WHAT DO WE GET FROM TUNING ?

1. This piece is a rewrite and amplification of notes which appeared in various Triple-M Bulletins. The background assumption is that your engine is in reasonably good condition, particularly in respect of valves, valve gear and camshaft. This is possibly more true nowadays than it was a few years ago, but . . . .

2. Many of the remarks made, especially when quantifying increases in power, apply to **small** changes and become less accurate as the changes become larger.

3. **Swept Volume**

The greater the swept volume of an engine, the more power it is likely to produce (all other things being equal). Thus, if we have an engine of swept volume V_1 and in crease it to V_2

$$\text{New power} = \text{Old power} \times \frac{V_2}{V_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

4. Naturally this will apply best to **small** changes. If V_2 is too great an increase, carburettor and valve sizes may need to be increased pro rata to get the full benefit and, if these components were a bit on the small side in the first place, no increase in power at all may be realised. However, for boring your 847 cc PA out to 939 cc this equation is approximately correct. (But see para. 17).

5. It is not generally appreciated that nearly all MMM engines can be bored out to 60 mm bore. The two breather PA blocks are identical to the PB so can obviously be treated in this way. Even the J2 (and hence the M, D, C, and F) can be converted to 939 cc by boring right out and fitting a 60 mm liner—which may be semi-wet. Many of the 6-cylinder cars have been bored out to 1,408 cc and possibly more as some PBs have seen bores of 62.5 mm (1,018 cc) and I have even seen a PB quoted as being of 1,044 cc. Both Geoff Coles and Steve Dear can give practical information on such an operation.

6. **Revs per Minute**

Engines have their peak power quoted at a specified r.p.m. In the case of many MMM cars this is 5,500 r.p.m. To rev. the engine any faster will not produce any more power because the engine cannot inhale the petrol/air mixture fast enough and each power stroke becomes weaker. If the breathing of the engine can be improved by port profiling and polishing and matching, different valve timing, different camshaft contours, different carbs, etc., so that it sucked in mixture at, say 6,000 r.p.m., as efficiently as it did previously at 5,500 r.p.m., then the peak power would be improved in the ratio 6,000 to 5,500 (or by 9%).

7. Needless to say, this statement contains a great many "ifs". We will return to some of them later.

$$\frac{\text{Power at revs. (1)}}{\text{Power at revs. (2)}} = \frac{\text{Revs. (1)}}{\text{Revs. (2)}} \quad \ldots\ldots\ldots\ldots\ldots \text{(2)}$$

8. **Compression Ratio.**

The thermal efficiency of an engine depends upon a great many factors some of which we cannot alter. One which can be changed and is popularly believed to be the gateway to vast power changes is compression ratio. Alter the compression ratio and you alter the thermal efficiency (the work obtained for each pound of fuel burned). Hence, for better or for worse, you alter the power that the engine will produce.

9. The term in the formula for the thermal efficiency of an internal combustion engine which involves the compression ratio is:—

$$1-\left(\frac{1}{r}\right)^{(n-1)}$$

r=compression ratio

and n is 1.3 approximately for a petrol engine

10. Calling this expression "e" we can produce a table thus:—

r	e
5.5	0.400
6.0	0.415
6.2	0.420
6.5	0.430
6.8	0.437
7.0	0.442
7.5	0.453
8.0	0.464
8.5	0.474
9.0	0.483
9.5	0.491
9.8	0.496

11. Thus, providing that no horrid symptoms like pinking, knocking, detonation, holed pistons or broken cranks occur, raising the compression ratio raises the thermal efficiency.

12. If the ratio of an engine is increased from 6.2:1 to 8.0:1, "e" changes from 0.420 to 0.464. if nothing else is changed the power will be increased in this proportion. We will have increased the compression ratio (and hence the stresses on the bottom end of the engine) by 29% but the increase in power is only 10%. Thus, although raising the compression ratio is an easy way to boost the power of an engine, it is rather hard on the crankshaft and connecting rods compared to other methods. (J2 owners please note).

$$\frac{\text{Power at } r_1}{\text{Power at } r_2} = \frac{e_1}{e_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

13. When the compression ratio is increased, the rate of burning of the mixture in the combustion chambers is increased. Thus, it may be necessary to retard the ignition. Look in "Blower" and you will see that the NA, with a c.r. of 6.2:1 sets its spark at 20 degrees B.T.D.C., while the NE at 9.8:1 is set at T.D.C.

14. The relationship between ignition advance and compression ratio is not linear. However, up to about 7.0:1 no re-setting should be required. At about 8.0:1 about 15 degrees B.T.D.C. should be about right. Actual running of the engine will indicate the best setting if you have taken a really big slice off the cylinder head (rather you than me).

