# Elements of PATTERNMAKING

*EDGAR T. WESTBURY explains how simple patterns can be designed and made for small castings*

NEARLY all model engineers find it necessary at some time or other to study processes and skills which are generally regarded as outside the sphere of orthodox engineering. The successful construction of a model often involves much more than the fitting, turning and assembly; for instance, many models are built from castings, and the quality of the finished products may depend on the accuracy and finish of these components. While ready-made castings are offered for most popular models, special ones may be needed for an original work or for an exact scale reproduction, and these in turn. require special patterns. The services of a professional patternmaker when they can be obtained, are often very expensive, especially for the exacting requirements of small and intricate work. The many requests for advice sent to ME shows a widespread demand for practical information on the principles, problems, methods and materials of patternmaking.

We must have a clear understanding of what is meant by "pattern" in this context. Like " model," it has many definitions; and indeed the two words are often synonymous. A dressmaker uses a two-dimensional pattern, usually of paper, and a pattern described by numbers and symbols is used for knitting. But the patterns which concerns us here are three-dimensional " models " of the castings which are intended to be produced, with certain alterations to make the moulding easier and to allow for shrinkage and machining.

The need for castings in models can sometimes be avoided bv different methods of construction, such as fabrication or machining from the solid material. You should ask yourself if these would be better for a articular piece of work-a great eal will depend on whether identical components are required. These methods are essentially individual, and must be repeated in detail for each single part. But when once a pattern has been made, it can be used to produce an unlimited number of castings, involving no further detail work except the essential machining of surfaces.

Even for a single component, the casting often has advantages. Fabrication is simple enough for parts which do not involve intricate shapes, but when a scale representation of full-size engine parts (usually castings) is needed, it may become quite complicated and involve, the building up of small and delicate details by soldering, brazing or welding. Machining from the solid may be equally complicated. It often involves wastage of material and time, unless you have stock material of the approximate shape and size.

Both these methods are often employed to save time and trouble when the finished design of the component or machine is of less importance than its utility. They should usually be recognised as expedients rather than as the most efficient form of design or construction possible. Castings are an aid to good design, because the metal can be distributed as and where it is needed, structures can be stiffened by ribbing or channelling, and bosses or facings can be added for the attachment of other parts. Not all designers take advantage of these facilities; and crudely designed castings, which might just as well be replaced by chunks of stock metal, are by no means uncommon. There is room for improvement in many castings at present used in model work.

FOR THE SCHOOLS

Objections to making patterns and to getting castings made from them are often raised on the grounds that they cause delay. Much depends, of course, on whether foundry services are readily available. So far as actual time on the work is concerned, you will often find it much quicker to make a pattern and get it cast than to obtain the stock material best suited for fabricating it or machining it from solid. Moreover, it creates-a methodical approach to the problems of design, rather than a haphazard and hasty "near-enough " attitude of mind.

The facility of making castings may often determine details, or even basic principles, in the design of machines; on the other hand, constructional problems may often be simplified by care and forethought in the design of the castings. It is sometimes said that anything which can be drawn on paper can be patterned, cast and constructed; but the designer or draughtsman who does not consider the problems of the patternmaker, moulder and machinist must inevitably restrict efficiency in production.

As I have already said, a pattern is not necessarily a true model of the finished casting-which is to be provided. Usually some deviations from and dimensions are necessary. They include allowance for contraction: most metals shrink when changing from the molten to the solid state, and the pattern must therefore be made larger than the required size of casting, to an extent determined by the expansion of the metal from which the casting is to be made. This varies in different metals and alloys, from about 1/8 in. in the foot for iron, to 1/4 in. in the foot or more for brass, gunmetal and aluminium.

There must be allowance for draught; it must be possible for the pattern to be withdrawn from the mould without dragging, or disturbing the impression which it has made in the sand. Any projections which interfere with removal must, of course, be avoided-this may often dictate the design of the component -and it is highly desirable, if not absolutely necessary, that the sides of the pattern should taper away from a defined parting line, which may be at the base line for a flat casting, or the centre line for a round casting.

