The MUNCASTER steam-engine models

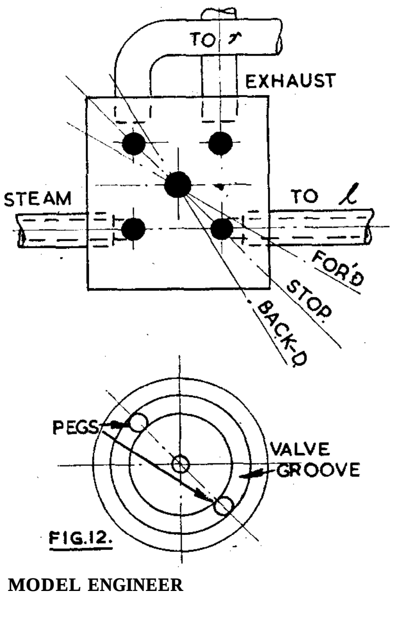
3-Simple slide-valve engines

EDGAR T. WESTBURY is reviewing some classic models of the past in the light of modern techniques

Continued from 7 March 1957. pages 337 to 339

IN THE ISSUE of February 21, it was stated that an oscillating engine can be made to reverse its direction of rotation simply by changing over its steam and exhaust connections; this applies to all engines timed to work without lap or lead, whether single or double-acting, and with any number of cylinders, with the exception of those having flat slide valves.

It is therefore possible to equip any of these engines with a simple reversing control, consisting of a four-way change-over cock or valve, and such a control is indicated in the plan view of the double engine, Fig. 11. Details of the reversing valve are given in Fig. 12, where it will be seen to consist of two essential parts, a stationary portblock, with four ports and their connecting pipes, and a rotating valve with interrupted annular groove just like the portblock shown in Fig. 9. These parts are lapped to fit truly together and held in friction-tight contact by a spring acting on the centre pivot.



When the valve is turned into such a position that the blanked portions close two diametrically opposite ports in the block, communication to the cylinders is shut off; this is the " stop " position. By moving it in a clockwise direction,. however, steam is admitted to the pipe 'marked ***R,*** and exhaust connected to ***L;*** while moving it the other way reverses these connections. I would suggest, in order to improve the seal of the valve face and make it less critical in angle of movement, that the width of the groove stop should be increased by fitting a peg of larger diameter, or other means.

A VERTICAL BOILER

The boiler recommended for either of these engines is shown in section in the elevation drawing, Fig. 13, and in plan view, Fig. 14. It is preferably made in copper, about 3/64 in. thick, or 18-gauge, for the shell, with end-plates 1/16 in. thick or 16-gauge, which can be beaten or spun to the shape shown. For relatively low pressures, which should be perfectly satisfactory for these engines, riveting and soft soldering will be safe enough, though as a precaution in case the boiler should ever run dry the joints of the inner flue and cross tubes, which are in contact with the flame, may with advantage be silver soldered.

The flue is 1-1/4in. dia. by 16-gauge, with cross tubes 3/8 in. dia. by 20-gauge, and the steam-pipe, which may either be brazed directly into the top of the boiler or fitted with a union joint, is 3/16 in. dia.

Whatever other fittings are attached to the boiler, a safety-valve must on no account be omitted; this may be of a simple type, combined with the filler plug, as shown in Fig. 15. The boiler should be hydraulic tested to stand 50 p.s.i. without leakage or distortion, and the safety-valve spring (which should be of rustless steel or phosphor-bronze) adjusted so that it lifts at 35 lb. Firing may be by spirit, paraffin or gas, as described in previous articles.

SIMPLE SLIDE-VALVE ENGINES

The majority of steam-engines, large and small, are equipped with slide-valves for the distribution of steam, and of these, the simpler types employ an eccentric (which is essentially a form of crank) for direct operation of the valve in fixed phase relation to the piston stroke.

