Technical Information
Bulletin No. 14

PREPARATION AND ASSEMBLY OF

TRIUMPH

UNIT CONSTRUCTION 6T, TR6 & T120 ENGINES FOR MAXIMUM PERFORMANCE

A number of special high performance components are available for the above Triumph machines which may be fitted to increase the power output. This Bulletin tabulates and corelates all the necessary technical information that is available, so that the owner who wishes to increase the performance of his machine may do so, starting from a point experience has shown to be the best. These alterations are not suitable for machines which are to be retained for normal road use.

If he follows the sequence outlined he will achieve the optimum for the particular chosen condition, after which the maximum will be gained by his own experience and endeavours.

WORKSHOP TOOLS

It will be assumed that the following items are in the owner's possession and that he has both the experience and necessary workshop facilities:—

WORKSHOP MANUAL
PISTON RING CLIPS
DIAL TEST INDICATOR
ENGINE TIMING DISC & POINTER
SET OF FEELER GAUGES
CONTACT BREAKER EXTRACTOR D484
CAMWHEEL EXTRACTOR & REPLACER TOOLS Z89, Z144, Z145
CLUTCH EXTRACTOR DA50/1
CRANKSHAFT PINION EXTRACTOR Z121
C:B OIL SEAL PILOT D486

SECTION 1. ENGINE

Strip out completely and examine for wear, fatigue, misuse and any signs of damage. Remember that if you intend increasing the performance of the machine, all the components will be subjected to higher loads and the trouble and patience required to achieve this condition will be wasted if a suspect item is refitted and subsequently gives trouble. Fit new gaskets and washers throughout.

(a) Crankcase

Rebuild with new con rod and flywheel bolts and nuts and clean out the sludge tube.
Fit the E5162 inlet camshaft and E5047 exhaust camshaft in conjunction with E3059R tappets (cam followers). For machines from engine number DU24875 use exhaust tappets part number E6490. For machines to be used on the road or in Clubmans type events with full silencer equipment, it is essential to use the alternative exhaust camshaft part number E4855. This camshaft is fitted as standard equipment to TR6 & T120 models. The exhaust cam timing figures would then be—exhaust valve opens B.B.C. 48° and closes 27° A.T.C., measured with 0·020" tappet clearance or with the alternative method suggested. Align and bolt up the crankcase halves, taking care that the rotary breather and spring is properly located in the inlet camshaft and drive side crankcase half. Fit the piston rings using tapered face top and second compression rings and standard oil control rings. The original 8·5-1 compression ratio pistons (7·5-1 for 6T) may be retained or the alternative pistons giving a compression ratio of 9·0-1 (Part No. CP206) or 11·0-1 (Part No. CP202) can be fitted. Locate the pushrods and pushrod tubes ready for fitting the cylinder head after this has been prepared. It should be unnecessary to repeat that the engine should have been assembled after all the components have been individually cleaned and oiled, and oil liberally used during the assembly process. The 11·0-1 pistons are not suitable for use in a machine to be retained for road use.

(b) Cylinder Head

Use the high performance cylinder head c/w guides part number E5727 and carburetter adaptors Part No. E5351 and E5352 and two insulating blocks Part No. E4918 to enable 1⅛" choke carburetters to be used with advantage.
The engine performance is far more dependent on the port shape and size, rather than finish. The port section should be almost constant, free from sharp corners, bumps or waviness and the finish should be good. It has been found that a mirror finish is not absolutely necessary. Final port finishing, after the shape has been satisfactorily achieved, should be done with the carburetter adaptors in place and the ports blended in as a whole.

The optimum size of valves are fitted as standard equipment, but exhaust valves of Nimonic material are available, part number E4604. The ports do not need any alteration other than blending out. Grind in the valves and fit a new set of interference racing valve springs Part No. CP102, and bottom cups Part No. E1544. The inlet guides may be shortened (with a resultant shortening of life in consequence) and streamlined to reduce port obstruction to a minimum. This is not necessary on the exhaust valve guides, for unless the section is adequate to carry away the heat a temperature build up can occur and the stem and guide will suffer. When fitting the cylinder head make sure that the inner edges of the bores in the copper gasket are rounded and that no sharp corners are existing to introduce pre-ignition.

