In describing the function of the slide-valve and the effects of lap and lead [Fig. 17, March 12], no particular mention was made of exhaust timing. It would be a mistake to regard this as insignificant, but it is generally satisfactory to allow it to keep in phase with the steam admission, as it must inevitably do so in a simple slide-valve, and it is usual to make the inside edges, in other words the width of the valve cavity, such that they just, and only just, span the inside edges of the cylinder ports at mid travel (right-hand diagram).

Thus the slightest movement either way opens one or other of the cylinder ports to exhaust. Occasionally, however, engines are timed to give either positive or negative exhaust lap, by narrowing or widening the valve cavity; the latter is the more common and its object is usually to avoid excessive "cushioning" or compression, or to eliminate risk of back pressure in the exhaust system.

The conventional stationary or so-called "mill" engine forms an excellent exercise in steam-engine construction, and is deservedly popular. Several examples of these engines were...
designed by Muncaster, all generally similar in major features but differing in size and certain details. The first, shown in Fig. 18 [March 21], is scaled down from a fairly large engine, 12 in. bore x 18 in. stroke, in the proportion of 1 in. to 1 ft.

No dimensions are given on the actual drawing, but Muncaster gives a table of dimensions worked out to exact scale. I have taken the liberty of modifying some of these to give round fractional figures, as most constructors would undoubtedly wish to use standard drills, reamers and stock materials wherever possible; but general proportions have been closely adhered to.

The cylinder dimensions for the 1 in. scale model are 1 in. bore x 1-1/2 in. stroke. Piston rod diameter 3/16 in., crosshead fin. wide inside fork, with crosshead pin 3/16 in. dia. Connecting rod, circular section, fishbellied, 3/16in., dia. at the two ends, swelling to 1/4in. centre; length between bearing centres 2-5/8 in. Crankshaft 7/16 in. dia., with journals reduced to 3/8in., x 1/2in. bearing length; crankpin 1/4 in. dia. x 5/16 in. long. Flywheel 5 in. dia. with rim section 1/2 in. square. Eccentric throw 7/64 in., rod circular section, tapered from 1/8 in. to 7/64 in. Valve spindle 7/64 in. dia., valve travel 7/32 in. Port dimensions: steam-ports 5/64 in. x 7/16in., exhaust 5/32in., wide. Valve travel 7/32in., lap 5/64in., cavity 5/16 in., lead 1/100 in. Steam inlet 1/4 in. dia., exhaust outlet 5/16 in.

As the constructional methods for this and the second engine are generally similar, they may be considered together. In the latter case, illustrated in Fig. 19, leading dimensions are given on the drawing. Both engines are intended to be built from castings, though fabrication of most of the components is practicable.

The main components are mounted on a long box-section bedplate, with machined facings where required, and it is desirable to machine these in order to ensure accurate location and secure mounting of the parts, but in the absence of proper facilities they may be filed and scraped, accuracy being checked by means of a surface plate.

It will be seen that both engines have an outboard crankshaft bearing, or "pillow block," which must be accurately lined up with the other bearing mounted on the bedplate; for this reason the actual foundation on which the latter is mounted must also be flat and true. It may be made from a thick slab of well-seasoned hardwood, with a cavity cut out to clear the flywheel.
Many constructors, no doubt, would prefer to make the engine self-contained by extending the cast bedplate to carry the outboard bearing; I have designed most of my engines to avoid the need for extraneous parts which have to be lined up. A single bedplate with facings for all essential parts, machined off to the same level throughout, greatly facilitates accurate construction.

The cylinders of both engines are bolted down to the bedplate, being provided with cast feet or flanged brackets, and the bearings, which are of the split plummer block type, are similarly fixed. Details of the steam-chest, flywheel, connecting rod, crank and eccentric sheave, with its strap, are given in Figs 20 to 23.

The main difference in the two engines is in the type of crosshead employed; the first example has die blocks fitted to the extended ends of the crosshead pins and working between girder-shaped guide bars mounted on pillars fixed to the bedplate, while the other has a slipper type crosshead working on single guide bars each side. Both types are well established in full-size practice; they require very careful lining up in respect of height and parallelism with the cylinder axis to ensure smooth movement of the piston rod.

In this respect they may possibly be more difficult to fit than the trunk type of crosshead, in which alignment is automatic if machining is properly carried out; on the other hand, they are sometimes preferred because they offer facility of adjustment to compensate wear or initial errors.

The crosshead of the first engine is forked to admit the little-end eye of the connecting rod, but in the second arrangement matters are reversed by forking the end of the rod to span the slipper crosshead block. This type of rod may be a little more difficult to shape than the previous type, but it looks very nice when properly carried out and I have given instructions on how to produce forked rods from the solid in articles on the Unicorn mill engine.

Muncaster suggests forging parts of this nature, which is very sound advice—or at least it was in his time, when nearly all fitters had some knowledge of smith’s work; but this seems to be practically a lost art nowadays. There are, however, many Continued on page 515
Oil-bath lubrication is of course employed, and I recommend the use of a light oil, such as Shell Vitrea, so as to keep down losses due to fluid friction. It is of course necessary to fit an au vent or breather to the top of the box, but I have not shown this as its position will have to be arranged so as not to interfere with any control gear fitted to the cover. The box should be filled to a depth of 1/2 in.

Various modifications of the details of the gearbox may suggest themselves to readers but the general design, in which all really essential features are incorporated, can be guaranteed reliable and efficient.

One point which should be noted about reverse gears of this type is that the gears are only under load when actually in reverse, which will normally be no more than a very small proportion of the total working time; when running ahead, the gears run idly and the only losses are those due to running friction and oil drag, which can be kept very low; thus there is no appreciable reduction in the performance of the boat.

To be continued.