximately 1/4" from the bottom edges of the gaskets.

Milling the cylinder head the amount suggested will make radical changes in the shape of the combustion chamber and 'squish' area, and thus necessitate other modifications. The obvious change in the combustion chamber after milling, is that the shroud around the intake valve is almost completely removed. In cases where over .150" is milled from the head face, this shroud no longer exists. This is good. By removing the shroud we will allow the fuel to enter the cylinder faster, and thus be able to fill more of the cylinder in the same length of time. Therefore, we have increased the volumetric efficiency, and at the same time the effective compression.

Great care must be exercised in inspecting the edge of the combustion chamber for sharp edges. These will glow when hot and cause detonation and/or pre-ignition. The sharp edges left after milling should be smoothed off to an approximate 1/32" radius.

Blend in the spark plug relief in the combustion chamber floor. Smooth off the sharp edges around the spark plug hole. The cylinder head milling operation will also remove almost completely the chamfer opposite the spark plug hole. This chamfer should be replaced by grinding off the edge of the combustion chamber.

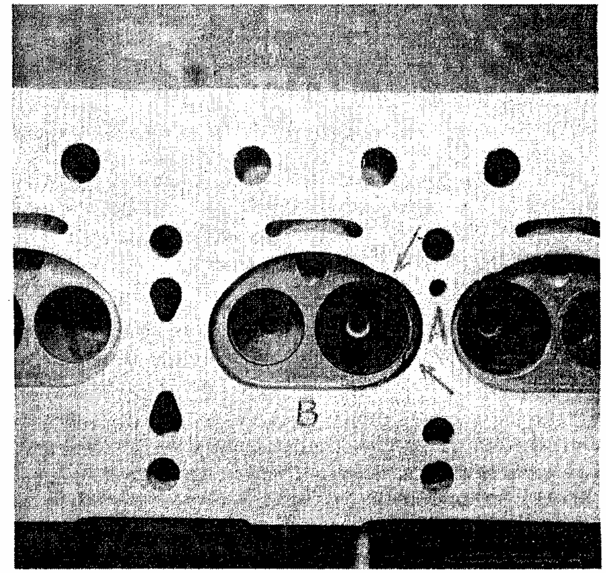


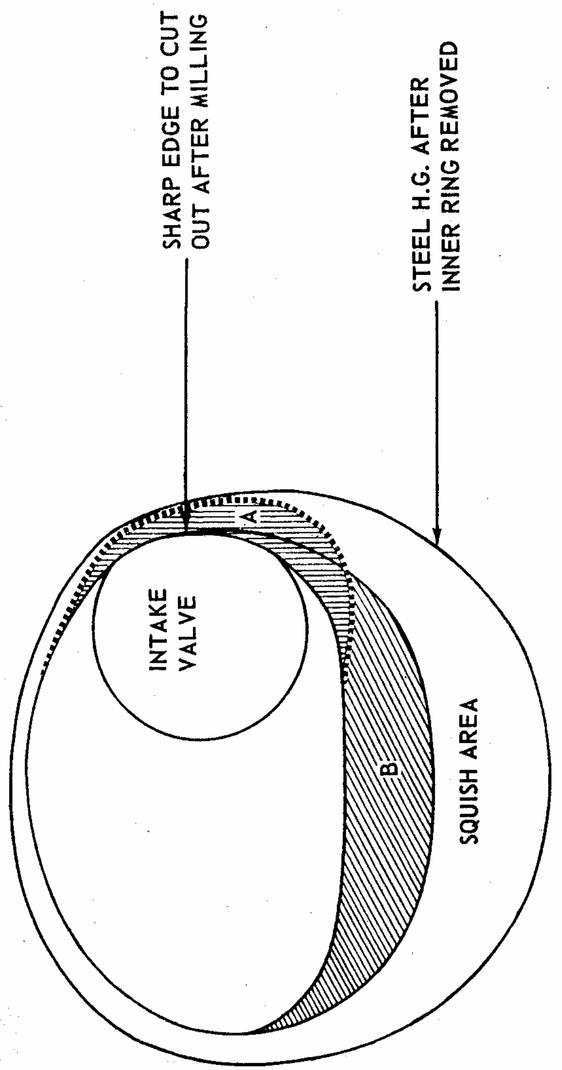
Figure 3

Figure 3 illustrates a fresh milling job, and the areas marked 'A' and 'B' where grinding will be needed.

Increases in compression tend to promote turbulence in the mixture as the piston nears top dead center. This turbulence is absolutely necessary for complete combustion. With normal compression ratio, the 'squish' area provides a jet of fuel into the flame front which accomplishes this job very well. As we have increased the compression a great deal, there is no need for such a large 'squish' area, that will absorb heat from the combustion process and drain off power. This drain is minute, but nevertheless a loss. By replacing the chamfer, and radiusing the edge of the 'squish' area even further, you will reduce the turbulence slightly, which due to the increase in compression will not matter. However, there will be a slight gain in reducing the area of metal that can absorb heat during the combustion period, and this will be beneficial to total power.

Figure 4 shows a drawing of the combustion chamber, and the approximate areas to remove material. This drawing is not to scale and should not be used as a template.

The grinding operation around the combustion chamber must be taken slow and easy so that there will not be a loss of the head gasket seal. Therefore we will use the actual head gasket for a pattern to determine exactly where it is possible to grind.



MILLING WILL ALTER THIS COMBUSTION CHAMBER
CONSIDERABLY – DO NOT USE AS A TEMPLATE

FIGURE 4
TR-3 – TR-4
COMBUSTION CHAMBER SHAPE
NOT TO SCALE
R. W. KASTNER 6/63

To achieve maximum compression for any given milling of the cylinder head face . . . and due to the increase in bore and opening up of the intake valve shroud . . . it will be necessary to fit the steel head gasket, Part #202755. This gasket is part of the decompression kit for the 1991 cc engine as used in the TR-3. As this gasket was designed for use with a much smaller bore (83 mm), it will be necessary to cut away a portion of the gasket. See that none of the gasket material protrudes into the combustion chamber. There are two sealing rings in the gasket which fit around each bore. It is necessary that one half of the inner ring be cut out. Remove the ring with a rotary file and finish off with 80 grit emory paper. Paint around each combustion chamber on the cylinder head face with die maker's blue (the type that dries), then fit the steel head gasket up to the cylinder head using four tapered posts to hold the gasket in its proper position on the stud holes. Scribe around the inside of the gasket bores. You should now have a duplicate of Figure 5. To avoid damage to the valve seats, slide two old valves into the combustion chamber before grinding in this area.

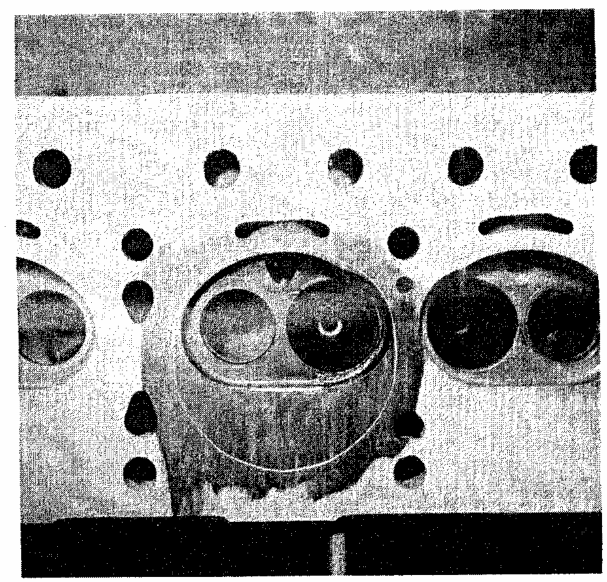
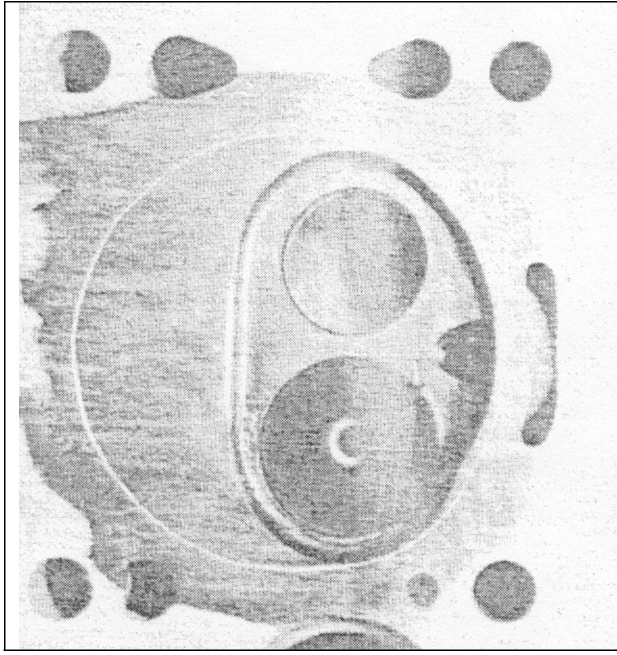
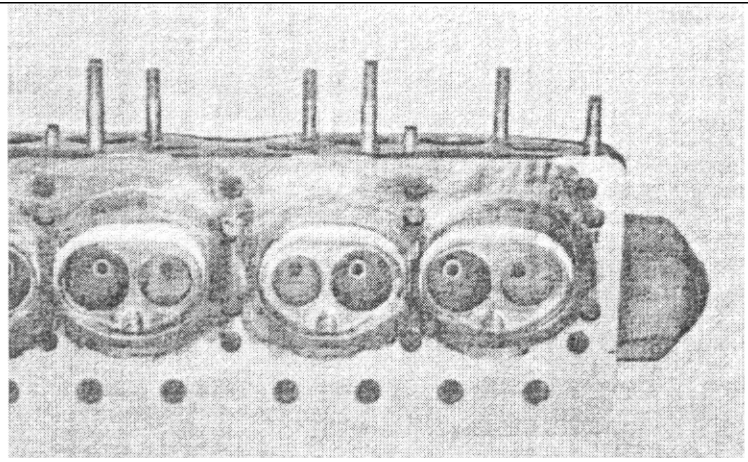
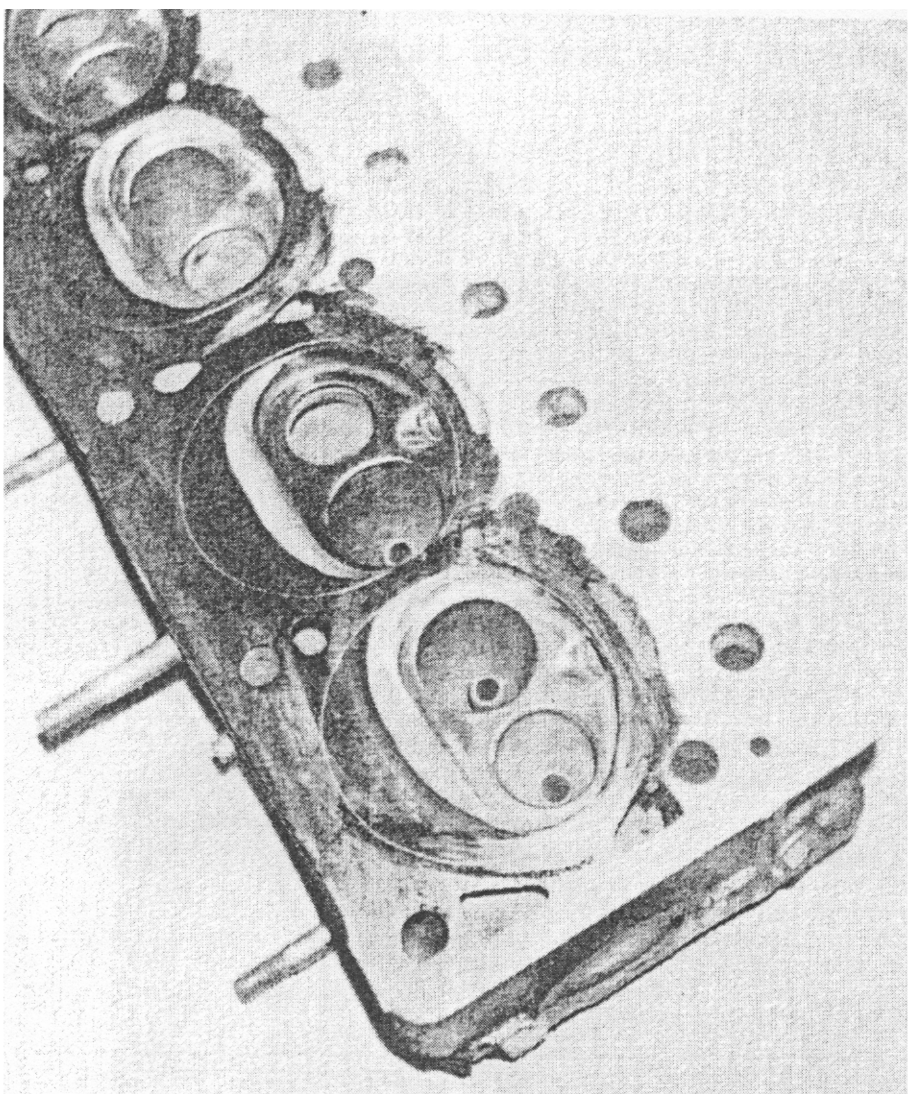


Figure 5

First grind in the long chamfer indicated as position 'B' in Figure 3. The length of this chamfer must be reduced as more material is removed from the cylinder head face, so that you do not grind into the water passages.







