BRITISH LEYLAND

TRIUMPH

COMPETITION PREPARATION MANUAL

TR-4-4A

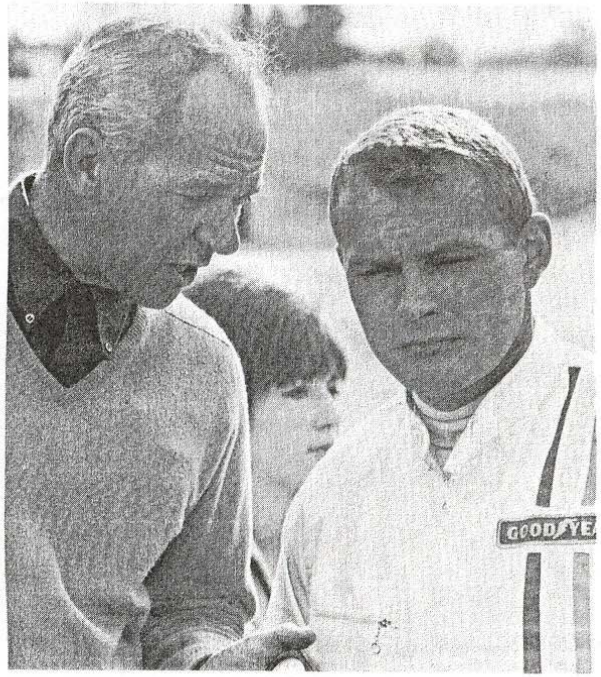
4th EDITION

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.

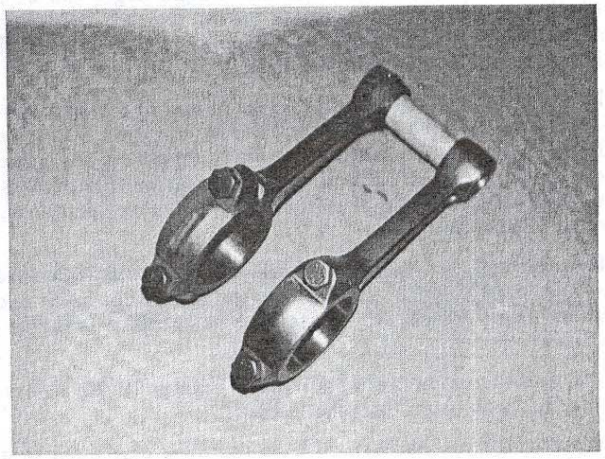


Figure 1

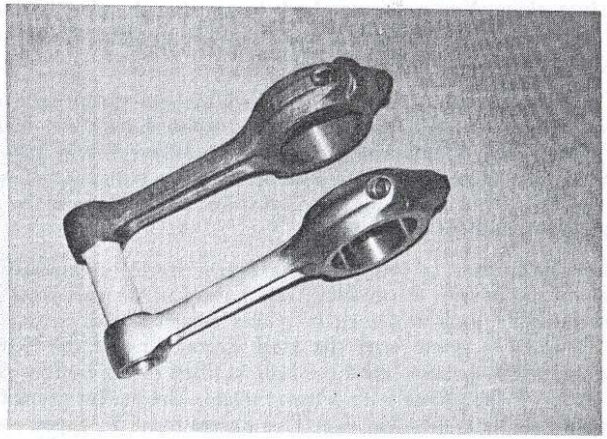


Figure 2

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.

