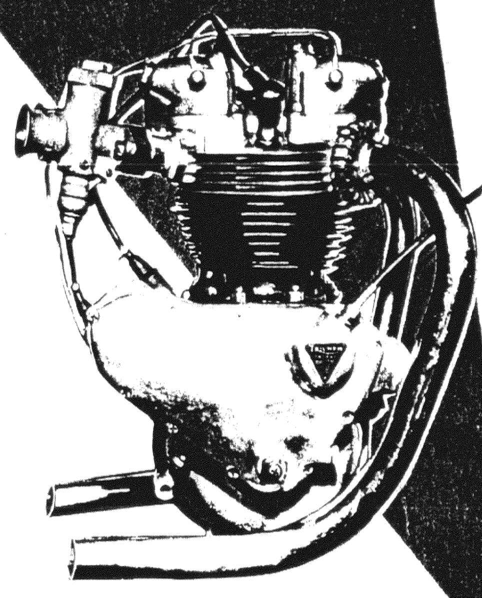
$4.00

Secrets of More Horsepower Through

TUNING THE 650

TRIUMPH 'B' RANGE ENGINE



By Dwain Taylor

Secrets of More Horsepower Through

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TRIUMPH

"B"-RANGE ENGINE

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T & M MOTORCYCLE SALES
110 PINE AVENUE
ALBANY, GEORGIA

Foreword

We have had so many requests for information on speed work on the 650 B range Triumph in conjunction with cam sales and engine building, that we found it necessary to publish a "book" answering as best we could the questions most frequently asked by dealers and riders with limited hop-up experience. It was our original intention to write a sheet of several pages, and mimeograph it and offer it free in an effort to have a form letter type of thing that could be used to help our cam customers. As work progressed, the sheet slowly but surely grew into a monster, and this book is the final product. The information in this book is free, although we have no way of knowing how much it has cost through trial and error to learn what will work to advantage and what will not. The valuable time spent in its preparation was also donated, but the price of printing could not be absorbed, and hence the charge for it.

The information and methods outlined on the following pages are not endorsed by any factory, distributor, etc. They are not necessarily right or correct in the eyes of some people, but the important thing is *THEY WORK*.

In reworking the Triumph engine, we must keep in mind that although it responds almost fantastically to the clever tuner's hand, it is not originally a racing device. It is a brilliant and wonderful design, but was produced to sell at a price for transportation. With motorcycle people being what they are, it is not surprising they want to try and improve the performance of their machines. It should be pointed out, however, that these improvements cost money, not only in initial investment, but also in upkeep, and work of this kind should be looked upon as an expensive hobby.

DWAIN TAYLOR

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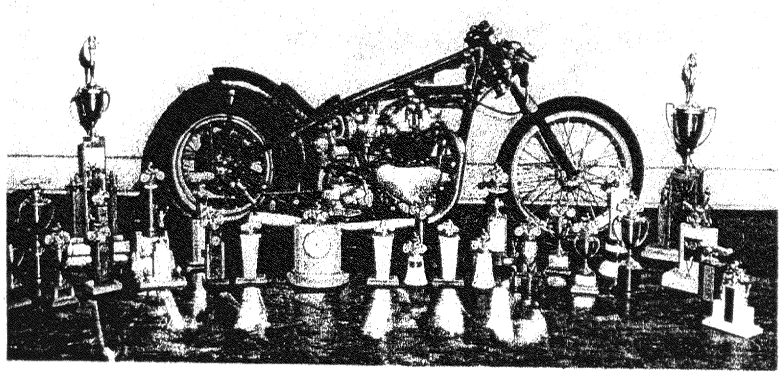


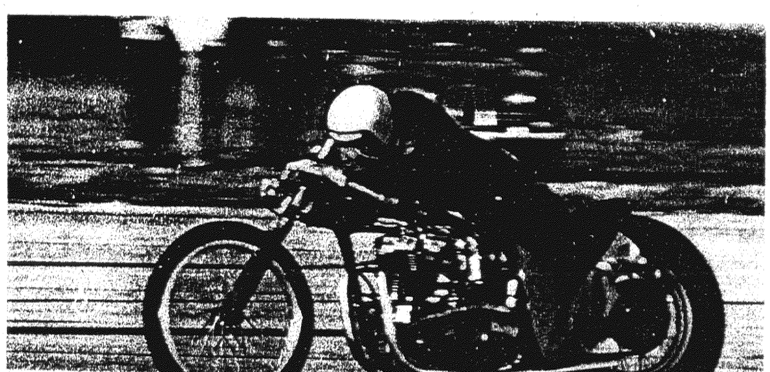
"GRANDMA"

Fuel burning Triumph dragster built by T&M. Undefeated in its class since 1957. Usually runs in the mid 10s and high 120s. Best ET to date 10.34. Best speed 134.40.

Winner of

Southeastern Drag Championship	5 Times
Alabama State Championship	4 Times
Georgia State Championship	4 Times
Daytona Fuel Class	2 Times
among others.	

Uses T&M Cams.



BILLY DENBY

On T&M's "Grandma" winning the open fuel class at Daytona in 1960.

CHAPTER 1

Cutting and Balancing Flywheels

There are probably as many ideas about light and heavy flywheels as there are men to build hot motorcycles and cars. After trying several engines both ways, the following conclusions were drawn. A lighter wheel will, believe it or not, come off the starting line considerably better, will excellerate faster from any R.P.M. (effects diminish as R.P.M.s build up), will only very slightly impair idling characteristics, seems to have no effect on traction on pavement and very little on dirt, and apparently changes absolutely nothing from a top speed standpoint. After all, why spend money for ultra light cam wheels, clutch parts and etc., and leave four pounds of excess meat on a part that turns much faster? Here, we can take a lesson from the hot rod boys who have brought this thing down to an exact science and spent more money learning than any of us. They believe in light flywheels; the writer does, too, and the lighter, the better (for dragging). Now, a word of warning about cutting them. If too much is taken off they can explode and wipe out most of the engine. If you follow the dimensions given on the drawing (Plate No. 1 and 2, pages 6 and 7) you should have no trouble.

In the area where the bob weights are left sticking out on the wheel, a round pointed tool should be used for the last cut so as to give a slight radius at this heavily loaded corner. Always file off the sharp edges at the beginning and ending of these bob weights so as to keep a fracture from starting here. If you are going to use a used crank assembly, it is most certainly worthwhile to magnaflux it when you are finished up, also if it is one of the late type one piece cranks watch out for loose flywheels. Check this before you waste time cutting it. Any crank assembly available from Triumph with 1⅝" journals is satisfactory, but don't be tempted to use the 1-7/16" older type cranks. They will almost certainly break.

A good method for chucking in the lathe is to mount the crank assembly on centers at both ends with the drive side next to the chuck. You can then drive the crank in the lathe with a tool made up from an old motor sprocket with extensions welded on that will catch the jaws of the chuck. The timing side oil feed hole is true with the bearing, but because of the threads for the motor sprocket holding stud, the drive side will run out slightly.

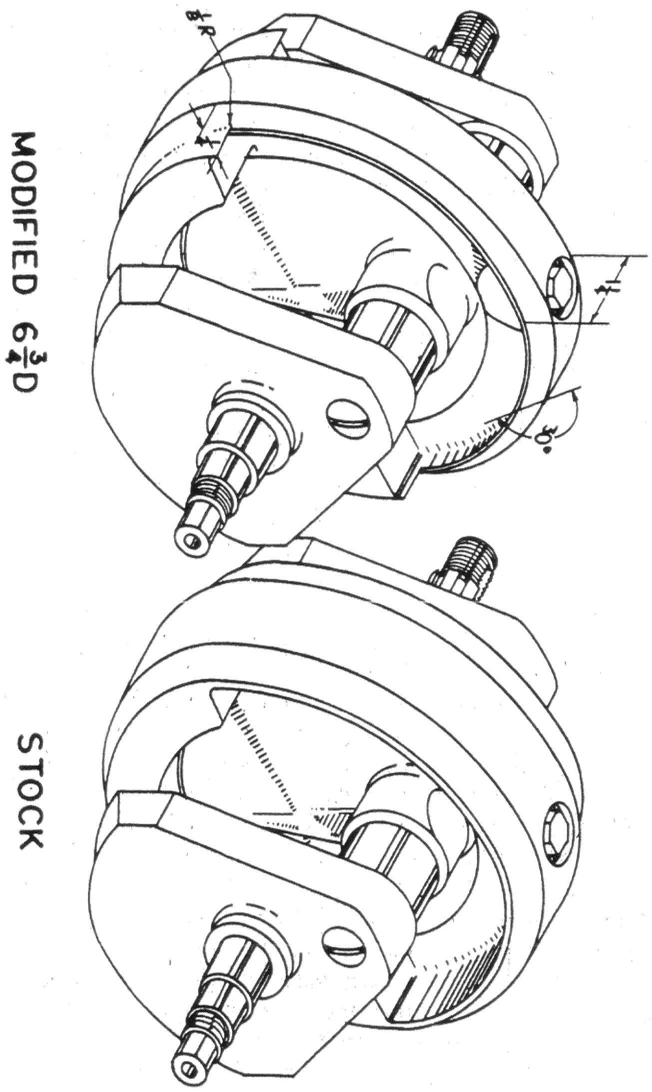
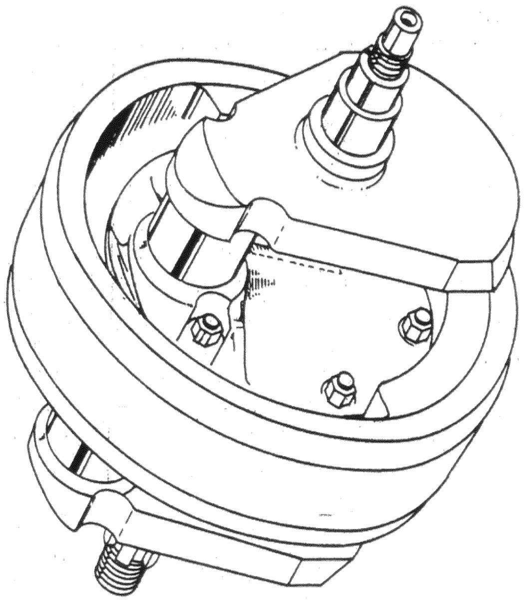


PLATE NO.1



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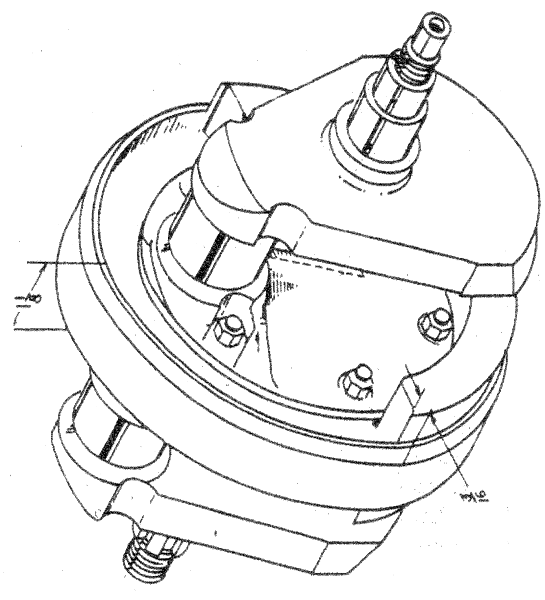


MODIFIED $6\frac{1}{4}$ D.

PLATE NO. 2

It is most important from a vibration standpoint that this drive side main bearing is made to run true by moving the center with the chuck. After this is done, you may find the flywheel running out a few thousandths even though the main bearings are true. If this is the case, don't worry about it. Get those mains true, they are what count.

As the final cut is approached on the side of the wheel a wafer edge will begin to appear on the opposite side of the wheel from the bob weights. If you keep cutting deeper and deeper until you finally clear off this wafer edge, the wheel will probably be hopelessly out of balance. Keep in mind you want to take the same amount off all the way around. When this wafer edge is down to about 3/64" thick at its base, finish it up with a sharp chisel from the top and file the edges down later when it is out of the lathe. We usually polish the outer rim of the flywheel just because it is so easy to do with the belt polisher we have for polishing cam shafts. For my money polishing the entire wheel, or the inside of the cases to a mirror finish is worthless unless you don't have anything better to do, and don't mind throwing away the time.

After all cutting and polishing is done, the crank assembly must be thoroughly cleaned inside before balancing is done. If it is the older type three-piece assembly it should be disassembled and cleaned. Be sure to mark the wheel before disassembly so that it will go back on the same way it came off. Use new E-1562 bolts and W-103 nuts.

If the wheel is warmed slightly, it is much easier to reassemble. With the wheel in the vice and the crank journals at top center, install the E-1562 bolts at 3 and 9 o'clock first. These are a tighter fit than the others, and serve to line the whole thing up. Pull all six of them down together, and let the wheel cool. After it is cold, retighten and punch them.

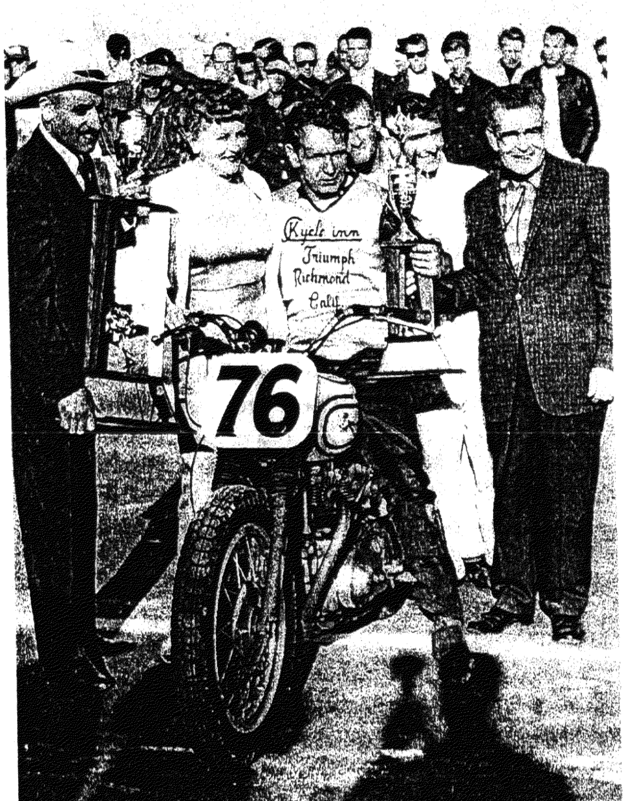
If you are using the later one-piece crank, there is no need to remove the flywheel. The sludge trap must be cleaned, however. The plug on the timing side can be removed easier if a ¼" drill is used to lightly drill the locking punch. Next, remove the E-3907 flywheel bolt at the crank journals. This bolt anchors the delivery tube into position. A spoke makes a good tool to insert through the plug hole and into the hole in the tube just vacated by the E-3907 bolt. A pair of vice grips on the spoke will pull this tube right out. After everything is thoroughly cleaned, reinsert the tube with the hole facing the outside of the flywheel and replace, and tighten the

E-3907 bolt. Install the sludge trap plug, and tighten and punch it.