⅝" can be ground back with a head mill of approximately .090". This distance is reduced as the mill cut is increased. Radius this chamfer into the combustion chamber to a distance of about a half of the combustion chamber depth.

Now grind out area 'A' in Figure 3 to the scribe line of the gasket. Blend the cuts from areas 'A' and 'B' together. After polishing, the combustion chamber should appear as in Figures 6 and 7. Make up a cardboard template of the first combustion chamber, and repeat the operations on the other three chambers.

Final finishing of the entire combustion chamber can best be accomplished with a Craytex wheel and a high speed grinder — but patience and emory paper will also give an excellent finish.

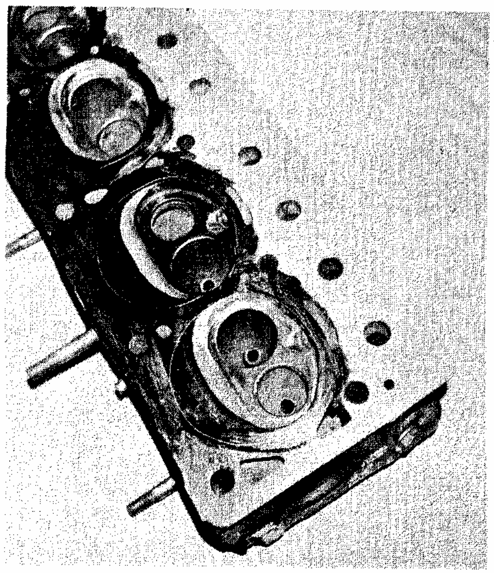


Figure 6

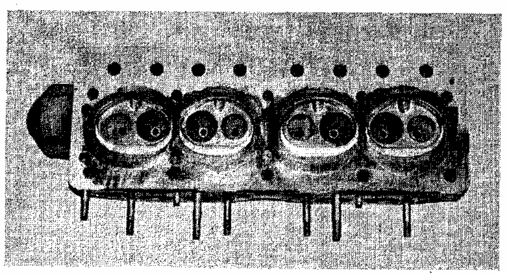


Figure 7

VALVE SEATS

The valve at high revs is open for an extremely short length of time. As the speed rises, it becomes more and more difficult to fill the cylinder. Therefore, we must do everything possible to assist in increasing the efficiency of the valve seat and throat area.

The intake valve will operate with complete reliability given a valve seat of only .020". Because of the additional heat involved with the exhaust valve, use a .032" seat.

As we have narrowed the valve seats (to the outside edge of the valve) a considerable amount, we must enlarge the valve throat of the cylinder head to achieve maximum use of this seat. This operation may easily be accomplished with hand tools, scrapers, grinders, etc. However, the most uniform and best method is to use a side and face cutter in a drill press or milling machine — see Figure 8.

Use the valve guide as a pilot. Lower the cutter until the point of the cutter is almost to the valve seat surface. Check that the cutter is not touching the actual seat area. The method for checking the pattern of the cutter is to apply die maker's blue to the seat area, then slowly rotate the cutter with just a light pressure on the head/seat area. A ring of bright metal will then show. If this ring is just inside the valve seat, proceed to bore to a depth of .250". Remove the tool and make the same lay-up and check on each of the other valve throats. It is possible to increase the overall useful area of the valve by 5 per cent using this method. The useful size of the valve has been increased without using anything other than the standard valve unit.

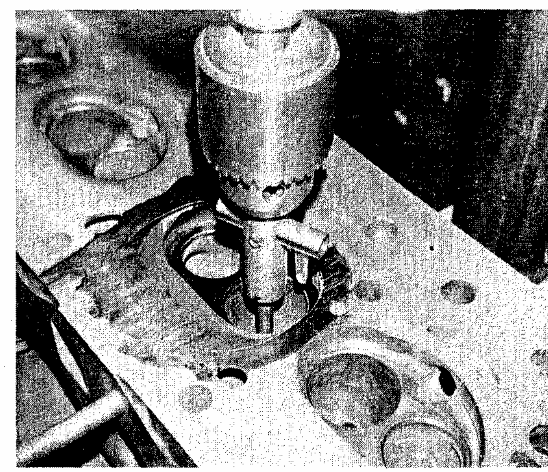


Figure 8

The seat should be cut to an angle of 45 degrees, and the valve itself to 44 degrees. This will insure a proper fit with the seat on the outside edge of the valve. Do not attempt to use a cutter in the valve throat unless the cutter is held by the valve guide. It is quite easy to grind out the additional material inside the valve throat with a high speed grinder such as used for porting. If you do use a grinder, BE CAREFUL! One little slip and you have just lost a cylinder head. For this reason, I encourage the use of a side and face cutter piloted from the valve guide.

After the cutting or grinding operation, clean the ports and seat area well, and check with die maker's blue to be certain that the seat area is still proper. Grind the valves in lightly to remove any burrs left from the boring operation. Lap the valves in with fine paste, and note if the seat is proper as described above.

VALVES

The valves can be lightened slightly, and polished a considerable amount. The intake valves are a little rough (coin finish). By mounting the valve in a lathe, first cut back the area shown in Figure 9. Now make a light cut across the face of the valve to insure that the surface is true. Rough polish the entire valve head area with 80 grit emory cloth. Then mount the valve in a drill press and proceed to finish out the polishing at high speed, first with 240 then with 320, and final polish with 400 wet or dry sandpaper.

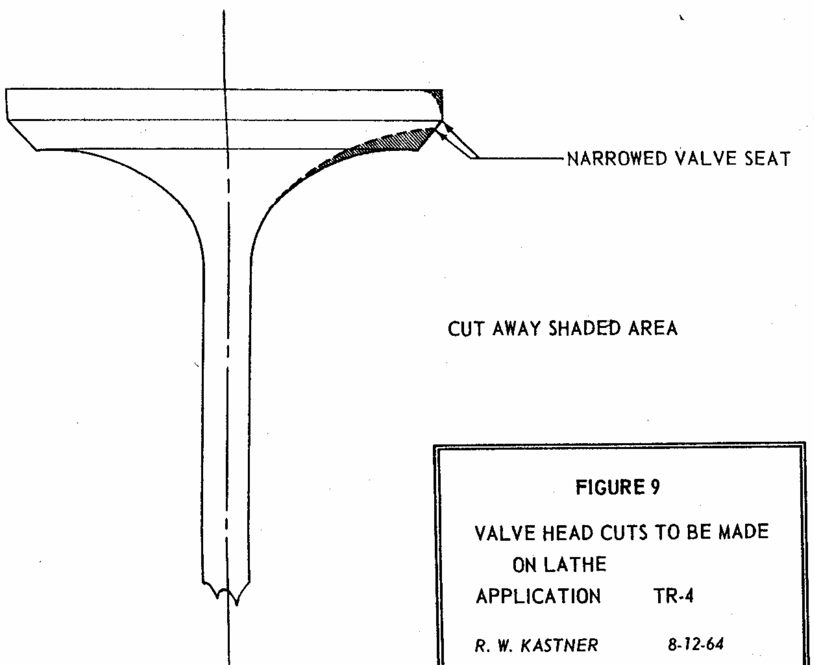


FIGURE 9

VALVE HEAD CUTS TO BE MADE ON LATHE

APPLICATION TR-4

R. W. KASTNER 8-12-64

VALVE SPRINGS

There are two types of heavy duty valve springs, part number for both being V 015. The earlier type is fitted with two special springs which are placed on a special depth pad, and fitted up with a steel collar.

The later type is a kit composed of eight special inner springs and eight light alloy collars. Fit the inner spring inside of the *stock* outer spring and hold in position with the light alloy collar. There are no spacers used under the later type spring.

Due to the reduction in valve weight with the alloy collar, the spring tension has been reduced. Thus additional protection is given to the camshaft lobes and cam followers.

Figure 10 shows the stock outer spring and the new inner spring with light alloy collar. The later type spring will not give any difficulty with coil bind up to valve lifts of .500". The kit is made up to use lifts up to .450", and should your camshaft have a higher lift, it will be necessary to remove .050" from the bottom face of the alloy keeper. The purpose of this is to provide clearance between the top of the valve guide and the collar at full open lift.

When fitting the optional 'F' cam and early type springs, be certain to check the inner valve springs for coil bind at full lift of the valve.

There are two types of exhaust valve. During tests we have not found any advantage in one over the other, when total power was the object. The later type valve has a chrome plated stem, which is an advantage.

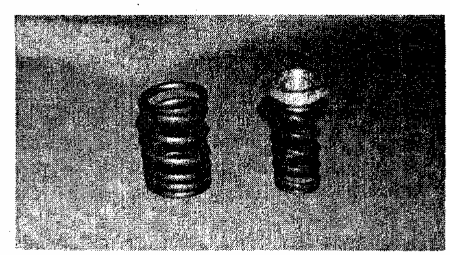


Figure 10

PORTING

A considerable amount of material can be removed from the intake ports to create a 'large' port, which is most effective at top end. With the latest type cylinder head — the third one mentioned under the heading 'CYLINDER HEAD' — it is possible to make a constant velocity type port with higher gas speeds. The highest power reading has been achieved with this cylinder head, ported a very slight amount.

In this type cylinder head the intake ports are cut out to 1½" throughout the port length. With the earlier type cylinder head, due to the chamfer at the manifold face, the port is enlarged to 1⅝" for a distance of approximately 1" into the port, then gradually tapering down to 1½" at the valve pocket.

The larger port is a little better on full top end power, but the smaller diameter — 1½" throughout the entire port length — is more flexible, and for the most part is a better arrangement for road racing.

Special attention should be given to the area under the valve seat (valve throat), to make sure that it is blended into the port with no sharp edges. A very fine polish is desirable, but certainly not a necessity.

Reasonable finish on the port is expected, but primarily make no changes in cross section without a long taper, and be careful not to leave pockets through the port.

We are held to a specific valve diameter, and with the latest optional 'F' cam, the gas speed through the valve at full lift is approximately 285 feet per second — assuming that the valve throat has been corrected as described in an earlier section.

Gas speed in the valve pocket is approximately 270 feet per second. With the smaller diameter port the speed is 250 feet per second. Gas speed is maintained at 250 feet per second through the intake manifold and cylinder port until the gas dumps into the valve pocket, and starts up through the valve throat area. At this point the speed increases to the minimum possible through the valve itself.

(Manifold porting is covered in the manifold section).

There has always been some controversy over the question of leaving the intake guides intact or cutting them off. If the rocker geometry is correct there will be no more than normal guide wear if the guides are cut off. There will be a slight — and I mean a slight increase in port area.

If the rocker geometry is off, the guides will wear very rapidly and make the installation of new guides necessary quite regularly. I have made tests with the guides intact, and with them cut off, and am not able to say there was any improvement in power with the guides cut off. Therefore in your porting of the valve pocket area, grind away the guides so that all areas of the port pocket can be smoothed out. Then when the job is completed and polished, install new guides for a good job.

