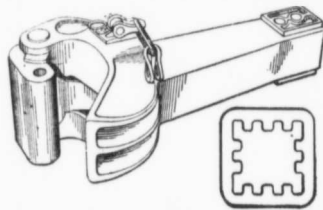


Steel castings come in as another link between cast iron and wrought material. Next is wrought iron, with its tensile strength and ductility above malleable castings. Then comes carbon again in combination and we have steel, which in its mild form is some stronger than wrought iron, and with higher carbon very much stronger. Next



Figs. 4 and 5—Coupler Draw Bar and Section of Shank.

come the alloyed steels, either in castings or wrought, which surpass all. But carbon steel—in other words, the regular commercial product—when cold worked, such as cold rolled or drawn shafting, and in one of its highest forms, as high carbon drawn wire, has as much as 10 times the tensile strength of cast iron; hence it is easily seen how widely qualifications for different uses may vary.

WHERE CAST IRON IS PREFERRED.

Much money and often sore disappointment would be saved if fundamental principles were considered at the start. Cast iron being the basic metal is cheapest per pound,

pressing sheet metal is well advanced, but the sharp effect in surfaces and intricate and delicate forms possible in cast iron cannot be realized in wrought material cheaply enough. A stove, whether for gas or coal, is an impossibility in wrought, and even if so made would not stand the heat like cast iron. Cast iron water pipe costs much more per foot than wrought steel, yet it is used almost exclusively for water mains because of its resistance to corrosion by contact with the earth, water, etc. The highly practical difference between the tensile and crushing strength of cast iron is an important factor in maintaining the supremacy in many articles. This principle is well illustrated in the Hodgkinson beam, Fig. 1, where in order to use a minimum amount of metal to support a given load it has about five times more sectional area in the lower flange than in the top. The beam itself has given place to wrought steel, but the principle remains.

CHILLED CASTINGS.

Chilled cast iron has its hardness produced by chemical change taking place from sudden cooling, which is a different matter altogether from hardening a piece of steel, for by heating the steel again the hardness may be taken out; but subsequent heating under ordinary conditions will not take the hardness out of chilled cast iron. Another principle often involved in the choice of materials is that of the wear of one on the other. A wrought or fibrous material wearing on a cast iron or granular one is the best condition so far as these metals are concerned. For instance, the wheel box with wagon skid, Fig. 13, is universally of cast iron, on account

often decides the choice of material, as some articles can be made in wrought so much lighter than castings. This factor is highly important where muleback transportation is involved. In rail joints, forms which can only be made of steel castings will be limited in use because of the uniformly close fit necessary. Many efforts have been made to produce these in castings, but even such forms as Fig. 2 are made cheaper in wrought and there can be no question about their

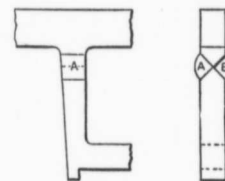


FIG. 7.

FIG. 8.

Parts of Forged Locomotive Frame.

being better. In journal boxes for railroad cars efforts in pressed steel are quite recent, but so far there is nothing to report. In journal box wedges drop forged ones have made considerable advance against castings, but the great body of these are still made in castings, mostly malleable, and it will be interesting to watch the outcome.

MALLEABLE CASTINGS AND THEIR ADAPTATIONS.

Malleable castings with their large development are limited to a considerable degree by size, or rather by thickness of section, owing to the fact that this material differs physically and chemically from the surface to the center. The best part is on the outside, and the nearer that this better condition can be made to reach clear through, the better the article. A section containing 1 sq. in. would be much better if of $\frac{1}{4} \times 4$ in. than of 1×1 in. There are, therefore, many articles which are of excellent quality in lighter sizes of castings, but in heavier are better of wrought; hence another condition divides the uses of the two materials—namely, where size determines the quality. Chain swivels, Fig. 3, are largely, in fact almost wholly, made of malleables in the lighter



FIG. 6—Cast Steel Locomotive Frame.

but is not therefore the cheapest, even per pound, when it comes to being put into commercial forms. A straight, clean 60-ft. railroad rail cannot be made of cast iron as cheaply as of wrought steel, leaving quality out of the question. On the other hand, for many articles wrought metal would be gladly accepted in place of castings, but price determines that castings shall be used. In this class are door lock parts, engine beds, flywheels, car couplers, brake wheels, sash weights, and parts for cars, for agricultural implements and for household articles without number. On the other hand, there are many articles in which both prices, on account of form, and quality, on account of granular structure, favor plain cast iron. These include ingot molds, smoothing irons, balls for pipe welding, furnace plates, many forms of forging and pressing dies, finishing rolls for rolling mills, etc. It is true that rolls for heavy roughing work are often preferable in steel, but for finishing, cast iron ones are best and would, therefore, be used even at a higher cost. They clean themselves, where wrought rolls would let the hot metal stick to them.

A stove burner shows a wonderful combination of the economical, useful and ornamental in cast iron articles which will never be reached in wrought material. The art of

of wearing qualities as well as cost. Chilling steel castings in the sense mentioned has not so far been done commercially. A little has been done in uniting chilled cast iron to steel castings, but this is limited to plain forms.

WIDER FIELD FOR MORE RECENT PROCESSES.

The art of casting is so much older than that of rolling, forging and pressing that we may reasonably look for comparatively more development along these last named lines. As to rolling, slitting rolls for cutting hammered plates into nail rods came first. Sheet rolls are about 175 years old, while grooved rolls have been in use only about 125 years, and three-high rolls came in the last generation. It is only 100 years since formed up sheet metal commenced to displace castings in forms which had been in use for thousands of years. When it comes to bars of uniform section, or even those having an alternate limited change of sectional shape and of any considerable length, price alone determines the choice of the wrought, while the quality is also in its favor. In this list are such as railroad rails, wire, concrete reinforcing bars, frames for buildings, bridge members—in fact, an endless number.

The matter of freight for long distance



FIG. 9—Cast Iron Step.

FIG. 10—Malleable Step.

sizes, say up to $\frac{1}{2}$ in. But when it comes to a swivel, say, for a 2-in. chain, which must pass through a 9-in. circular opening and uniformly stand a test of 250,000 lb. pull, malleables are not equal to the requirements, owing to the thick section. Harness snaps are almost wholly made in malleables, of course, with a wrought steel spring, and yet some of the heavier ones are demanded, and a comparatively few are made, in wrought.