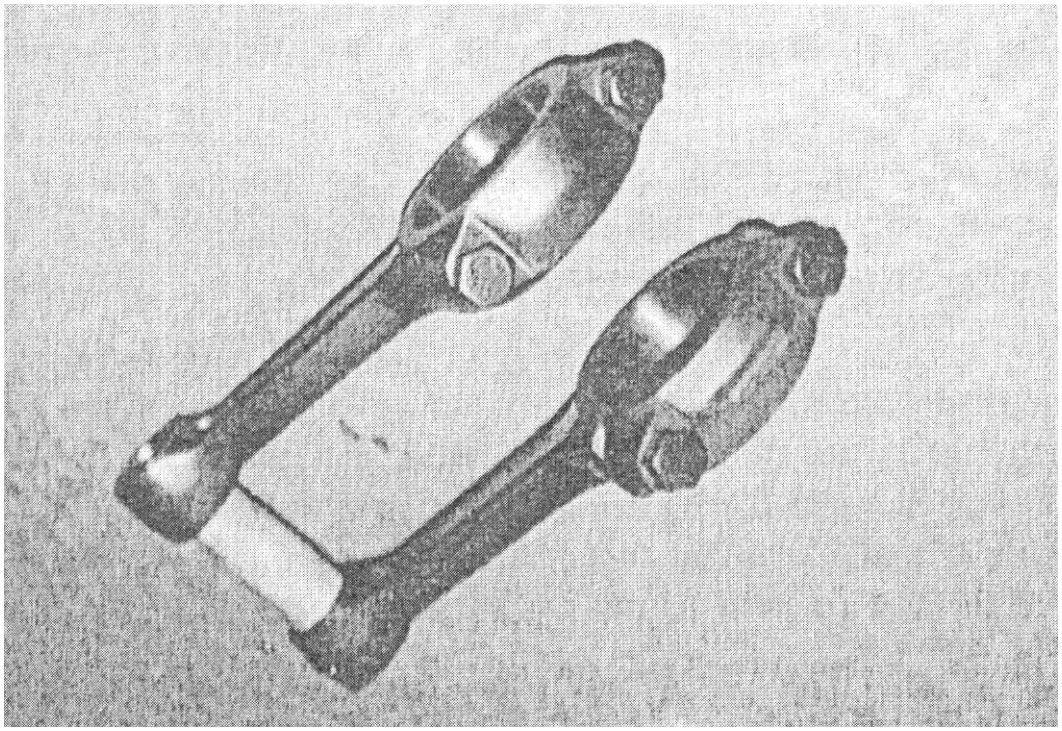
Needless to say do not use an air or electric impact wrench. Do your torquing to 80 ft./lbs. with a good torque wrench. DO NOT RE-USE THE LOCK TABS.

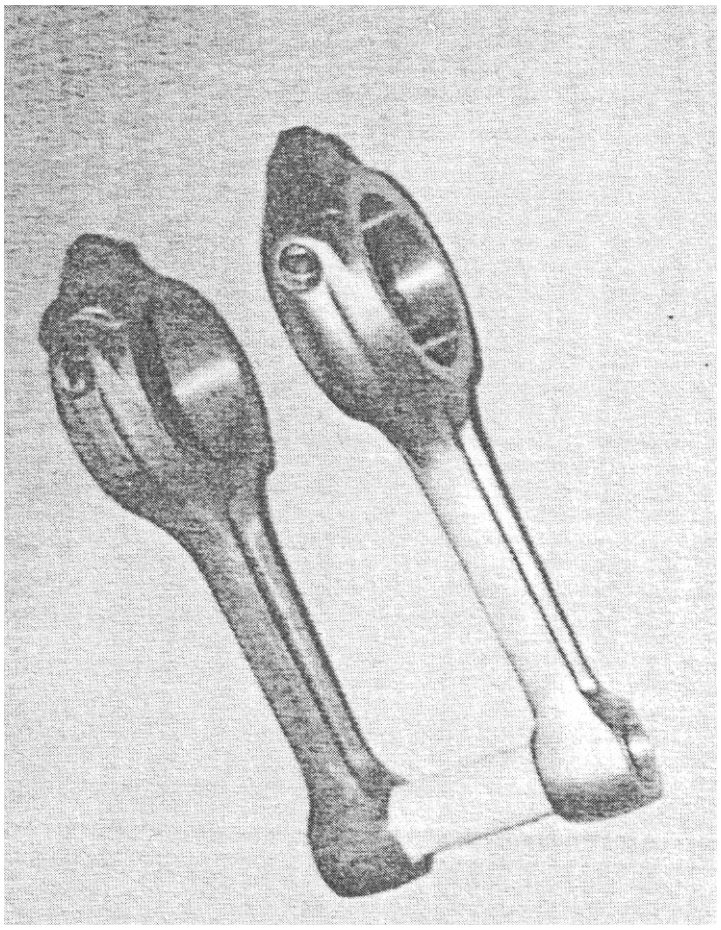
PISTONS

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 ¼″ 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.