EXAMPLES

15. You can check the truth of this so far by working out some examples with a known answer.

16. **Example 1.**

The J2 engine has a swept volume of 847 cc, a c.r. of 6.2:1 and produces 36 b.h.p. at 5,500 r.p.m. What power can be expected from the C type with AB head (same pattern at the J2), 9.8:1 compression ratio and 746 cc swept volume at 6,400 r.p.m.?

It should be noted that the C-type had relatively improved breathing in that it had a smaller swept volume and larger ($1\frac{1}{4}$ inch) carburettors compared to the J2.

Answer. $$36 \times \underset{(1)}{\frac{6,400}{5,500}} \times \underset{(2)}{\frac{746}{847}} \times \underset{(3)}{\frac{0.496}{0.420}} = 43.6 \text{ b.h.p.}$$

equation

(1) (2) (3)

Quoted power of the C-type is 44.1 b.h.p. at 6,400 r.p.m. so, even though some of the changes (particularly in respect of compression ratio) are not "small", the answer is not badly inaccurate.

17. **Example 2.**

The PA engine has a swept volume of 847 cc and a c.r. of 6.2:1 and produces 36 b.h.p. at 5,500 r.p.m. What power can be expected of the PB engine having a swept volume of 939 cc and a c.r. of 6.8:1?

Answer: $$36 \times \frac{939}{847} \times \frac{0.437}{0.420} = 41{:}6 \text{ b.h.p. at } 5,500 \text{ r.p.m.}$$

Quoted power of the PB is 43 b.h.p. at 5,500 r.p.m. This answer is disappointingly inaccurate as we have in this case, made only small changes and would therefore hope for our simple equations to be a close approximation to the real thing. A clue may be found in "Maintaining the Breed" where John Thornley says "Initially, the improvement of power output derived from these changes was disappointing, and it is interesting that this was rectified merely by an alteration in the width of piston ring. The rings used for the original test were 0.078 inches wide and the resulting power was 39.9 at 5,500. Substitution of rings 0.093 inches wide improved this to 43.3 b.h.p. at the same engine speed."

18. This merely demonstrates the care with which predictions must be made. But let us make some.

19. **Example 3.**

The compression ratio of a PB engine is raised from 6.8:1 to 8.0:1. No other alterations are made. What power can we expect from the engine now?

Answer:

$$43 \times \frac{0.464}{0.437} \times = 45.7 \text{ b.h.p. at } 5,500 \text{ r.p.m.}$$

20. **Example 4.**

The NE has a modified valve timing with greater overlap than the other o.h.c. MGs. Quoted power is 74.3 b.h.p. at 6,500 r.p.m. on a c.r. of 9.5:1. Power at 5,500 r.p.m. is 68.4 (see power curve in "Maintaining the Breed"). Assuming that in all respects except valve timing and c.r. the NE cylinder head is the same as that of P.A., what power could be expected of a PA with NE type valve timing, no other modifications being made?

Answer:

$$68.4 \times \frac{4}{6} \times \frac{0.420}{0.491} = 39.3 \text{ b.h.p. at } 5,500 \text{ r.p.m.}$$

Note: I believe that 4 and 6 cylinder type camshafts with NE timing are available from the spares sec. at the time of writing.

21. **Example 5.**

The above car is now bored out to 60 mm + 0.060" (986 cc), given a c.r. of 8.0:1 and mods to the inlet which allow it to breathe as effectively as before to 5,500 r.p.m. (see later for more of this). What is now the expected power?

Answer:

$$68.4 \times \frac{4}{6} \times \frac{986}{847} \times \frac{0.464}{0.491} = 50 \text{ b.h.p. at } 5,500 \text{ r.p.m.}$$

It can be seen, therefore, that there is quite a struggle to make one of our unblown four cylinder engines produce 50 b.h.p. (read 75 b.h.p. for the six cylinder types). How, then, is it that some of these speed shops appear to make 100 b.h.p. per litre a simple matter for hot engines? The answer lies in breathing and some aspect of this will now be discussed.

22. **The inlet Tract.**

Ideally this should be straight and gradually tapered down to the inlet valve seat. Of course, it is not.

23. Adding four Amal carburettors instead of two S.U.s will eliminate two right-angled bends and have a beneficial effect. The only data I can offer on this topic is that Mel Jones' J2 improved its Silverstone lap times from about 1 min. 37 sec. to 1 min. 31 sec. with this modification. As far as I know, no other significant modifications were done concurrently. Later, the car got down to 1 min. 27 sec. or so in this form. However, if we draw the conclusion that this mod., properly done, is worth a 6% improvement on lap times we will not be wildly inaccurate.

24. Chris Lawrence fitted six Amals to Porthos when he was chasing Loti and Coopers in the late nineteen-fifties.

25. However, the improvement comes in spite of the shortcomings of the system. Let's get back to the gradually tapering inlet which is the ideal required, (see fig. 1).