The exhaust ports can be treated a little differently, because the exhaust gas is moving out of the valve and into the port under pressure. Usually it is best to taper the port out to the edge of the manifold face, and match into the header assembly. Enlarging the exhaust port beyond the size of the gasket has not provided any benefit to power.

CYLINDER SLEEVES

The sleeves must be carefully cleaned to make certain that no residue of rust or old gasket cement remains on the outer surfaces. Carefully clean the section of the sleeve that fits on the figure '8' gaskets. Wipe the outer surfaces with laquer thinner to remove the last traces of grit, etc. Lightly hone the sleeves so that the piston rings will seat easily.

Wash the sleeves with a high detergent soap, dry thoroughly, and immediately oil all over. Now wipe all over with a dry clean rag so that only a light oil film remains on the sleeve, to prevent rust.

We have made some changes in the combustion chamber that make it necessary to alter the sleeve on the top edge. The combustion chamber area is enlarged around the intake valve, and this portion of the combustion chamber will overlap the sleeve edge. We must now match in the cylinder head shape to the top of the sleeve.

Set in the sleeve gaskets without cement, slide the sleeves into their bores in the block. Paint the top portion of the sleeve with die maker's blue. Now apply a light coat of thick grease or modelling clay around the top of the sleeve approximately 1/16" deep in the area where the combustion chamber overlaps. Wet the cylinder head on the area around the combustion chamber lightly with kerosene or light machine oil.

Now settle the cylinder head into position on the block and torque up to approximately 50 lbs. Carefully remove the head and you will see that the grease has been squeezed out on the top of the sleeves, except in the area where the combustion chamber overlaps. The grease will be in a crescent shape.

Using a sharp awl, scribe the grease line carefully onto the sleeve. Wipe off the grease, and the scribe line should now be in sharp view through the die maker's blue.

Grind out this crescent shape of sleeve material at a 45-degree angle. Make certain that this relief does not extend further than 3/32" from the top ring.

Before removing the sleeves, mark both the sleeve and the block so that the sleeves can be installed later in exactly the same position.

Remove the sleeves, clean carefully, apply gasket cement to the figure '8' gaskets, and make the final installation of the sleeves.

The top of each sleeve should now appear as shown in Figure 11.

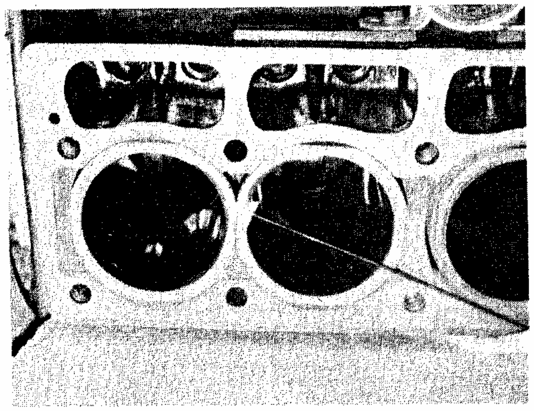


Figure 11

INTAKE MANIFOLDS

There are two types of intake manifold in use on the TR-4. These are both series produced and fitted as normal. The number 1 has short tubes on a log, and the number 2 has longer tubes and no log. See Figure 12. The number 2 is fitted to those TR-4's delivered with Stromberg carbs. There is an advantage to fitting this type of manifold to an S.U. carburetted car. However, when completely re-worked (at considerable time and effort), the number 1 or earlier type manifold is equal to the number 2 or later type.

This latter type, which we will call number 2 from now on, is longer than the number 1 manifold, and you must make certain that the carburetor linkage does not foul the inner fender well.

The ports of the intake manifold should be slightly larger at the carburetor end than they are at the cylinder head face. This will fit in with our purpose of increasing the gas velocity in a steady manner throughout the intake passage.

Polish out the intake manifold, then match up the carburetor body to each port so that there is no overlap of material. Be certain to clean out the balance pipe thoroughly before the manifold is installed.

EXHAUST MANIFOLD

The stock manifold is the same on all of the TR-3 and TR-4 vehicles, and while this manifold is of good design, a definite power increase can be obtained by fitting the optional exhaust header system — Part # V 113.

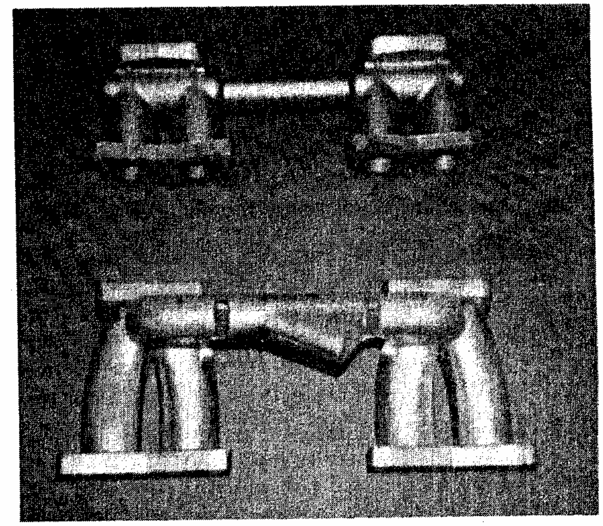


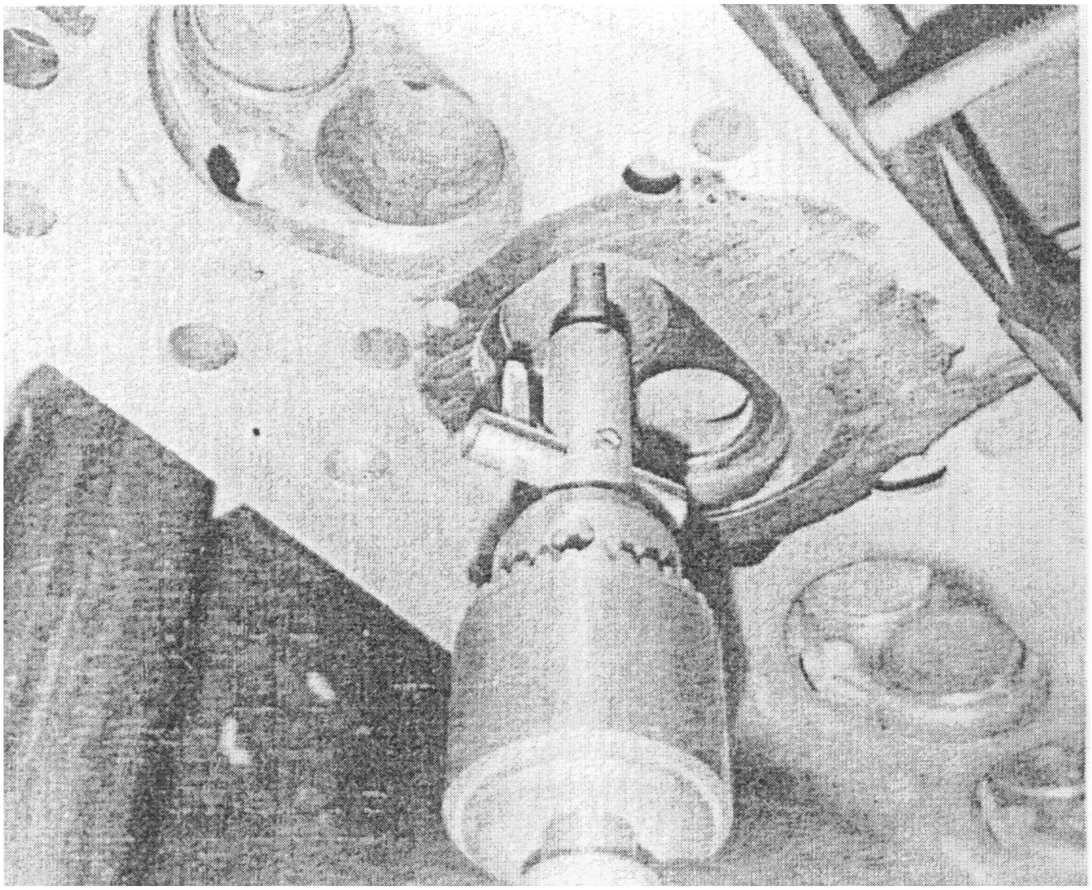
Figure 12

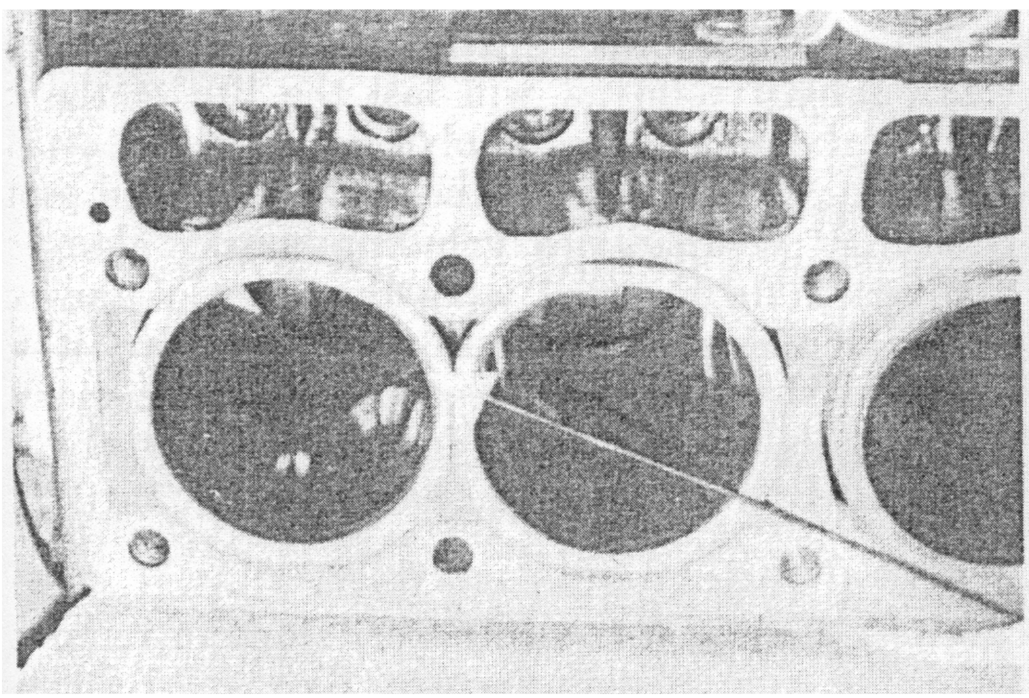
This competition header is the "four-into-one" style.

Various tail pipe lengths have been tested and generally the best performer is 45" in length, measuring from the end of the single collector tube, which is the last or bottom piece of the exhaust header assembly.

You can figure that the shorter the pipe, the more power will be established in the higher rev range; the longer the pipe, the more power in the lower rpm range.

The tail pipe should be made of $2\frac{1}{2}$" O.D. tubing. The length suggested will end the pipe just in front of the right rear wheel. Be certain to install sufficient hangers on the tail pipe. It's suggested that you fit a ten inch length of flexible exhaust pipe tubing into the tail pipe assembly so that the engine torque is not taken up on the tail pipe hangers. Usually this flex pipe can be fitted in directly after the end of the main header collector pipe.





FLYWHEEL AND CLUTCH

The standard flywheel is of cast iron and approximately 31 lbs. in weight. SCCA regulations allow the fitting of any flywheel and it is recommended that an aluminum flywheel be used. Flywheels of this type are available on special order from several sources.

Be sure to install flywheel locks on the assembly bolts to the crankshaft, and turn down the tabs. Do not re-use the old locking tabs.

The competition clutch — Part #V115 — is a special version of the standard unit that is 'beefed' up for competition purposes. Those building their own clutch pressure plates to a higher capacity should bear in mind that excessive pressure will act much the same as insufficient pressure. Too much pressure will warp the pressure plate, give difficulty in releasing, and will reduce the amount of contact area with the driven disc.

There is a special driven disc — Part #V346 — that has proven itself very satisfactory in extended service for racing. The unit is constructed from special steel, and has a machined hub which is riveted to the solid plate. The lining is a special type which is permanently bonded to the clutch disc.