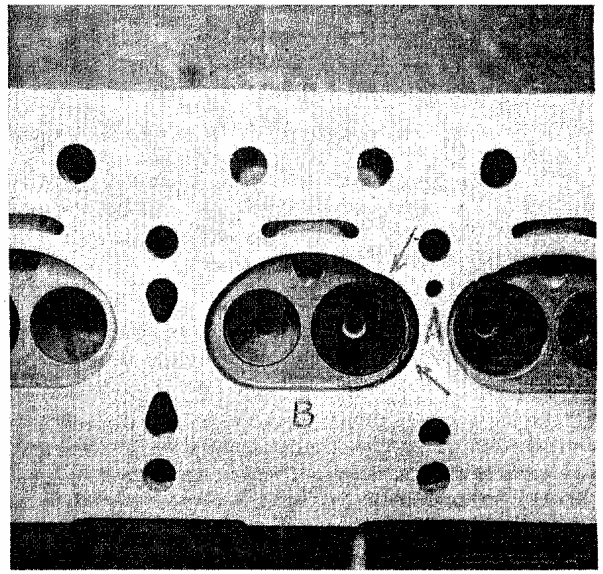


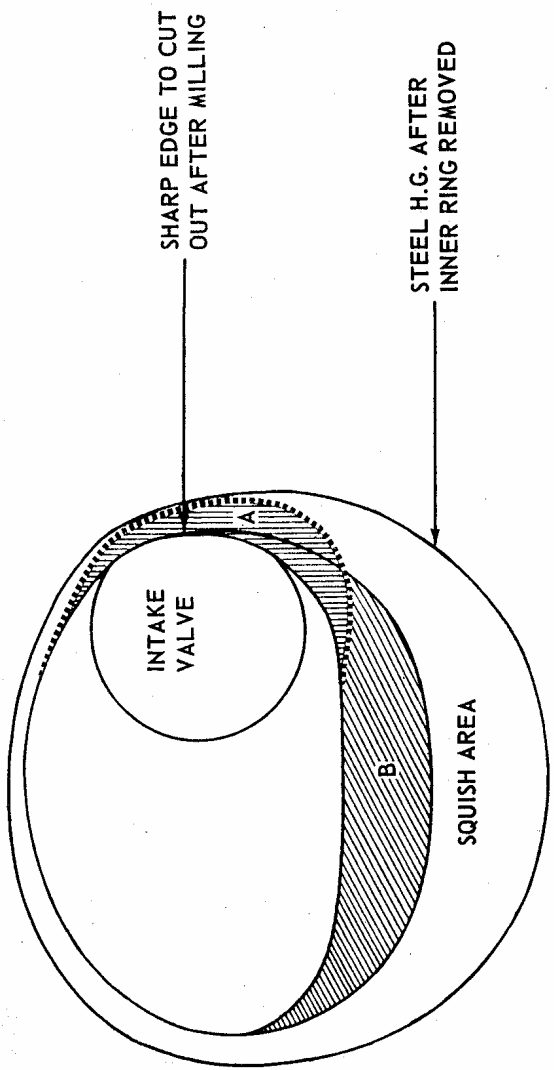
Figure 3

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.