26. Compare this with the J2 where we have areas of cross-section at various points on the inlet tract like this:—

Carburettor ($\frac{7}{8}$" diameter S.U.) at venturi	= 0.55 sq. in.
Manifold at joint with carburettor	= 0.60 sq. in.
Manifold at entrance to inlet port	= 0.80 sq. in.
Inlet valve fully open	= 0.60 sq in.

27. If one polishes the inlet ports on the cylinder head and matches the joins at the head and manifold, one may, in theory, be helping the inlet gases on their

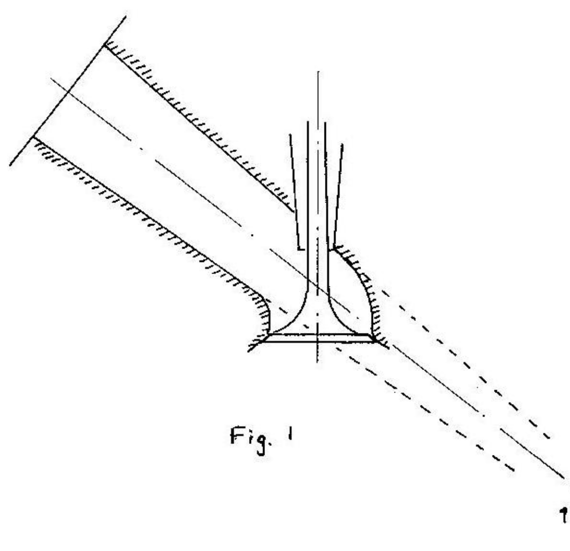


Fig. 1

headlong rush to the pot but one will be opening out that 0.80 sq. in. dimension even more and moving away from the gradually tapering ideal.

28. What is really needed, preferably in the following order, is:—

1) An increase in inlet valve opening area, up to about 0.75 sq. in.
2) An increase in carburettor size.
3) Reshaped inlet manifold.
4) Polished and matched inlet manifolds and ports.

29. **The Inlet Valve.**

The problems here are threefold:—

1) On the J the valve lift is too small (0.27 inch). This was improved on the L, P, K, Q, N, and R types to 0.31 inch but this is still too little even in an idealised situation as shown in fig. 2. Paradoxically it was 0.282 inch on the M, D, F, and C (AA head) types.

2) BUT the valve circumference is shrouded for three-eighths of its length by the wall of the combustion chamber. This is so for all models. (Fig. 3). Thus, in our case the area available for inlet gases to pass through at the valve is the shaded area in fig. 4, i.e.

$$\frac{5(\pi dh)}{8} + \frac{3(\pi dl)}{8} \text{ .... and "l" is very small .... (5)}$$

3) The inlet valve is only FULLY open for part of the inlet stroke of the piston.

30. **Increased Valve Lift**, can be obtained by "backing off" the cam. This is the process of taking off a piece from the back of the camshaft and hence increasing the lift. (Fig. 5).

31. This process cannot be done too violently on our cars because the smaller base circle diameter of the cam alters the required adjustment and hence the geometry of the rockers. This, in turn, alters the valve timing.

32. Additionally the J, C, D, F, and M camshafts might be unacceptably weakened by the process. It is appropriate to mention here that 10% extra lift will increase forces on the camshaft by up to 20%. However, CAM lift is increased from 0.22 inch to 0.24 inch by backing off 0.20 inch and valve lift is increased pro

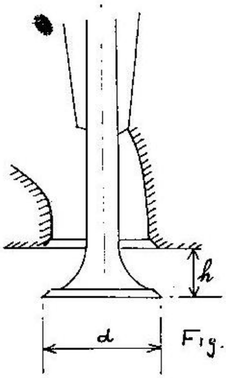


Fig. 2

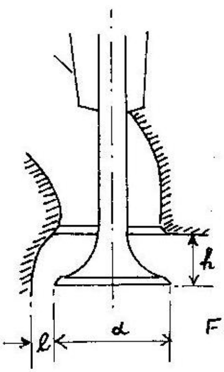
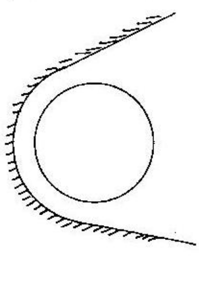


Fig. 3



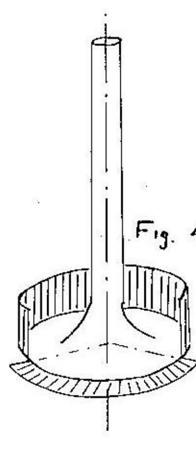


Fig. 4

rata. On the J and C (AB head) lift is increased from 0.27 inch to 0.295 inch and, on the K, L, N, P, Q, and R types, the valve lift is increased from 0.31 inch to 0.338 inch. Has anyone ever done this? If so, what were the results? I must confess that I have tried it. Alas the camshaft was so worn that the thing was a flop anyway. We were one ruined camshaft worse off at the end of the exercise.

