Three core materials were tested. The first was made from commercial power transformer laminations of silicon steel .017 inches in thickness. The second was a core prepared from steel taken from a well known radio transformer with laminations of .004 inches in thickness. The third sample was prepared by molding together fine filings of the second steel with a binder of paraffin and rosin. A power hack saw was used to produce the filings. The results of the tests showed losses as follows: Silicon steel .017 inches in thickness gave 4.570 watts loss per cubic centimeter or .290 watts loss per gram; radio transformer steel .004 inches in thickness gave 3.702 watts loss per cubic centimeter or .225 watts per gram; ground transformer steel .394 watts loss per cubic centimeter or .049 watts loss per gram. These comparative results were all taken with a constant power input to the high frequency circuit. The frequency of the exciting circuit was 603 kilocycles and was thus inside the longer wave length broadcasting band.

A radio frequency transformer was built with a removable core and placed in the circuit of a radio frequency amplifier. Resonance curves were plotted using both cores two and three with a constant input to the circuit. These curves showed the maximum ordinate of the resonance curve for the laminated steel to be only 11.66 per cent of that for the ground steel. This compares very favorably with the ratio of the losses which was 10.62 per cent for equal volumes. Cutting down the iron losses thus very greatly increases the efficiencies of these transformers.

A MAGNETIC METHOD FOR THE DETERMINATION OF THE ELASTIC LIMIT OF IRON AND STEEL.

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This report is a summary of a portion of the thesis work done by Victor E. Schlossberg, B. S. in E. E., '26, and Paul E. Duffendach, B. S. in C. E., '27, at the Rose Polytechnic Institute.

While studying the elongation of a sample of steel due to its magnetization, Mr. Schlossberg investigated the effect of applying a tensile stress to the sample while it was subjected to a fairly strong magnetic field. The sample, a 1½-inch cylindrical steel bar, was placed in a 100-ton Olsen testing machine which could be run at a very uniform speed. Two primary coils supplied with constant current from a 32-volt storage battery gave the required magnetomotive force while a secondary coil, placed between the two primary coils and connected through a damping resistance to a ballistic galvanometer, served to indicate any change in flux due to the stress applied. A strain gauge was also attached to the sample to indicate the elongation.

Considerable care was taken to shield the apparatus from stray fields which might mask the effect to be studied. With this arrangement, a uniform change in flux would produce a correspondingly uniform deflection of the galvanometer. With the testing machine running at constant speed, stress, strain gauge, and galvanometer readings were taken every ten seconds. These readings were plotted in two curves, stress against strain and stress against galvanometer deflection.

The samples of steel and wrought iron showed the usual abrupt change in the stress-strain curves at the yield point. The stress-galvanometer deflection curves showed a slight progressive increase in flux for stresses up to approximately half of that at the yield point. For stresses approaching the yield point from this value the rate of increase of flux became much more rapid till the deflection reached a sharp maximum point at about 400 pounds per square inch before the yield point. From this point the increase in flux rapidly diminishes to zero and a decrease in flux begins, giving a reversal of the galvanometer reading at, or very close to, the yield point. A series of tests on different samples of the same steel and iron, with the machine run at different speeds show curves of the same general form and with the point of maximum deflection occurring consistently within two or three hundred pounds of the same stress. This maximum point evidently indicates rather sharply the true elastic limit and the intercept on the stress axis, the yield point.

Figure 1 shows a typical set of curves for a mild steel while figure 2 shows the same for wrought iron. Strain gauge readings were plotted directly and the stress is given in pounds per square inch.