As for balancing the crank, here again you will find more ideas on percentage of reciprocating mass, primary and secondary vibration, and etc. than Carter has pills.

Every once in a while, I am persuaded to try one more time that mysterious process of Dynamic balancing. We have now had four different outfits dynamically balance one or more crank assemblies in an effort to get one a little smoother. In my opinion, it is not worth the price. They are just as smooth if they are carefully balanced staticly on parallel bars with factory (Z-120) weights. At one time we seriously considered the possibility of buying one of these machines. The writer worked with it several days and decided against it. Since our engine has both pistons up and down together, it must be treated as a single from a balancing standpoint. *The instructions that came with the dynamic balancer said single cylinder cranks could be balanced just as well staticly.* We are well pleased with static balancing, and recommend it to you. If, however, you are determined to use the dynamic method the best people we have used is West Electronic Balancing Company in Denver, Colo. This is a waste of time, but if you decide to have them balance it, you must send the crank, both rods, inserts, circlips, rings and pistons. Sixty-nine per cent seems to work best for a dragster. Our method is, like I said before, to use the factory (Z-120) weights on a pair of hand-made parallel bars. These are very easily rigged on a ¼"x 8"x 12" steel plate. Weld ½" round cold roll 5" high and 6" apart to this plate. Be certain the bars are perfectly parallel and level. You can then drill and tap a hole at each corner on one end and in the center on the other end of the plate to effect a three-point final leveling device. Put the weights on the crank, set it on these bars, and drill the heavy side so that it will stand in any position.

A light flywheel may be used with little or no noticeable ill effects in a street motor, and should most certainly be used in an all-out effort machine for scrambles or drags. We do not wish to solicit business cutting and balancing flywheels, but we will do it for you if you like. If it is the older three-piece type, send six new E-1652 bolts and six new W-103 nuts with it. If it is the later type one-piece crank with the bolt on flywheel, take all three of the E-3907 flywheel bolts out and check the wheel for looseness on the crank. If you can move it on the crank by hand, send it back to Triumph for a replacement. If it is tight, throw the old bolts and E-2288 washers out, and pack three new bolts and washers in with it to us. We also have facilities for grinding the crank journals. If you have found the journals worn, and want us to grind them, you must put a note of instructions to this effect in with the crank. Charges for cutting, cleaning and balancing the crank are $45.00 B. Charges for grinding both journals are $15.00 B. We do work of this kind for Triumph dealers only. We do not do work or sell cams direct to riders or other dealers.



DICK DORRESTEYN

Uses T&M Cams. Very popular California Scrambles and TT Champion. His Triumph built by Kenneth Harvey of JK Cycle INN, Richmond, Calif. Ken says "During several years of use, T&M Cams have never let us down. They are the best we have ever used."

CHAPTER 2

Interesting Information on Cams

It has been said that the cam is the most important part of a competition engine. While this is a very broad statement, it does contain a germ of truth. Only by using the correct cams can we draw in and burn the biggest charge of combustible mixture for a given cubic capacity, providing that the rest of the engine has been built accordingly. Of course, a pair of good cams can do very little by themselves. They are a vital part of the total combination that goes to make a fast engine, but we must bear in mind they are only a part, and that an engine is not necessarily slow or fast strictly because of a good or bad cam. In the final analysis, it is the total combination of parts from the tip of the carburetor air bell or air filter to the end of the megaphone or straight pipe that produce the performance characteristics in the R.P.M. range best suited to the type of competition engaged in that we are after.

Theoretically the ideal cam would open the intake valve instantly to full lift at about 10° before top center, stay full open until about 40° after bottom and then close instantly. Naturally, such abrupt cam action would create unbearable mechanical stress and cause numerous other complications. Consequently, cams must be contoured to open and close the valves in a more gentle manner. In actuating the valves we are limited to a certain amount of valve train acceleration and deceleration. It is necessary that we maintain a reasonable amount of valve lift over the greater part of the intake and exhaust strokes so we have no alternative but to lead and lag the valve opening periods to such an extent that the intake and exhaust cycles actually overlap. This valve overlap would at first glance appear rather detrimental, which it is at low R.P.M.s. However, as R.P.M.s build up this deficiency diminishes and actually becomes an asset. Mainly from this action comes the old expression, "getting on the cam."

After spending considerable time and money through trial and error in an effort to find the best possible all-around cam combination in the way of cams and tappets for a 650 range type, we have settled on a No. 9 intake with standard tappets and a No. 6 exhaust with 1⅛" racing tappets. This combination gets on the cam at 3800 to 4400 R.P.M.s depending on the exhaust pipe set-up. With straight pipes they will come on at considerably lower revs.

(More about exhaust pipes later on.) This combination continues to pull hard up to just under 8000 where it begins to taper off, and with the length of the stroke of the "B" range 650 Triumph being what it is this is more than enough. With the 9-6 set-up the rider will not float exhaust valves and consequently bend them near as easily when he misses a shift or overwinds for some other cause, as with a pair of No. 9's. Comparing the 9-6 set-up to a pair of 9's further we find the 9-6 gets on the cam a little earlier, produces about the same amount of power, but goes off a bit earlier also. Thus, the pair of No. 9's make a better cam for all out top speed where nothing else is to be considered. These are rather wild and brutal, and certainly should not be considered for road bikes where long mileage is to be covered. On the other hand a pair of No. 6 cams (considered ultra race just a few short years ago) will produce more torque at low revs than the 9-6 set-up, but the engine will run out of breath sooner than with the 9-6. In most cases a pair of No. 6 cams is best for scrambles, T. T. and etc., and can be installed in street motors with little fear of valve failure providing the valve train is properly lightened. (More on this later.)

The 9-6 set-up produces a happy medium between these two mild extremes. It has part of the advantages of both and few of the disadvantages of either. The 9-6 set-up is safe for use in street motorcycles providing the fellow doesn't frequently take long cross country trips, and is very well suited to the drag strip where both torque and top speed characteristics are needed.

With a 9-6 set-up the No. 9 intake valve begins opening some 40° before top center, or before the piston starts on the intake stroke. This is done to give the valve a head start on the piston, and we find that at top center the valve will be well off its seat, so as to offer little resistance to the incoming charge. The intake valve remains opened some 70° after bottom which is long after the piston has changed direction and is coming up on the compression stroke. The intake charge having been put in motion builds up inertia and tends to continue to flow long after the piston changes direction. Should the intake valve have been closed at bottom center it would have a considerable throttling effect on the intake charge.

Looking at the No. 6 exhaust cam, it is seen that the valve begins opening some 65° before bottom center, or before the power stroke has actually been completed. This slight loss of useful power is offset by the fact that the exhaust gases leave the cylinder partly under their own pressure, thereby reducing the effort on the engine's part to expell the burnt gas on the upward stroke of the piston. This lead is commonly referred to as "blow down." The exhaust valve remains open for some 35° after top center. Here again kinetic energy comes into play in that the burnt gases continue to flow out and scavenge the cylinder. A mild super charge is effected by the exhaust gases actually drawing the intake charge in across and out the exhaust port during the overlap period. This is commonly referred to as "cross flow."

With the above in mind it is obvious that it is of no use to compare the cam design with respect only to actual points of valve opening and closing. The important things are lift and rate of lift, and only when these are ideally suited to the demands of the engine can the desired increase in horsepower without destruction be achieved. It is no hard task for the man designing cams to pile more and more metal on the lobe. There seems to be a race on on the West Coast at this time to see who can grind a Triumph cam that will flip a valve open fastest, highest and drop it the hardest. Some of these things sure look impressive to a rider, but a good mechanic will marvel that the poor engine can even run at an idle without destroying itself with a thing of this kind working in the valves. It is most disheartening to spend the many hours necessary to install a pair of cams in a "B" range Triumph to find little or no increase in performance, and then have the job swallow a valve before the mechanic finds out what is holding it back. Here, we have to draw a parallel comparing cam lobes to carb jet sizes. There is an ideal point to go to with both. When this point has been reached it is both foolish and detrimental to go beyond.

It is sometimes hard for a rider to understand this. You can see by the chart (Plate No. 3 on page 14) the No. 6 is considerably wilder than the wildest factory cam, and the No. 9 would probably make the English designers shudder. We know from experience the engine will survive for a surprising length of time with cams like this, but obviously to go very far beyond this is foolish.

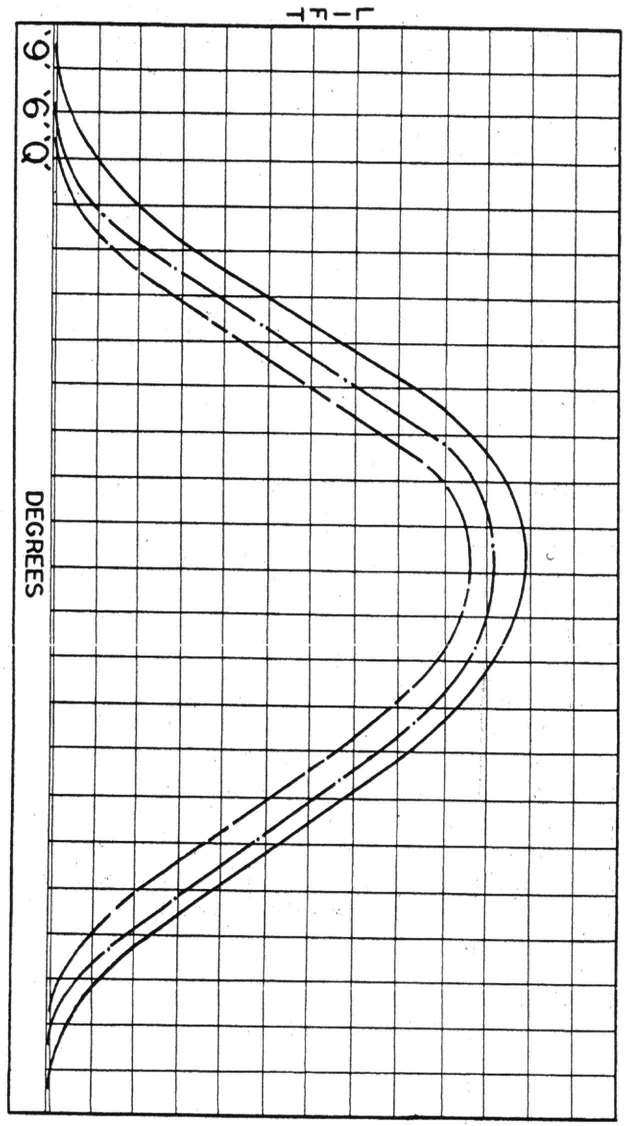


PLATE NO. 3

CHAPTER 3

How to Degree in a Set of Cams

The crankcases, pistons, barrells, and tappets must be assembled before any work toward degreeing cams is done. For information on assembly, see page 58. The engine is far easier to work with if it is secured in the vice. If you don't have a rig to mount a "B" range engine in the vice, the easiest and probably best way is to cut a rectangular section from a ¼" steel plate the size of the sump plate. Drill four ¼" holes the same as the sump plate and one larger hole to clear the sump tube. Weld 6" of ½" round stock to it vertically for the vice to grip. If you have a swivel base vice, this method is especially practical. Probably the best degree wheel for a price is the one handled by Triumph Corporation and Johnson Motors. Triumph's part number is CD3. They also have a good adaptor for this wheel, part number CD-123. Accurately locating the wheel is really quite simple but very important. Set the engine as nearly as you can guess at top center. Set the wheel so that your pointer reads top center. Now derive any kind of a stop to stop the pistons about 1" from top center. Rotate the engine forward to the stop and take a reading from the wheel. Rotate it backward to the stop and take another reading. If you guessed correctly both readings will be the same. If they are not, move either the wheel or pointer so that they will be the same. The wheel is now located.

From time to time small changes are made in the lobe design of our cams as we gather more and more information and are convinced these changes will be beneficial. Therefore the degreeing figures we are about to work with below are purely for example. Degreeing instructions come with each pair of cams, and you should always follow these instructions. For the purpose of example let's say the timing card that came with the cams says the No. 9 intake opens 40° before top center and closes 70° after bottom at .025 lift with standard grind tappets.

This is really quite simple when you fully understand what is to be accomplished. In other words, you want the intake valve to be .025" off its seat and lifting when the engine is 40° before top center. In referring to valve here we mean actual rise of the tappet, not valve movement. In a Triumph they are slightly different, and they must always be timed from the tappet. By degrees, we mean degrees of crankshaft rotation. Now, in an effort to tell exactly when .025" has been reached, we need one more piece of equipment, namely a dial indicator. If practical, you should get a dial indicator with .400" to .500" maximum travel so that it will be possible for the cam to turn clear over with the dial in place. Easiest method of anchoring the dial is to fasten it to an E-1596A head bolt. (This is the one with the extension for the head brace on top.) Then use a standard push rod to connect the dial with the tappet. Three key cam wheels (E-1486A) will usually be required.

With the aid of a D-181 cam gear installer fit camshaft gears to intake cam in standard timing position. For standard timing use the keyway opposite the two dots (or keyway opposite the single dot if there is only one dot on the gear). Mesh gears according to normal timing marks. Set the dial indicator needle to zero with slight pressure on indicator when tappet is on the base circle of cam. Rotate the engine until the dial gauge indicates the cam to be on .025 lift when valve is opening. Note degree wheel reading at this point, and then rotate engine until .025 lift shows on the dial gauge when the intake valve is closing. Note reading on degree wheel again. Having found these two readings (with standard timing), decide which way the cam gear must be moved to obtain the desired timing. If you move one tooth on the gear it changes the timing 15°. With three keyway camwheels, it is possible to split a tooth three ways (5°) by changing to another keyway. If it is out 12° to 17° it will be possible to bring the timing in just by moving the gear against the idler one tooth. This would put you within 2° of perfection, and that is close enough.

Since the idler gear has three teeth less than the cam gear the timing marks will no longer line up after the engine has been rotated one turn, and if you are caught in this position and turn the engine the wrong way, it will take quite a number of turns before the timing marks will line up again. Of course, this doesn't mean the engine is no longer in time when it is rotated one turn. If after moving the gear one or more teeth, you find you can't get within about 2° of the ideal, the next step will be to move to another keyway. Which keyway? There are only two left and you stand a 50-50 chance of hitting the right one if you move either way. There are various methods for deciding which one to choose, but the simplest way out is trial and error. So put it in either one and time back up with the dot on the outer flange of the gear directly across from the keyway selected. On some later three key gears there is only one dot, and it is at stock timing. In this case you have to decide which tooth on the gear is directly across from the keyway you have selected. After locating and timing back up, follow the same procedure as before. If this keyway will not bring it in within two degrees the third and last one will.