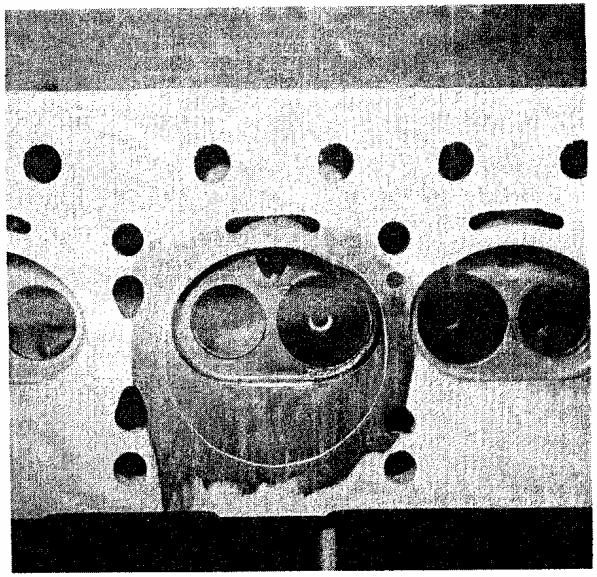
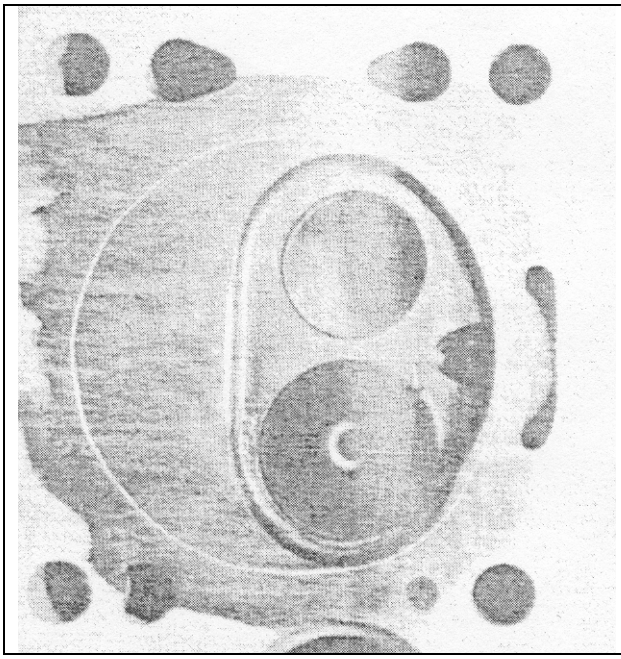
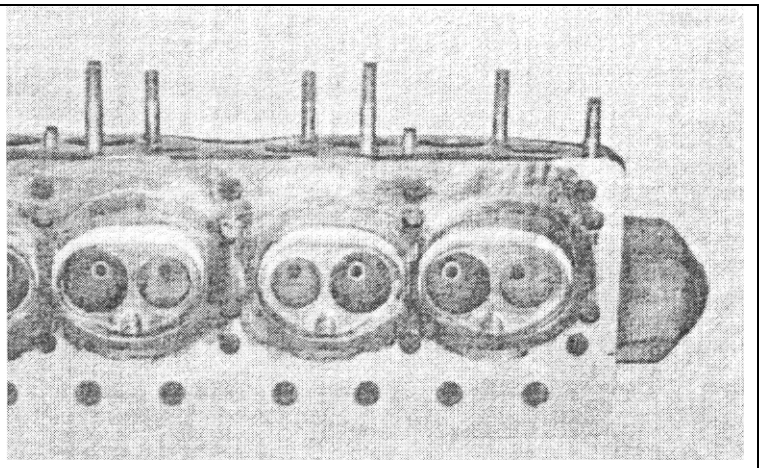
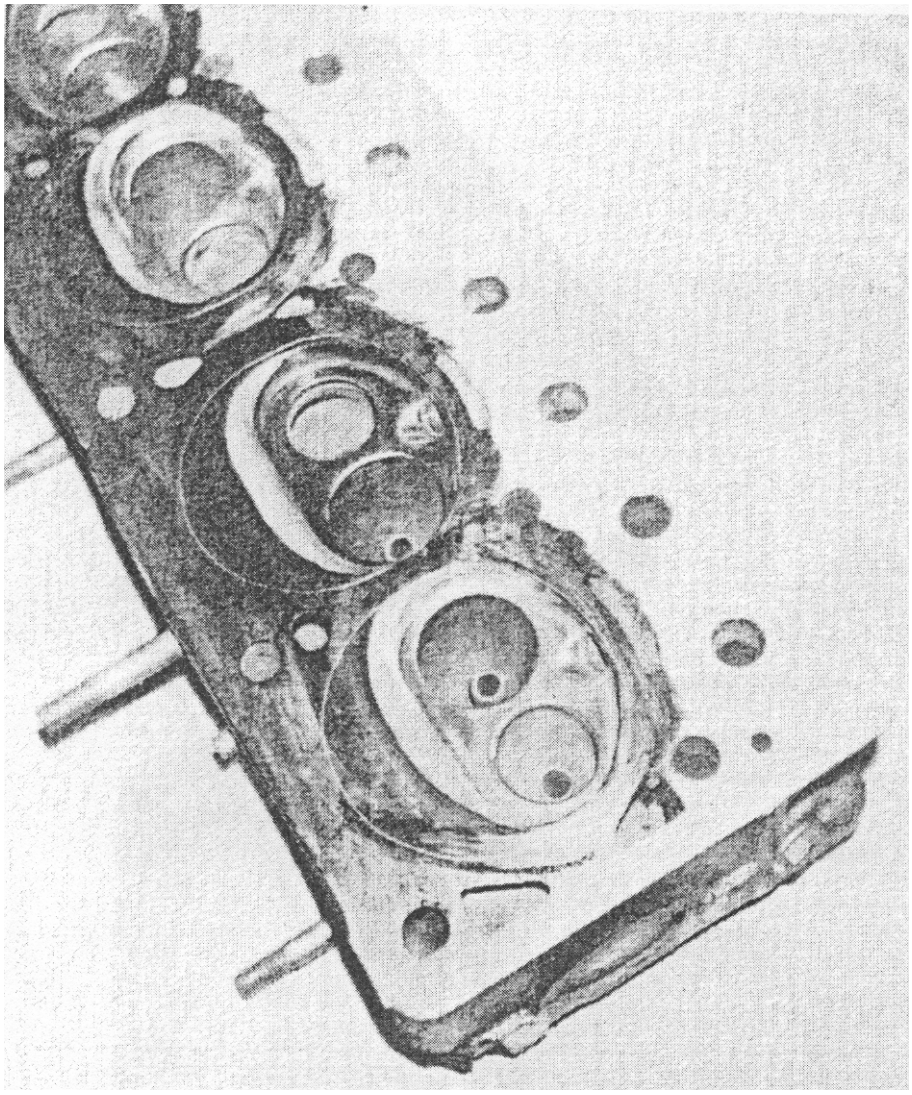