We have seen only two failures of this type of driven disc, and in both instances failure was caused by oil seepage onto the clutch plate which allowed slippage, the resultant heat warping the disc. The pressure plate and disc combination described will carry in excess of 160 horsepower.

The diaphragm type clutch was introduced with the TR-4A. This unit has a 8:5" diameter and is highly recommended for both the TR-3 and the TR-4. This unit has been used with great success in the cars prepared by the Competition Department with horsepower figures in the high 150's. This clutch was used in the TR-4A cars entered in the Sebring 12 hour race in 1966 with fine results as the cars won the class 1, 2, 3, and also won the team trophy.

When fitting the diaphragm clutch to the TR-3 or the TR-4 it will be necessary to redrill the flywheel as, of course, the bolt pattern of the smaller clutch is different. With the early TR-3 models, it will also be necessary that the later type starter be used. The early type starter is too long and will foul the bell housing if the later type TR-4 gearbox is used.

NOTE: It is mandatory that the diaphragm type throw-out bearing be used whenever the diaphragm clutch is fitted.

ROCKER ARMS

The standard rocker assembly is a fine, trouble-free assembly that, given even reasonable treatment, will last the life of the car. The standard rockers can be lightened considerably by grinding away the superfluous metal at the adjustment nut end, at the valve end, and along the top length. Remove the casting flashing and grinding marks along the entire length. Remove but a very little material from the sides of the rockers. By inspection of the ground radius on the nose of the rocker, it will easily be seen where the rocker strikes the valve stem. Considerable material will be shown on both sides of this mark. This additional material can be removed by grinding. Do not grind on the nose radius.

After finishing down to a smooth finish all over, the radius of the nose should be carefully stoned with a fine whet stone to remove the fine grinding marks left from the time of manufacture. Be careful during this stoning not to change the radius.

Inspect all of the ball ends and the locking nuts. Replace any of these parts that show even the slightest sign of rough threads, or chipping on the slotted end of the ball end screw. Test the rockers on the rocker shaft for fit. There should be just a slight amount of side play.

If the car is more than a year old or 15,000 miles, I would suggest that all of the bushings be replaced and honed to fit a NEW rocker shaft. The springs that retain the rockers in their correct position have a square cut coil for the last coil-end. Grind the end of each coil-end so that the wire is as close to parallel to the balance of the coil as possible.

PUSH RODS

There are three different types of push rods that may be used in the Triumph engine. First is the small tube having a copper color. UNDER NO CIRCUMSTANCES USE THIS PUSH ROD. It will not stand the stresses of racing and is prone to bending.

The second type is of a larger diameter and is finished in the natural steel color. This tube is most satisfactory for all uses and will give good service.

Thirdly, we have the competition push rods — Part #V018. These are made of a special steel, are smaller in diameter than the standard large type, and have sweated end fittings rather than welded ends. Because of the sweated ends they are very good to work with when correction of the rocker geometry is needed.

For all out racing the competition push rods will give the best service. They are easily recognized by their black color. These rods are slightly shorter in length and will compensate in a stock engine for the rocker geometry, when the thin steel head gasket is installed in place of the standard copper asbestos unit.

ROCKER GEOMETRY

When the cylinder head is milled, the rocker geometry is changed unless the rocker assembly is shimmed, or the push rods shortened. When the valve is half open, the rocker arm and the valve stem center lines should be at 90 degrees, and the rocker radius should be directly in the center of the valve.

If the geometry is off you will have excess valve guide wear, and also a rounding off of the valve stem ends. It is possible you may even experience very fast wear on the end of the valve stems. A stopgap method of adjusting the geometry is to pack up the rocker pedestals — but this is not the best method.

In milling the cylinder head we have affected only one part of the cylinder head assembly, this being the push rod length. It is therefore necessary to shorten the push rods to the correct length, thus regaining the proper geometry as described above. As we have indicated, the competition push rods have sweated end pieces, and therefore shortening of these rods can easily be accomplished in a lathe.

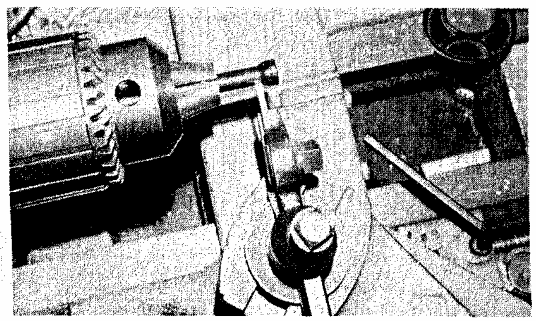


Figure 13

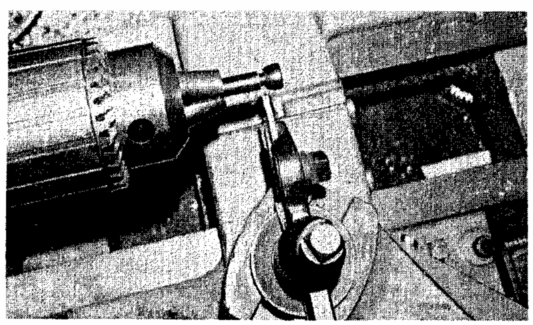


Figure 14

Note Figures 13 and 14 which show the lathe set up for this process. The parting tool involved is ground to the width that you wish to remove. The material is turned from the end of the rod right up next to the cup end. The cup end can now be driven back down into the push rod for a good tight fit. Occasionally, it is necessary to apply a LITTLE heat on the end of the tube, to drive the cup end back into position. DO NOT USE EXCESSIVE HEAT or you might well remove the temper from the cup end piece.

As a general rule it is best to shorten the push rods approximately three-quarters of the amount that was milled from the cylinder head face, then adjust each push rod for the correct length for the particular valve.

It is done in this manner of 'a bit at a time' because you cannot put metal back onto the push rod.

Rocker geometry that is 'way off' can usually be determined by a clicking of the tappets even though the adjustment checks out okay. If this occurs in YOUR engine, fix it. Don't let this condition exist. You will lose power and wear out things needlessly.

CAM FOLLOWERS

The standard cam followers can be fitted as furnished with a slight amount of work. Smooth off the sharp edge of the cam follower at its base with 240 wet or dry sandpaper. Polish the cam followers all over. It is possible to lighten the cam followers approximately 15 per cent, but this work must be done in a lathe. To lighten, remove .375″ from the top end of each follower in a lathe with a parting tool. Radius the edges. Further lightening can be accomplished by boring the internal diameter an additional .050″. Further boring can be done, but this will make the shell rather fragile, without giving much benefit.

Your author has been using cam followers as described for a number of years, and has never experienced any trouble with the units due to lightening.

When building up your engine or replacing the camshaft, remember to replace the old followers with new ones. DO NOT drill holes in the sides of the followers.

Drain holes were attempted in the bottom of the follower . . . but a rash of broken followers — the foot breaking off, etc. — and the idea was speedily dropped.

Replace any follower that shows even a slight pit.

CAMSHAFTS

A tremendous amount of effort has gone into providing Triumph owners with the very best in performance camshafts. Testing has gone on constantly for three years with other grinds, grinds from speed shops . . . and the special 'hot' ones from the big advertisers of this type of equipment.

Nothing tested had the outright power and reliability of the units furnished by Triumph.

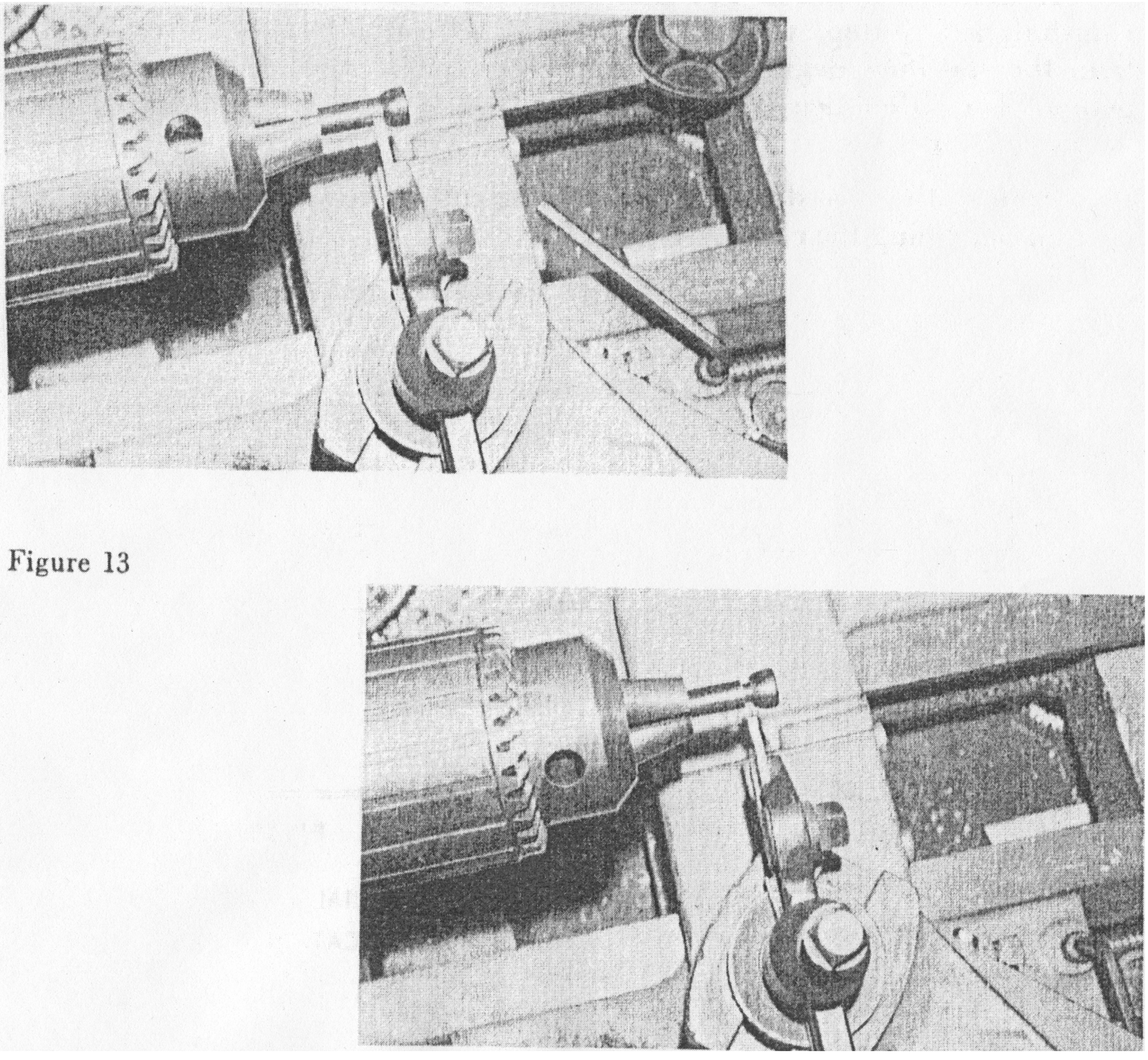


Figure 13

In the beginning, the Competition Department offered the "C" camshaft as a mild street/race unit. With the widespread availability of better gasoline, this camshaft has been dropped as it is now possible for higher compression ratios to be used and thus more camshaft timing and lift.

The "D" camshaft is now suggested for street/race use, but there must be an increase in the compression ratio. The minimum compression ratio is 10.0 to 1. Without this increase in compression, the r.p.m. range below 3500 will be very sluggish. The power range on the "D" camshaft is between 3500 r.p.m. and 5500 r.p.m. The timing of the "D" camshaft is as follows:

Inlet opens 33° BTDC — Inlet closes 71° ABDC

Exhaust opens 71° BBDC — Exhaust closes 33° ATDC

Duration is 284° — Total lift at the valve is .393

When using a degree wheel, the checking clearance is .010 at the camshaft.

The rocker arm adjustment is .014 hot.