To anyone who intends to build engineering models of any kind, I consider that a practical understanding of the simple slide-valve engine is essential, and one of the first essays in construction should be devoted to producing a working model of such an engine. Judging by the many queries received on this subject, it would seem that the steam-engine does not receive the attention it deserves in elementary technical

Right, Fig. 11: ***Plan view of a complete twin-engine plant, showing (top half) crankshaft and (at the bottom) cylinder and the reversing valve***

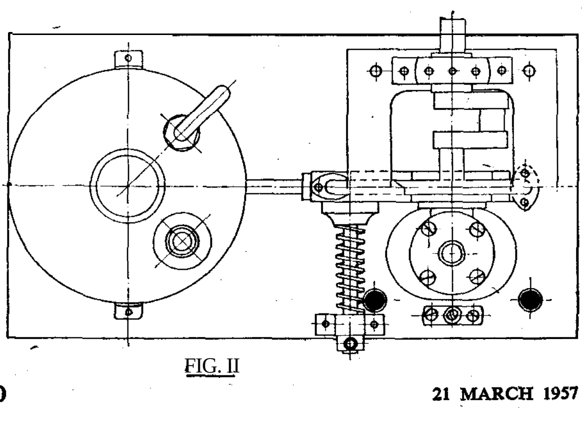


FIG. II

Left, Fig. 12: ***The portblock and rotating disc of the reversing valve, showing connections to cylinder portblock***

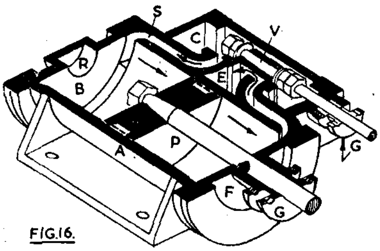


Fig. 16: Section through cylinder and steam-chest of slide-valve engine

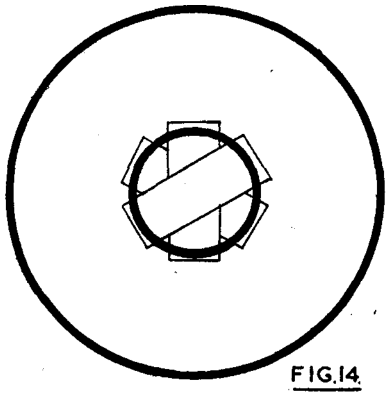
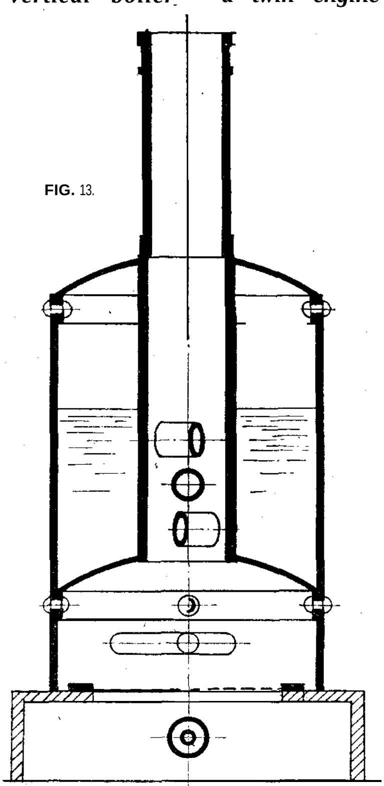


Fig. 14: Sectional plan of boiler, showing cross-tubes

Below, Fig. 13: *Section of simple vertical boiler a twin engine*



education, as many intending constructors do not appear to have mastered its basic principles. I feel sure, therefore, that more experienced hands will not grudge a little space devoted to this important subject.

In my own articles on steam-engines, I have always recommended beginners to start right away on building a slide-valve engine, without worrying about the conventional oscillating engine, which is generally regarded as the first stepping stone to progress in construction.

My reason for this advice is not simply because it is possible to attain higher efficiency with the slide-valve -though this is an undisputed fact -but because the latter gives facilities for the observation of valve events, also for checking and experimenting with timing; in this way it teaches the constructor more about engine functions than is ever possible with an engine in which the means of steam distribution are both invisible and immutable.

When once the principles of the direct-acting slide-valve have been mastered, one can, if one so wishes, go on to study the more complicated valve gears which enable the expansion of steam to be controlled or rotation to be reversed.

Muncaster quite rightly devotes careful attention to the elementary principles of slide-valve operation and gives an isometric section of a steam-engine cylinder and steam-chest which I reproduce here (Fig. 16) to illustrate the essential features. The piston, ***P,*** is shown at about half stroke, moving in the direction of the arrows, and the slide valve, V, is in the appropriate position in relation to it at this stage.