(c) Valve Timing

Triple keyway timing gears are already fitted as standard equipment to enable accurate timing to be achieved, and these should be assembled with the proper tool, otherwise damage to the camshaft, camwheel or crankcase bush will occur.

First and foremost, a degree timing disc must be bolted to the driveshaft and T.D.C. accurately established, using a D.T.I. dial test indicator through the plug hole on the crown of the piston.

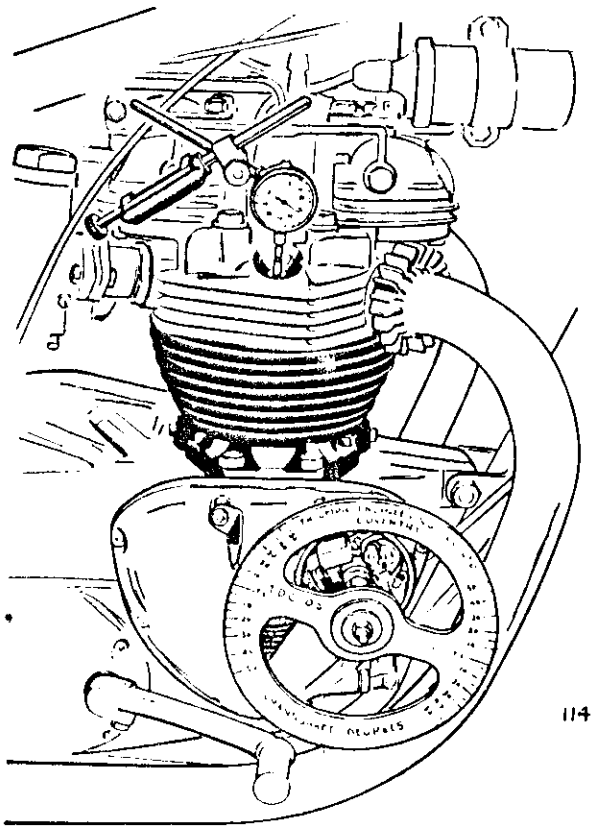
NOTE. From engine number DU13375, provision was made for establishing T.D.C. quickly and easily by inserting T.D.C. tool D571/2 in a hole provided behind the cylinder block for this purpose after removing a blanking plug. The engine should be slowly rotated until the plunger of the tool locates in a keyway provided in the flywheel. The engine will then be at true top dead centre.

Fix a pointer at 360° with the pistons at the top of their travel and adjust accurately until the indicated piston travel either side of T.D.C. gives an equal number of degrees either side of 360°.

Once this has been achieved, fit the crankshaft timing pinion and intermediate wheel. If a D.T.I. is not available, T.D.C. can be established using a marked rod through the plug hole on to the piston crown, rotating the engine as before so that the pistons travel down the stroke either side of T.D.C. to a mark chosen on the rod at about 1" of piston travel from T.D.C. Adjust the timing disc to read equally either side of 360° with the rod down to this mark.

Similarly, where reference is made later to 0·020" lift with zero valve adjustment, and no D.T.I. is used, then set the adjustment at 0·025" with the other valve on the same cam fully open, and the 0·020" point referred to is when a 0·005" feeler is just "nipped". This alternative drill applies right through the procedure.

FIG. A



Timing Disc D605/8 and D.T.I arrangement for timing the ignition

METHOD 1 Initial Valve Timing

Fit the exhaust rocker box with one push rod and adjust the valve adjuster to 0·020" (0·50 mm.) clearance on the cam base circle.