33. **High Lift Camshafts** are the other way to obtain increased valve lift. Leonard Reece has a high lift master cam (0.28 inch of cam lift which represents a valve opening of 0.384 inch) which he claims will give NE valve timing, when applied to an NA cam (and hence to the K, L, P, Q and R). By bitter experience Geoff Coles and I found that this cam profile did not transplant to the smaller base circle diameter of the J cam. We persevered in the attempt and, although I do not think that Geoff now uses his hot high-lift camshaft, I still have mine in modified hand-ground form and believe it to be worth up to three seconds a lap on the Silverstone Club circuit.

34. Precautions to note if this cam is used are:—

1) If the valve springs become coil bound on opening a spot face grind will have to be carried out on the cylinder head at the foot of the springs. The depth of the grind need not exceed 0.060 inch.

2) The valves will be getting pretty close to the cylinder block and piston crown at t.d.c. (neither valve should be fully open at t.d.c.). This will need to be checked, especially if large slices have been taken off the cylinder head.

35. **Combustion Chamber Shape.**

The other constriction, that of the edge of the combustion shrouding the rim of the valve for nearly half of its circumference, is more difficult to overcome. The combustion chamber can be cut away a bit. I have seen 1/16th in. taken off but more would be nicer. Has anyone ever tried this to destruction on a slave head? If so, what were the results? the principle of the thing is shown in fig. 6.

36. After all this some cutting away of the cylinder wall may be necessary if the kind of situation shown in fig. 7 arises. The top of the block back to the shaded line can be removed but DO NOT go below the level of the top piston ring in your enthusiasm.

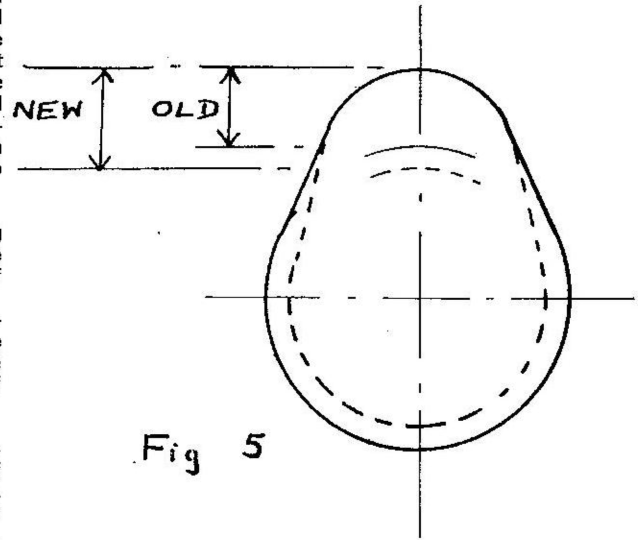


Fig 5

37. Summarising So Far.

If we take the inlet valve diameter as $1\frac{1}{8}$ inch, i.e., $1\frac{1}{4}$ inch actual, less the width of the seats, the areas of cross-section of the inlet passage at the inlet valve when fully open will be:—

	J etc. sq. in.	P etc. sq. in.
Standard	0.60	0.69
Cam backed off to 0.020 inch	0.655	0.75
High-lift cam (+0.060 inch)	—	0.85
Cam backed off and combustion chamber wall relieved 1/16th inch	0.74	0.83
High-lift cam + chamber wall	—	0.93
Combustion chamber wall relieved 1/16 inch	0.68	0.77

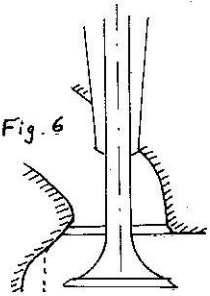


Fig. 6

38. Thus it is possible to obtain a reasonable area of passage at the inlet valve in P types etc. but more difficult in the J type and allied models.

39. Different Valve Timing.

The desirability of altering the valve timing should be mentioned here. The NE valve timing, for instance, is:—

	Inlet Opens	Inlet Closes	Degrees of Crankshaft Rotation
NA etc.	15° b.t.d.c.	55° a.b.d.c.	250°
NE	25° b.t.d.c.	60° a.b.d.c.	265°

An extra 15 degrees on top of two hundred and fifty does not look much but, remember that this extra is all with the valve fully open (assuming that the opening and closing ramps of the two cams are the same). Thus, as the valve is fully open for barely half the total opening period, the NE timing really represents up to about 15% improvement in valve opening, and should give about 8% to 10% improvement in power at the same engine speed. (See para. 20).

40. M, D, and F type owners might like to reap similar benefits by building up their cams and regrinding to J type profile. Has anyone ever done this?

41. From paras. 20 and 39 it would appear that an X% opening increase of the inlet valve, may increase peak power by something like $\frac{X}{2}\%$. It ought to be possible to use this as a simple rule of thumb, at least for small changes if corresponding improvements are made elsewhere.