Figure 5

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.







5/8″ 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.

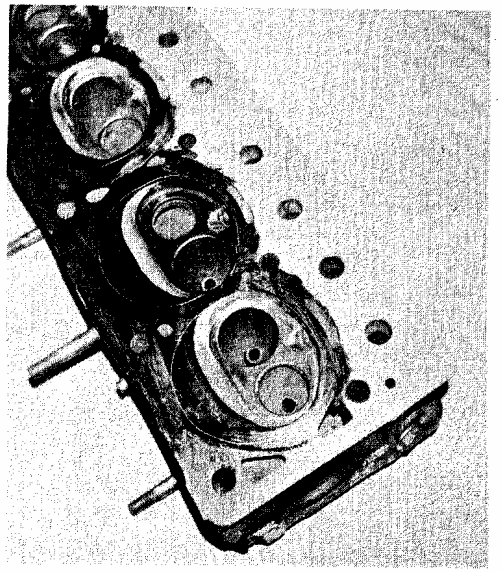


Figure 6

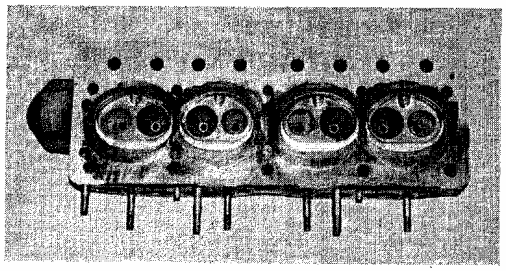


Figure 7

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.

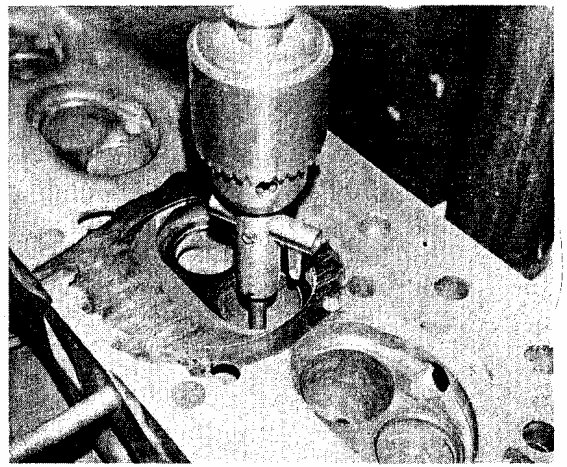


Figure 8

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.