The next step in camshafts is the "F." This is a full racing type camshaft and is not recommended for street use. The power range is from 4000 to 6000 r.p.m. The minimum compression is 11.7 to 1. The timing and other specifics of the "F" camshaft are as follows:

Inlet opens 39° BTDC — Inlet closes 81° ABDC

Exhaust opens 81° BBDC — Exhaust closes 39° ATDC

Duration is 300° — Total lift at the valve is .432

When using a degree wheel, the checking clearance is .010 at the camshaft.

The rocker arm adjustment is .014 hot.

The latest camshaft for the TR-3, 4, 4A is the G-3. This camshaft is quite radical with a high lift and fast opening rates. The power range is 4200 to 6500 r.p.m. The minimum compression is 11.7 to 1. This camshaft is also strictly for racing purposes. The timing and specifications are as follows:

Inlet opens 51° BTDC — Inlet closes 79° ABDC

Exhaust opens 79° BBDC — Exhaust closes 51° ATDC

Duration is 309° — Total lift at the valve is .499

When using a degree wheel, the checking clearance is .011 at the camshaft.

The rocker arm adjustment is .016 hot.

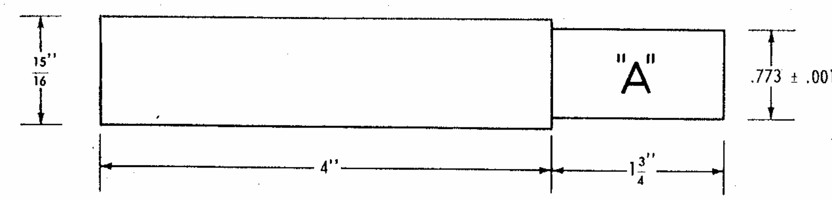
All of the camshafts furnished by Triumph through its Dealer organization have been carefully checked for truth and accuracy according to the timing diagram supplied with each unit. There are copies of these camshafts being made. But you cannot replace the original article with a copy. BEWARE OF IMITATIONS. (See carburetor section for needle recommendations).

Now, each Triumph camshaft furnished as an option for the TR-3, TR-4 or SPITFIRE is ground with the latest type, new equipment. However, the cam will only do the job if you follow the instructions. Be sure to install new cam followers. Install a new timing chain and tensioner if there is the slightest doubt as to its ability to do an accurate job.

The camshaft timing diagram is included with each camshaft, and is a straightforward information sheet with but one exception . . . YOU MUST DO YOUR DEGREEING FROM THE CAMSHAFT — NOT FROM THE VALVE. The cam cannot make allowances for improper rocker geometry, mis-ratioed rocker arms, flexing in push rods, etc., etc. The only accurate method is from the camshaft itself.

It must be pointed out that improper rocker geometry will alter the camshaft lift timing, wherein a different lift ratio is applied at some other than the specified degrees of crankshaft rotation. Everything must work together. The difference between a horse and a goat is more than a pair of horns. . . .

Figure 15 is a drawing for making up a dummy push rod which is used in degreeing the camshaft.



DUMMY PUSHROD

FIGURE 15

MATERIAL — STEEL
APPLICATION — TR-4

AREA "A" TO FIT INSIDE BORE OF CAM FOLLOWER

R. W. KASTNER 8/18/64

One last piece of advice . . . coat the camshaft all over with a good lubricant such as Lubriplate or S.T.P. before installation. The most critical period for wear on a new cam is the first few minutes of running.

Adjust the rocker clearance hot in the following manner:

Adjust number 8 when number 1 is full open
Adjust number 7 when number 2 is full open
Adjust number 6 when number 3 is full open
Adjust number 5 when number 4 is full open
Adjust number 4 when number 5 is full open
Adjust number 3 when number 6 is full open
Adjust number 2 when number 7 is full open
Adjust number 1 when number 8 is full open

CARBURETORS

The S.U. and the new Stromberg carburetors are very similar in design, except that the latter uses a more easily adjustable jet screw, and instead of a machine fit on the piston and dashpot, utilizes a diaphragm arrangement. The diaphragm gives a more accurate air depression and raising of the piston than the S.U., but some trouble will be experienced in procuring different needle shapes. We will deal first with the needles.

The simplest method is to make up a small .006" shim tube that will slip over the S.U. needle shank. As the difference in diameter between S.U. and Stromberg needles is .013", there will only be .0005" difference, which will not hinder the fitting to the Stromberg piston.

Wrap a small piece of .006" brass shim stock around the shank or fitted end of an S.U. needle; remove the formed tube of shim stock, and cut it in half down the length of the tube. Now fit the S.U. needle to the Stromberg piston, and slide the half-tube of shim stock in next to the needle shank opposite the piston set screw. This will force the needle up tight on the shim stock when the set screw is tightened, and center the smaller needle shank. There is not a definite needle correlation between S.U. and Stromberg carburetors, because of the more accurate lift of the latter's piston. But the method described will put you close to the correct mixture the first time without making up special needles.

Make certain that the top bearing of the jet in the Stromberg carburetor does not stand proud of the carburetor body. This can be adjusted with small shim washers under the jet bearing head. Should you experience a lack of fuel in the float chamber, increase the needle and seat size to .225" diameter, the stock size being .175".

Other than thinning the throttle shafts and throttle butterflies, there is not much else that needs to be done in the carburetor area. If you have thinned out the throttle shafts, be certain that you solder the butterfly retaining screws into position.

The S.U. carburetors use a small coil spring to hold the jet head up in its correct position. These springs have a tendency to become brittle when exposed for some length of time to the additional heat from the optional exhaust system.

Replace these springs with old fashioned soft shop wire. You will normally have the adjusting nut turned down approximately 14 flats. Set the adjusting nuts down 12 flats, then replace the springs with the wire and tighten the wire up by twisting the ends. After the wire is tight, turn down the additional two flats of the adjusting nuts, and you'll have a fitting that is very tight and will not lose its adjustment. It is best to have two loops of the wire — not just one.

The following are S.U. needle recommendations for the various Triumph racing camshafts:

	Lean	*Standard*	*Rich*
'C' CAMSHAFT	S.M.	R.H.	R.G.
'D' CAMSHAFT	R.H.	R.G.	R.F.
'F' CAMSHAFT	R.G.	R.A.	R.B.
G-3 CAMSHAFT	R.G.	R.F.	R.B.

DISTRIBUTOR

The original factory distributor has been used in all of the modifications detailed in this book. The Triumph Competition Department has attempted to tie together a basic engine that does not require the purchase of several expensive pieces. The distributor is a good example.

True, there are possibilities in different advance curves, but as the average owner interested in racing HIS Triumph does not have the type of equipment at hand to work with, your author has also foregone his equipment so that you might duplicate the results achieved, without adding too much to the racing budget. The standard static ignition timing of 10 degrees is a good starting point, and you will not finish more than just a couple of degrees one way or the other from this. Quality of fuel and compression ratio dictate the timing that can be carried without detonation. Tests must be made with each individual engine as no two are exactly alike. One of the best methods is to power time on a chassis dyno in 3rd gear at approximately 5000 rpm. Remove the distributor cam and lube the weights of the mechanical advance mechanism. Check to see that the springs operate satisfactorily, re-install the cam and tighten up well. Lube the cam shaft with Lubriplate or other lubricant designed for this purpose. Install new points and condenser. Make certain that the point plate does not wobble. Should this occur, changes are made at the same time with the ignition timing and erratic running or power loss may be experienced.

Do not start a race with a new set of points. The rubbing block which bears on the distributor cam wears quite rapidly for the first hundred or so miles, and in wearing allows the points to close up, thus retarding the timing. Check out the distributor cap carefully for cracks or wear on the contacts due to mis-aligned rotors, then button up the assembly.

It is extremely important that you check out your distributor to find the total advance. This can be best accomplished by checking in a distributor machine. It is worth the cost of a few dollars. Knowing the amount of distributor advance can easily save you from over-advancing the engine and thus blowing up the complete works.

When speaking of total advance, we are speaking of that advance provided through the mechanical advance mechanism and also that advance as installed static at the crankshaft.

When the compression is raised to 10.2, the maximum total advance should be 30 degrees. When the compression is raised to 10.2 to 11.2, the total advance should not exceed 28 degrees. When the compression is raised above 11.2, the total advance should not exceed 26 degrees.

For those wishing to make a slight improvement in power with a full racing engine, a slight improvement can be made with an advance curve that gives a total of 26 degrees at 4000 r.p.m. and increases one degree for each additional 500 r.p.m. up to 6500 r.p.m.

IGNITION WIRING

Replace the standard ignition wiring with a full metal thread type wire. Make certain there are no radio supressors in the high tension lines. Check the spark plug connectors to see that they are tight, yet will rotate on the spark plug. If the connectors are too tight, they will loosen the threaded end of the spark plug, and the entire end and connector could fall off at a very embarrassing moment. Keep the wiring clean.

THROTTLE LINKAGE

The standard linkage as fitted is a good reliable system that given just a little upkeep and care, will last indefinitely. Inspect the ball joints so that they are kept from becoming too loose, possibly allowing the link to drop off. (Again, an embarrassing moment!)

There is an adjustment on the end of each link that will allow you to tighten up the ball end, after a certain length of time has passed and wear of the ball set in. Carefully test the linkage before deciding that it's okay for racing. If the ball end is too tight, sticking occurs and usually you cannot get full throttle.

When you are quite certain that everything is as tight as possible, with complete freedom of the system, peen or punch mark the ends of each link.

Remove the linkage at least three times a year, and disassemble completely. Check the small springs in the end of each link carefully. If they fail, so does the entire system. These springs keep tension on the ball end.

OTHER ENGINE PARTS

Drill the heads of the bolts that hold the generator mounting plate to the cylinder block. These bolts are run straight through the block wall, and the loss of one can produce a fantastic oil leak which is very difficult to repair in a hurry around the hot exhaust headers. Safety wire these bolts. Drill the front, bottom generator bolt and safety wire this bolt after installing the generator.

Drill and safety wire the camshaft bearing bolts on the left side of the block. Drill and safety wire the oil gallery bolts on the same side.

Wrap all of the water hoses with plastic ignition tape. This will prevent scuffing and damage from spillage of lubricants, gasoline, etc. Remove the thermostat and open the bellows to the full-open point. Break the bellows so that the flap cannot close. Re-install the thermostat. This will slow the warm-up of the engine and is not suggested for street use.

Racing engines must be at the correct temperature and keeping the thermostat in position, though broken at the full open point, guarantees the amount of restriction in the water system. You must have a restriction in the system or the water pump will force the coolant through the radiator too fast for proper cooling to take place, and the engine can overheat very quickly.

Do not use a new fan belt, and do not have the belt adjusted too tight. This can cost you a race as easily as running out of gasoline. Fan belts tend to stretch a good deal during the first hundred or so miles. Bargain with a friend for a good used belt, or fit a new belt for practice, then re-adjust it. If the belt is too tight this will literally eat up horsepower, and possibly ruin the belt with consequent overheating . . . and 'bang'.

FUEL PUMP

Install the optional electric fuel pump — Part #V010. This is best mounted in the trunk compartment, or on the vertical panel just to the rear of the driver's seat. In either of these locations only short lengths of hose will be needed. Also the pump will be exposed to unheated air, thus retarding the possibility of vapor lock or pre-heating of the fuel.

The standard mechanical pump is quite adequate for racing, but is objected to primarily because of its location on the engine where the fuel is heated just before going to the carburetors.

Fuel temperature is very important. Locate your lines so that there will be a minimum of heat exchanged.

The mechanical pump utilizes a small neoprene seal to retain oil in the pump body. Should this seal wear excessively oil will seep by and be forced out the pump breather hole. You can lose an enormous amount of oil in a very short length of time from this failure. So, invest in the optional pump and get the safety and advantages of cooler fuel supply.

When installing the electric fuel pump remove the old mechanical type, and make up a plate of steel or aluminum to fit the opening where the mechanical pump was bolted to the engine block.

SPARK PLUGS

The Triumph Competition Department has been using the Champion spark plugs exclusively for the past two years as these units have shown themselves to be the most reliable and able to produce clean firing under the most adverse conditions.

If your engine has a compression of approximately 10 to 1, it is recommended that the L66Y plug gapped at .022 be fitted. This is a racing type plug, but can be used quite successfully with street/race engines. Although the heat range is considerably cooler than a normal street plug, this plug will give all the benefits of a hot plug, but will not burn up under high pressure use in a modified engine.

