Balancing single-cylinder engines

BEGINNER'S WORKSHOP

by Geometer

ALLIED to crankshaft construction for single-cylinder engines, particularly those intended to run at high speed, is the problem of balance, since it is while the crankshaft is being made that provision can best be effected for subsequent balancing. That is, the crankshaft webs can be suitably shaped or extended to avoid the necessity for separate balance weights-with the need for secure mounting to obviate the possibility of their working loose in service.

The need for balancing is obvious on the simple thesis that to start matter in motion requires a force, and to stop it demands another force, while the greater the " weight " of matter and the more sudden the starting and stopping, the greater the forces involved.

In an engine, the major reciprocating parts comprising piston, rings, gudgeon pin and part of the connecting rod, set up forces along their line of travel; and if the engine is unbalanced, the forces, acting through its structure and mountings, set up vibration.

Lightness in the reciprocating parts is important to keep the forces as small as possible. Hence, in high speed engines,. it is customary to employ alummmm-alloy pistons, hollow steel gudgeon pins and duralumin connecting rods. In certain types of engine, good balance is achieved in opposmg one set of reciprocating parts by another. The flat-twin horizontally-opposed petrol engine and the single-acting vertical twin steam-engine are examples.

In a single-cylinder engine, although it is usual to speak of balancing, complete balance is not possible-the unbalance is shifted from one direction to another. In reference to diagram ***A,*** a balance weight could be attached to provide a force W completely to balance WI set up by the reciprocating parts at top dead centreand again at bottom dead centre. But the crank being turned at right angles there is no force to oppose comletely that of the balance weight in direction X, and at a further half turn in direction Xl. So the engine would be no less unbalanced than before.

To avoid this, the unbalance is divided, the force ***W*** opposing only part of that ***W1,*** and forces acting at X and Xl are thereby reduced. Usually, the balance weight corresponds to the whole of the revolving masses, which can be balanced, plus half the reciprocating masses. The piston with rings and gudgeon pin are reciprocating masses, so half. these weights are taken. The small end of the connecting rod is a reciprocating mass, half of which is taken, too. But the big end is a revolving mass, so the whole of this is taken.

Using a balancing bar and cotton, and steel balls or lead shot in a tissue paper bag, the piston complete is weighed, as at B, and half taken. The connecting rod big end is weighed, as at C, and the whole of this taken-the small end resting on a block. The small end is weighed similarly, and half taken.

The total number of balls or shot then form a weight which should hold the crankpin horizontal when suspended from it by cotton, as at ***D,*** with the crankshaft resting on knife edges-which can be strips of steel about 1/32in. thick bolted each side of a board, and this levelled in the vice.

A heavy balance, weight is corrected by reducing its stze, or drilling or enlarging holes such as Y, Yl. Often, however, the difficulty is to provide sufficient weight in the web. The crankpin can be partially drilled to help, and where the crankshaft size is determined by the crankcase, the balance weight can be extended sideways, as far as connecting rod clearance will permit, as at ***E.***

Where the shaft runs in the open, the balance weight can be extended radially Z beyond the circle swept by the crankpin. For extra weight, a lead plug can be used at times, held in by a steel screw; and where no provision has been made, a steel balance weight can be bolted on. ❑