

ENGINE CONSTRUCTION DETAILS

ALTHOUGH the crankshaft, connecting-rod and piston of an i.c. engine form a design assembly about which, from the first it might have been thought there was little to discover, the constructor in settling their proportions and layout is able to modify substantially their functioning together. In particular, the one-way thrust on the piston can be usefully employed to reduce certain tendencies to undesirable effects.

It is inevitable, of course, for power strokes to involve considerable pressure, imparting not only down thrusts but side thrusts to the piston. From side thrusts come friction and wear and so far as is practicable proportions and layout should be designed to reduce them.

Again, with a light-alloy piston used

against a wall as at *A*. With the ladder vertical there is no side thrust. But when it is sloped there is down thrust *N*, thrust through itself *O*, thrust to the wall at the top *P*, and thrust away at the foot *Q*. Taking the foot of the ladder away from the wall, a point is reached at which, without

By GEOMETER

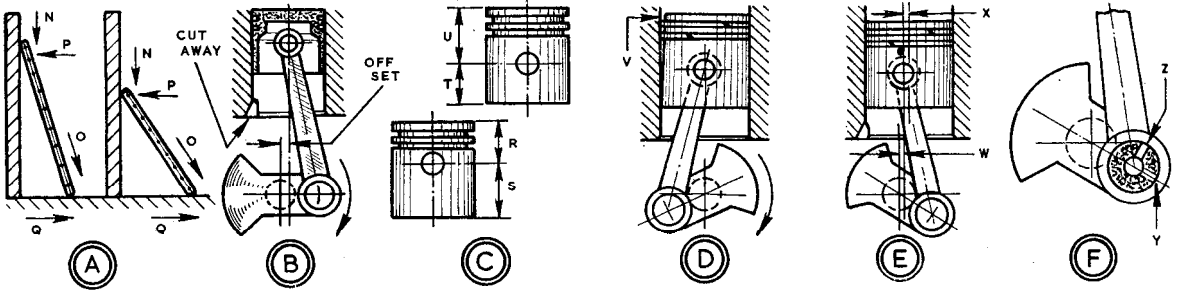
down thrust having increased, side thrust becomes such that the ladder falls flat.

Side thrust on a piston is as at *P*; and given for an engine a fixed stroke, and for ladders a fixed distance from the foot of a wall, a long connecting-rod corresponds to a long ladder, a

layout. On exhaust and compression strokes upwards, pressures are lower and side thrusts smaller. The cylinder may require a cut-away to clear the connecting rod.

The position of the gudgeon pin, as at *C*, has an effect on piston slap. Where the compression centre *R* is shorter than the skirt length *S*, slap is likely to be heavier than where the proportions are reversed with *U* and *T*. This arrives as at *D*, from the extra clearance which a piston has at the top *V*, to allow for expansion. The gudgeon pin is the reaction line against piston thrust downwards; the axis moves sideways as the piston rocks, and the nearer it is to the top of the piston, the greater the sideways movement and the heavier the slap.

With the gudgeon pin centrally in the piston, down-thrust is balanced on the gudgeon pin axis; but if the axis is offset in the piston, an over-balancing tendency is brought about



for dispersing heat and reducing weight, the considerable clearance which must be allowed for expansion can result in slap at TDC. It occurs when combustion pressure is applied, and may be aggravated or alleviated according to general proportions and layout.

It is because of the slope which the connecting-rod takes as the crankshaft makes a half revolution, that side thrust is imparted to a piston. Without the slope there would be no side thrust. As it is, side thrust is related to slope, becoming the greater the more the connecting-rod diverges from vertical. This may be demonstrated by analogy with a ladder

short connecting-rod to a short one -with which latter arrangement side thrust is increased.

Nevertheless, while reduced side thrust is a point for a long connecting-rod, there are others against it-extra weight, less rigidity at speed, increased overall dimensions of the engine. Together these settle length at roughly twice stroke.

Because of the one-way thrust on the piston on power strokes, the effect of a long connecting-rod can be obtained while using a short one. It is done as at *B*, with an offset between crankshaft and cylinder centre lines, so the connecting-rod is kept nearer vertical on power strokes-the Desaxe

to reduce side thrust and slap at the top.

Thus, there are three possibilities for alleviating side thrust and piston slap with one-way power thrust on a piston-Desaxe crankshaft, top-heavy piston, offset gudgeon pin axis. All together these make up an arrangement as at *E*, where the crankshaft is offset *W* from the gudgeon pin axis, and this is offset *X* from the cylinder centre line, while the gudgeon pin is lower than midway in the piston.

A tendency to throw oil from a big-end is reduced as at *F*, by changing the drilling from the top *Y* of the crankpin to the side *Z* where centrifugal force is less.