Several factors will tend to make a cam that will time perfect appear to be out. In other words, it will time perfect on say the opening side of one intake lobe and be two or three degrees out at the same spot on the other intake lobe. This condition can be caused by improperly ground or worn tappets, worn tappet guide blocks, tappet guide blocks that were not installed in the barrell exactly square, worn cam gears and several other things. If this condition develops (this is not serious and shouldn't be worried about unless it is out as much as 5°), and you can't locate the trouble (of less than 5°) then you should take the best advantage between the two. It is better to fudge a bit on intake opening and exhaust closing than vice versa. If it is out more than 5° (very rare), and you can't locate and correct the trouble, have your dealer send the cams back to the people who did the grinding (that will be us, I hope).

The chances of this happening with T & M cams are extremely rare providing you ordered first quality cams. We check every pair in a test engine to see that they will time correctly before they are put into stock or sent out. After you are satisfied with the intake timing, go on to the exhaust, and follow the same procedure using the figures given on the card that comes with the cams. (The No. 6 exhaust will frequently time correctly on standard timing position.)

When you are satisfied with the degree readings obtained with both cams it is worthwhile to check the sequence of the two. It is possible to get perfect degree readings and have exhaust cam directly follow the intake so as to open on compression stroke instead of waiting for exhaust stroke. It is simple to spot this by watching the tappets and pistons while slowly turning the engine. Should you make a mistake in the timing outlined above and get into this, simply rotate the exhaust cam 180°, and check the degreeing again. Wrap a few turns of tape around the idler spindle so that this gear can't slip out of position while you are degreeing the magneto.

Degree in the magneto before you disturb the degree wheel. Information on magneto timing is on pages 29 through 31.

CHAPTER 4

Correct Method for Determining Cam Lift

The lift and shape of a cam lobe are controlled completely by the lift and shape of the master on the cam grinding machine. The operator cannot change this lift and shape by grinding additional metal from the lobes after they once clear up, or cut all the way around the lobe. In other words, if a No. 9 lobe were ground and miked for size and put back in the cam grinding machine and an additional .050" were ground off it would change absolutely nothing in the way of lift or timing factors. After a statement like this, the average person will ask, "How is it possible to grind metal off a cam without decreasing the lift or timing factor?" Well, suppose you wanted to increase the lift of a cam without adding metal. How could this be accomplished? Simply by grinding the heel, or base circle of the cam down. The valve adjustor would then compensate for this lower base and a higher lift would result along with wilder timing factors. This is the method used by some automobile cam grinders. On the other hand, if you wanted to decrease the lift of a cam it could be accomplished by grinding off the top of the lobe only. Now, what does it do to a cam to grind both sides the same amount? Absolutely nothing from a lift or timing standpoint. See Plate No. 4 on page 19. True, the size of the cam lobe is smaller, but this doesn't make any difference at all (as long as the size stays within the limits of the valve or tappet adjustor). It is not size, but shape that we are after.

The standard factory E-3275 ramp cam has a base circle diameter of .795; while the base circle on the E-3325 sports cam mikes anywhere between .812 and .817. The majority of our reground cams mike about .810. However, when we regrind cams on the E-3275 shaft we frequently wind up with base diameters as low as .785. It is for these reasons you are completely misled when only miking the overall dimensions from base circle to the top of the lobe in an effort to determine lift.

The two lobes may mike differently this way and still have the same lift (and timing factors). The only way to determine cam lift with mikes is first to mike the base circle and subtract this amount from the overall size of the lobe. Be certain you check this way before you return cams for warranty because of wear.

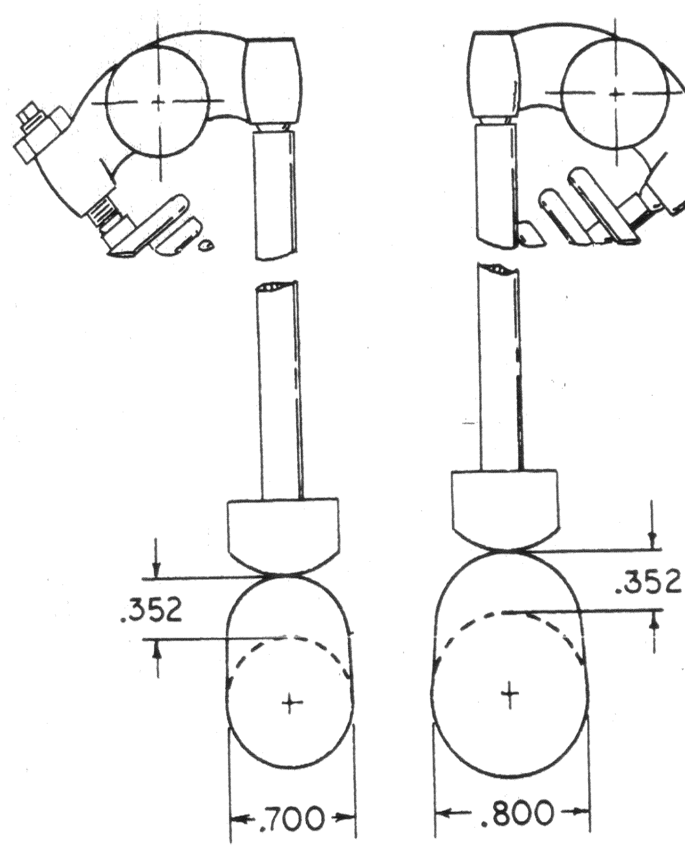


PLATE NO. 4

CHAPTER 5

Cams and Cam Combinations Available From T & M for Use in the "B" Range Twins

(Sold through Triumph dealers only)

No. 6

This cam has been a favorite grind on the West Coast for a good many years. It is best suited for scrambles, T. T., etc., where more torque is required in the lower (3500 to 5000) R.P.M. range, although it will continue to wind considerably higher. For T. T. and scrambles it works best with moderate (1-1/16" to 1⅛") carburetor and port sizes, straight pipes and 10 to 10.5 to 1 compression ratio. Only a limited amount of weight reduction in the valve train is required with a pair of No. 6's. Price exchange $56.25 B first quality and $30.00 A second quality.

No. 9-6 Combination

The No. 9 is a wilder cam than the No. 6 with more lift and overlap. When it is used on the intake with a No. 6 on the exhaust, it gives a happy compromise where a combination of low rev (4000 to 5500) torque is produced with the ability to produce more power in higher R.P.M. range (7000 to 7500). This combination is best for ¼ mile dragsters, road racing, etc. It is also safe to use in street motorcycles providing long hard road trips are not frequently taken. It produces best results with moderate carb and port sizes (1-1/16" to 1⅛"), three inch open or 4" reverse cone megaphones, and 10 to 10.5 to 1 compression ratio. Extensive weight reduction in the valve train should be utilized. Price exchange $56.25 B first quality and $30.00 A second quality.

No. 9

Best suited for straight away and top speed where R.P.M. is kept in the 6000 to 8000 range. Produces best top speed results with large(1-3/16" to 1¼") carbs and ports, 4" open megaphones and 10 to 10.5 to 1 compression ratio. Extensive weight reduction in the valve train is essential. Not recommended for general street use. Price exchange $56.25 B first quality and $30.00 A second quality.

All of the above cams and combinations can be supplied with a kit of thrust washers and needle bearings. This is a worthwhile investment when you are going "all out." This set-up not only substantially reduces the power loss to friction, but also makes a more reliable job for dragsters, etc. With this needle cam kit there is no machining or case cutting to do. It is as simple as installing a new set of bushings, and a set of clearly printed instructions on the installation comes with the cams. When ordering this special kit specify what grind, or combination you need and add the nomenclature "needle kit." The standard shaft is not quite hard enough for needle bearings, and we undercut and build up not only the lobes, but also both bearings. The same ultra hard material used on the cam lobes is used on the bearings. We then grind both lobes, and both bearings on the same machine at the same time. This results in extreme accuracy throughout. As you can see, this is in itself about twice the work required for a pair of standard cams. In addition to this, we make up the special thrust washers and crank case breather extension required. It is a beautiful job when finished (even the oil feed holes in the needle bearings line up perfectly with those in the case), but rather expensive. Price $112.50 B per pair exchange.

We will, on special order grind "Twingle" cams. That is a cam with both lobes on one side to make a twin fire like a single. We certainly do not recommend doing this to a Triumph, as there is no advantage except the novelty of it. With a set-up like this the load is doubled on not only the camshaft itself but also on every part in the engine as well as the whole drive right back to the rear wheel. This is a basic change in design, and that is something we would do well to stay away from. We have received inquiries about this type of cam in the past, and feel it worthwhile to list it here. If you must do this, we urge you to use a pair of No. 6 cams, as there is too much danger of camshaft failure with No. 9's. Price $67.50 B per pair exchange.

CHAPTER 6

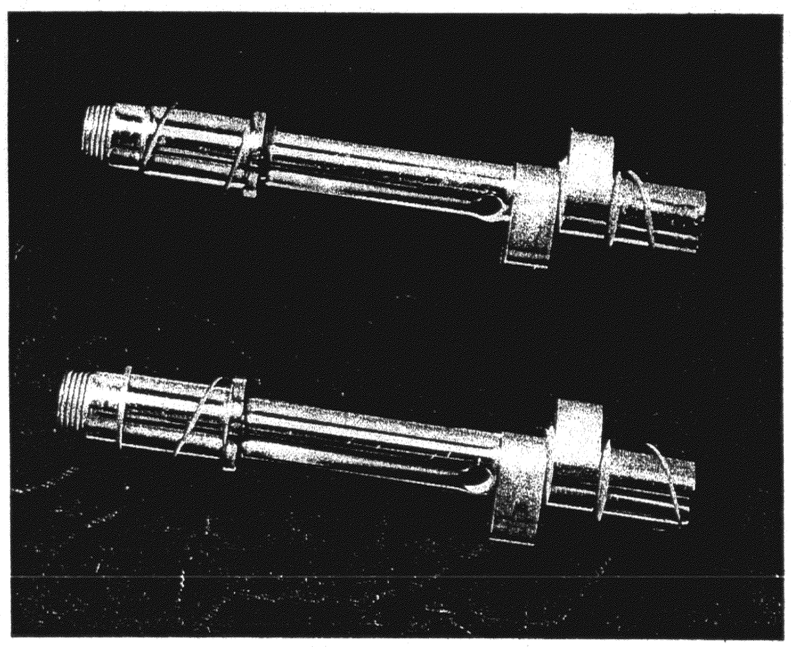
Guarantee on T & M Cams

There are very few reputable manufacturers that will guarantee any of their products for life. As a matter of fact at the time of this writing no one else will give any kind of guarantee on Triumph cams. We do. Naturally, we cannot guarantee the shaft. In the first place we didn't make it. In the second place we didn't sell it. We reworked it for you, and we can only guarantee the work we did. We do, however, make every effort to keep shaft failures down. In the fall of 1958 we started magnafluxing every shaft immediately after it is cleaned, and before any work is done on it. About one out of twenty show signs of failure at the crank case breather hole. Up to this time we have been absorbing this loss thanks primarily to those dealers who gather up the old cam cores lying around and ship them to us.

If you are a dealer you can help this cause by putting in a few extra cores next time you order cams. We will allow $2 each on these used cores (if the bearings are not bad) toward the price of a pair of our cams, or you may credit your account with them to draw against in the future. This is what most dealers do, as it is far easier to just send a postal card when they need cams and not have to pack up a pair of used ones every time. In the fall of 1960 we devised and put into use a method of hardening the bearings on the shafts so that virtually all wear has been stopped here. It was not an easy task to devise a system that would harden these bearings without having to grind them, warping the shaft, or affecting the toughness of the hard face overlay on the lobes, but it has been done, and bearing failures have almost been eliminated.

GUARANTEE ON CAMS

The metal in T & M cam lobes is guaranteed against wear, break-up or failure of any kind forever. Should you have a failure in one of our cam lobes, return it to the Triumph dealer from whom it was purchased. He will in turn send it to us together with a used shaft for exchange, and we will immediately replace it free of charge. We will not honor warranties sent in from riders or other motorcycle dealers.



T&M CAMS

The world's best cams for the world's best motorcycle

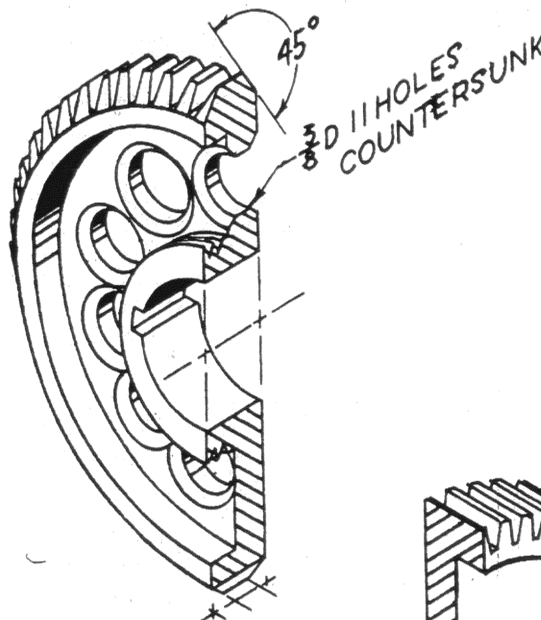
CHAPTER 7

Lightening and Beveling Timing Gears

Naturally, no phenomenal horse power increase can be expected by weight or friction reductions in rotating parts such as camwheels and idler, but some small good can be done with no loss of strength. Work of this kind is only recommended when going all out such as T. T., drags, etc., and is not to be done in road motorcycles. The weight of the idler gear and cam wheels can be reduced by almost one half, and the frictional loss lowered somewhat by drilling and beveling teeth. It is far smarter to rework the standard gears and have the strength and low frictional loss of good steel than to pay a high price for soft quick wearing high friction aluminum timing gears. We must keep in mind that we are going to ask these gears to take much greater loads and turn greater speeds with our wild cams and heavier springs than they were originally designed to and therefore it is foolish to sacrifice strength by replacing the original equipment with softer material. Neither should we weaken the gears by taking away metal at the most heavily loaded point at the base of the teeth. Frictional loss can be lowered with no loss of strength by beveling the teeth on the timing gears from the base to the top at an angle of 45°. (See Plates No. 5 and 6 on pages 26 and 27.) This is easily and accurately done on a valve facing machine. It is necessary to make up a tool to hold the gear in the machine. (See Plate No. 7 on page 28.) A wire buffing wheel does a good job of removing the small burs formed in the grinding operation.

The E-1486A cam wheels can be drilled even though they are good material. Use the tool made up for grinding the teeth in a lathe to accurately locate a scribe line halfway out between the hub and teeth. A pair of dividers will accurately locate the 11 points from which to drill. It is best to use a smaller (3/16") drill for a pilot and follow it with a ⅜" bit. The square shoulders left by the ⅜" bit should be countersunk with a larger drill bit or countersink tool.