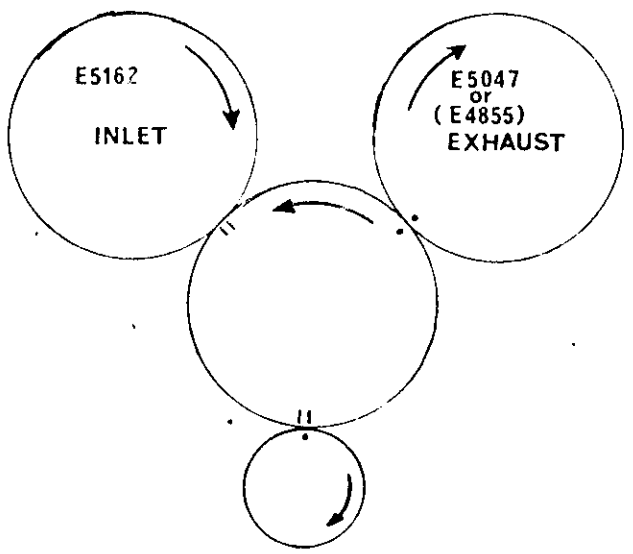
Set the engine rotating forward, that is, in its normal correct direction of rotation, to 35 A.T.C. Rotate the camshaft in the opposite direction until all the play in the push rod and rocker gear is taken up; fit the exhaust camwheel, lining up the nearest keyway to give a mesh without disturbing the setting of the cam. Mark the keyway used on the camwheel, for if the wheel has to be removed to equalise between the cylinders later, and no mark is made, the previous careful work can be lost.

Remove the exhaust rocker box and push rod and fit the inlet in a similar manner, using the previous cylinder as reference when fitting the push rod.

Again rotate the engine forward to 35 B.T.C. and set the valve adjuster to 0·020" (0·50 mm.). Rotating the camshaft in the same direction, assemble the camwheel to the shaft as before. Mark the keyway chosen on the camwheel.

This method of initial assembly ensures that the exhaust closing—inlet opening overlap is correct and this is the condition to aim for if either cam open period proves to be short and the theoretical figures cannot be achieved.

FIG. B



Valve Timing marks (all models)

METHOD 2

Alternatively, if the fitter is more adept, the camwheels can be assembled initially with the shafts as shown in the accompanying drawing during crank case assembly, and the engine subsequently fully built including the final assembly of the push rods, cover tubes and rocker boxes. Again the keyways selected (this time to the appropriate marks on the wheels) should be marked to make handling easier if and when final vernier adjustment of the timing is made. This method probably requires more time to obtain final accuracy than the step by step method described earlier.

The valve adjusters should now be set at zero, with only a sliding fit between the rockers and the valve tips. Fit a dial test indicator firmly to the cylinder head. It is most essential that the D.T.I. is rigid and secure, otherwise erroneous results will be achieved. If a D.T.I. is not available, set the adjusters at 0·025" on the base of the cam (*i.e.*, the other valve on the cam fully open) as referred to earlier, and carry out the same drill using a 5 thou. feeler gauge, the point of "nip" being the equivalent of 0·020" lift zero clearance.

First check the inlet by rotating the engine "forward" and log the point on the degree disc not where the valve commences to open, but at 0·020" (0·50 mm.) lift. This ensures that the followers are off the base circle and all slack in the rocker gear has been taken up. Still rotating "forward", check the point where 0·020" is reached on closing. It is usually found that the lift of the cam is greater than the range of the D.T.I., and therefore it is advisable to rotate the engine "backwards" until the inlet opens and rises well past the 0·020" mark and then reversing the direction, rotate the engine normally "forward" and log the point where 0·020" is reached as the valve closes.

Then check the other cylinder on the same camshaft.

ADJUSTING THE CAM TIMING AND BALANCING BETWEEN CYLINDERS

The object now is to balance the inlet opening (I.O.) between the cylinders, *i.e.*, choose a nominal to suit both and adjust the camshaft using the camwheel keyways to ensure this position occurs at 35° B.T.C. engine rotating "forwards".

