CHAPTER THIRTEEN

The Mechanics of Modification

In earlier chapters we have considered many aspects of the technique of engine modification. In this final chapter we shall discuss a few of the practical problems one meets when applying these techniques. This chapter is something of a hotch-potch with very little logic in its arrangement, but a liberal use of headings will help the reader to find a particular subject quickly. It is assumed throughout this chapter that the reader, whether he be owner or professional mechanic, is tuning an engine for competition work. A modern rally, especially in the modified class, comes inside this definition.

CYLINDER HEAD WORK

Compression ratios and how to change them

Whether we remove metal from the cylinder head face or fit high compression pistons it is still necessary to measure the compression ratio of the engine, both before and after modification. We also need to know how much metal to remove from the head or how much to increase the compression height on the new set of pistons to obtain a desired increase in compression ratio.

The compression ratio \( R = \frac{V+v}{v} \) \( \quad (15) \)

where \( V \) = the swept volume of one cylinder, i.e. the engine capacity in c.c. divided by the number of cylinders.

\( v \) = the clearance volume in c.c.

For our particular purpose, the equation is more convenient rearranged in the following form:

C. Campbell, *The Sports Car Engine*
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Thus, if we wish to raise the compression ratio from $R_1$ to $R_2$ the clearance volume $v_1$ must be reduced to $v_2$.

This reduction in clearance volume is given by:

$$v_1 - v_2 = V \left( \frac{1}{R_1 - 1} - \frac{1}{R_2 - 1} \right)$$

(17)

For example, if the swept volume of one cylinder,

$V = 400$ c.c.

$R_1 = 8.0$ to 1

$R_2 = 9.5$ to 1

The required reduction in clearance volume,

$$v_1 - v_2 = 400 \left( \frac{1}{7.0} - \frac{1}{8.5} \right)$$

$$= 10.08$$ c.c.

**Measuring the clearance volume**

The volume of the combustion chamber can be measured directly by filling the volume with thin oil. Some prefer to place the cylinder head face down on a sheet of plate glass and to fill the combustion chamber through the plug hole from a graduated measuring cylinder. The cylinder head face should be lightly covered with Vaseline to provide a good seal between it and the glass. The filled level of the oil in the plug hole should be slightly higher than the plug reach to allow as close as one can judge by eye for the interior volume of the plug. The writer prefers to place the cylinder head upside-down on the work-bench with the plug tightened in position and to fill the head from the open side of the combustion chamber. Before filling the cylinder head the face must be checked for perfect level by means of a spirit level, using packings under the head to get the desired level. The combustion chamber space of the cylinder to be checked is then filled with oil, a steel rule being placed across the head face to verify that the oil level is exactly flush with the head face. A glass measuring cylinder graduated in c.c. is used to obtain the exact volume measurement taken to fill the combustion chamber space.