For the full racing engine, there is a choice of two plugs. The particular choice is made on the weather and engine configuration. Generally with a full out engine using a compression ratio in excess of 11.7, the best plug will generally be the L61Y. This is the coldest recommended and the coldest we have found necessary.

If the weather is quite cool, or you are running-in the engine, or if the engine is oiling up slightly, the slightly warmer plug, L64Y, should be fitted. This type plug normally does not turn the chocolate color (except in street use) so often described in tuning manuals, but instead will have a slightly yellow or tan color. This color might not cover the entire ceramic as the projected nose does have a tendency to be washed by the incoming charge.

If you are getting little black specks on the ceramic, this is generally an indication that you have all the ignition timing that you can stand and that you are getting a slight amount of detonation. If you find tiny silver colored balls on the ceramic, this is the sign of heavy detonation and you should immediately retard the timing.

Be certain that you do not overtighten the spark plugs. They need only be tight enough to hold the plug in the cylinder head and make a good contact. This will amount to about 10 to 15 pounds torque. Do not throw away your plugs just because you have a race or two on them. These plugs will last quite a long time and should only need cleaning and refiling to make them as good as new.

TIRES

There sometimes seems to be some mysterious genie who establishes correct tire pressures. . . . I can only assume this when I see people driving a TR-4 asking other drivers, who are competing in a SPITFIRE. . . . "What are you running for tire pressure?" Silly . . .? You bet it is!

With the TR-3, 4 and the beam axle TR-4A the following pressures are recommended as a starting point: front 42 pounds, rear 39 pounds. With the I.R.S. TR-4A it is recommended: front 28 pounds, rear 30 pounds. This recommendation is made considering that you are fitting any of the normal racing type tires in the 900 to 950 range. In the Competition Department we have been using the 920 Indy Firestone racing tires and have found them to give exceptionally good results.

If the front end does not respond as it should — it understeers — then INCREASE the front tire pressure by about 3 lbs. This additional pressure will tend to stop the tire from rolling; you will have a larger patch of tire in contact with the track with the obvious benefits.

If the back end comes out too fast and you seem to be broadsliding every turn instead of driving through, increase the rear pressure by about 3 lbs. and increase the front 1 or 2 lbs. The increase in the rear pressure will stop the oversteer, but will make the additional pressure in the front necessary to counteract any understeer that may develop.

Increases of 3 lb. increments will make fantastic differences in the handling of your TR. They should not be made hit or miss. Sure . . . the car feels better with low pressures . . . but that's because you aren't going fast enough.

You gain in speed through the corners, and feel just as comfortable if the tires are STICKING. Remember: the only thing that keeps the car on the road is a little tire patch approximately 5" long and 7" wide. When you use low pressure you are allowing the tire to roll, and you loose part of this patch. When this happens, you lose traction and off you go into the weeds.

Another point. Racing tires will build up excessive heat if under-inflated.

Check with your racing tire distributor — he has the answers. Be right . . . instead of asking silly questions.

The standard steel disc wheel and the wire wheel are fine for street or minor competition use, but when fitted with the wide, soft racing tires the tire bite can cause a lot of flexing in the wheel which will not only limit the length of time the tire can stick, but the life of the wheel as well.

It is recommended that the alloy racing wheels be fitted for racing purposes. These wheels are made of high grade material and as they are turned on a lathe, the rim periphery is very smooth and accurate. These wheels are available in rim widths varying from 5 to 6 inches. Use the maximum width allowed for you car under racing regulations. The wider the wheel the better the chance you have of keeping a larger portion of the tread in contact with the road and, therefore, a better bite and handling.

The alloy wheels are approximately 7 pounds lighter than a wire wheel and extension and are approximately 3 pounds lighter than the standard steel disc wheel. Obviously any decrease in the unsprung weight is going to be an advantage in road handling.

Torque the wheel nuts to 55 ft./lbs.

ANTI-SWAY BAR

The standard factory fitting — Part #510584 — is recommended for both street and racing use. It will assist in keeping the rear wheel in contact with the road, and will induce understeer. The larger the bar diameter, the quicker the bite coming out of a corner . . . and the more understeer.

As fitting the No-Spin Differential Unit — Part #V011 — will also increase understeer, it will pay you to test different settings on the shock absorbers, and with or without the anti-sway bar to arrive at perfect cornering power.

I have been using a bar of 11/16″ diameter on my test car, and found that the cornering power was greatly increased.

The bar is a real necessity on high-speed tracks. You can use a general rule that the faster the track, the more understeer, this being applied by increasing shock settings and installing a larger diameter sway bar.

In most racing applications it will be necessary to change the front wheel camber to ½ to 1 degree NEGATIVE camber. This job is best left to competent front-end man who will be familiar with the technique.

Be certain to set the toe-in to 1/16″ to zero after the camber is adjusted.

One last note — the normal fittings and rubber pieces from the standard-size sway bar can easily be modified to accept a larger diameter bar.

TORQUE RODS

The rear axle torque rods are an absolute MUST for a competition machine. This special torque rod will very much limit the spring wind up and as a result give superior acceleration from a standing start. The rods will come into effect while cornering, and by limiting the spring wind up, will at the same time stop any tendency for rear axle steering. You will also find that braking, and reduction of the nose dive on hard straight-line braking, will be greatly improved. The torque rods are bolted up under the rear spring "U" bolt plate. With the rod in the direct middle of the spring line, arc-weld the forward end to the chassis frame. The rubber grommets in the torque rods are pre-set and should not be tightened further. Overtightening will in some cases produce wheel hop and also a loud squeak on cornering.

NON-SLIP DIFFERENTIAL AND REAR AXLE RATIOS

We have found that the 4.55 axle ratio is the best for good acceleration, and when mated with the overdrive allows the use of this ratio on any track. For the most part, your competitors find it necessary to gear for the longest straight, and by doing so, reduce their acceleration out of each corner. We still have the good short course acceleration, yet always have top overdrive to fall back on. When the car is without overdrive, and straightaway speeds do not exceed 110 mph, I suggest the 4.3 ratio. When installing the rear end limited slip unit be certain that you install the axle spacer button. The end float of the rear axles must be set and this cannot be done without the spacer. Due to the additional heat and force that is applied to the ring and pinion, I recommend that you use General Motors Positraction rear axle lube.

STREET TUNING THE TR-4

Although the majority of the optional equipment we have mentioned, which is available ONLY from your local Triumph Dealer, has been specially designed for racing purposes, there are some items that can be put to good use in building a 'hot' street car.

Before starting to modify your Triumph remember . . . it is very difficult to return a modified part back to its original configuration. Therefore, the outlay of money to return the car to stock condition will doubtless cost more than your investment to 'hop it up'.

Be sure in your own mind that you are prepared to tolerate some of the disadvantages of a 'hot' motor car BEFORE you go on a modification campaign.

The easiest way to more power — and the cheapest — is through compression. The Triumph engine will take up to 10.2 to 1 compression without any increase in measurable wear. Consequently this is the ratio, we'll work with.

Remove the cylinder head, strip out the valves and springs. With aid from a competent automotive machine shop, mill .090″ from the cylinder head face. After milling, wash out the entire cylinder head very carefully, INCLUDING the water jackets. Shavings from the milling operation will sometimes clog up the water passages and cause overheating.

Smooth off the sharp corners on the combustion chambers — be certain to blend in the sharp edge that will be around the intake valve. Grind the valves in the normal manner, and re-install with a new set of standard or the optional valve springs.

We recommend fitting the 'D' camshaft. Install new cam followers. The camshaft will align very close to the original timing marks, and present no problem in maintaining the correct camshaft timing. Lube the cam generously with Sta-Lube or Lubriplate grease.

Check the distributor end float for the proper clearance (TR-4 Workshop Manual specification).

Polish out the intake manifold and intake passages of the cylinder head. Although this work will not give a great power increase at the lower rpm used in street driving, the job is well worth doing, and provides the satisfaction of doing a complete and proper job. You will find that with the optional camshaft fitted, more fuel will need to be available. So install a pair of R.H. needles in the S.U. carburetors.

The modifications so far detailed will give you approximately 120 horsepower, with fine reliability.

Should you wish to carry out further modifications, install the optional exhaust header system. This unit will increase the power by approximately 6 horsepower, which will be utilized all through the power range as it will allow the camshaft to operate more efficiently.

You may find it necessary to adjust the carburetors after the header installation by two flats or so on the rich side.

The next step, particularly if your Triumph is fitted with overdrive, is to fit an optional gear ratio.

I would suggest the 4.3 with overdrive, and 4.1 with standard transmission. The increase in acceleration will be very noticeable. Now that things are working well in the power department, some thought should be given to improving the handling.

For those a little short of ready cash, the first installation should be the anti-sway bar. Next the competition springs, then the Koni shocks.

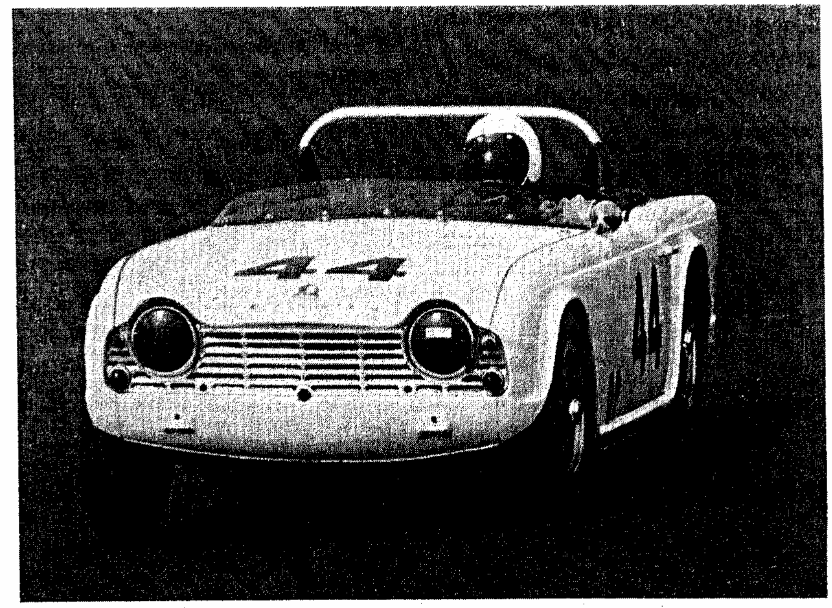
If money is not a problem by all means install the No-Spin Differential assembly. The torque rods are real frosting on the cake, and will definitely help in the autocross, gymkhana and ¼-mile acceleration contests.

If you find yourself consistently using higher revs than normal, install the oil cooler. The oil cooler is particularly advised for those living in the more tropical or desert areas. The more muscle in the engine, the more heat will need to be transferred. Make certain that you keep the cooling system clean and in good condition. Do not remove the thermostat.

Keep track of things in general, and you will have a great time driving your Triumph.

As a potential or actual competitor with a Triumph, British Leyland Motors Inc. is keenly interested in your performances and progress. Feel free at any time to write to the company, detailing your successes. And should you require advice or assistance in any way, write to:

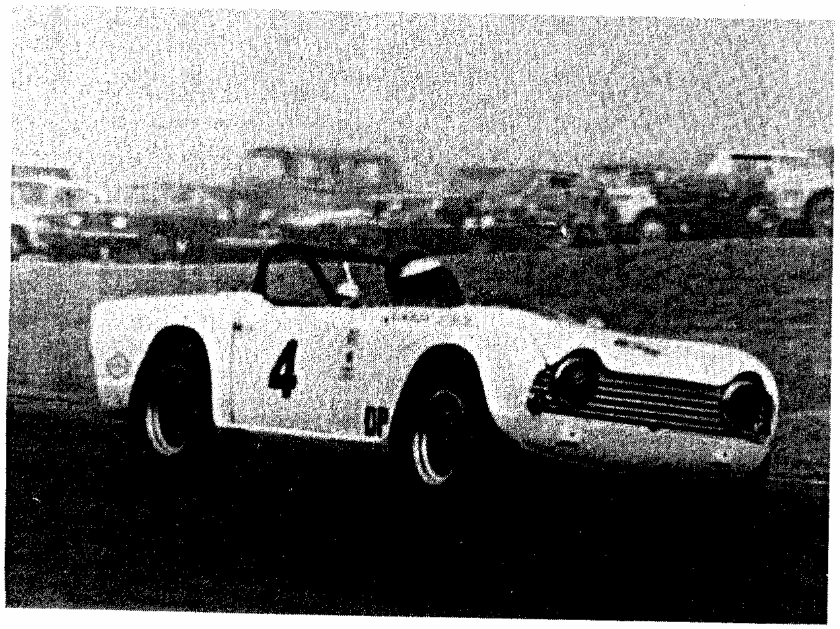
BRITISH LEYLAND MOTORS INC.
Competition Department
East of Mississippi — 600 Willow Tree Road, Leonia, N.J. 07605
West of Mississippi — P.O. Box 1557, Gardena, Calif. 90249



BOB TULLIUS IN HIS TR-4

In the preparation of this booklet every effort has been made to insure accuracy, and all of the suggested modifications have been tested in actual competition over a period of time. However, readers will appreciate that in any modification of a motor vehicle, and in automobile competition itself, certain risks are inevitably involved.