To "adjust" the cam, the camwheel has to be removed and the wheel replaced in such a way that when re-meshed the cam is either advanced or retarded as required. The teeth of the camwheel are pitched at 7½° apart (*i.e.*, 15° engine) and the three keyways are equi-spaced, therefore giving 5° engine steps back or forward. When the camwheel is removed and in your hand, rotate the engine the amount it is necessary to "adjust" the timing (making sure the cam does not move once the wheel is removed) and carefully offer up the camwheel and re-mesh in a position where cam keyway and teeth line up and mesh correctly.

Remember, if the engine is rotated forward in this operation the cam will be retarded relative to the engine, and vice versa.

Once this has been done, check both cylinders and log the figures, and if successful, remove the previous keyway marks and etch or permanently record the final position, for if at a future date the intermediate wheel is removed, the marks as standard on the wheels will not give any guide to refitting.

It is important that the camshaft is "at rest" when the camwheel is removed. Do not attempt to remove with the valve open and the spring compressed, otherwise the previous settings will be lost if the cam spins to rest.

Repeat the above on the exhaust camshaft, aiming at the mean exhaust closing at 35° A.T.C.

When this has been achieved, again permanently mark the camwheels, fit the nuts and continue the assembly of the engine.

The limits on the cams are $\pm 2\frac{1}{2}°$, so that if you achieve your settings within these limits your adjustments are as correct as possible.

When the timing cover has been cleaned, refit, using the oil seal pilot tool D486 to avoid damaging the contact breaker oil seal.

(d) Ignition Timing

The ignition should be set in the fully retarded (static) position to the following settings. Check BOTH Cylinders.

From engine No. DU101—DU5824. 11° B.T.C. crank position or 0·036" B.T.C. piston position. (Giving 39° B.T.C. fully advanced).

From engine No. DU5825. 15° B.T.C. crank position or 0·068" B.T.C. piston position. (39° B.T.C. fully advanced).

The full timing procedure is given in Section B31 in the workshop manual.

The engine unit may now be fully built with the exception of the primary drive, which should receive attention as below.

SECTION 2. PRIMARY DRIVE

The primary transmission is of the duplex chain type with a chain tensioner. The engine sprocket and clutch sprocket have 29 teeth and 58 teeth respectively. The clutch is of the three spring twelve plate type with integral shock absorber. Bonded clutch plates available under part number T1885 are particularly suitable for high performance work. Some riders prefer to remove the primary chain cover, and allow a cooling stream of air over the clutch etc. This is entirely a matter of preference, but in this case the chain tensioner should be removed and an independent oil supply arranged. An endless "racing specification" chain should be used.

SECTION 3. GEARBOX

Again the specification of gears and ratios is purely a matter of choice and the type of event to which they are to be subjected, but generally speaking the following types of gear clusters are best suited to the indicated use:—
Close Ratio—Road racing and high speed work.
Standard Ratio—Normal touring, scrambling, etc.
Wide Ratio—Trials riding.
Again it is unnecessary to reiterate that unless the owner is absolutely satisfied with the crankcases, bushes, bearings, shafts and gears etc., it is wasted effort to refit them for high performance work. When selecting suitable gear ratios it is best to remember that the ideal is to choose the point where the rider expects to reach his maximum speed in top gear and to achieve his maximum r.p.m. at this point.
Safe maximum r.p.m. can be taken as 6,700 r.p.m.
Generally speaking, the power curves fall away above these r.p.m., and revs. in excess of these have often been achieved and maintained successfully without any resultant distress, and decisions to exceed them must be the responsibility of the rider, who alone can "feel" the potentialities of his motor under the conditions in which he is riding.

SECTION 4. FRAME

(a) Forks

It has been found that for scrambling a stiffer front action is desirable, and it is usual to fit sidecar springs and/or heavier grade oil. The quantity should not be increased.
Internal front fork damper kits are available by ordering through your local Triumph dealer. Both the forks and rear suspension must, of course, be finalised to give a balanced condition best suited to the rider.