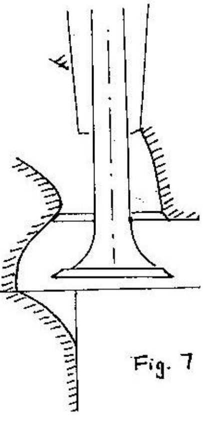


Fig. 7

42. Thus, from the table in para. 37, possible increases in power from these modifications may be postulated.

	P etc.	J etc.
Cam backed off 0.020 inch	+ 4%	+ 4%
High-lift cam (+ 0.060 inch)	+ 11%	+ —
1/16 inch off combustion chamber	+ 6%	+ 7%
Combustion Chamber + cam backed off	+ 10%	+ 11%
Combustion Chamber + high-lift cam	+ 17%	—

43. Now re-read paras. 4 & 6. Interpreted, this means that such power increases will be forthcoming only if other changes are made to improve or maintain the **balance** of the inlet system.

44. **The Carburettor.**

On a four cylinder engine the firing order is 1-3-4-2. Therefore the two cylinders which draw air from the forward carburettor fire consecutively, (and similarly for the after carb.). Now, cylinders fire at 180 degree intervals and the inlet valve is actually open for 250 or more degrees of crankshaft rotation. Therefore, when no. 1 cylinder begins to inhale, no. 2 is still breathing in quite hard and is going to do so for a further 70 degrees of crankshaft rotation. The greater the overlap of one's valve timing, the greater the duration of this period of peak demand. Meanwhile the other carb. is sitting idle.

45. The normal method of compensating for this is to fit a balance pipe between the two carbs. It is also a good thing to try to increase the size of the carburettors to allow for this period of peak demand.

46. If we put twin $1\frac{1}{4}$ inch S.U. carburettors on a 4-cylinder engine we have:—

Point in System	Standard area of cross-section sq. in. (for P-type)	Possible modifed area of cross-section
Entry to bell-mouth extension, $1\frac{3}{4}$ inch diameter, say.	—	2.41 see para. 47
Bellmouth/carb. join	0.60	1.23
Venturi by jet	0.55	1.10
Carb./manifold joint	0.60	1.23
Manifold/head joint	0.80.	1.00 see para. 48
Inlet valve	0.69	0.77 see para. 49

47. A bellmouth extension will give the air a more gradual start to its headlong dash down into the cylinder. They will thus give a better flow over the jets and may thus be expected to provide a small but unidentifiable increase in power. They DO NOT ram tune.

48. This is picked as a mean between the two adjacent readings and assumes that the port on the cylinder head is opened out to $1\frac{1}{8}$ inch diameter and tapered uniformly down to the inlet valve. The manifold is modified to suit and matched to the cylinder head. This figure would have been different if other modifications had been made to the inlet valve.

49. Assumes that the combustion chamber has been cut back by 1/16th inch as described in paras. 35 and 37.

50. **Example 6.**

The car in examples 4 and 5 has now had its inlet ports modified as in para. 46 and twin $1\frac{1}{4}$ inch carbs. fitted. Assuming that we have now allowed it to breathe as effectively as the NE at 6,500 r.p.m., what power can we now expect?

Answer:

$$74.3 \times \frac{4}{6} \times \frac{986}{847} \times \frac{0.464}{0.491} \times \underbrace{1.06}_{\text{from para. 42}} = 57.8 \text{ b.h.p. at } 6{,}500 \text{ r.p.m.}$$

51. If we choose to increase the lift of the camshaft we could clearly aim for 60 b.h.p. or more if the inlet tract was suitably modified and profiled.

52. **The Exhaust.**

The remarks regarding the inlet valve apply in reverse to the exhaust valve and systems. Valve timing, valve opening and combustion chamber walls can all be altered in a similar way.

53. **The Exhaust Pipe System**, is capable of improvement but I have no idea how many extra b.h.p. are likely to be obtained from such modifications. Probably the effects are similar to bell mouth extensions on the carburettors—they consolidate probable improvements in power.

54. In descending order of merit systems may be classified thus:—

1) A 1-4 and 2-3 pairing as on modern racing systems.
2) A 1-2-3-4 faired system as on the J4.
3) A bunch of bananas as on the PA.
4) A cast manifold as on the J2.

55. I have a very nice bunch of bananas manifold for my J2 which seems to make no noticeable difference compared to the standard system; (apologies to Mike Ellman-Brown who gave it to me years ago). However, one feels that some difference there must be. Has anyone any experiences to add?

56. **Six Cylinder Engines.** Going back to para. 44, the firing order for a 6-pot model will be 1-4-2-6-3-5. Therefore, in contrast to the four cylinder engine, demand for inlet gases is made on alternate carbs. (in a two-carb. system). Cylinders start their inlet valve opening at 120 degree intervals and therefore demands are made on individual carburettors at 240 degree intervals. Therefore the peak demand period of the four cylinder engine does not occur.

