inspecting same. An examination of the show case immediately reveals to one the great care necessary to produce such perfect fractures, also to make the process easily understood by users, and we have pleasure in endeavoring to give a rough description of same. The first fractures are of the iron in the rough state, exactly as received at the works, in Sheffield, from Sweden. The next set shows the Bliske steel, or converted bar iron, which is broken into small pieces and along with the various alloys and rare metals, melted in a small crucible. The next fracture in direct order is the ingot fracture, from which the finished bar is forged. This, of course, is the one of most interest to the user. Fractures of a few of the standard grades of tempers, manufactured by this company, are displayed in the finished state, including the present day high speed steel ("Capital"), special Dannemora extra hard cast steel for use on chilled rolls and similar hard materials. "D.S.W." (Dannemora Steel Works) Brand—an oil or water hardening steel, suitable for roughing tools, etc., where the machinery is too heavy for the ordinary carbon tool steel, but not heavy enough for high speed, and is also an excellent finishing steel. As regards ordinary carbon steels, we think you will agree with us the following list covers a very large field, and we are confident that The Eagle & Globe Steel Co., Limited, will be able to satisfy even the most "hardened tool steel critic,"—from the following list:—

No. 1 temper (1½ % carbon), for razors, etc.

No. 2 temper, (1¼ % carbon), for turning tools, small drills, and cutters.

No. 3 temper (1⅛ carbon), for punches, taps, rimers, and large drills.

No. 4 temper, (1% carbon), for chisels, small shear blades, etc.

No. 5 temper, (⅞% carbon), for sets and large shear blades.

No. 6 temper, (¾% carbon), for dies, hammers, snaps, etc.

Messrs. Drummond, McCall & Co. are also showing a few samples of "Capital" brand high grade files, of full standard Sheffield weight, and guaranteed to outlast the low grade, light weight, high discount article by 3 to 1. Also, as they are made from special material, actually costing to produce three times as much as the ordinary carbon file steel, one cannot do otherwise than see that they are eminently suitable for recutting, and we understand the manufacturer guarantees them to go through the process at least twice.

Physical Characteristics of Cast Iron

Paper Read Before the Engineers' Club of Philadelphia—Cast Iron in Structural Use—Experimental Results do not Harmonize with Theory of Flexure.

By James Christie.

Cast iron is probably the most complex, variable and uncertain form in which iron is used. Not only is the content of extraneous metals and metalloids variable, but the condition in which the associated carbon exists and the character of this association are determined largely by the influence of silicon and possibly other metalloids. Again, the physical properties of the metal are influenced by casting temperature, rate of cooling, etc., so that altogether we can only predicate the probable strength and stiffness of a casting in the most general way, and forecast results which will suit an average from which individual castings may vary widely in extremes. Gray iron of the foundry grades is alone considered here. The grading of the pig metal at the furnace has been determined in the past by the appearance of the fracture, but recently, as much of the product is run in metal molds and the appearance of the fracture is deceptive, the tendency is to grade by chemical composition, the softer and weaker metals having the highest silicon and the lowest percentage of combined carbon. Taking three grades of foundry pig and assuming that these are used for different classes of castings, we would have:

No. 1—2.5 to 3 per cent. silicon for light castings.

No. 2—2 to 2.5 per cent. of silicon for medium weight castings.

No. 3—1.5 to 2 per cent. silicon for heavy weight castings.

As a general average, all the grades will carry about 3.5 per cent. carbon in total.

Physical Properties.

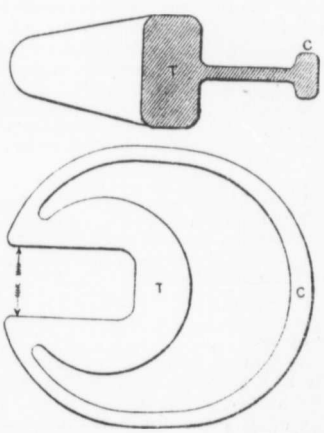
The recent specifications of the American Society for Testing Material require a transverse test on specimens 1¼ in. in diameter and 12 in. between supports, load in the middle:

2,500 lb. or over for light castings.

2,900 lb. or over for medium castings.

3,300 lb. or over for heavy castings.

with deflection before rupture not less than 1-10 in. The tensile strength of the aforesaid grades respectively is required to be not less than 18,000, 21,000 and 24,000 lb. per square inch of section. While these standards are valuable in maintaining a high quality of product, yet they may imperfectly represent the resistance of the metals in actual service. We know that cast iron is



Frame of an Open Gap Machine, Illustrating Tension and Compression Stresses in Cast Iron.

in extensive use that falls far short of these requirements. High tensile strength is frequently associated with brittleness and is not always indicative of superiority.

For heavy machinery, etc., cast iron is used in heavy masses, through which working stresses are imperfectly distributed, and probably is much softer and weaker in the middle of the mass, where it has cooled slowly, than at outer surfaces, where the metal has more rapidly cooled. Furthermore, castings are usually under considerable internal strain, due to unequal contraction, and although this internal strain gradually disappears, it may have some disturbing influence after the casting has been put in service. It has been the practice of the writer to assume an ultimate tensile strength of 16,000 lb per square inch for ordinary iron castings, and to limit working stresses from 2,000 to 4,000 lb. per square inch, according to the conditions and character of the service.

Cast iron offers a high resistance to compressive stress, and although this resistance varies within wide limitations, it may be assumed as a working basis to be about six times that of the tensile strength, or, say, 95,000 lb. per square inch of section.

Cast iron is imperfectly elastic as compared with the superior forms of the metal. It presents no definable elastic limit and exhibits marked permanent set under low loads, either in tension or compression. Experiments continued for several years indicate that when loads exceeding one-half the ultimate are applied, failure eventually ensues. It may, therefore, be assumed to have a practical elastic limit in tension of about one-half the breaking load.

The coefficient of elasticity is likewise variable, in contradistinction to the constancy of the elasticity, under ordinary conditions, of wrought iron and steel.

Recorded experiments indicate that the modulus of elasticity varies considerably in extreme cases, and is nearly alike in tension and compression. A modulus of 13,000,000 lb. appears to be a fair valuation for direct tension and compression, or for bending loads applied transversely this modulus appears to average 16,000,000 lb. when used in computation with the commonly accepted formula for flexure.