Mr. Duffendach applied this method to the more difficult task of determining the elastic limit for malleable cast iron. The samples were furnished the Department of Civil Engineering by the National Malleable and Steel Casting Company of Cleveland for this investiga-

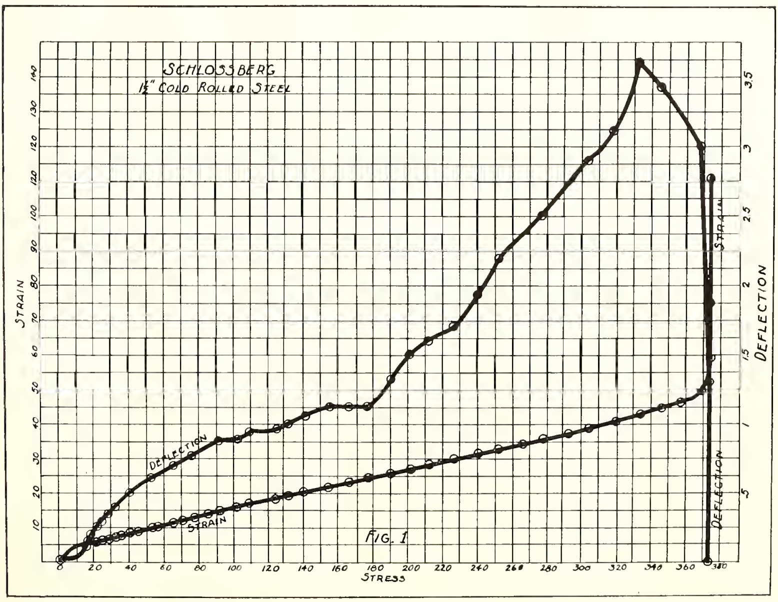

Fig. 1—Stress-Strain and Stress-Deflection curves for mild steel.

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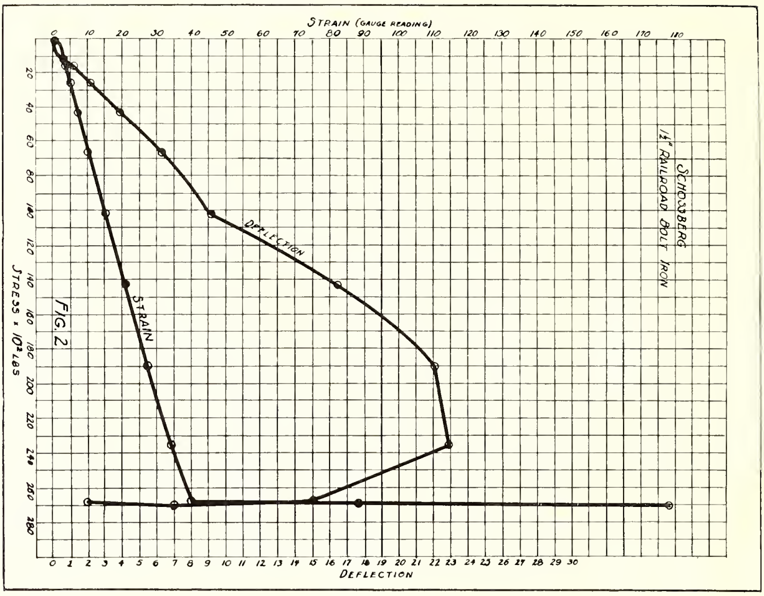

Fig. 2—Stress-Strain and Stress-Deflection curves for wrought iron.

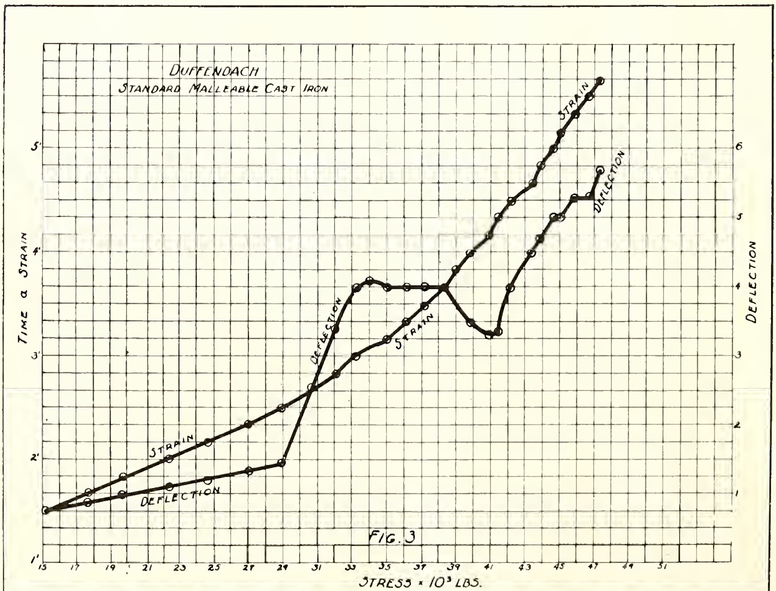

Fig. 3—Stress-Strain and Stress-Deflection curves for malleable cast iorn.