57. Behold, I tell you a mystery. Why does the six-cylinder engine have larger carburettors than its four cylinder counterpart? E.g., 1 inch carbs. on the PA compared to $1\frac{1}{8}$ on the NA. It would seem that they should have the same size of carb. for the same size of cylinder at any given state of tune. Nevertheless, while it would seem that NA owners could safely retain their standard carburettors while their P type brethren are gaily looking for something bigger than one inch in diameter, if straight comparisons are to be made with the NE for the purposes of estimating power output resulting from modifications, they will be closer if $1\frac{3}{8}$ jobs are fitted. Can anyone comment on this please?

58. Keen-eyed readers will have noticed another paradox in the text so far. "Why", they will say, "does the PA have exactly the same quoted power output as the J2 when it has a larger valve opening (paras. 29 and 37) and a better exhaust manifold (para. 54)?".

59. The probable answer to this is twofold. First, the PA engine has much more internal friction than the

J2 having extra and bigger bearings in the crankshaft and the camshaft and more crankcase windage—ask any J2 owner who has fitted a Laystall crank. Also, the actual power at the piston may not be much more because the improvement of inlet valve opening was not matched by changes for the better elsewhere. See paras. 26, 28 and 37. The inference is that a pair of $1\frac{1}{8}$ inch S.U. carbs. (ex Frog-Eyed Sprite?) bolted straight onto a PA or PB might produce an immediate but small power increase without any other modifications.

60. **Summary So Far.**
These are laid out in the table. This is full of personal preferences. For instance, I do not like high compression ratios. DG 5405 ran on an 8:1 c.r. at one time but it is now back to a little under 7:1. Ratios of the order of 9.5:1, although possible, put a very great strain on the engine for the extra power realised. 8.0:1 has therefore been taken as a maximum to which it is useful to go. It is also assumed that M type owners who are after a little extra power will have already equipped themselves with the later M type camshaft which was fitted to engine 2023 and thereafter.

61.

Model	Standard Power Quoted	Bore out to 60 mm	Relieve Comb Chamber Walls to 1/16" around valves	Mod. Cams	Fit Big Carbs	c.r. to?	Polish, match and taper ports, etc.	Possible Resulting Power
M, D	27 at 4500	Yes	Yes	No	No	6.8	Yes	34.8 at 4500
M, D Lays'l Crank	,,	,,	,,	Yes J2?	No	8.0	Yes	36 at 4500
J1, J2	36 at 5500	Yes	Yes	No	2 x $1\frac{1}{4}$"	6.8	Yes	44 at 5500
J1, J2 Lays'l Crank	,,	,,	,,	Back off .020"	2 x $1\frac{1}{4}$"	8.0	Yes	48.5 at 5500
PA PB	36 at 5500 43 at 5500	Yes + .060"	,,	NE	2 x $1\frac{1}{4}$"	8.0	Yes	58 at 6500
F	37 at 4100	Yes	Yes	No	2 x $1\frac{1}{8}$"	6.8	Yes	47 at 4100
L K(1100) K(1100) K(1271) NA, NB	41 at 5500 41 at 5500 39 at 5500 48 at 5500 56 at 5500	Yes + .060	Yes	NE	2 x $1\frac{3}{8}$"	8.0	Yes	70 at 6500 70 at 6500 70 at 6500 86 at 6500 86 at 6500

62. Those who are intoxicated by the thought of an 86 b.h.p. unblown NA will be matched by those sceptics who wonder why we are messing about with such penny numbers. After all, this is barely 60 b.h.p. per litre and funny Formula Ford (sorry to use that word) cars with 22 mm diameter orifice restrictors fitted in the inlet manage between 80 and 100 b.h.p. per litre. How do they do it? The answer (or at any rate part of it) lies in ram tuning.

63. **Ram Tuning.** Much is said about "ram tuning" of the inlet. This merely means that the natural frequency of vibration of the column of air in the inlet ports is such that the oscillation which is set up as a result of the suction impulse created by the opening of the inlet valve and the piston rushing down the bore becomes a pressure wave just as the inlet valve is closing. The result of this is that there is an extra large gulp of air passing through the inlet valve just as it is closing. The natural frequency of vibration required can be calculated if we decided on the r.p.m. at which we wish to ram tune and the valve timing is known. But we cannot calculate the natural frequency of a given inlet manifold system because it varies to an unknown extent upon such things as length, diameter (not uniform), bends, temperature, pressure, interplay between cylinders, etc.

64. The only way to get ram tuning really right is to get it nearly so by previous successful practice and then play about with all the variables one by one while the engine is on a test bed with a dynamometer. Unless any MMM man has such a device and the facilities to make and modify manifolds and things at will, testing each variation precisely, we might as well forget this.