Allowance must be made for machining. The surfaces to be turned, planed or milled must be

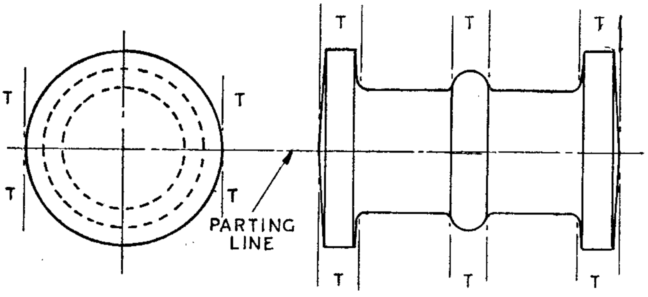
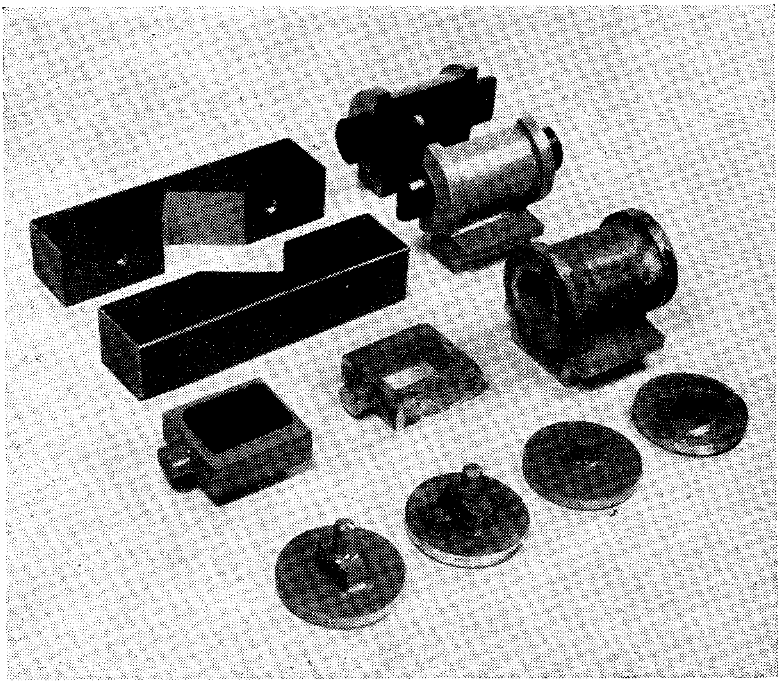



*Fig.* 1: ***Pattern for a simple cylindrical casting***

thickened enough for them to finish to the required dimensions.

Extensions must be provided on all patterns for castings which need to be hollow, or have undercut details which cannot be cast directly from a simple mould. The core prints, as they are called, serve the double purpose of supporting the separately-made core, and locating it in the correct position in relation to other surfaces of the casting. For anything except plain round cores, it is generally necessary to make coreboxes to form the internal shape of hollow castings.

The first and most essential thing that any patternmaker must study is how to be sure that the pattern will not only make a negative impression in the mould or matrix, but also that it can be withdrawn freely without disturbing the impression. The shape is involved, and also the method of locating the pattern in the mould. It is useless to try to make patterns unless these fundamental points are clearly understood. We sometimes



***Patterns, corebox and castings for parts of a locomotive cylinder***

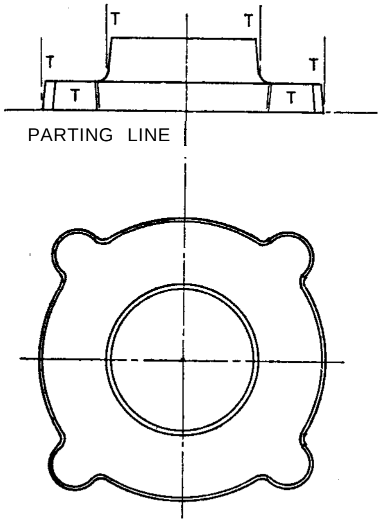



***Fig. 2: Shallow endplate pattern***

hear it said, " Don't worry-the moulder will make something out of it." This is probably true, but whether the " something " is what you really need is another matter.