Only those who believe that they are mechanically competent to undertake the suggested procedures are advised to do so, as the Company cannot assume responsibility for damage or injury incurred as a result of following any of the procedures set forth in this booklet.



JOHN KELLY, 1968 D PRODUCTION CHAMPION

TR-4/4A

SCCA Class **E** Production National Champion 1962

SCCA Class **D** Production National Champion 1963

First, Second, Fourth in Class (GT 11) SEBRING
12-Hour Grand Prix of Endurance 1963

SCCA Class **D** Production National Champion 1964

American Road Race of Champions — **D** Production 1964

American Road Race of Champions — **D** Production 1965

American Road Race of Champions — **D** Production 1968

APPENDIX I

TR-4A COMPETITION PREPARATION

by R. W. Kastner

In addition to the IRS suspension there are several minor changes in the structure and small components of the TR-4A when compared to the standard TR-4.

FRONT SUSPENSION

The lower "A" frame on the TR-4A is connected to the chassis frame with an intermediary bracket. This additional bracket allows adjustment of the front suspension without bending of the components. Shims are added or taken out between the bracket face and the chassis point to adjust caster and camber. Equal amounts of shims behind each bracket adjust the camber while the shims to the rear only adjust the caster. It is recommended that the front camber be set to ½ to ¾ degrees *negative.* The caster to be set at 3-5 degrees *positive.* The toe-in set at zero.

The above setting should not be established until all other suspension parts have been replaced as necessary per the following instructions.

It is recommended that the standard front shock absorbers be replaced with the Koni shock part number V-443. These can be ordered through your local Triumph dealer. The Koni is adjustable when additional stiffness is called for and thus makes the installation of great value.

This particular shock has a rubber bumper in the dust cover which acts as the suspension stop. It is necessary to remove the rubber stop before making any adjustment. Do not fit any shock absorbers that do not have a bump stop incorporated. For initial set-up adjust the Koni shocks to 3 half turns. (This adjustment for *racing* only).

The front springs should be replaced with Triumph springs part number 201899. These springs are wound to the left and therefore easily distinguished from the normal spring unit. The latest production run of the TR-4A has a spacer over the top of the front spring which must be removed.

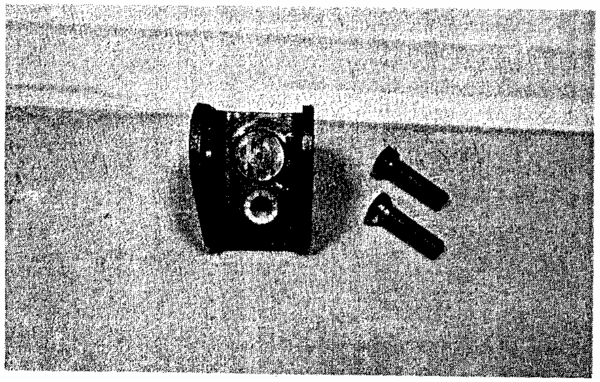


Figure 1.

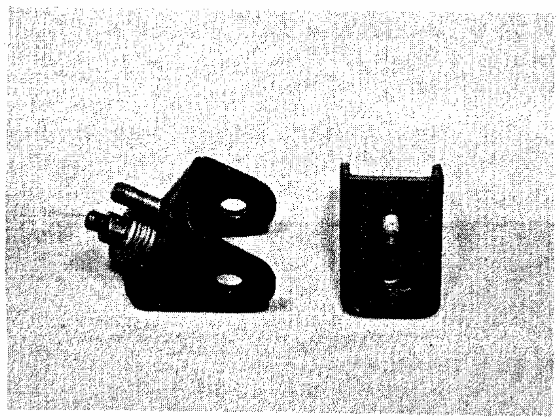


Figure 2.

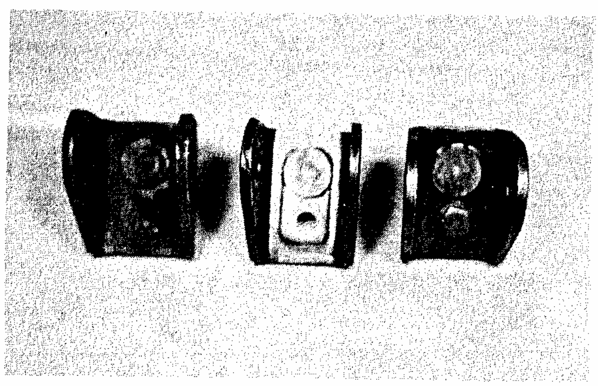


Figure 3.

Due to the fantastic increase in cornering power with the most modern tire designs it is highly recommended that the brackets which hold the lower "A" frame to the chassis be modified.

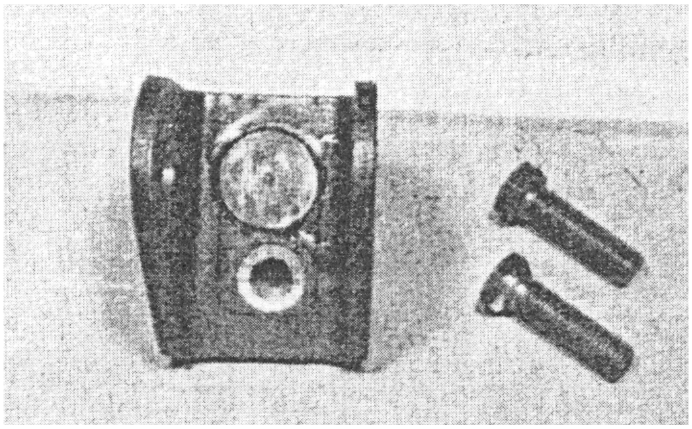
Study the photos as listed figures 1, 2, and 3. Figure one shows a bracket drilled and chamfered ready for the addition of the prescribed extra bolt. Drill a 3/8" Dia. hole and chamfer as shown in figure 1 at 45 degrees with a counter sink tool. Tool the under-side of a 3/8" x 1½" S.A.E. bolt of good quality at the same angle. This tooling is best performed in a lathe. The under-side of the bolt head then should mate with the angle of the chamfer made on the bracket. The bottom bolt in figure 1 shows a bolt completed as described above.

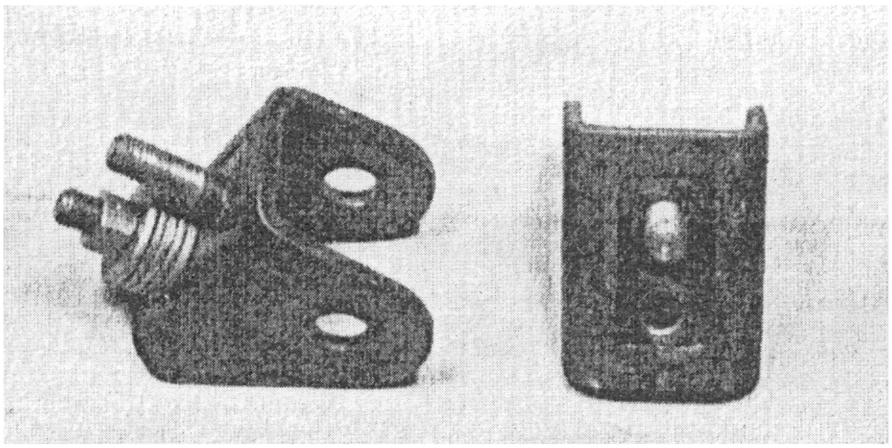
Slip the bolt into the bracket, slide over several washers on the back side, install a nut and tighten up. This configuration is shown in figure 2. Braze the bolt head to the bracket. Remove the nut and washers. Before installing the bracket make up a back up plate for the chassis frame of 3/32" mild steel. Drill the plates and frame mount to accept the bracket bolts. Make up all four brackets in this manner and install with the bracket in the normal position then put the steel back up plate on the inner side of the frame. Use good quality bolts and nuts and apply "locktight" after the suspension has been adjusted. Figure 3 shows a standard bracket on the left, the drilled unit in the center, and the modified bracket on the right.

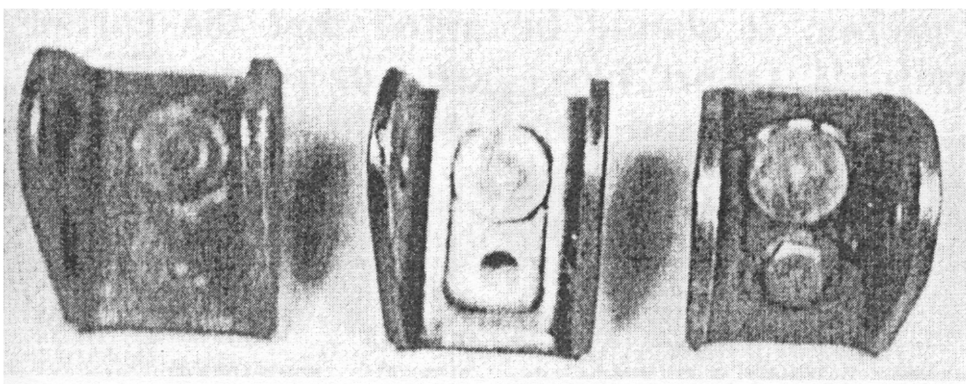
REAR SUSPENSION

It is recommended that the outer rear stub axle be removed and magna-fluxed every four races. The disassembly is very simple and well worth the time involved. It has been found that when fitted with extra wide racing tires and a limited slip differential the axle loadings are increased a fantastic amount. Careful attention must be paid to these components.

The very latest production TR-4A cars are fitted with a special treated outer axle that is considerably stronger than the earlier type and will stand the rigors of racing although it too should be checked often as suggested above. It is possible to tell the latest axle from the earlier axle by paying close attention to the threaded end of the stub. The later type shows a bluish color on the steel at the point where the threads stop and the machining starts for the hub. If you find that your axles do not have the bluish color as described order from your dealer axle number 137478 and replace. This change is necessary only if racing tires and a limited slip are installed but is recommended for high speed cornering work of any type.







Remove the inner axle shafts and check the axle keys for signs of wear. Replace the keys at about the same periods as the magnafluxing of the outer stub axle units. Lathe tool steel bits make a very good replacement and will last almost indefinitely. Careful attention must be paid to the four "U" joints of the rear axles. Make certain that the nuts are tight and in good or new condition. It is best to replace the nuts each time after removal. It is very important that the rear hubs be set up as described in the section on axles, bearings and hubs.

When reinstalling the axle assembly be certain to torque the nuts on the six studs of the control arm to 12-14 pounds *only*. Do not overtighten or you may strip the threads from the aluminum control arm. The inner axle shaft nut should be tightened 90 to 100 lbs. The outer hub should be tightened 100 to 110 lbs.

Special rear springs part number V-449, are available from Triumph and are a must for proper handling under racing conditions. These springs are considerably stronger than the stock units and therefore it is *not* recommended that they be fitted for street use. The ride will be greatly affected by the installation of these springs and make street driving quite uncomfortable. The rear wheel camber is adjusted only by making the springs shorter or longer. There is no normal camber adjustment. The special springs should give your TR-4A 0 to ¾ degree negative camber. If the camber is more than this figure shim up the springs with spacers to bring the camber into the range listed. These figures are specified with the car in racing trim. (Bumpers and top removed).