65. If any MMM chap is lucky enough to have the run of such facilities (ha, ha), he might start by testing a standard engine and following a path outlined in the previous pages, letting us know how accurate the predictions and assumptions have been. He might then try some more sophisticated tuning techniques and tell us how to get even more urge from our engines without buying a supercharger. Which brings us to . . . .

66. **Supercharging,** which is **the** way to really get power from our engines.

67. Before going any further, it may be appropriate to mention that your scribe has never fitted a supercharger to his car (but just you wait). Therefore I will not mention any of the practical points like stiffness of mounting brackets, sizes of belts and pulleys, layout of manifolds, choice of carburettor needles, problems of methanol mixes and at what pressures these fuels become desirable. Rather I will plead ignorance on these matters and ask for articles on actual installations which have been put on to MMM cars. Would-be supercharger men are recommended to visit events where supercharged MMM cars may be expected to be desporting themselves. For justification of this coward's way out I would refer you to the title of this piece.

68. However, it should be mentioned that none of the measures described so far should result in expensive noises if one's engine is in good condition. This

does not necessarily apply from here on. In passing it is interesting to note that the fitting of a supercharger on a P or an N type in pre-war days did not invalidate the works guarantee provided that the pressure did not exceed six pounds per square inch.

69. A summary of some of the superchargers which are available or which I have seen installed on MMM cars is given in the table below. There is also some gen in our old friend "Blower" (an appropriate name).

Make	Type	Availability	Driven from	Remarks
Marshall	Rootes	Sold in kit form pre-war, IZ75 model for J and P types and size 85 for K and N types. Type 85 was standard on 1934 K3. Sold as kit for T types post-war, type J75 being almost the same as IZ75. Many ex-W.D. cabin blowers are of the same type. Manufacturing rights are held by Sir George Godfrey and Partners.	Nose of crank or by belts, both methods can be seen in use.	All Rootes type blowers give a good boost at all revs. They are therefore good for fitting to road or all-round competition cars. They are efficient (i.e. they do not absorb much power) up to pressures of 15 lb./sq. in. Above this they are not so good in this respect and above 18 lb.sq. in. or so they are no good at all. Hence the need for two-stage layouts on cars requiring really high pressures and using this kind of blower.
Wade	Rootes	Type R010 sold in kit form for T types post-war. A big Wade is currently sold by Allards. Also used on several diesel engines and can be found as ex-cabin blower.	Ditto.	
Power-plus	Vane	Fitted to C, J3, J4, and 1933 K3 in various sizes. Not as good as later vane types in reliability or in efficiency. Now very scarce and worthwhile only if you want an original installation.	Nose of crank.	All vane type superchargers can be used to provide higher boosts (up to 28 lb./sq. in. in the case of the Zoller). Not as effective as the Rootes types at low revs. But this is not really noticeable for some types (so I am told).
Centric	Vane	Sold pre-war as a bolt-on kit for P and N types and seems to have been used frequently on other cars. Types 125 and 160 have been noted by your scribe. Not many about.	Mostly belt-driven but at least two crank-driven examples in the MMM.	
Arnott	Vane	Type 1600 sold as kit for T types post-war. Not very often seen.	Belt.	
Shorrock	Vane	Types C75B and C142B currently sold by Allard Motor Co. Also sold as bolt-on kit for T types. Readily available new or second-hand.	Belt. Not suitable shape for fitting between dumb-irons.	
Zoller	Vane	Fitted to Q and R types as standard. Also available pre-war as bolt-on kit for P and N types. Now rare. The Zoller kit was **much** more expensive than the Centric and Marshall kits so, presumably not many were sold.	Nose of crank or by belt.	
Cozette	Vane	Never seen one on an MG. used on Austin 7s so expect it would do for a 750 cc MG.		

70. Supercharging was the most popular way to obtain big power outputs before the war and fell out of fashion for political reasons. At high pressures (over 10 lb./sq. in.) cooling problems and all manner of mechanical frailties begin to raise their ugly heads. Some of our cars successfully used much higher pressures and up to 36 lb./sq. in. was pumped into a Q type. At such pressures it is necessary to use methanol based fuels.

71. Atmospheric pressure is 15 lb/sq. in. This simple formula is crude but it works:—

$$\frac{\text{Peak power at P lb/sq. in. boost}}{\text{Power unblown}} = \left(\frac{15+P}{15}\right) \quad \ldots\ldots\ldots (6)$$

72. It should not work because power is lost in driving the supercharger (some of it is recovered when the pressure in the inlet manifold drives the piston down on the inlet stroke) and because the pressure in the inlet manifold of an unblown car is never exactly atmospheric anyway (at least, not on an MMM car). But it does work, possibly because all the inaccuracies cancel each other out. Better is:—

$$\frac{\text{Power at P lb/sq. in.}}{\text{Power at Q lb/sq. in.}} = \left(\frac{15+P}{15+Q}\right) \quad \ldots\ldots\ldots\ldots\ldots (7)$$

73. **Example 8.** The quoted power of an 847 cc PA on a c.r. of 6.2:1 is 36 b.h.p. at 5,500 r.p.m. What Peak power can be expected from the QA which is 746 cc, has a c.r. of 5.5:1, is blown at 28 lb/sq. in. and revs. to 7,200 r.p.m.?