To compensate for contraction, it is possible to obtain special scale rules to suit the various metals, but for occasional work it is usually fairly simple to work out the approximate variation of all essential dimensions for the required enlargement of the pattern. Ordinary sand castings cannot be made to fine limits in any event, and in work of small ***size*** the necessary rapping of pattern, to loosen it in the mould before withdrawal, is equivalent to enlarging it to some extent.
operation also lessens the importance of draught, if the pattern is not too deep, but the best course when you are drawing any pattern is generally to get it full clear of the mould as soon as it is lifted.

Machining allowance is simply a matter of adding metal to faces which have to be machined. In making drawings for patterns, it is usual to mark these faces ***f,*** indicating that they have to be "fettled " or machined. The amount to be added may vary; in full-size work it may be 1/8 in. or more, but in small work I have found that 1/16 in. is usually enough if the other casting dimensions are reasonably correct. Excess machining allowance wastes metal and machining time; it does not help in any way towards final accuracy, and it sometimes encourages machine operators to be careless in setting up castings, on the grounds that the job will "clean up all right."

Castings which have to be made hollow require internal cores. Their size and location are indicated by extended plugs or spigots known as core prints. These produce impressions in the mould, into which the separately-made cores are laid. Plain round cores, which are made in standard sizes and cut to the required length by the moulder, involve no extra work on the pattern apart from the addition of the prints. Sometimes square or rectangular cores may be had, but for all special internal shapes coreboxes must be made.

A first consideration in designing any pattern is how it is to be disposed in the mould, which in normal practice is made in a two-part box, or "flask." Some patterns can be moulded more than one way up, but nearly always there are reasons why one particular way is preferable or essential. The joint between the two halves of the mold, or in other words the "parting line," is therefore the main datum line in the pattern. Wherever possible, it should be a straight line. Sometimes it must be stepped or otherwise deviated.

A simple cylindrical casting, such as a spacing pillar or bollard, with end flanges and a central beading (Fig. 1) needs to have the pattern located horizontally, with the parting line on its true axis. Each half of the mould will thus receive a semicircular impression. No special provision for draught is necessary on the curved surfaces, including the beading; but the sides of the end flanges need to be slightly tapered,. as indicated at T. Particular attention needs to be paid to the finish of these surfaces so that there will be no dragging from the mould.

If the pattern is flat and relatively shallow, such as the endplate shown in Fig. 2, the parting line of the mould can be at base level, with all side surfaces tapering away from it as at T. Alternatively, the top of the flange can be the parting line, if the taper on the edges is reversed, but the first method is preferred by most moulders as the mould can be made in one half of the box only. With this component, the four lugs are intended to take fixing screws, and holes for them will need to be provided. Sometimes an attempt is made to provide holes in the casting, to avoid the need for drilling. This is practicable if the holes are large enough, and well tapered in the pattern; but small holes are difficult, as the projections which they leave in the mould will be very fragile and liable to collapse, to the probable detriment of the metal in the region of the lugs. Usually the best that we can hope to do is to locate the hole positions by indentations at an included angle of about 60 deg. Their practical value is often dubious, and in marking-out and drilling of the casting after it is made is usually more satisfactory.

Another common example of a shallow flat casting is the locomotive homblock in Fig. 3. If it has a plain flat surface where it is to be attached to the frame plate, it can also be cast in one half of the box. More often it has a raised register strip on two or three sides as shown, and this must make its impression in the other half. Taper for draught is in any event provided on all parts of the outer projecting flange, and especially the stiffening ribs or struts.