E-1471 idler gears in the later "B" range twins ('60 and '61) can be drilled the same way, but older ones are too hard to drill. Check the hardness with a center punch in the area where you are going to attempt drilling. If it will punch, it will drill. In this case you can follow the same procedure as outlined for camwheels, except you will drill only 9 ⅜" holes. If the gear is too hard to drill, you will have to either be content with just grinding the



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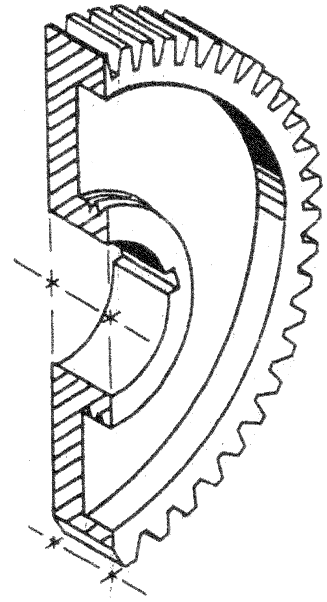

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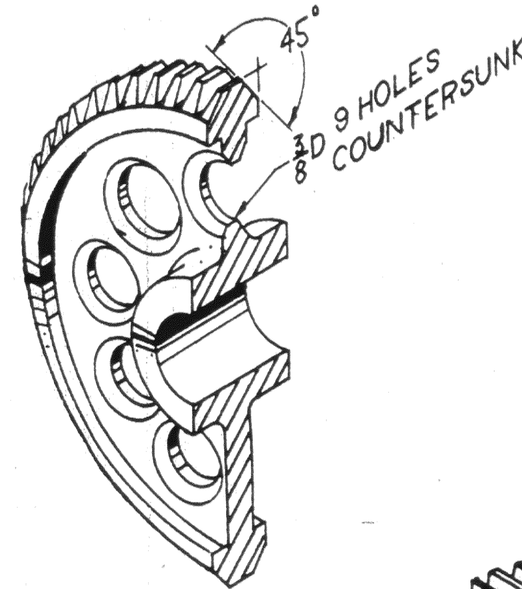
PLATE NO. 5



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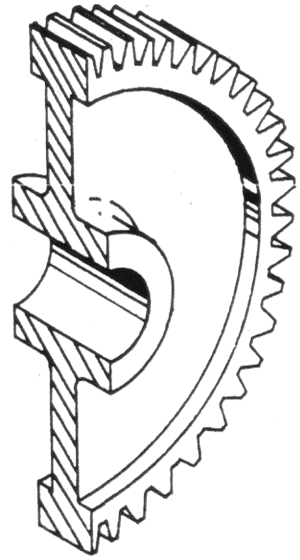


STOCK

teeth, or replace the gear with a later one. Do not try to soften the gear.

An E-3411 steel mag wheel with fixed timing is best for dragsters and top speed. Do not drill this wheel, as it will cut away the oil retaining flange on the back side. There is no need to bevel the teeth as it runs against the camwheel that is beveled.

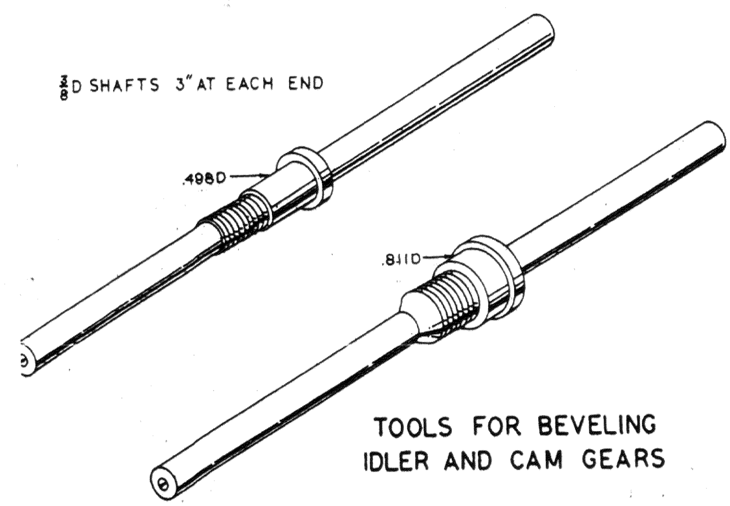


PLATE NO. 7

CHAPTER 8

Degreeing in the Magneto

Needless to say, the performance of the entire balance of the engine combination hangs on the ignition system. With our deeper breathing ability, higher compression ratios and higher R.P.M. ranges the load put on the magneto is greater. In order for the engine to develop its full potential it must have a strong unfailing spark at exactly the right instant. If there is any doubt about the quality of the magneto you are going to use, it is certainly worthwhile to disassemble it and have a good magneto shop check the armature, and if it is a B.T.H. mag the magnet should be recharged. It is worthwhile to rig a device to spin the mag up to about 4000 RPM (this is the equivalent of 8000 engine revs) with a jump spark to check it after reassembly. If you have any doubt about your mag, and can't locate a local electric shop to check it out, either replace it with a new one, or send it back to Triumph or Johnson Motors for them to check.

The range of new magnetos for a B range Triumph is rather limited. Selection depends largely on the price you wish to invest and the type of use you are going to put it to. First choice with most good tuners is a Lucas racing mag. These are high (about $200), but they offer several advantages. Lucas builds and assembles these more carefully, and like any Lucas mag they will fit right on the motorcycle with no alteration. They are more accurate than other Lucas mags especially in regards as to the location of the cam lobes so as to fire both cylinders at more nearly the same degree reading. Our experience with them has been quite satisfactory. They are not perfect, however. The platinum points they come with are good while new, but get old rather fast. A standard Lucas magneto will do a good job, although it is not as accurate as a whole. This inaccuracy will usually show up when you are degreeing in the mag.

It is most important that both cylinders fire at, or within one degree of the same degree reading. The Lucas racing mag will usually do this though not always, and the standard mag seldom will. It is not too difficult, however, to make both sides fire at the same reading. This is done by carefully working the leading lobe in the camring with a hand stone so as to retard the opening, and make it correspond. It is essential to use a light when degreeing in the mag.

Cellophane or tissue paper is satisfactory for standard use, but we are now dealing with a special job, and therefore want everything right up to snuff. In order to use a light on a Lucas or BTH mag it is necessary to remove the condenser screw. This is the long screw in the center of the points that holds the breaker assembly in place in the armature. The contact points can then be used as a switch to turn a light off and on, and thereby give you the exact point of breaking. The breaker assembly fits rather well in its taper, and usually will not come loose while timing the mag providing the condenser screw was tightened up before removing, and no hammering is done in the gear installation.

Should this assembly jump out while installing the mag gear, it will usually go back in without changing the timing more than about 1°. Our method is to carefully set the point gap at 12 ths. and time the mag correctly on the top lobe, then turn the engine to the breaking point on the bottom lobe to determine how far it is out. The bottom lobe is almost invariably a few degrees ahead of the top one. After determining the number of degrees the bottom lobe needs to be retarded, the condenser screw serves as a good tool to insert in the center of the points to remove the assembly. A circular motion of this screw engaged in the assembly about ¼" deep will readily break the taper loose. You can now go to work on the advanced lobe. Naturally, the place to cut is right at the point of opening, or at the beginning of the lobe.

Keep in mind the mag turns the opposite way from the crankshaft. After working a bit with the hand stone the point assembly can be reinserted, and both lobes checked again to determine how much difference remains. Continue to work this down until the lobes are within 1° of the same. 37° to 38° seems to work best for scrambles, TT, etc., while 39° to 40° is best for drags and 40° to 41° for top speed. Caution: Be certain the mag gear retaining nut is tight before you settle for the degree figures shown. If the mag is timed correctly and you go back and tighten this nut the timing may change.

In addition to the Lucas series there is available from the West Coast a domestic rotating magnet magneto that has been thoroughly reworked for racing purposes, and comes with an adaptor plate attached to fit the B range Triumph. One advantage of this mag is the relatively low initial price which is about half that of a Lucas mag. This mag has no distributor and therefore fires both plugs at each impulse. This may be considered an advantage as some tuners seem to think this wasted spark tends to keep the plugs clean and therefore helps retard the chance of load up or plug fouling. At any rate, no ill effects are noticed from this wasted spark. We have had good service from these mags once they are mounted, but they don't mount as easily as the Lucas mag. The top two E-2022 studs that hold the magneto to the crankcase must have about ¼" cut off and the F-1008 nuts must be beveled in order to mount it. Usually, after this work is done the magneto case strikes the crankcase and a good deal of filing of both parts is necessary to correct this condition.

After it is finally mounted we find the screw that connects the condenser to the points, also holds the coil wire and holds the points to the case. This is the screw used to adjust the points, and therefore the condenser cannot be removed from the circuit to facilitate timing with a light without disturbing the breaker point setting which in turn changes the timing. A light must be used to get the accurate timing necessary, and therefore more work is called for. The easiest way around this problem is to use a stud in place of this 10-32 screw. Screw the stud into position, and lock the points down with a nut. Time the magneto and then attach the condenser and coil wires with a second nut. This works well, but when an attempt is made to install the cover we find the kill or stop button lead anchored in the cover with a spring designed to make contact with the screw we have replaced with a longer stud with two nuts stacked up on it. The easiest way out of this problem is to discard this ground lead and forget about a stop button. Should you feel that a stop button is necessary, one can be installed with more work yet.

Although this magneto fires both plugs at once, this doesn't mean it has to fire both cylinders at the same degree reading. We have seen these as far as 5° out. This can be corrected by positioning the cam so that it is opening the points on the leading side and with the aid of a soft drift tapping the cam downward away from the points. Do this gently and check again.

After the whole thing is finished up, one wonders whether the price savings and other possible advantages are worth the effort. There is one more thing that can be said in the mag's favor. It is very reliable, and it produces a hot spark. There also remains one thing that should be said against it, and that is its very heavy weight. It is quite a job for those 3-5 16" studs to hold it rigidly in place while under the influence of vibration, and therefore it shouldn't be used for hard long distance work such as road racing.

CHAPTER 9

Lightening the Valve Train

Probably the most vital group of parts of a modern high reving overhead valve engine is the valve train. We must bear in mind that cam operated valve motion is a special one of which only the opening phase is a positive movement, relying on the tension of the valve spring for the closing operation. The reciprocating valve motion becomes very rapid at high R.P.M. which produces a pronounced inertia effect on the reciprocating parts. Under these conditions the spring must be strong enough and/or the valve train light enough for the tappet to follow the cam contour. If it is left behind, in mid air, we have a condition which is commonly called "valve float." This is very harmful to the valve gear and other parts of the engine. The resulting abrupt seating of the valves causes high loadings on seats and valve heads and the hammering of the tappet against the cam lobe can be disastrous. With high compression ratios the piston to valve clearance becomes very small, leaving little room for valve movements, especially when the cam is a radical one such as the No. 9 or 6 with considerable overlap.

Serious valve float may cause the valves to get tangled up, or the piston to hit a floating exhaust valve that did not return to its seat fast enough. Obviously, there are two ways to correct this situation. The easiest of which is use heavier and heavier valve springs with the resulting high horsepower loss and the almost unbearable load the whole valve train is forced to endure. The second and by far best way is to lighten the reciprocating parts of the valve train to the point that a slightly heavier spring can do the job. Here, we can look to the factories who are producing highly specialized racing motorcycles for guidance. The oldest trick with these people is to do away with most of the reciprocating parts in an overhead valve engine by the application of overhead cams. This gives a far better racing engine, as a much wilder cam can be used with a much softer valve spring. The resulting advantages are quite obvious.

In the case of some of the very latest works racing engines we find not a softer valve spring, but indeed no valve springs at all. This is achieved by a rather complicated and expensive system of dual lobe overhead cams, one of which opens the valve, and the other closes it. With this desmodramic set-up it is not only possible to use these ultra wild cams with no overload on the valve train, but also to put all the horsepower normally required to rapidly compress heavy valve springs to work turning the rear wheel. So, we see the world's best engineers not using heavier valve springs, but trying to lighten the load in general on the valve train. A smart tuner will follow this idea as far as is practical when working in a standard production motorcycle.

Now that we have decided what is to be done (a compromise situation of a little heavier valve spring and a lighter valve train) we must not lose sight of the fact that there are not one but two requirements of an efficient valve train. They are lightness and RIGIDITY. In other words, it must have a high stiffness-to-mass-ratio. These are two contradictory conditions, and that is why we must make doubly sure that if we lighten or replace the original reciprocating parts with lighter ones we do not end up with a valve train that is sadly lacking in rigidity, and dependability.

There are many tricks for lightening the Triumph valve train that have proved reliable with us for many years, and outlined on the following pages you will find these explained in detail and where necessary you will also find drawings of the stock parts compared to the reworked part.

Tappets

With our 9-6 cam set-up the radius of the intake tappet (No. 9 cam) is standard E-3059, and the exhaust (No. 6) is 1⅛" or factory racing tappet E-3059R. A word of warning here. Don't try to use "R" tappets on No. 9 cams or anything flatter than 1⅛" radius on No. 6 cams.

You will gain nothing but trouble. Naturally, this information is supplied with our cams. The first step in preparing a tappet, assuming it is a used one, is to regrind the face or the radius. You will note the Triumph tappet has a stelite tip brazed on to make contact with the cam. If the tappets you are going to use don't have this tip, or if this tip fails to completely cover the end of the tappet when you are finished grinding it, throw it out. Tappets produced by Triumph in the early 1950's did not have this hard face on them.

Dealing first with the full drag or full race tappet. See Plate No. 8 on page 34. As you can see by the drawing the width of the tappet has been brought down to 5/16" and the stem is drilled to 3/16" with a home-made "rocker button" pressed in. A tappet

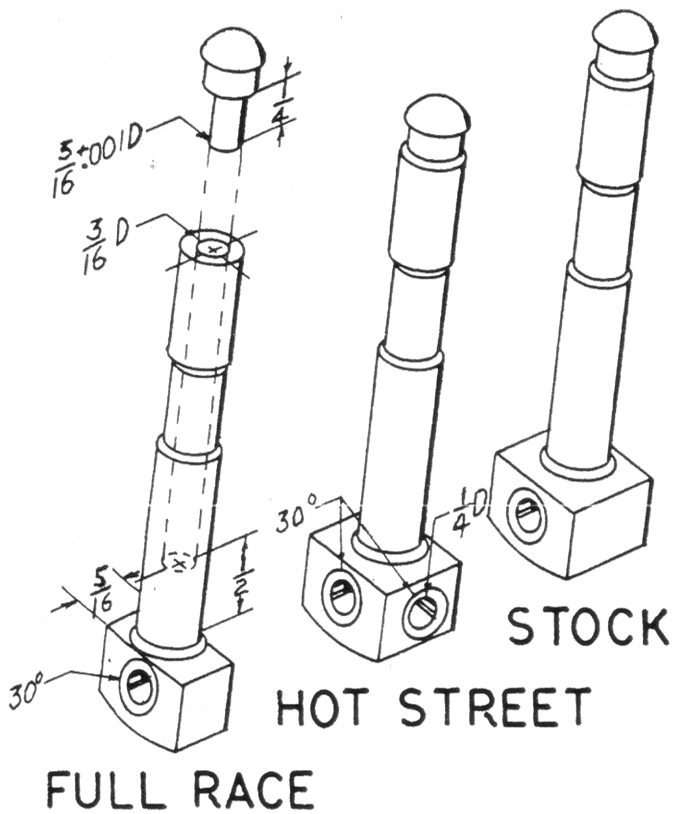


PLATE NO. 8

of this kind will do a good job if you use a *really hard cam.* T & M cams stand up very well with narrow tappets for drags, scrambles, flat track, etc., but naturally you wouldn't put a small tappet of this kind in a street motorcycle where long distances are frequently to be covered. WARNING: DO NOT USE THIS TYPE OF TAPPET ON STANDARD TRIUMPH CAMS OR SOFT CALIFORNIA CAMS. The lobes of these cams will not survive even for a few miles with narrow tappets. It is really quite simple to grind the edges down. Since you are only relieving weight and friction, there is no need for any extreme accuracy. After the grinding is done, countersink the hole in the head with a larger drill bit to avoid the possibility of fatigue failure here. In order to drill the stem the factory ball must be removed. This is quite hard on the surface, and the easiest way to accurately cut it off is with the aid of a valve facing machine. Obviously the end must be square, as it serves as a seat for the button you are going to make. After it is ground off, you will find it has a relatively soft core, and can be drilled in a lathe. It is most important that this 3/16" hole be located accurately in the center of the stem as it will serve as a guide for the button.