Answer: $$36 \times \frac{746}{847} \times \underbrace{\left(\frac{28+15}{15}\right)}_{\text{equation 6}} \times \frac{0.400}{0.420} \times \frac{7{,}200}{5{,}500} = 113 \text{ b.h.p. at } 7{,}200 \text{ r.p.m.}$$

The quoted power of the QA is 112 b.h.p. at 7,200 r.p.m. we are very lucky to have been so close. Try another.

74. **Example 9.** The 847 cc M type produces 20 b.h.p. at 4,000 r.p.m. What power can be expected from the 746 cc C type with AA head and supercharged at 12 lb/sq. in at 6,000 r.p.m.? The different valve timing will be assumed to allow a breathing efficiency at 6,000 r.p.m. equivalent to the M type's at 4,000 r.p.m.—what else can we do anyway?

Answer: $$20 \times \frac{746}{847} \times \left(\frac{12+15}{15}\right) \times \frac{6{,}000}{4{,}000}$$
$$= 49.4 \text{ b.h.p. at } 6{,}000 \text{ r.p.m.}$$

The quoted power of the C type in this form is 52 b.h.p. so we are still quite close—our luck is holding.

75. Thus, your PB owner who seeks a modest increase in power to 60 b.h.p. can get it simply by strapping on a supercharger which blows at 6 lb/sq. in.

E.g. $$43 \times \left(\frac{15+6}{15}\right) = 60 \text{ b.h.p. at } 5{,}500 \text{ r.p.m.}$$

Compare this with all the rigmarole outlined in paragraphs 1 to 55! No problems should be encountered. If he were doing this in 1936 he would not even have invalidated his guarantee.

76. It has been common practice to boost road cars up to 10 lb/sq. in., at which point the otherwise standard PB is giving 72 b.h.p. (the same as the J4) and the NA some 90 b.h.p. Pre-war Cream Cracker and Musketeer cars were blown at 15 to 18 lb/sq. in. and the Musketeers were bored out to 60 mm I believe. Well, work out the probable power for yourselves.

77. Never mind about that, suppose all the other mods. we contemplated for an unblown car were to be carried out too.

78. **Example 10.** The NA in example 7 has its own compression ratio reduced to 6.0:1 and is fitted with a blower which delivers at 18 lb/sq. in. What power can we now expect?

Answer: $$86 \times \frac{0.415}{0.464} \times \frac{33}{15} \times = 169 \text{ b.h.p. at } 6{,}500 \text{ r.p.m.}$$

79. Before you all rush off to buy Allard-Wade 4R020/4190 blowers for your NAs it would be as well to find someone who can provide you with some Q or R type pattern con-rods. Has anyone any drawings? What about it Mr. Spares Secretary? Reflect that this is lots more power than the catalogue K3 ever had and as much power per cylinder as the Q and R types possessed.

80. On a slightly less elevated plane, it might be possible for someone to market a blower kit based on the Shorrock C75B or C142B in bolt-on form which would puff a 939 cc (or 1,408 cc) engine at a modest pressure of 8 lb/sq. in. In this form and with the standard c.r. of 6.2:1 but using NE valve timing, profiled ports, cut-away combustion chamber walls etc., we could expect about 76 b.h.p. at 5,500 r.p.m. on the PB and 115 b.h.p. on the NA.

81. Such powers might make a few MGBs look a little slow. Good luck to you and please tell me all about your efforts for the 1974 or 1975 Year Book.

M.B.H.

THE TRIPLE-M BIBLIOGRAPHY

Nigel Musselwhite has sent the following additions to the list in the 1972 Year Book.

1. **Flat Out**, by George Eyston.

Gives the story of the Club President in his early days, told in the first person and giving details of Ex.120, Ex.127 and the Mille Miglia.

2. **Motor Racing**, by Earl Howe.

A compendium of information by the experts in their fields, including H. N. Charles. It also gives the pre-war racing fuel mixes and deals with all aspects of racing. There are some good photographs too.

Eds. note: This book was actually first published in the year 1932 under the authorship of S. C. H. Davis. In subsequent years it was re-written many times, the final edition being considerably post-war. It would appear that Nigel's edition is of the late 'thirties).

3. **The Sports Car Engine**, by Colin Campbell.

A technical book written in non-technical language. If you put it all into practice, "you won't arf go".

4. **Sports Car Bodywork**, by B. W. Locke.

This is a very good book on body building and re furbishing. A complement to any collector's library.

Nigel Musselwhite.