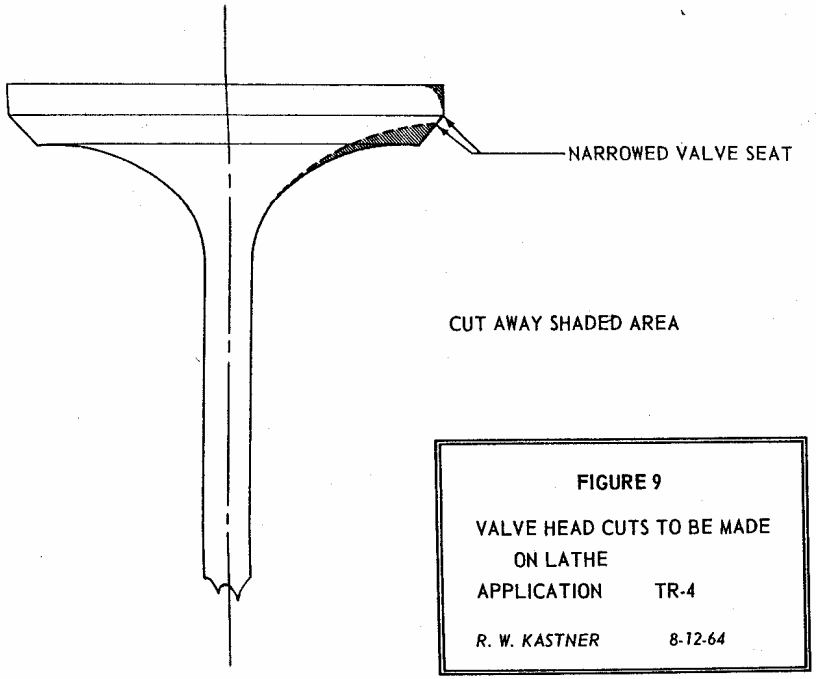


FIGURE 9

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.

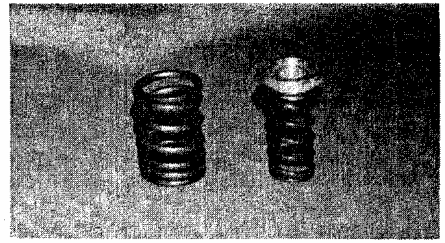


Figure 10

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.

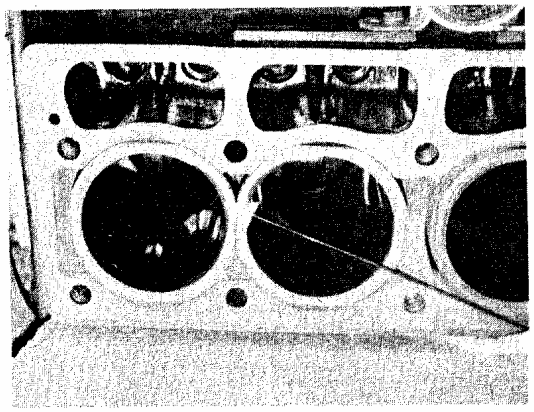


Figure 11

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.