The size of this hole must also be accurate so that the stem on the button will produce a light interference fit. It is best to drill this with a No. 14 (.182") bit and follow with a 3/16" reamer about ⅜" deep. Thus the .001" o.s. stem on the button will press in. The end from a standard Triumph push rod makes a good tool for this. Making the button is really quite simple for a good machinist. Just copy the factory here except put a 3/16" stem on it ¼" long. Actual forming of the ball can be done by hand on the lathe. Get this as near the same as the factory as possible and let it go at this. The shape of the ball is not as critical as you may think. A good grade of steel such as C-1045 is quite ample. We do not wish to solicit business making these tappets up. Any good machine shop can do all this for you except radius grind used tappets. Our price for radius grinding used tappets is $5.00 A per set of four. In case you find it impractical to do the rest of this tappet work we will do the whole job for $25.00 A per set of four, exchange. If you would like us to do this for you, please put a note in with the tappets telling us exactly what you want done. This work must be done through your local Triumph dealer. We do not do work or sell cams direct to riders or other motorcycle dealers.

Tappets for hot street motors can be drilled in the stem and a button pressed in the same as in the preceding paragraph, except for the width. For motorcycles commonly used on the street, you should leave the full bearing surface for longer life. As you can see by the drawing a worthwhile amount of weight can be safely removed from the standard end by drilling a second ¼" hole running perpendicular with the one the factory put in. Countersink this one also. The best method for accurately locating this hole is to use a fine scale for a straight edge drawing a line from one corner of the tappet diagonally across to the other. A second line drawn from the remaining corners will cross the first one, and give you an X at which point to drill. When drawing these lines do not take in the stelite tip on the tappet. In other words, you want to get the hole in the center of the tappet itself, not in the center of the tappet and the hard face tip. Here again, we do not wish to solicit business doing this work. We will, however, rework tappets for hot street motor use for the same price as full race ($25.00 A) per set of four, exchange. When sending tappets to us for this purpose, always include complete instructions. All work done by us and sent out must be done through your local Triumph dealer.

Pushrods

Here, the evil of laziness catches up with far too many of us. The idea being, "Why go through all this grinding, polishing, drilling, etc., if I can buy pushrods that are so light until it isn't necessary?"; or on the other hand, "Boy, if I do all of this lightening work and use some of those fabulous feather weight pushrods, this job should turn 10,000 without floating a valve." We must not lose sight of the fact that what we are after is *lightness and strength*. West Coast alloy pushrods sure are light enough—but strength and dependability? That is quite another matter. The fact is the very best pushrods available anywhere in this country at the time of this writing are the stock standard E-2620 alloy pushrods that come in all B range Tiger, Trophy, and Bonneville series. Upon close examination we find the feather weight pushrods are not actually so light after all. Three of them weigh about the same as two standard ones. Where, is this weight saved? Unfortunately it is saved at the bottom end where the tappet ball fits and at the top end where the rocker ball fits. The latter is the point of greatest load, and the most likely place for a pushrod to wear, or break. Why then should we give up the wearability and strength of good steel in exchange for such a little weight saving in the form of soft aluminum at this heavily loaded point? Experience has taught us that the featherweight pushrods are absolutely worthless.

Take the writer's advice and don't be tempted to try them unless you are fully prepared for a failure. They not only wear out abruptly, but are also prone to bend. This bending will occur when you need the rigidity of good pushrods most. That is the time when you are engaged in competition and pushing the engine to its maximum. You can't win any kind of race with a blown up engine. Some of the good tuners make up their own pushrods to suit themselves, but this is another story for another book. As for myself, I am perfectly satisfied with the stock alloy pushrods with the lone exception of an occasional break-out of the top cup or socket (referred to above as the heaviest loaded point on the rod). This breakage can be virtually eliminated by a careful polishing with emory cloth of the steel ends. The easiest way to do this, is to spin them in a drill or lathe with a fine emory belt on the ends. Polish the sides and if there are sharp edges or rough spots at the top or end, by all means polish this off. Understand, we are not trying to lose weight here, but to get a chrome-like finish on a heavily loaded part for added strength. Steel, under a load will act very similar to glass in that it will break at the scratch or flaw. If you are going to use used pushrods, be certain they are dead straight, and it is worthwhile to magnaflux the ends. Should you find one of the ends loose on the rod, replace the pushrod. Save this end, you will have use for it as a tool for replacing rocker buttons and as already mentioned for pressing in homemade tappet buttons.

Rocker Arms

With a Triumph, we are dealing with a mass production motorcycle made to sell at a price you could afford, and to be used for common transportation. It was not given the fine hand work to parts such as the rockers that are required in a racing machine. Had all this special work for racing been done at the factory, you probably wouldn't own it, because of the high initial price. Since we are now making a racer from it we need to do some of this work. The rocker spindle (E-1512) is an interference fit to the rocker box. It will readily push out with the aid of a vice and spacer or better still, a press. It is not good to try to drive this spindle out with a hammer, as it is hard and therefore somewhat brittle. It's a good idea to warm the box before you start to make the job easier. After the rocker spindle and arms are out, thoroughly inspect the inside of the rockers to see if any sign of roughness or galding has occurred. When you are satisfied they are okay, remove the adjustor screws (E-1513) and the rocker buttons (E-1483) to prevent damage to these parts during grinding and polishing. This button is also an interference fit, and a hammer and punch with the aid of a spacer such as a ⅜" drive socket will readily remove it. Assuming you are using used rockers, it is worthwhile to magnaflux these along with the spindles before you waste a lot of time on them. After all grinding and polishing is done, you should have them magnafluxed again, as the polishing sometimes uncovers flaws or cracks hidden below the rough cast surface.

The rockers in a "B" range twin will, because of the very good grade of material, take a surprising amount of punishment, providing you don't weaken the arms in the grinding operation. Here again, a good tuner will not lose sight of the two requirements of an efficient valve train. Lightness and RIGIDITY. Obviously, the further you get from the center of the rocker spindle, the faster the speed, and therefore the greater the inertia becomes. It is these most outlying points around the threaded adjustor and the rocker button hole that can be made to give up weight with no loss of strength. In fact, the rockers should, because of their lighter weight and polished surfaces, be stronger when you are finished with them than they were when stock. Very carefully grind away the excess material around the adjustor and botton hole evenly down to no less than 1/16" thick. (See Plate No. 9 on page 39.) Don't let the arm get hot enough to turn blue, as these are heat treated and will lose strength if you do. Do not grind any material from the top of either arm, and none from the bottom of the adjustor side. The button side usually has a square shoulder about halfway between the button and spindle caused by the factory machining the bottom of this arm square to give a seat for the button. This little shoulder should very carefully be blended out, not to remove weight, but to do away with the weak spot brought on by the relatively square corner at its base. You will also note a rib running directly down the sides of both arms caused by the seam in the mold when they were made. This little rib is all the metal that should be ground from the sides of the arms. The factory does not always locate the oil feed passage from the spindle to the button accurately, and this passage will sometimes appear when grinding away the rib on the

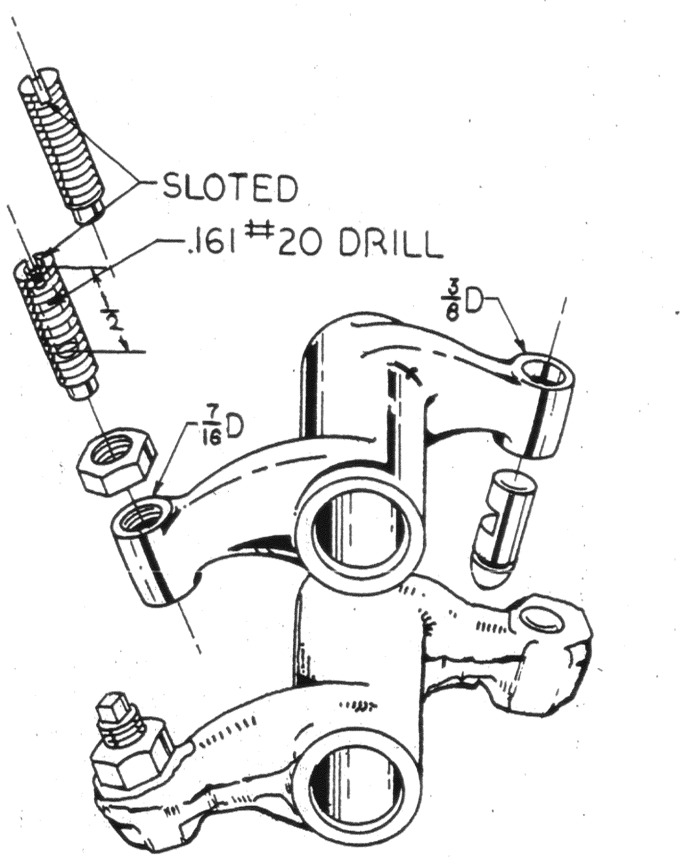


PLATE NO. 9

side, or in the polishing operation yet to come. If this happens, throw the rocker out and start over with a new one.

Probably the easiest place in the whole engine to go overboard and botch the job is in the grinding of these arms. It is foolish indeed, to grind away at a good part of this kind until the strength and rigidity is all gone.

The handiest tool we have found for polishing the rockers is a belt device driven by a high R.P.M. electric motor. Every automobile machine shop who grinds crankshafts has one or two of these machines for polishing crank journals after grinding. Perhaps you can borrow or rent one of these belt polishers to work over your rockers. If you can, use the used belts these fellows are going to throw out. The new ones are about 50 cents each and they are just too sharp. The old used ones will cut fast enough and a lot smoother. If you are unable to locate one of these machines for your use, the next best thing would probably be the kit of rubber abrasive wheels from Webco. They cut much slower, but if you are patient, they will do a good job.

Keep in mind, the idea for doing this polishing is to increase dependability and reliability. It is not to remove any weight. The arms should be brought to a chrome-like finish on both sides as well as bottom and top right down to the center. The center should be polished from the point where the arm joins it out about ¼" so as to blend the arm to the center. If you are using a belt polisher, a much better job can be done if the belt is cut into smaller belts about ⅛" wide. This narrow belt is far easier to work in the tight places. Little good can be gained other than from the appearance standpoint by polishing the entire center, but when we are doing it we usually polish the center anyway. It can be done so quickly and easily on one of these belt polishers, and looks so much nicer it seems a shame not to do it. A cloth buffing wheel with some rouge will finish up the job very nicely. It is now a simple matter to press the button back into position with a pushrod end. Be certain the oil passage lines up so that oil can feed to the ball.

The aircraft people have a system of cold treating their rocker arms which is said to greatly increase the strength of heat treated parts of this kind. This system consists of submerging the parts to be treated in alcohol and letting them stand for about two hours on dry ice. The length of time is not critical as long as they come down to approximately the temperature of the dry ice. They then let them stand in the alcohol and slowly return to room temperature.

This is supposed to change the molecular structure of the metal, and thereby increase the strength of the part. Since we have had so little trouble with broken rocker arms in the "B" range, our tests are inconclusive at the time of this writing. We have treated the last two sets of rockers we reworked for our own use this way, and I am only prepared at this time to say there is no harm done. This, as far as we are concerned, is still experimental, but we will pass the information along to you anyway.

The rocker spindle should be inspected for any signs of roughness or galding. A light polishing of the spindle where the rockers make contact is a good idea. Before you are satisfied with this, make certain the rocker is perfectly free on the spindle. Some years ago the writer went through untold machining to install needle bearings here on two different motorcycles. One of these failed abruptly, and I was satisfied the time spent on them was wasted. This is quite a machining operation that we won't go into, as I just don't consider it worthwhile. Some improvement can be made in the action of the rockers on drag or full race motors by pressure feeding the spindle from the plug directly in the front of the timing cover. To do this you simply screw the existing plug out and replace it with an E-1601 adaptor bolt, (this is the one used to drain oil from the spring compartment on iron head models) run through the banjo fiitting cut from an overhead oil line. E-1335 copper washers make an excellent seal for this. Use CD-33 3/16" reinforced neoprene flexible tubing to connect to the overhead oil line.

This will give 60 to 70 pounds of pressure to the rocker spindles and give added lubrication to cams, tappets, etc. This is quite a lot of pressure, and reinforced tubing must be used. Either safety wire or clamp it to the banjo fitting and overhead oil line with E-3513 Triumph clamps. While you are about it you will find it worthwhile to cut the rigid overhead oil lines between the T and the fittings at the rocker spindles and rubber mount them the same way. Alloy heads will drain fast enough, and give no trouble flooding with oil. The iron head will, however, fail to drain fast enough with this set-up, and if you are using one of these it will be necessary to tap the inside of the E-1601 adaptor bolt and fit a No. 100 4/042 amal carb jet here to serve as a restrictor.

We do not wish to solicit business grinding and polishing rocker arms, but we will do this for any Triumph dealer for a price of $50.00 A per set of four. This includes the work on the adjustors outlined below.