Steam is admitted under pressure to the steam chest, C, tilling the space around the back of the valve, which has a flat face in contact with a stationary flat surface in which three ports are formed. The two outer ports open into passages, ***SS***, leading to the respective ends of the cylinder, and the central port, ***E,*** is in communication with atmosphere, or the exhaust pipe system.

Both the piston and the slide-valve are connected mechanically to the external working parts by rods which pass through packing glands, ***FG,*** to avoid leakage of steam at the openmgs in the cylinder and steamchest.

At the position illustrated, steam is being admitted to the rear or closed end of the cylinder and forcing the piston outwards; the valve meanwhile is moving in the opposite direction, so that it will cut off the steam supply as the piston nears the front end of the cylinder. During this period, the other side of the piston is in communication, through the passage, ***S***, and the cavity in the centre of the valve, with the exhaust port, ***E,*** so that the steam in this space, which has already done its work, is displaced by the piston and is free to escape.

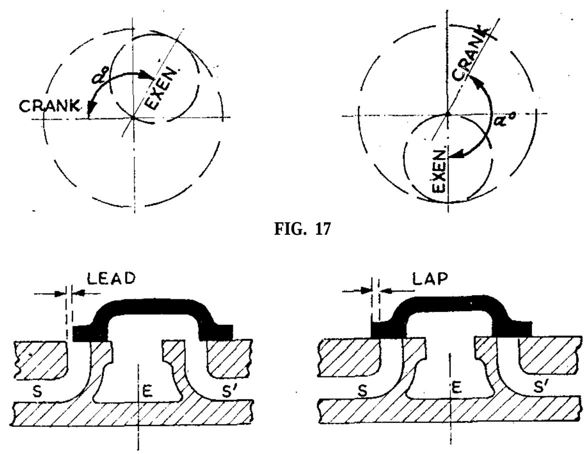
By the time the piston has completed its outward stroke, the slide-valve has moved to commence opening the front end of the cylinder to live steam and the rear end to exhaust, so that the motive force on the piston is reversed and it starts on its return stroke.

An engine of this type is said to be double-acting, as power is applied to the piston on both forward and return strokes; it is the orthodox arrangement for most types of steam-engines, though single-acting engines, in which power is produced on one side of the piston only, are employed for certain duties, particularly where it is desirable to keep the weight of working parts as low as possible for the attainment of high speed.

LAP AND LEAD

In early steam engines it was usual to make the closing faces or lips of the slide-valve on either side of the

Right, Fig. 17: Diagrams illustrating " lap " and " lead," showing corresponding positions of the crank and eccentric (clockwise rotation)



Below, Fig. 15: A simple safety-valve

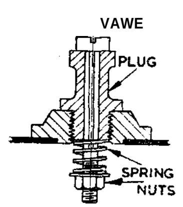
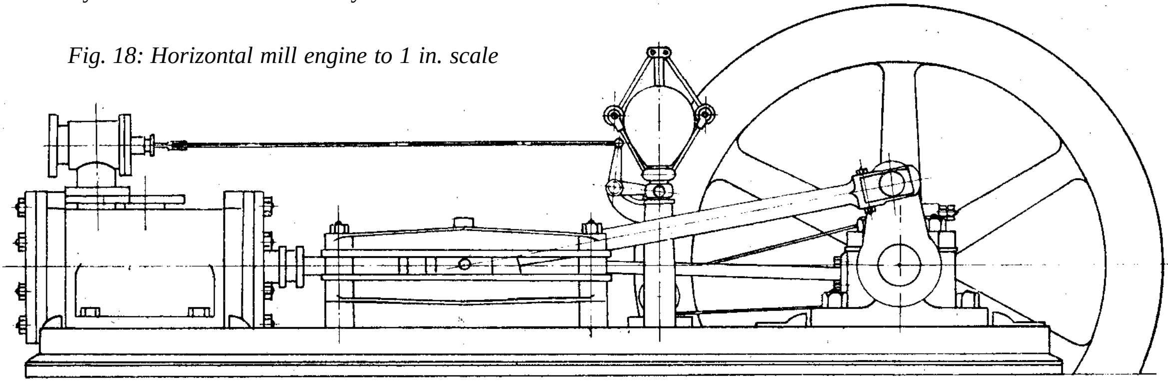
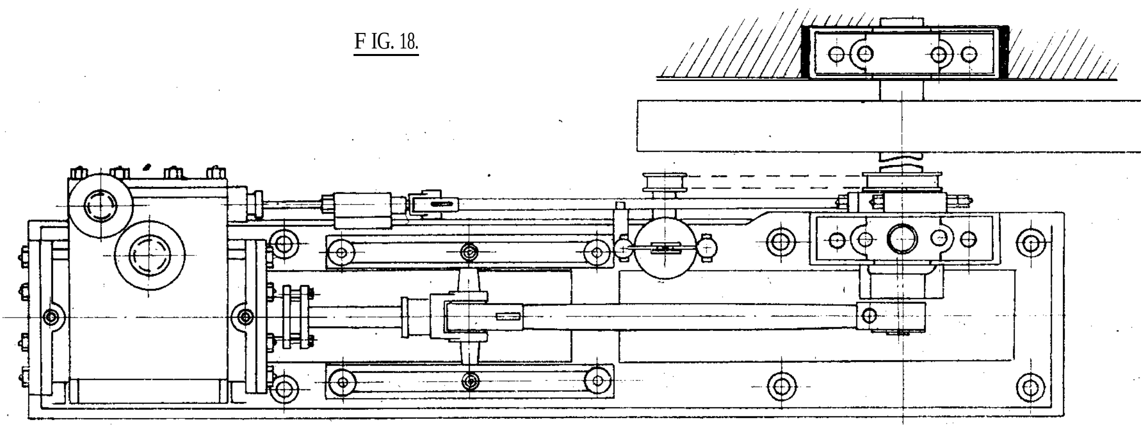