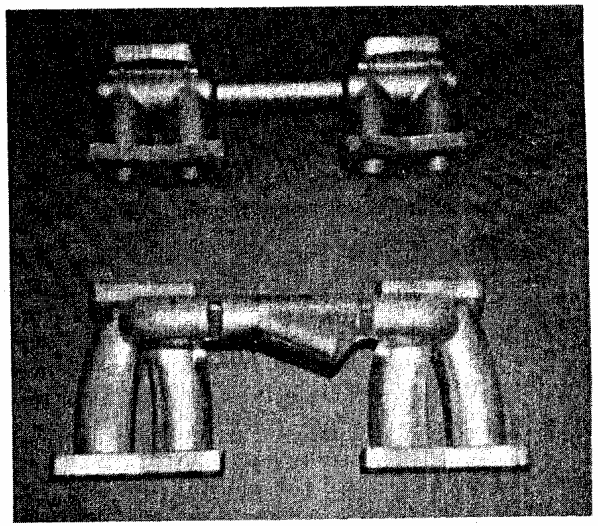


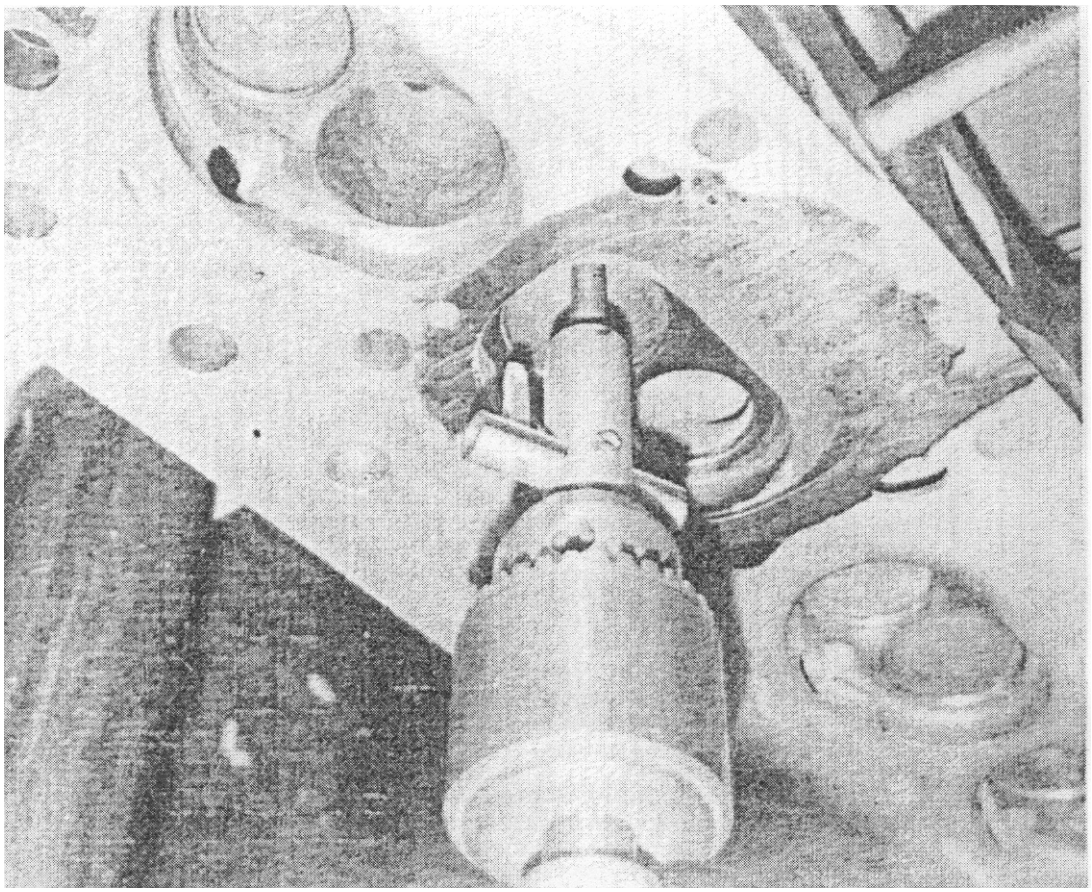
Figure 12

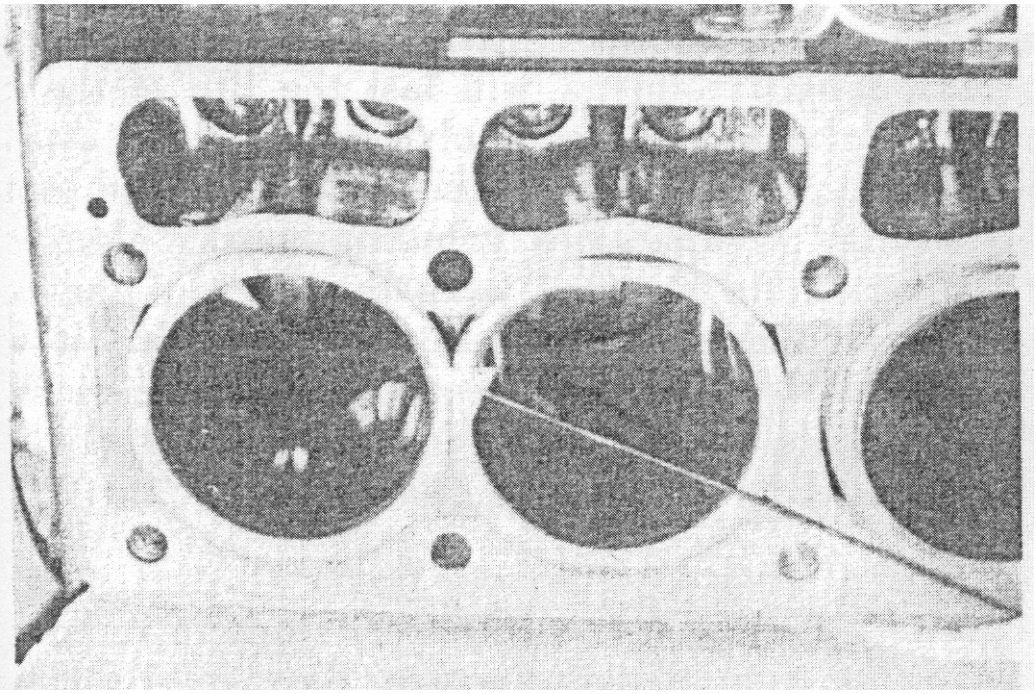
This competition header is the "four-into-one" style.

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 2½″ 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.