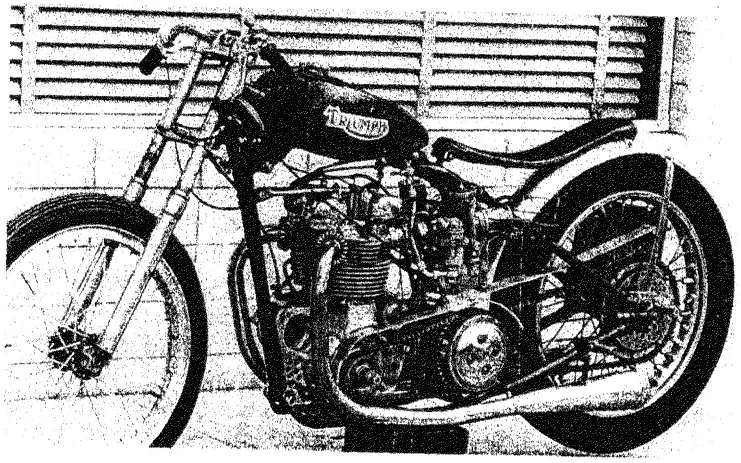
Valve Adjustors

In addition to the weight we have already saved on the rocker arms, there is one more point here that can be made to surrender weight with no loss of strength. The E-1513 rocker adjusting pin (valve adjustor) has a square head and a solid shaft. For normal work this square head is good, as it is much easier to adjust the valve clearance with a wrench. For our racing engine, however, we will be content to sacrifice a little ease of maintenance in return for a nice weight saving with no loss of rigidity. For street use or in motorcycles where long distances are to be covered, it is best to be satisfied with just cutting off the square section on top of the adjustor, and making a screwslot with a hacksaw instead. This adjustor is surface hardened, and it is rather hard on hacksaw blades to cut it although it will usually cut. The best way is to grind it off. Be careful not to get it too hot, as it is heat treated. Not much trouble is experienced cutting the screw slot as the adjustor has a relatively soft core.

In the case where we are going all out as in a dragster or full race job, a further weight reduction can safely be accomplished by drilling a .161" (No. 20) hole ½" deep. Naturally, you will have to keep ham fisted mechanics off the lock nut after this is done. This drilling operation must be done in a lathe where you can keep the work centered. Obviously you will not want this hole way off to one side leaving the other side weak. Wait until after this hole is drilled to cut the screw slot, as the slot will tend to pull the centering bit off center. It is also safe to grind or turn the lock nut down to two-thirds of its stock thickness. (See Plate No. 9, page 43.) For information on assembling rockers to rocker boxes, see page 61.

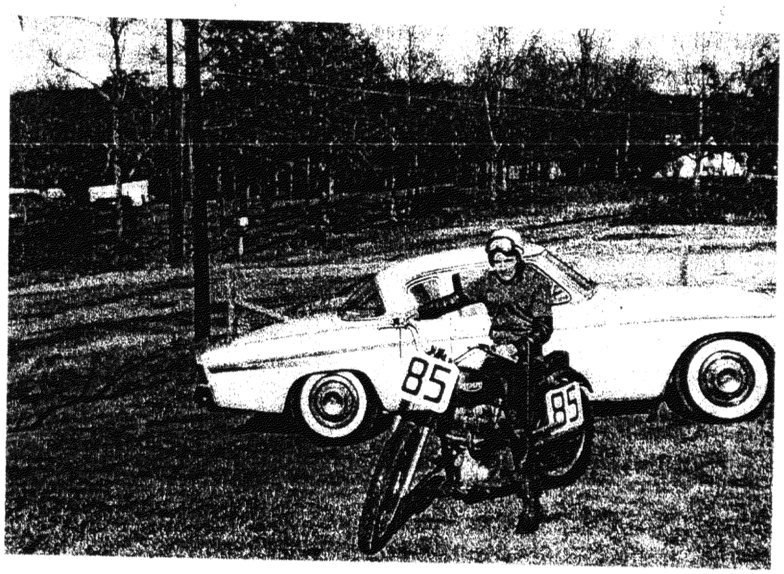
Valve Springs and Retainers

The choice of the correct type of valve spring to be used on a certain engine and with a certain cam is one essentially governed by experience and sound judgment. As we have already decided, we do not wish to use a valve spring pressure too great, but it is obvious that stock valve springs will not be suitable for our purpose since our reworked engine operates in a higher speed range and will be equipped with a special camshaft having acceleration and deceleration characteristics different from those for which the stock springs were designed. The importance of avoiding valve float has already been stressed, and in our engine the valve spring not only has to return



TRIUMPH DRAGSTER

Built by Fay Myers of Denver, Colo. This potent fuel burner has turned the ¼ in 10.5 at 131MPH. Uses T&M Cams. Fay says "I would not hesitate to recommend T&M Cams to anyone who is looking for more power. After using them 4 years, I am convinced they are the best Triumph cams available."



RAY DURHAM

Charlotte, N.C. Popular Scrambles & TT ace in the East. Uses T&M Cams.

the valve to its seat, but it also has to push back the rocker arm, pushrod, and tappet. With a racing camshaft this becomes quite a task at high R.P.M. even with our lightened valve train. The best tuners seem to agree on S-W springs as their choice.

Our experience through the past several years with these springs has proved them to be excellent. They are sold to dealers in the East under Part No. CD-71 by Triumph in Baltimore, and are sometimes referred to as "Jomo" springs by them. They are sold in the West by Webco, Part No. 1085. Unfortunately, there are no really good English valve springs available in this country for the "B" range 650 Triumph. The English racing springs that are available are too stiff, and they shrink rather quickly. When fitting the S-W outer spring, the close wound coil must be at the bottom, or toward the head. There is no difference in the inner spring.

In addition to the lightening work we have already done, there is one more bit of reciprocating weight in the valve train that can be safely and easily reduced. This is the top spring retainer. Two different types of alloy spring retainers are now available for our use. One of which is produced on the West Coast that you are probably familiar with. We have had quite satisfactory results with these, but as we will see below they have certain disadvantages over the second type now available from Triumph in Baltimore.

Dealing with the West Coast type first. A mechanic who hasn't used these before, will at first glance wonder how to get the small keepers over the valve stem. Fact is they won't go over the stem the way they come, as the two parts were not separated or even partly separated by the manufacturer, and this operation must be done in the shop. The easiest way to hold these small parts to cut them is to drill a ½" hole about ⅜" deep in a wooden block. This hole will support the keeper so that it may be sawed in two. It is very difficult to saw these exactly square, and therefore they must be kept in pairs, and not be mixed up. Carefully remove the burs formed in your cutting operation with a file. After these are assembled to the head measure the valve spring length. The total length of the spring with the valve on its seat should be no shorter than 1-5/16" and no longer than 1-11/32". It is more convenient to measure from the top of the bottom cup to the bottom of the top retainer. Since the outer spring extends 1/16" into the lower cup the dimensions for measuring here would be 1¼" to 1-9/32".

Here we find the shortcomings of the West Coast collars. Providing the head and valves are in good condition, the spring will be approximately 1/16" too short. There are several ways of extending the spring length. You could take the valve back out and face the valve seat down 1/16", but a good tuner would know this is dead wrong. Another way is to cut the head down 1/16" where the spring seats against it. This is a little better, but a lot of work and not the best way. Still another way is to grind the shoulder off the bottom of the lower spring retainer. This is better and easier than the first two, but there is a better way still. Our method is to (after measuring to find out exactly how much too short the spring is) cut the square shoulder on the valve stem that the keepers seat against, back 1/16" or whatever is necessary to give the desired spring length.

Naturally, this job will have to be done on a small lathe. Use a cutting tool with a straight edge and a very small slightly rounded point to prevent the forming of a perfectly square corner. The very small radius will help keep down the possibility of fatigue here. After this is cut, any roughness caused by the cutting tool should be polished off with emory cloth. (That belt polisher is handy here.)

The big advantage in using the second type (Part No. CD-224) distributed by Triumph in Baltimore is that the spring will not be too short, and therefore the cutting work described in the preceding paragraph is not necessary. This is achieved by recessing the keepers in such a way as to give about the same spring length as standard Triumph parts. As a matter of fact the spring will sometimes be a bit too long, which is very easily corrected by fitting the steel discs from an ordinary New Departure bicycle coaster brake as spacer washers between the lower spring retainer and the head. A further advantage offered by these is that the keeper is already cut almost in two, and this eliminates the work of sawing them. They are a little lower in price to boot.

CHAPTER 10

Compression Ratios

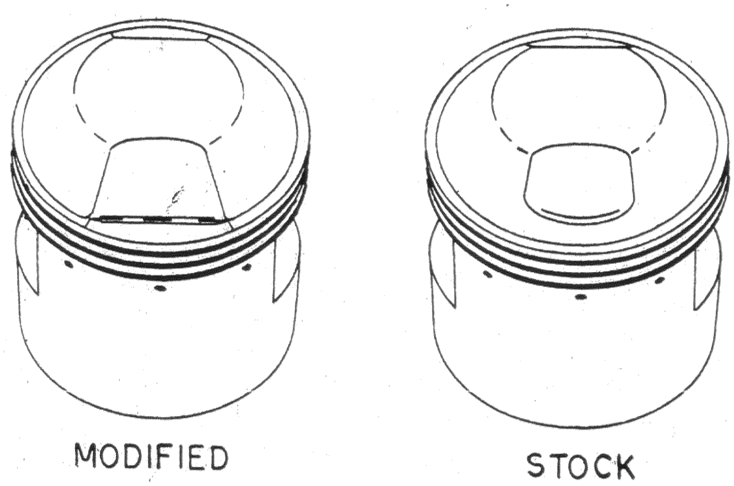
Compression ratios, like virtually everything else in the engine must be tailored to meet the demands of the job. Experience tells us that "the higher, the better as long as it doesn't knock," is not necessarily correct. As a part of the all important *total combination* we find by going higher and higher we reach a peak in performance, and when going past this peak the power of the engine not only fails to increase, but will actually begin to fall off. The only way to accurately determine this point is to start with standard compression ratio and gradually work up to a peak and beyond. We here at T & M have done just this. We started with 9 to 1 using a splayed head and went up ½ point at a time to 12 to 1, and then worked our way back down trying a variety of combinations of pistons, cylinder and head grinding, etc. We found that the 650 B range Triumph would run relatively smooth with almost no tendency to spark knock with an alloy head when run on 105 octane pump gas with 12-1 compression ratio. However, we also found a definite weakening of power in the mid and high R.P.M. ranges compared with a little lower set-up. Probably this is at least partially brought on by the fact that the crown on a piston of this type is so high that it interferes with the cross flow of gases, and prevents the deep breathing necessary for real power, especially in the higher RPM ranges. (See page 13 on valve timing and cam action.) We have found the best all around power producing point when going all out to be 10 to 10½ to 1, with pump gas.

At the time of this writing pistons are available for the 650 B range Triumph with higher compression ratios of 9, 9½ and 12 to 1 only. However, there are a variety of ways to get 10 to 10.5 to 1. Filing the dome on a 12 to 1 down is the most obvious and the least recommended. To begin with, there are no really good 12 to 1 pistons available. Even the ones from Triumph designed to be used with alcohol are sand cast and therefore slightly inferior. When we file the top thin the chance of failure is even greater.

We are now left with the old automobile method of grinding the head, or the top of the barrell. In doing this, special equipment is needed and some other problems will raise their ugly heads, such as weakening the alloy head by removing the strengthening bead around the bottom of the combustion chamber, or ruining a perfectly good cylinder barrell that may be used for some other purpose later. In a Triumph, we are fortunate in having a head gasket some .050" thick. We can then by simply removing this gasket get the equivalent of grinding the head or barrell .050" with no loss of structural strength, or butchering of barrells. We are also fortunate in having a very clever design whereby the head bolts are almost perfectly located to give even pressure on the head, and thereby making it possible to effect a good seal without a gasket.

Naturally, the head and barrells were not machined to the tolerances necessary to effect a positive seal this way, and it will be necessary for us to improve the faces of this joint. This can be very simply done by taping a piece of fine emory cloth to a good smooth piece of plate glass and carefully lapping the head and barrells until they are completely smooth. After they clear up it is worthwhile to change to crocus cloth to finish up the job. If this work is carefully done, the barrells will lift the head when coated with 20 or 30 weight oil. If a light coat of aluminum paste from the settlings in the bottom of an aluminum paint can is smeared evenly over the head to barrell joint, it will not leak. For more information on this assembly operation see page 62. The removal of this .050" thickness raises the compression ratio a little less than 1½ points. Now, all we need to get the desired compression ratio of 10 to 10.5 to 1 with an alloy head, is a good dependable 9 to 1 piston with large valve cutaways to help keep the valves from hitting the piston. We will need these large cutaways even with standard valves because in effect the head will be .050" closer to the piston than with a gasket.

Such a piston is available from Beck in New York. It is manufactured by Hepolite and carries the Part No. 14087. This piston is so well suited to this application that it is not even necessary to trim the crown to clear the small strengthening rib in an alloy head. It is, however, necessary to increase the valve cutaway on the intake side of the piston. If standard size exhaust valves are used in a splayed head it is not necessary to cut the exhaust side. An old connecting rod makes a good jig to hold the piston in the vice so that a body file may be used to trim this cutaway. It is the lip that stands up at the bottom of the factory cutaway that must be trimmed off. See Plate No. 10, page 48. In addition to raising the compression ratio, this slightly changes the shape of the combustion chamber for the better. Should you decide later to derace, it is easier to reinstall the gasket than buy a new head or cylinder.



14087 HEPLITE PISTONS

PLATE NO. 10

When using the 14087 Hepolite with a head gasket it is necessary to add .002" clearance to the recommended piston clearance. Naturally, when the compression ratio is raised by removing the head gasket we get more heat, and therefore more expansion which in turn calls for even more piston clearance. Satisfactory results can be obtained by adding .005 to the recommended bore for this application in an engine that will be given little or no break in before it is called on to deliver maximum revs. A 650 "B" range Triumph has a standard bore of 2.795". (T-120's come with 2.796".) Should we use a .010" oversize piston it would then be necessary to bore to 2.795 + .010 + .005 which is 2.810". The smoother the finished bore is, the better. For information on maximum bore sizes see page 51. Grant rings are recommended here, because of their added radial depth. Ring gaps of .014 work well.

Naturally, you wouldn't do the work outlined above to a road motorcycle where it is commonly used for transportation. For a hot street motor the very best piston available at the time of this writing is the M.C. forged 9½ to 1. Triumph in Baltimore offers this piston under Part No. CD-204. It comes complete with Grant rings and circlips. This is the ONLY 9½ to 1 piston available that is worthwhile. There are some other 9½ to 1 pistons for the "B" range 650, that at first glance appear to be better suited for racing, but they are not. Don't even be tempted to try them.

Best results are always obtained with a splayed head, but if you don't have one the above will work with a standard alloy head. Compression ratios of higher than 9½ to 1 are not recommended with iron heads or the first alloy heads put on 1956 motors before engine No. 75026. For more information on heads, porting, etc., see page 52.

CHAPTER 11

Stroking and Boring

The easiest way to more power is more cubic inches. This is a sound statement that will be denied by few. But is it worthwhile in our case? First, let's consider the possibility of lengthening the stroke in a 650 "B" range Triumph. Since our crank and rod assembly is more similar in design and construction to that of the automobile than to the accepted motorcycle design of the past, perhaps we can copy some of the tricks of the hot rod boys. One of their favorites is to grind a big crank journal off center so as to make a smaller journal with a longer stroke. They then use rods from an earlier model of the same make together with special pistons with the wrist pin located closer to the top of the piston so as to keep the rings from running out of the top of the bore. We have the big crank. We also have the earlier model rods that are 3/16" smaller. By grinding the big crank off center we can fit the 3/16" smaller rods and pick up 3/8" in the stroke.