The rear wheel alignment should be set to ⅛″ *toe out*. This is adjusted by adding or subtracting shims from the point where the control arm bolts to the chassis frame. It has been found that there sometimes is a change in the camber setting when shims are added to the inner control arm point only, but there is not a specified pack that can be recommended. Be certain to recheck the camber after setting the toe out position.

Remove the rear shocks and dismantle by removing the damper valve and the top cover. Pump out the existing oil. The standard shock has a valve with a steel colored spring (grey). These valves should be replaced with valves from the competition TR-4 shock which have a spring that is a dull copper or bronze color. In lieu of these valves the standard TR-4 or TR-3 valves which have a bright copper color spring can be installed. Fill the shock with #40 weight racing oil. Be certain to pump all the air from the shock. This is done by moving the lever up and down while holding the shock absorber in a vertical position until all signs of air bubbles have ceased. Refit the shock absorbers fitting an additional nut behand the threaded plate which holds the shock to the chassis frame.

DIFFERENTIAL

The TR-4A differential accepts the normal range of TR axle ratios and the limited slip without modification to any components. The latest type limited slip has a thrust button installed and for fitting to the TR-4A *this button must be removed.* To remove the thrust button it is necessary to separate the halves of the limited slip but does not require any special tools. Be certain that the case is reassembled with the marks on the case in alignment.

BRAKES

It is recommended that the pressure residual valve part number 116197 be fitted in the hydraulic system. This valve should be fitted before the "T" fitting on the left frame rail near the engine oil filter. It is *not* recommended that the 10″ rear brakes be installed as the normal fitting has been found more than sufficient. The larger brakes disturb the braking ratio considerably which usually results in the rear brakes locking up. Remove the dust covers from the front disc brakes. Install competition type front brake pads. Normal rear brake lining is sufficient.

ELECTRICAL

The TR-4A is a *negative* ground vehicle. This must be remembered when changing the coil or battery. If you should suffer a failure of the regulator or generator be certain that the proper replacement is used.

VALVE SPRINGS

Use the recommended competition spring set. Part # V015.

CARBURETORS

Earlier models of the TR-4A were fitted with the Stromberg CD 175 carburetors while the latest production are fitted with S.U. units. Either type is permissible in S.C.C.A. racing. It should be noted that the earlier type TR-3 and TR-4 intake manifolds (short type) are *not* permissible as this manifold was never fitted to the TR-4 and therefore can not take advantage of the update rule. This manifold is pictured in figure 12 at the top of page 21 in the Competition Preparation Manual.

REAR AXLES, BEARINGS AND HUBS

TO DISMANTLE:

Remove the outer hub nut and washer then draw off the hub. The rear hub bearing assembly will be removed with the hub. Remove the key and

TO ASSEMBLE:

Press the outer hub bearing cone up to the shoulder on the hub. Press the outer and inner hub bearing outer races up to the shoulders in the bearing housing. Install the inner and outer oil seals. Feed the stoneguard, bearing spacer, inner cone of the inner hub bearing, and a new collapsible spacer onto the stub axle shaft. Fit the key with the inner end in line with the two indentations on the shoulder of the keyway. Pack the spaces between the bearing rollers and the recess in the bearing housing with high temperature bearing grease.

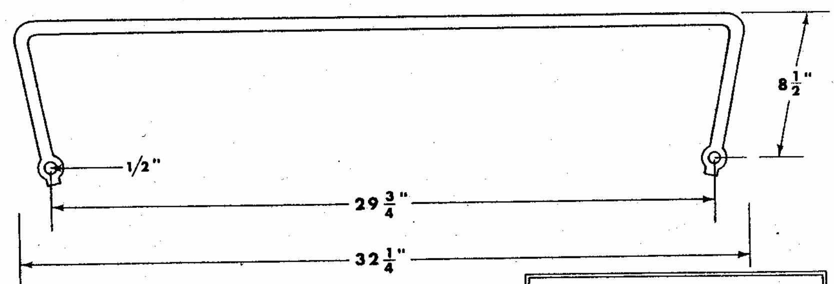
IMPORTANT: Carefully wipe the grease from the roller faces and be certain you do not turn the bearing or hub after installation as the film of grease on the rollers can give an improper end float setting. Be certain that the outer race for each bearing is dry with no grease on its face. After the end float has been established you may then turn the hub which will in turn grease up both the rollers and the outer cone from the lubricant packed into the bearing.

Pass the bearing housing assembly over the stubshaft so the inner hub bearing outer race engages with the inner cone. Be careful — avoid damage to the lip of the oil seal. Feed the hub onto the stubshaft followed by the washer and the nut. Torque to 100 to 110 pounds. Wind the adjuster nut up against the stoneguard until it is finger tight. Mount a dial indicator on the hub with the stylus of the indicator passing through the provided hole in the hub and resting on the flange machined surface of the bearing housing.

Move the bearing housing away from the indicator as far as possible, use a rocking motion to insure a full contact between the bearing parts. Now zero the indicator with a rocking motion. Push the bearing housing as far as possible towards the indicator. Note the reading. Tighten the adjusting nut one flat at a time while carefully watching the indicator. As the nut is tightened the end float will diminish. When the total float is between .002 and .004 secure the assembly with the lock nut and tab washer.

WARNING: If the end float has been reduced below .002 the collapsible spacer ***must*** be replaced. Merely slacking back the nut is ***not satisfactory***. The axle bearing unit is now complete and may be reinstalled in the chassis.

REAR ANTI-ROLL BAR (RACING SPECIFICATION)



TR 4A ANTI-ROLL BAR — REAR
MATERIAL — 6150 OR 5524 STEEL
9/16" OR 5/8" DIAMETER
R. W. KASTNER '67
DIAGRAM NOT DRAWN TO SCALE

Installation of this rear anti-roll bar will induce oversteer and is recommended if the balance of the suspension system has been attended to as described in the competition preparation manual. It is of particular advantage if the car is fitted with the non-slip differential unit as the anti-roll bar will negate the understeer that is normally produced when the non-slip unit is fitted. Increasing the diameter of the roll bar or shortening of the leg length of the roll bar will increase the amount of oversteer. Start with a 9/16-inch bar and only fit a larger diameter if it is found that excessive understeer is present. Fitting of front and rear anti-roll bars will tend to reduce the body roll considerably which is desirable if the steering stays at a near neutral condition. Oversteer can be corrected by fitting a front anti-roll bar, or, if one is already fitted, increasing the diameter of the front bar.

Make up two brackets of mild steel 3/16-inch x 1½-inch x 3-inch to hold the roll bar to the frame. These brackets will be bent to 90-degrees with each leg measuring 1½-inch long. Drill one leg of the bracket for the special cage bracket No. 121793. These cage brackets are used in the normal front sway bar kit and hold the rubber bushing block in place. Purchase two of the cage brackets. Purchase two of the rubber bushing blocks No. 121791, Slide the rubber over the sway bar and push on the cage bracket. Bolt up the steel 90-degree angle brackets previously made up.

Make up or purchase two steel washers 2¼-inch diameter with a ⅜-inch center hole and 3/32-inch or ⅛-inch thick. Make up or purchase two washers 1½-inch diameter with a ⅜-inch center hole and a 3/32-inch or ⅛-inch thick. Weld the smaller washer to the larger with the center holes in alignment. You will need one of these assemblies for each side.

From 1/8-inch steel stock make up two brackets bent at 90-degrees which are 1½-inch wide, one leg being 2¼-inch long and the other leg being 1¾-inch long. Drill a 3/8-inch hole in the long leg 1-inch from the end. Drill a 7/16-inch hole ½-inch from the end of the short leg. These brackets will hold the sway bar link to the bottom of the trailing arms.

Slide the welded washer assembly through the rear coil spring and into the cast hole in the trailing arm which is directly under the spring. Slide a 3/8-inch bolt through the center hole of the washer, fit up the steel bracket with the odd length legs to the bottom of the control arm and tighten up tight. The short leg should be towards the inside of the control arm and parallel to the drive shaft. Purchase two front anti-roll bar links No. 121797 and fit these to the brackets under the trailing arm. The link is fitted on the outside of the bracket. Fit up the sway bar to the links with all the rubber grommets and special washers. Tighten up fully.

With the vehicle on the ground in normal running condition, camber and especially weight, push the sway bar back up against the frame until brackets holding the rubber bushing and special cage are flush with the frame member.

See that the links are perpendicular to the ground then mark the frame so that the brackets can be removed and welded into place. After the welding, reinstall the sway bar onto the brackets and the job is completed.

PARTS LIST

2	121793	Cage Brackets
2	121791	Rubber Bushing Block
2	121797	Roll Bar Links

ENGINE

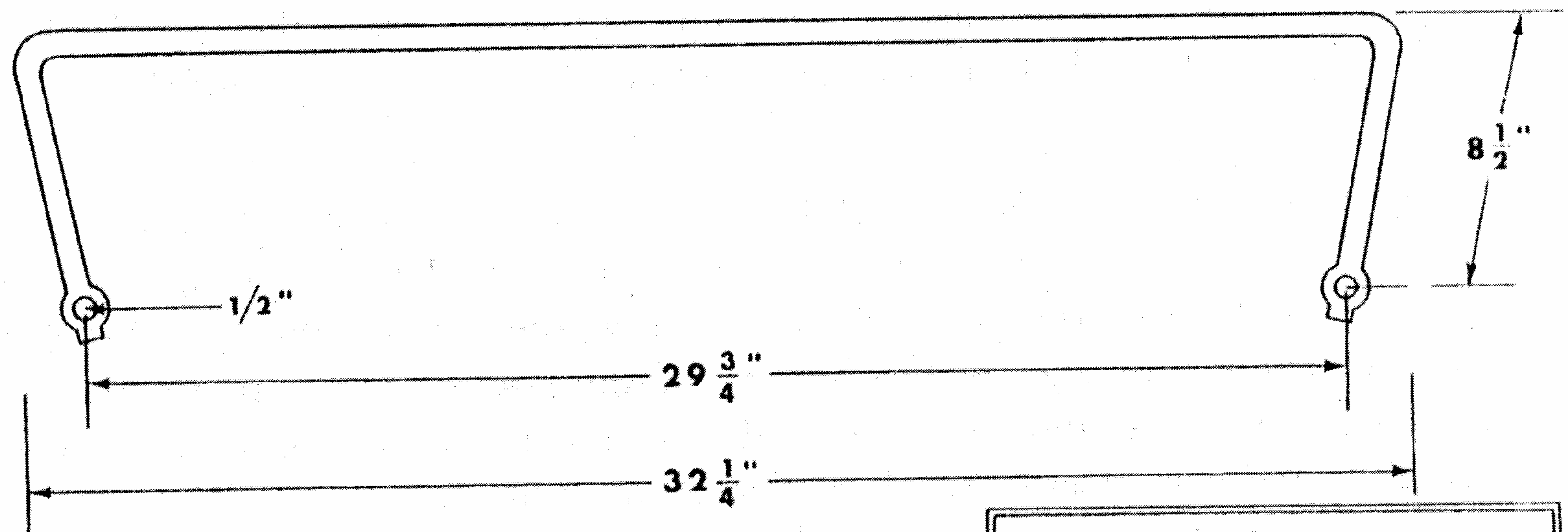
All engine modifications as described in the early pages of this book apply unless specifically mentioned in this amendment.

When other data concerning the modification to chassis or drive line is finalized the information will be made through the competition department. This information will be published in the T.S.O.A. Bulletin. It is recommended that you join the T.S.O.A. so that all information will reach you as quickly as possible. Membership is $5.00.

WRITE: T.S.O.A.
600 Willow Tree Road
Leonia, New Jersey 07605

NOTES

REAR ANTI-ROLL BAR (RACING SPECIFICATION)



TR 4A ANTI-ROLL BAR — REAR
MATERIAL — 6150 OR 5524 STEEL
9/16" OR 5/8" DIAMETER

R. W. KASTNER '67

DIAGRAM NOT DRAWN TO SCALE