(b) Exhaust Equipment

If silencers or megaphones are used it is most essential that they are adequately sway braced between the silencer or megaphone nose clips and the bottom of the frame down tube.
The standard silencer Part No. E4949 used throughout the 650 cc. range of machines is quite suitable for high performance use.
The type of event to which the machine is to be subjected controls the type of exhaust system, but it can be roughly summarised as under:—

High performance road work—"straight - through" absorption type silencers.

Road racing (a) Circuits with good, long straight sections and high speeds—megaphones.
(b) Short twisting circuits—straight through with extensions.
(c) Scrambles and cross country work where flexibility is required—straight throughs with extensions.

Using the recommended camshafts, the maximum performances are obtained as under:—

Straight throughs with extensions	1¾" outside diameter of exhaust pipe
Straight through absorption silencers	1½" outside diameter of exhaust pipe
Megaphones	1 5/16" diameter or 1½" diameter for almost comparable results.

This applies to all models.

SECTION 5. EQUIPMENT

(a) Carburetters

Most racing conditions will demand a twin carburetter specification for ultimate performance, and basic settings for the more widely used set of conditions are appended at the end of the booklet. Once again it is not necessary to reiterate that these are basic settings and jet and slides, etc., have to be tried to suit the particular machines and type of running that is to be encountered and are a matter of test and experience.
Air cleaners are desirable for scrambling.

(b) Tacho equipment

A tachometer can be fitted to all models, but in the case of machines using a nacelle, it will be necessary to make up a bracket for mounting the tachometer. A list of all the parts required is shown in the replacement parts manual for the machine concerned. From engine number DU24875, a new type of right angle drive tachometer gearbox was fitted. This can be fitted to earlier machines if required, but it will also be necessary to change the tachometer head and drive cable.

(c) Handlebars

Only the standard type of handlebars are available from Triumph spares sources.

(d) Wheels

Wheels should be balanced for high speed work, and the balance weights are provided under Part Nos. W1197 (½ oz.) and W1198 (1 oz.). Mention should be made of the absolute care and attention that must be paid to wheel, tyre and brake maintenance so that they are always in the best possible condition.

(e) Brakes

Great care must obviously be taken over the preparation of the brakes, as these will be called upon to perform duties far in excess of that required for normal road touring. The standard fully floating brake shoes should be retained, if in good condition, and fitted with racing linings with the proper relining equipment available in most motorcycle workshops. We are not able to supply or advise the most suitable linings for any given event. Do not forget to chamfer the leading edges of the lining to avoid brake "grab". Check the brake drum for ovality and the brake anchor plate for fatigue cracks.

GENERAL

(a) Polish

As with the inlet ports where the care taken in producing a good shape and blending is more important than a highly polished finish, so it is with the general assembly. Polished flywheels, cams, rods, crankcase internals are not as important as a high degree of care in assembly and installation, and are a waste of time unless every item on the machine is in first class condition and properly fitted.

(b) Blending of Radii

On rotating and other parts liable to high stresses, the removal of sharp corners forming "stress raisers" is important and can prolong the life of an engine by increasing its inherent fatigue resistance, but, also (like the art of "lightening") can easily be carried to excess with resultant lack of section and consequent loss of strength. Generally speaking, light application with a polishing bob or fine grade carborundum stone on suspect sharp edges and corners is sufficient to reduce them to within safe limits.