Now, what about the special stroker pistons? Apparently, this is the first stumbling block. There are no such pistons available for a Triumph. If there were some way to get around this, would it be possible to safely add to the stroke by this method? The answer is NO. The 1-7/16" cranks can not take the power of our reworked engine when the stroke is stock. To weaken a good 1 5/8" journal by grinding 3/16" of metal from one side would, because of the size of the oil passageway, hopelessly weaken the most heavily loaded part in the engine. Although the writer has never been foolish enough to try this, there are those who have. We had a case of this that was done in California. The engine was shipped from the West Coast to a rider in a nearby city, and the first time we saw it the motorcycle was being towed in with a broken crank. It had survived for less than 100 miles. We also had contact with a second one built here in the Southeast with much the same results. Obviously, this is not the way to do it.

A second method the car people use is to weld up the journals and regrind them to a greater stroke after straightening the shaft. We are faced again with the lack of special stroker pistons and the weakness of the crank brought on by the rather large oil passageway. And in addition to this it is almost impossible because of the design of a Triumph crank to straighten it after welding.

If we could somehow secure a blank crank from the factory that had neither journals ground or oil passages drilled, it would be possible to pick up about ¼" total stroke without weakening the crank. Naturally, the factory will have nothing to do with such foolishness as this, and neither will the distributors. By private methods of my own, I did manage to locate two cranks of this kind, and unknown to the factory they were "liberated" and sent to us.

After much labor and head scratching on our part, they were installed in two motorcycles. Much to my dismay the machines would run no faster or produce no more power than before. Take it from someone who knows about this. *It is not worthwhile to stroke a Triumph.* This is a basic change in design and that is something we should stay away from.

As any good Triumph mechanic knows, the head bolts are located very close to the edge of the cylinder walls, and keep us from enlarging the bore enough to do anything other than ruin a good set of barrells. Boring a 650 "B" range Triumph more than .050 oversize is not recommended, and this is just not enough to increase the power. The biggest bore of the best two motorcycles we have running on gas here at T & M at the time of this writing, is only .020 over.

CHAPTER 12

Carburetors and Ports

Like virtually everything else in the engine, port size, shape, and length, carburetor type and size, and valve sizes are largely dependent on the balance of the combination, and must be tailored to meet the demands of the engine. It appears at first glance, that the larger the port and carburetor the better. This is not quite true. It is only in the very high R.P.M. ranges where monstrous carb and port bores come into their own, and the slight gain here is hardly enough to offset the work that goes into them.

Before you start welding on adaptors, reaming ports and using huge intake valves you owe it to yourself to try the standard splayed head with stock intake and exhaust valves and 1-1/16" TYPE 10TT9 Amal carbs. This is the TT carb that came as standard equipment on 1955 BSA ROAD ROCKETS. We have experimented with carbs all the way up to 1½" with a variety of lengths and tapers with larger intake and larger exhaust valves trying to find the best all around combination. For dragging and acceleration the stock set-up with TTs hasn't been bettered by us yet. Installation is very simple, and you don't ruin the head in the process. The best port length is achieved simply by the installation of a CD-34 ½" carburetor spacing block. This is the Formica block used in the old RW2 dual carb manifold set-up.

It is also used in the CD-223 balance tube kit now available from Triumph. Although it is advertised as 1-1/16" bore it is usually 1-1/32", and must be enlarged. This can be done either in a lathe or on the wet hone used by automobile machine shops to hone connecting rod wrist pin bushings, king pin bushings, etc. When using this carb set-up the type 302/3 top feed remote float bowl does a good job when mounted in the center between the two carbs. A much cleaner running engine results from situating the bowl exactly between the two carburetors. If the bowl is located too far to the rear the engine will tend to lean out on vicious acceleration, and load up on sudden stops. If it is located too far forward the opposite will result.

The set-up that works best on a splayed head is to hang the bowl from the top between the carburetors on its rubber mount from the rear gas tank support lug on single frame models and from the head brace frame lug on the duplex frame models. The 302/3 bowl comes complete with rubber mount and a threaded hanger screw for elevation adjustment. The standard 302 bowl that was designed to mount rigidly on the bottom of the carburetor can easily be adapted to remote mounting by drilling a ¼" hole in the 14/255 banjo retaining nut and using a stove bolt with the head turned down to 11/32" and a lock nut on the top. The material in the standard 14/255 nut is too thin to tap and thus the need for a stove bolt. The stove bolt screw head is too large to pass down inside of the top of the bowl and still permit the nut to tighten down against its gaskets, and thus the need to either grind or turn it down in a lathe. After running a jam nut down against the top of the banjo nut solder should be lightly puddled inside the banjo nut to prevent gas leaks around the stove bolt screw head. The rigid hanging arm on the bowl can be sawed off and the outlet hole tapped for ⅛" pipe. Since you are using two carbs a second outlet hole will be required with either type bowl. This can be accomplished through the use of a T fitting or better still by moving half way round the bowl and drilling a second outlet hole and tapping it for ⅛" pipe. A good simple rubber mount is obtained through the use of two F-967 gas tank pads and ¼" body washers.

The proper float level is achieved when the factory outlet hole in the bowl lines up exactly with the carburetor intake hole in the banjo fitting on the bottom of the carb. Clear plastic gas line can be forced over the banjo fittings by soaking it in hot water. This is especially useful in the connections between the bowl and carb because of the lack of space for conventional fittings. Main jet size will wind up between 300 and 330 with this set-up at sea level.

The TTs are far more consistent and easier to jet in than GPs of the same size and produce about the same amount of power. Theoretically the GP is a better carb, but for reasons we will go into now it is not better for our application than the TT. Upon close examination of the inside bore on a 1-1/16" TT we find the mixing chamber body to be 1⅛" with a taper down to 1-1/16" near the outlet of the carb. This slight ridge 1/32" high serves as a ventura to help atomize the gas. It is possible to bore this short 1-1/16" portion of the TT out to 1⅛" and have a straight through carb of 1⅛". When this is done, performance is sacrificed. This ridge in a TT must not be removed. After trying a pair of these carbs in a standard 1⅛" bore with the factory ventura left in and 1⅛" ports, we found no increase in performance on one machine, and actually noted a slight loss on another. Going way out to 1¼" with ports and carbs we found more power in the very high R.P.M. range, but no better ET or speed in ¼ mile.

Now, if we are going to settle for 1-1/16" carbs and ports, why not use the G.P.? The G.P. comes in three basic sizes. The No. 15 with an internal bore of 1-1/16", the No. 10 with a bore of 1-7/32" and the No. 5 with a bore of 1⅜". These bore sizes are measured at the spray tube. Should we decide on a type 15 we find it is 1-1/16" straight through with no ventura. On the other hand the 1-1/16" type 10 has a bore of 1-7/32" and tapers back to 1-1/16". This gives us a total taper or ventura of 5/32". This is too much. It is most unfortunate the size G.P. that suits our requirements best on gas is right exactly at the point of type change with the G.P. We are either forced to have no ventura at all, or one that is far too great. The 1-1/16" straight through No. 15 does not produce as much power as the 1-1/16" TT, and although the type 10 with its big bore and small opening does produce about the same amount when it is properly jetted, it is a pill to jet in, and changes with the weather. Thus, if we are going to use a type 10 G.P. it is necessary to bring the port size out to suit the carb if we are going to take full advantage of this special carburetor. In this case we must use either 1⅛" or 1-5/32" ports, and when all the welding and reaming is done to achieve this, there is such very little improvement on gas until it is hardly worthwhile. The little improvement that is noted is only in the very high R.P.M. range. Never cut the standard adaptors out beyond 1-1/16". They will break in the threads if you do. If you are going larger it is necessary to make up alloy adaptors and heli ark weld them to the head.

The monoblock and the Dell'Orto offer these same disadvantages in that they are both straight through carbs with no venturi. For all around best performance there is nothing better than the stock splayed head set up with 1-1/16" TT carbs. These are a bit wild for street use, and monoblocks appear to be best here. Through trial and error we have learned the following in comparison to standard splayed head with TT's:

1. 1/16" oversize (1-9/16") intake valves on a splayed head with 1-1/16" TT carbs and ports offer no improvement over standard valves.

2. 1/16" oversize (1⅜") exhaust valves in any late type head offer no improvement.

3. Polishing the exhaust ports offers no improvement.

4. 1⅛" monoblocks on 1⅛" ports with 1-9/16" intake valves produce very, very little more power than stock set-up, with 1-1/16" monoblocks.

5. 1⅛" monoblocks on 1⅛" ports with standard intake valves produce just as much power as the same set-up with 1-9/16" intake valves.

6. 1-3/16" to 1¼" carbs and ports with 1-9/16" intake valves produce slightly more power in the very high R.P.M. ranges than stock, but less in the lower ranges, and no better performance in the ¼ drags than stock ports, valves and 1-1/16" TT carburetors.

CHAPTER 13

Exhaust Pipes

For scrambles, TT, etc., on short tight courses where low end torque and tractor power are required, there can be little doubt that straight pipes are best. The 650 "B" range Triumph engine seems to perform best with 1½" diameter pipes, although some riders prefer the old 1¾" pipe. In dealing with straight extensions in the range of length that can be used on a motorcycle, it is generally accepted that the longer the straight pipe extension the quicker the job gets on the cam, and consequently the sooner it runs out of breath in the top R.P.M. range. On the other hand, the shorter the pipe the later it comes on, and the later it goes off. Exhaust pipe size and length are important in the total combination of machine and rider, but a set-up that fits one rider in scrambles or TT may not fit another rider on the same motorcycle at the same time, With exhaust pipes and megaphones as a whole it is largely a matter of compromise in that power added to the low rev. range means power taken from the high range and vice versa.

The only way to achieve the best all around compromise for a given rider on a given motorcycle for a particular scrambles or TT track is through experimentation. On tracks with long straightaways such as Fayetteville or Peoria there is enough advantage gained through the use of reverse cone megaphones on the long straightaway to more than offset the loss of torque in the corners. In dealing with road racing we are faced with the same decisions and the same line of thought will apply. The road race circuits, however, usually have much faster corners and much longer straightaways which calls for the use of megaphones altogether.

In one-quarter mile drags the tracks or strips are nearly enough alike to permit the use of an ideal set-up that can be worked out in one locality and expected to work in another.

Here, we are dealing with a type of event where enough torque must be maintained to pull the machine rapidly away from the starting line, and enough horsepower developed in the upper R.P.M. ranges to achieve the greatest maximum speed in the shortest possible time. Obviously, a motorcycle that will literally leap away from the starting line, and fail to deliver high R.P.M. power, will not be a consistent winner. By the same token, a machine that is so "cammy" until the rider can't get going without either spinning the wheel to the point of almost losing control or else bogging down a few feet from the starting line and yet developing tremendous power after it is once underway can't be a consistent winner either. The object is to get from start to finish in the shortest possible time. It is the E.T. or elapsed time that wins and not the rate of speed at the finish.

Our favorite combination for one-quarter mile drags is a 1½" exhaust pipe 32" long measuring the shortest distance from the inside of the pipe, and an open 3" megaphone. The best megaphone available at a price at the time of this writing is the No. 1271 KINGCO from Florida Cycle Supply Co. in Jacksonville, Florida. When using this megaphone be certain to add some strength in the form of brazing at the point where each end of the hanger rail joins the megaphone. These are prone to break loose here. A second very good combination for one-quarter mile drags is an E-3479 factory reverse cone 4" megaphone on the same pipe. This set-up produces a bit more low speed torque, and therefore makes the machine easier to ride off the line than an open 3", but the power produced in the higher R.P.M. ranges is not quite as great. A pair of these megaphones can be improved for dragging on the 650 by cutting one inch of the 2" cone away, so as to partially do away with the throttling effect of the cone. Some fellows like the action of short straight pipes with no flare of any kind, but after trying this in several lengths I am completely satisfied it is inferior to a small open or large coned megaphone for the quarter mile.

For all out top speed there is little doubt that open 4" factory megaphones on 1½" pipes are best. You must keep in mind, however, there is hardly any such thing as a race for top speed. Even when they turn them on at 100 M.P.H., the winner is still usually considered the one who can accelerate fastest from this point. Acceleration plays a vital role in virtually any type of event where speed is the determining factor. The acceleration obtained with a 4" open megaphone can be improved by the addition of a short ½ to ¾ inch reverse cone with almost no loss of top speed. Keep in mind that a drastic change in exhaust pipe set-up also calls for carburetor jet changes. If you decide to experiment with pipes, watch the plugs for signs of incorrect mixture.

CHAPTER 14

Assembling the Engine

Cleanliness is next to Godliness. If this statement has ever been true about anything, it is true about the parts to be used in this special engine. This is especially true of the parts that go to make up the rod and crank assembly. A grain of sand between the insert and rod will result in a binding condition that can't be tolerated. Carefully wipe out the inside of the rod and cap with a lint-free cloth. New inserts are better, and after they are thoroughly cleaned, carefully push them into the rod and cap. The rods, bolts, nuts, and caps are mated, you know, and will not interchange. A strip of fine crocus cloth should be used to polish lightly over the rod journals on the crank. Thoroughly lubricate the journals and install the rods. Tighten the nuts up together to the factory punch marks and check for play and freeness. When the rods are properly installed they should fall from their own weight. I prefer a castor base lubricant for initial assembly such as Castrol R.

After checking crankcase ball bearings for wear or pits, install them by heating the case. Never drive these bearings home. They will fall into position when the cases are hot. If you are going to use needle bearing cams the needle bearings should be installed before the cases cool. For instruction on installing needles refer to the printed sheet that came with the cams. These instructions cover installation of the crankcase breather also, but if the machine is to be used in dust and mud-free conditions such as dragging or road racing, the E-2254 rotary valve and E-2256 spring may be left out with no ill effects. If you are installing needle bearings in an engine to be used for this type of work, you may also leave out the GS87 breather disc and the short E-2260 bushing that comes with the kit. After the cases are cool, check the ball bearing mains to see if they are perfectly free to turn. Also check to see if the factory cutaways are sufficient for the cam lobes to clear the cases.

It will probably be necessary to work these cutaways out slightly with a rotary file in a hand drill. Use rags, tape or corks to mask off the needle bearings as well as the main bearings to keep these filings out. Blow the cases out thoroughly with compressed air when this work is finished. Lubricate the cam and main bearings, and install the crank assembly into the drive side case. Smear the joint lightly with non-hardening gasket compound and install the cams along with the crankcase breather if you are going to use it. 3M Super weatherstrip adhesive, Flex Seal or any other rubber base hard drying cement is not recommended. This type of material will harden before the cases are tightened together in the frame. Aviation Permatex No. 3 does a good job here. Fit the timing side case, and install and tighten the E-1455 top rear bolt along with the two E-1647 crankcase screws and the T-456 stud. This is the 5/16" stud directly in front of the sump plate. Check the crank and cams for free rotation.