Fig. 18: Horizontal mill engine to 1 in. scale



F IG. 18.



central cavity exactly the same width as the steam ports they controlled. The valve was timed to move at 90 deg. in advance of the crank, so that the ports commenced to open exactly at dead centres and a full piston stroke was occupied both for steam admission and exhaust.

It was soon found, however, that better working efficiency could be obtained by advancing both the opening and closing points, but not necessarily in the same ratio. Early steam opening could be used to cushion the piston movement, thus bringing it smoothly to rest at the end of its stroke and also to ensure that the maximum effort was available to start it on its return. By cutting off the steam supply before the piston reached the end of its power stroke, the expansive poroperties of the steam could be used to complete the stroke, so that by the time it was released to exhaust most of its energy had been usefully expended.

The means employed to attain this result are by designing and timing the valve to produce what is known as " lap and lead." I have been asked so many times to explain these terms that I consider it worth while to reproduce another of Muncaster's diagrams (Fig. 17) which, in conjunction with the previous drawing, should make them quite clear.

It will be seen that the lips of the valve are extended in width (or, strictly speaking, length, in the direction of travel) so that they overlap the ports, ***SS***, when in mid-travel, as seen on the right; the extent of the overlapping is termed "lap." Such a valve, if timed to move at 90 deg. in front of the crank, would give delayed steam opening and thereby reduce efficiency; to compensate this, the timing of the valve is advanced by shifting the eccentric so that it begins to open the steam-port slightly before the crank reaches dead centre; the amount of opening at the latter point, as shown on the left, is known as " lead."

The diagrams above the valve sections in each case show the relative positions of crank and eccentric to produce the required timing; on the left, the crank is on its dead centre and the eccentric approximately 120 deg. in advance of it-in the usual terminology, the " angle of advance " is taken as the amount *extra* to the original 90 deg. in front of the crank, so in this case it would be reckoned as 30 deg. The right-hand diagram shows the eccentric at mid-stroke, still leading thecrankbythesameamount,ofcourse.

Incidentally, I may mention that in my directions, for timing steam-engines in the past I have occasionally been criticised for recommending " rule of thumb " methods-in other words, timing *in situ* by turning the crank to dead centres and checking up on the actual valve position. It might be considered more " scientific " to deal in exact angles of advance, and this would be absolutely necessary in an engine having the eccentrics machined integral with the crank-shaft, or otherwise rigidly pre-located.

But in actual practice the measurement of angles on very small engine components is extremely difficult-one might easily make an error of two or three degrees in the location of a keyway on a small shaft, for instanceand, moreover, it is not always advisable to regard valve setting as being "immutable as the laws of the Medes and Persians."

● *To be continued*

WIN A MYFORD SUPER SEVEN LATHE

Readers are reminded that the closing **date for the MODEL ENGINEER competition, the prize for which is a Myford Super Seven lathe, closes on April 5..**