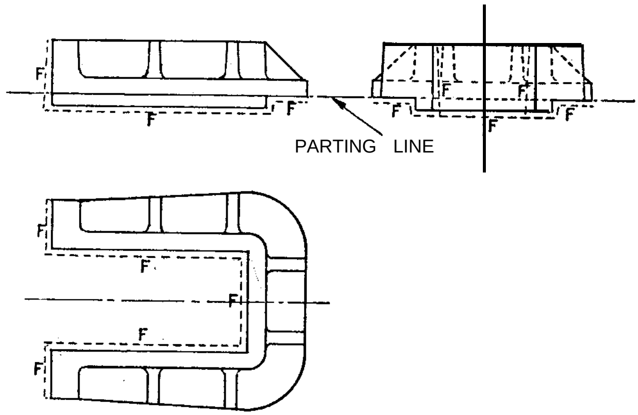



Fig. 3: ***Locomotive hornblock pattern. with allowance for machining***

* ***To be continued on March 7***

# *Only the best coal for threshing*

SIR,-As I have never threshed with a single-crank compound **Burrell,** I was interested in Ronald H. Clark's statement that this engine could do a day's threshing on **3½ cwt** of best coal.

There are a number of points to consider in a day's threshing : the length of the day (short six hours, full eight hours, long ten hours) ; the type and size of box, and the auxiliaries (trusser ? chopper ?); the class of crop ; the feeder (experienced, or just a casual ?) ; the general condition of tack ; and, last and most important. the coal.

A very great difference was to be expected between, say. a 54 in. Marshall Colonial box, with a **Hornsby** trusser, and a Humphries **Pershore** Light Farmer's box. The belt of the Marshall was much heavier, and I in. wider. and even when the machine was running empty would account for perhaps half a hundredweight in favour of the' Humphries.

Take next the class of crop being threshed. In threshing a light crop of short straw oats, we approached 3 **cwt,** with a **6 h.p.** double-crank compound and Humphries box. That day the sound of the drum hardly altered, while the **flyballs** kept on the largest circle. On the other hand, when we were threshing **vetch** (a variety of the **pea** family) with the heavy Marshall box and the same engine, we burnt well over half a ton. The governor arm went up and down like a yo-yo, and, had the belt off at least half a dozen times.

For threshing beans, a larger pulley was fitted, lowering the drum speed. The concaves were opened and thus there was much less friction on the beaters. The riddles, having much larger holes, were lighter, and on one occasion when we were threshing two-year-old beans we got down to the 5 **cwt** mark with the Marshall box and the same engine.

It will be seen that the double-crank compound could not have been so far behind the single crank, in economical running. It did not stop right on dead-centre. Imagine pulling a stuffed-up box round to get off dead-centre.

The top half of the rick or mow takes more coal to thresh than the bottom half, as this one involves throwing down and the other pitching up. One pitcher on the top can keep the feeder busy at the start, but further down the rick a good feeder can make several pitchers **sweat.**

Bearings and belts have to be in tip-top order. How I wish we could have had V belts for all the short driver ! Curiously. our men favoured the double-buckle belt fastener and refused to have anything to do with the Alligator or Peerless, with which salesmen haunted us.

Most important of all is the use of best coal. We found that the most economical was Welsh smokeless. Of course, it cost more? but we used it for haulage engines **working** in towns, where a wisp of smoke generally meant a court appearance.

I would not like to try to do a day's threshing on a ton of the stuff which often goes by the name of Best Coal today.

Cutting the bottoms of main crankshaft bearings, to drop the centre line of the crankshaft half an inch made a marvellous difference to a bad starter which we had, a single cylinder Marshall. without giving us any trouble with the gear tooth engagement.

E. H. **Jeynes.**