tion. They were standard test castings with only about four inches of uniform cross section. This is necessary to prevent flaws in casting. As a result it was not possible to use a strain gauge after the coils were in place. Preliminary tests showed a linear relation between time and elongation when the machine was run at constant speed. The readings were taken as before and the time plotted against stress to determine the shape of the stress-strain curve. For this kind of material the flux changes were much smaller so the number of turns on the secondary coil was increased and less resistance used in series with the galvanometer.

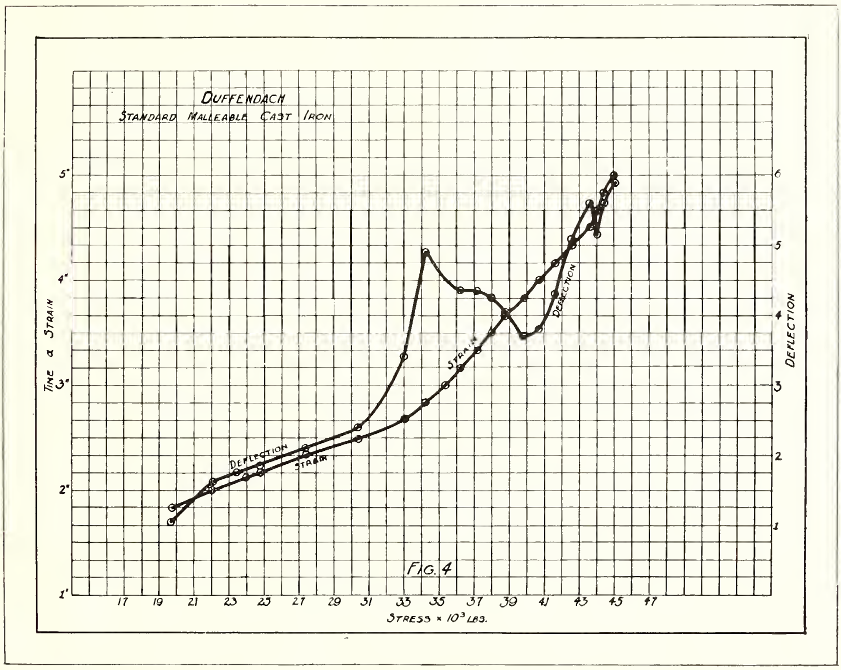

Fig. 4—Stress-Strain and Stress-Deflection curves for machined malleable cast iron.

Figure 3 shows a typical set of curves for the malleable cast iron. Figure 4 shows a set of curves for another sample which has had the surface machined away. The machining, which removed the outer skin of the casting, has produced little effect on the curves.

As expected, the stress-strain curves showed a gradual curvature which made it difficult to determine either the elastic limit or the yield point from them. The stress-deflection curves, however, showed much the same preliminary shapes with definite and consistent peaks for the elastic limit. After this point the curves differed widely from those for wrought iron and steel. The stress-strain curves showed no definite yield point with large slippage and this was confirmed by the deflection curve. After the initial drop in galvanometer deflection following the peak point, successive peak values were shown corresponding to successive slippage and resetting. These changes occcurred so rapidly that no actual reversal of the galvanometer reading was obtained.

The most consistent point on the deflection curve is the first peak point. For all the runs taken this point occurs within about 200 pounds either side of 34,200 pounds per square inch. From the curves shown it can be seen that the stress-strain curves show considerable curvature before this is reached. In spite of this, the consistency of the stress values at this peak point and its obvious interpretation from the wrought iron and steel curves make it the logical value to interpret as the elastic limit. This value can also be much more definitely located than any corresponding point on the stress-strain curve for this material.