GEAR RATIOS USING A 46 TOOTH REAR WHEEL SPROCKET

GEARS	STANDARD RATIO				CLOSE RATIO				WIDE RATIO			
GEARBOX SPROCKET	TOP	3rd	2nd	1st	TOP	3rd	2nd	1st	TOP	3rd	2nd	1st
17	5·41	6·44	9·15	13·40	5·41	5·89	7·02	9·15	5·41	7·73	11·9	19·6
18	5·11	6·08	8·64	12·51	5·11	5·57	6·64	8·64	5·11	7·30	11·2	14·8
19	4·84	5·76	8·17	11·80	4·84	5·27	6·28	8·17	4·84	6·92	10·7	14·0
20	4·60	5·47	7·77	11·43	4·60	5·02	5·97	7·77	4·60	6·57	10·1	13·3
G/BOX REDUCTION	1:1	1·19:1	1·69:1	2·44:1	1:1	1·09:1	1·30:1	1·69:1	1:1	1·43:1	2·2:1	2·9:1

ENGINE REVOLUTIONS PER MINUTE CHART

GEAR RATIOS	4·25	4·5	4·8	5·0	5·15	5·25	5·4	5·5	5·65	5·75	6·0	6·25	6·5
m.p.h. 50	2798	2962	3160	3292	3390	3456	3555	3621	3720	3785	3950	4115	4279
60	3357	3555	3792	3951	4068	4148	4266	4345	4464	4543	4740	4938	5135
70	3913	4143	4419	4603	4742	4834	4972	5064	5202	5294	5524	5754	5984
80	4477	4740	5056	5267	5425	5530	5688	5793	5951	6057	6320	6583	6847
90	5036	5332	5688	5925	6103	6221	6399	6518	6695	6814	7110	7406	7703
100	5596	5925	6320	6583	6781	6912	7110	7242	7439	7571	7900	8229	8558
110	6155	6517	6952	7242	7459	7604	7821	7966	8183	8328	8690	9052	9414
120	6715	7110	7584	7900	8137	8295	8532	8690	8927	9085	9480	9875	10270
130	7275	7702	8216	8558	8815	8986	9243	9414	9671	9842	10270	10698	11126
140	7834	8295	8848	9217	9943	9677	9954	10138	10415	10599	11060	11521	11982

This chart is based on a 350×19 Racing Rear Tyre giving 790 wheel revolutions per mile. 350×18=803 revolutions per mile.
350×19=780 revolutions per mile. 400×18=789 revolutions per mile. 400×18 Sports=777 revolutions per mile.

BASIC CARBURETTER SETTINGS (ALL MODELS)

Using high performance camshafts and E3059R tappets.

I.O. 35° B.T.C.
I.C. 56° A.B.C.
E.O. 56° B.B.C.
E.C. 35° A.T.C.
} All ±2½° at 0·020" lift, zero valve adjustment.

Exhaust conditions.
A. 1½" Straight through. 37" pipe length.
B. 1½" Straight through. 37" pipe length (best).
C. 1½" Megaphones. 31½" pipe length.

ALL MODELS	MINIMUM OCTANE RATING=95 OCTANE								
11·1:1 or 9·0:1 C:R.	AMAL 389 MONOBLOC			AMAL 389 MONOBLOC			AMAL 376 MONOBLOC		
EXHAUST CONDITION	A	B	C	A	B	C	A	B	C
CHOKE	1 3/16"	1 3/16"	1 3/16"	1⅛"	1⅛"	1⅛"	1 1/16"	1 1/16"	1 1/16"
MAIN JET	340	350	350	330	340	340	210	220	220
NEEDLE JET	·106	·106	·106	·1065	·1065	·1065	·1065	·1065	·1065
PILOT JET	25	25	25	25	25	25	25	25	25
SLIDE	389/3½	389/3½	389/3½	389/3	389/3	389/3½	376/3½	376/3½	376/3½
NEEDLE TYPE	D	D	D	D	D	D	C	C	C

These settings are intended as a guide only. No fixed settings can be given to satisfy every machine under any given conditions and the rider must finalise his own settings to suit himself.
We are not able to supply direct from these works and any parts or quotations required must be obtained through your local Triumph dealer or distributor.
NOTE. This bulletin is the only one available dealing with the tuning of this range of unit construction machines.

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