as shown on the sketch, compelling the hubs surrounding these cores to cool in advance of their natural time, and at least approximate synchronous cooling with the balance of the casting. The other portions of the casting during this period were kept muffled up in the sand and their cooling was delayed, while the cooling of the crank hubs was accelerated. After this method was adopted 12 such castings were made, all good, and they have been in service for some years.

Special Cooling Treatment.

The writer had to produce a number of large cylinder heads for Corliss engines, with ports for steam and exhaust valves formed in the heads. Structurally considered, the heads were like a cylindrical steam drum of large diameter but very short, having a flat head at each end, and were required to stand internal pressure. Considering the resistance to internal pressure, the cylindrical shell or outer wall could be designed quite thin as the strains in it were all tensile strains, while the heads, being flat and of great area, were subject to bending strains which demanded that these be greatly thickened up to make the flat surfaces, not easily stayed or braced together, strong enough to carry safely the pressure. In addition to this greater thickness of flat head, allowance had to be made for a machine finish on the flat surface, which was not required by the shell, and the disparity thus became still greater. The port openings for the admission and exhaust of steam made large holes in this head or flat plate, which were to be tied across ports by bars or ribs. In cooling by natural processes these bars almost invariably cracked in the casting, because the cylindrical shell being thin, cooled first, and was assisted in doing so by its position which was very close to the sides of the flask, where radiation was active. The flat head, on the contrary, was at the bottom of the flask, where radiation was poorer, and it was practically twice as thick as the rim and cooled more than twice as slowly. With these divergent tendencies trouble ensued. The rim cooled early and took on its final dimensions and in the form of a circle opposed to compression—the strongest possible shape. The head or diaphragm cooling later had its contraction tendency resisted by the stiff rim and a struggle was set up. The tension member was of course the weaker, and the large openings in the latter made the result a foregone conclusion. The diaphragm simply had to shrink or be stretched—the rim would not give—and the ribs broke.

We cured this trouble by the following means, as illustrated in Fig. 2: In the drag portion of the mould we placed a spiral coil of iron pipe through which we could circulate cooling water. This coil was placed as close to the face of the pattern as was considered safe, about 1½ inches away. The inner cores by which the head was hollowed out were also provided with similar interior cooling coils and the cope had a coil like that of the drag. After the casing was poured we waited for a few minutes to enable solidification to begin, and then we turned water into these cooling coils, and connecting the overflow to sewer connection, let the water run all night. The casting lay in the mould, the rim kept muffled in sand to delay cooling, while the coils close to the heads accelerated cooling. The result was most satisfactory and the castings produced by this process have stood the severest tests of several years continuous duty without failure. Heads of similar design made by other foundries cracked systematically, sometimes while the casting was still in the foundry, sometimes in the machine shop, but quite frequently not until after the engines were put into operation. In all cases the stress was there and the only question was *when* would it cause breakage.

It might seem almost unnecessary to say that flanges and other projections should be so designed that the moulder may most easily produce the desired shape without having to use complicated means. If the designer or draftsman were a man who had a little practical experience in foundry work he would see numerous opportunities for making shapes that would "draw" easily, rather than certain other shapes that look well on paper but are much harder to produce. On work of considerable size a little more time required to deal with a detail may prevent doing any pouring to-day, with a strong probability that the moulder can make that job last him "until to-morrow night." The designer should try to put himself in the moulder's place and imagine himself making the moul in question. Then he will see what a small difference in design sometimes causes a big difference in cost and risk. An instance of this is Fig. 3, and represents a prospective nozzle with a flange for steam or water connection. If the flange in Fig. 3 is at the bottom of a complicated casting it will require the flange pattern to be cut into removable sections or a troublesome embedded core is required. If practicable to design as in Fig. 4, the neck draws naturally and the main core forms the flange. This sort of change may not always be possible, as certain designs will demand loose bolts, while Fig. 4 would call for stud bolts, but there are cases in which the foundry's troubles can be reduced in this manner.

Breakages are sometimes difficult to account for, and the designer may think the fault is with the quality of the iron, when in fact this has nothing at all to do with the trouble, the shape and design being the true cause. The "physics of the foundry" were not properly understood when the design was made.

Card System for the Pattern Shop

By C. J. Fry.

Of the many places where a system is welcomed as an expert helper, the pattern shop is a most important one. To be a helper, it must be a system, simple and complete, and not a burden to the man who has to keep it up. There have been many pattern systems developed which contain some good points, but they are too complex for a small shop where the care falls to the pattern foreman. Again, a system which will work nicely in one shop will fail utterly in another, as it deals with a different class of product.

The following system has proved to be very simple, yet very efficient in the shop for which it was developed. There may be a few new ideas in it and some readers will doubtless notice some familiar ones, as the father of it made use of the good ideas he had met in various other shops, with enough changes to suit the following conditions: A small shop manufacturing a line of pattern-shop machinery of various sizes, but without the use of a foundry of its own. Improvements are continually being made in the machines, and these require many changes in the patterns.

4-18-1908 Mat. Gray Iron Patt. No. 24-1

Name Bed 12"

Weight		No. Parts	16 Loose Pcs.	Patt. Mat.
Rough 319#	Pattern	1	4	Wood
Fin. 278#	Core Box	2	3	Wood

			Where Used	
Out	4-19-08	Ideal Foundry		
In	4-26-08	O.K.	No.	Machine
Out			1	12"-No. 24 Lathe
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				
Out				
In				

Fig. 1—Card for Index.

The objects of the system are: First, to give each machine a number and the different parts on it another number, which in combination with the machine number forms the piece and pattern number, and to give similar parts of different machines a similar number. Second, to easily find out what castings have been ordered and how