It is important to install the magneto before installing the cylinder barrells, especially if you are using a West Coast mag. This mag is so crowded at the front top securing stud until the cylinders make it difficult to get at. Flex Seal or Aviation Permatex should be used on the joint.

Use a piston to push the ring square in the barrells to check the ring gaps. They should be .014". With our added piston clearance it will probably be necessary to use the next larger .010 oversize rings and cut them down. This is easily done by anchoring the handle of a thin file (such as a breaker point file) and stradling it with the ring in such a way as to cut both ends of the ring at the same time. After this is done, lubricate the wrist pin bushing in the rods and fit the pistons, pins, and circlips along with the rings. If you are using Grant rings, the bevel on the inside of the ring faces the top.

It may be necessary to warm the piston slightly so that the wrist pins will go into the pistons by hand. If it is going up without a head gasket, be certain the pistons go on with the filed down valve cutaways to the rear or intake side. Lubricate the tappet guide blocks in the cylinder barrells and install the tappets. If you are using a 9-6 cam set-up where the radius of the tappet grind is different, be certain the standard grind tappets go to the rear or intake side, and the R or 1 ⅛" radius go to the front or exhaust side. The barrells will only go on one way on later models because of the two E-1534A dowels located on the left hand or drive side crankcase. The cylinder mounting holes on the left hand or drive side of the barrells at the corresponding points are drilled a bit larger to accept these dowels. The 1 ⅛" or "R" radius tappets are a bit flatter than the standard ones, and can be easily spotted if they are held up side by side.

If the engine is going to be put up without a head gasket, the head bolt holes must be thoroughly cleaned, and this is best done before the cylinder is assembled to the engine. Any foreign matter left in these threaded holes may be forced out between the head and barrells, and have an adverse eflect on the head to barrell seal. These holes are easily cleaned with the aid of a 3/8" x 26 CEI tap. Install the barrells and turn the cam before you tighten the fastening nuts. Although it rarely happens, the No. 9 cam will sometimes touch the tappet guide block. If this does happen, slip the barrells back off and take the tappets out. The point of contact will be at the front and back of the inside of the guide block. Work this corner off carefully with a file, and check it again. We have only experienced two cases of this up to the time of this writing, so you can see this is quite rare. About .010 filed off corrected it in both cases with us.

After the barrells are installed, the cams and magneto can be degreed in. For this information see pages 15 and 29.

After you are finished with the cam and mag timing, thoroughly tighten the cam wheel and mainshaft pinion retaining nuts. The camshafts have left-hand thread, and the main shaft has right-hand thread. It is therefore possible to hold one and tighten the other. Never retighten the mag gear securing nut without rechecking the mag timing. Before installing the oil pump, it is worthwhile to completely dismantle it by removing the two plungers and the two body plugs that hold the springs and check balls in position. Examine the ball seatings, and if these show signs of heavy indentation, pitting or wear to one side of the seat, either replace the pump body or recut them with a 45° cutter or drill suitably sharpened. It is especially worthwhile to check this in the later aluminum pump bodies. Also inspect the balls and springs. If there is any doubt about their condition, they should be replaced. When fitting new balls, they should be given a sharp tap onto their seatings to insure a good seat. After the pump is reassembled, fill the body with oil and operate the plungers. This will prime the pump and at the same time allow you to check its pumping ability. A defective oil pump can ruin the whole job.

Before installing the timing cover check the E-378 oil feed bushing for wear. This is especially important if the timing side main bearing was bad. Coat the timing cover joint with 3M Super weather strip adhesive if mineral oil is going to be used in the engine. A good grade of non-detergent mineral oil such as Castrol is recommended. If you are going to use a castor base oil such as Castrol R this joint should be sealed with Flex Seal, as this type of oil has an adverse effect on 3M. Don't forget to remove the tape from the idler spindle before installing timing cover.

If you are setting it up without a head gasket, everything must be laid out and ready to go together before the head is installed so that this operation, once started, can go ahead to completion. If you are using an alloy head, the pushrod guide discs in the pushrod cover tubes should be removed. These are secured by a rather soft solder-like material, and will readily break loose with a hammer and drift. The pushrods will probably strike these guides with the wilder cams if they are left in place. The head bolt threads must be thoroughly cleaned of carbon or varnish deposits and very lightly oiled. Too much oil here will get between the head and barrell and affect the seal if it is being put up without a head gasket. The rocker boxes must be assembled also.

Assuming the rockers have been magnafluxed and thoroughly cleaned after polishing was finished, and the boxes themselves scrubbed out, and the spindles thoroughly cleaned, we are ready for assembly. The assembly goes easier if the boxes are slightly warmed. Give the spindles and the insides of the rockers a coat of oil. Discard the E-1574 thrust springs and replace them with an additional three or four E-1575 ½" thrust washers. This spring causes a slight drag on the rockers, and if we use thrust washers in its place, this slight drag can be eliminated. The rockers should have .015 to .030 end play. If three additional washers prove too loose and four too tight, it is possible to carefully grind a few thousandths off the adjustor end of the rocker to obtain the proper end play.

It is important that all of these washers be added at each end of the box so as to keep the adjustor centered on the valve stem. Only one washer is to be used on each side of the partition of the box as it was when stock. The spindles will press into the box with a very slight drag after the small ⅜ end engages the right hand or timing side of the box. At this end of the box be certain the outermost washer is an E-1330 with a ⅜" hole, as this washer is used to serve as a stop for the spindle. After the boxes are assembled and cool, use the banjo fitting from an overhead oil line together with two E-1335 copper washers to serve as a spacer and tighten the E-1435 domed rocker spindle nuts securely and check the rockers for end play again. When this nut is tightened, the left hand or drive side rockers may tighten up because of the spindle settling against its seat on the ⅜" washer.

If you are going to put it up with 14087 Hepolite pistons and no head gasket, place a small lump of soft modeling clay on the intake valve cutway on the piston. Oil the barrell to head joint lightly and install the head without the pushrod shrouds. Install the intake pushrod on the side you are checking along with the rocker box, and lightly tighten the head bolts. Set the valve clearance at nil or .001" and turn the engine forward until the intake valve opens and closes. Remove the head and see how much clearance there is between the intake valve and the piston. Minimum clearance here is .025". Repeat the operation on the other intake valve and check it also. If you followed the directions given earlier on cutting this piston, there will be enough clearance. If you do not have .025" clearance, it will be necessary to remove the pistons and file a bit more. If the standard 1-5/16 exhaust valves are used, they will clear the pistons, and therefore there is no need to check them. If your head has larger exhaust valves, and you cut the exhaust valve cutaways also, it will be necessary to check the exhaust side by the same method as the intakes.

Since we are going to remove the headgasket, the alloy head will in effect be .050" closer to the crankcase. This means the pushrod shrouds will be .050" too long, and *cannot* be assembled with the standard bottom pushrod shroud rubbers. Instead, use an E-3547 white top gasket on the bottom also. This does a perfect job and will not leak Install one of these to each tappet guide block and push it home. Install one to the top of each pushrod cover tube also.

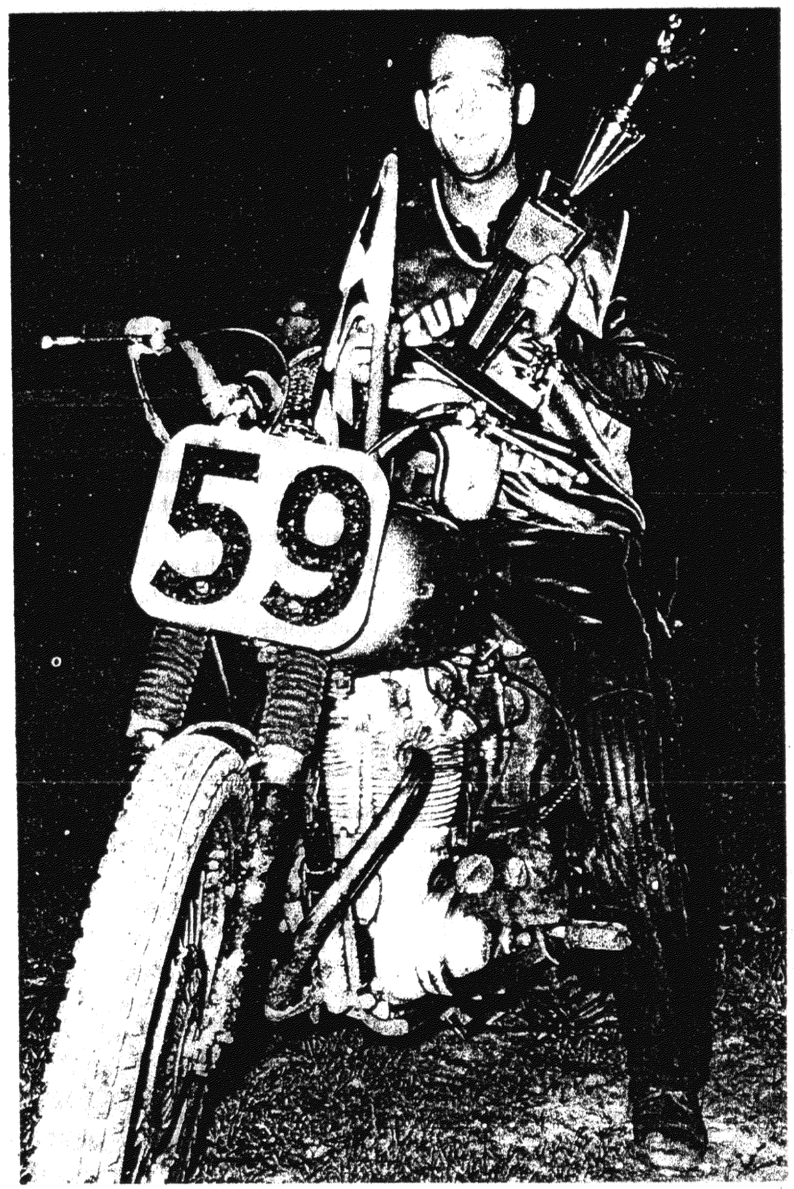
Use lacquer thinner to remove all traces of oil from the head to barrell joints, and smear a light thin even coat of aluminum paste from the bottom of an aluminum paint can over the joint on the head or barrells. Too much of this paste will cause it to be pushed out into the combustion chamber and get picked up by the rings. Install the pushrod shrouds and the head. Install the four short E-2873 head bolts and be certain each has a standard lightly oiled F-2184 washer under it. Tighten these bolts up just snug. Put a drop of oil in both ends of the exhaust pushrods and put them into position against the exhaust tappets. Turn the engine several times to be certain they are in place, and stop at the point where both tappets and pushrods are down. Paint the E-3552 rocker box gaskets with Aviation Permatex No. 3 and put it in place. Install the modified E-1513 valve adjustors and run them both down until only about two threads show on top of the rocker arm. By holding the rockers in the adjustor up ball down position with your thumbs, watch the rocker balls engage the pushrods. You can see this happening by tilting the rocker box to the rear of the engine.

Remember, we knocked the pushrod guides out of the tube, so we must make certain the rocker buttons engage properly in the pushrods. When these are engaged, let the rocker box go as far down against the head as the valve adjustors will permit. Now carefully loosen first one adjustor and then the other about one turn at a time until the box has settled against the head and .004" to .006" of clearance is obtained. Install the head bolts with their washers along with the two E-2982 ¼" bolts and the three ¼" nuts at the bottom front, tighten all of these just snug. Repeat the same operation on the rear or intake rocker box. Caution: Do not remove or completely loosen the adjustor after the box is assembled to the head, as the pushrods will fall out of the rocker buttons if you do.

Start torqueing the head from five foot pounds working from the inside or long head bolts first and the outer short bolts next. Torque down five foot pounds at a time until you reach 20 foot pounds. Tighten the remaining rocker box securing bolts and nuts, and install the E-470 adjustor lock nuts. Adjust the valves and tighten the lock nuts. Install the E-1564 rocker box caps, but leave them loose.

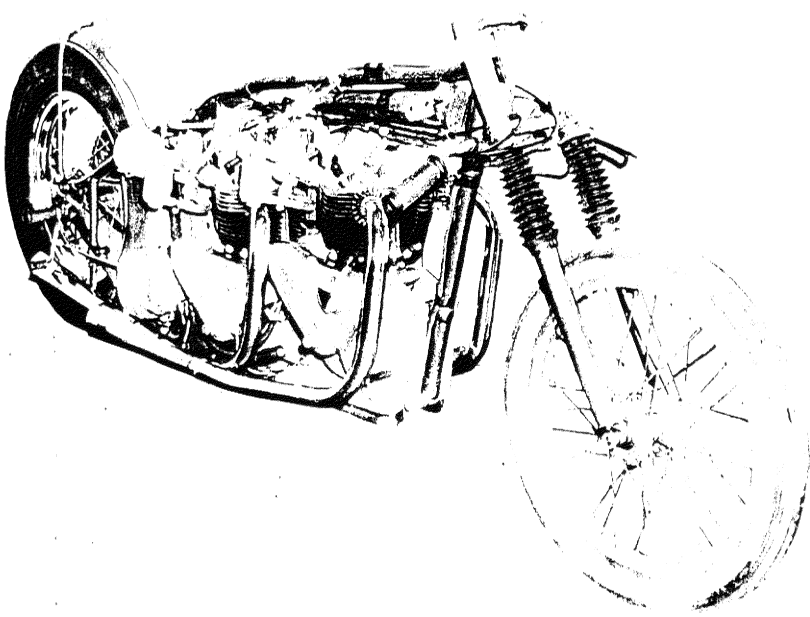
You are now ready to take the engine out of the vice. When this is done, dope the E-487 sump gaskets with 3M (if you are going to use mineral oil; and Flex seal if you are going to use castor oil), and install the sump gaskets, screen and plate to the engine. When using 3M on these gaskets, use a fine bead around the very outside of the gasket to prevent any possibility of 3M getting into the sump.

After the engine is in the frame, and all mounting studs tight, remove one rocker box cap from each box and pour ½ pint of oil into each. Tighten the caps. The standard caps will stay put better if the E-1577 gaskets are left out.



JIMHAYES JR.

Johnson City, Tenn. Popular FIM rider in the East on his T&M built Triumph. One of his many victories include the Central American flat track championship in Guatemala in 1961. Jim says ''I know I can always depend on that extra bit of horsepower from T&M Cams to get me in the front when the chips are down.''



THE "DEUCE"
Twin Engine Triumph Dragster

Usual Speed 140 MPH. Usual ET 10 Sec.
Turned 141.85 MPH. at 9.71 ET in the"Quarter" at NHRA
sanctioned Augusta Ga. International Speedway July 16. 1961.
Rider Billy Denby. Built by T & M Motorcycles Sales
Albany, Ga. and uses T & M Cams

Hughes Color Litho—Albany, Ga.