along the pressure curve, the right angle ABC, of which the side *AB* is equal to $^{10}\log 2$ in length, the curve intercepts on the vertical side of the angle a variable length *AC*, which admits of a maximum equal to p_{1u}, because the curve is so shaped. This way of looking at things supposes, that the wall in the situation *ABC* of the figure, that is to say, submitted to an internal pressure *A′C* and an external pressure *B′B* yields as a wall submitted to the sole internal pressure *AC*, combined with a purely hydrostatic state *B′B*, which is legitimate. It is then obvious, that the displacement ratios *u*/*r* must be corrected by subtracting from their values the pure elastic contribution, attributable to the hydrostatic state *B′B*.

Manning's theory has been tested by Crossland, Jörgensen and Bones [1958]; as far as great deformations and pressures p_{1u} are concerned, theory and practice give concordant results as well for a 0.15% carbon steel as for a low-alloy steel. By the way let us say, that the correct value of p_{1u} can only be measured, when the appropriate test is very slowly carried out. Otherwise the cylinder would appear to be too resistant owing to the fact, that the wall had not time enough for thinning down, as much as required. It is true, that Faupel [1956] has mentioned grievous divergences between his results and Manning's predeterminations but as he does not say anything about the torsion test rods and the former utilization of the cylinders, it is most likely, that the test rods steel was not in the same state as the cylinders steel.

Manning's theory has the same disadvantage as the elementary theory and eq. (15). Torsion tests results are necessary for applying this theory. One has thus tried to compute p_{1u} by means of empirical formulae such as the two following ones, which have been taken into consideration by Crossland and Bones [1958] and criticized by the same :
Faubel and Furbeck [1953] formula :

$$p_{1u} = \frac{2\sigma_y'}{\sqrt{3}}\left[2 - \frac{\sigma_y'}{\sigma_u}\right]\log k,$$

average diameter formula :

$$p_{1u} = 2\sigma_u\,\frac{k-1}{k+1},$$

in which σ_y is the upper yield stress in tension, σ_y', the lower yield stress and σ_u the ultimate tensile stress.

Unfortunately, Gladkovskii, Vereshchagin and Ivanov [1958] have mentioned that their results do not agree with both above-mentioned empirical formulae neither with others previously mentioned by Crossland and

BONES [1955]. On the other side, LIALINE [1959] has demonstrated, that by slightly modifying the average diameter formula

$$p_{1u} = (\sigma_y + \sigma_u)\frac{k-1}{k+1}$$

the question of safety is duly taken into account, provided that one utilizes the 0.01% conventional yield point σ_y, as far as steel grades are concerned of which the upper yield stress is not accurately defined.

An empirical formula, which has been proposed by LEINS [1955] and has been carefully studied by DAVID [1956] is worth mentioning

$$(k-1)\,\frac{\sigma_u}{p_{1u}} = \alpha + \beta\,(k-1)$$

Unfortunately this formula cannot be immediately applied. The parameters α and β, which are typical of the selected steel, can only be determined by carrying out bursting tests on cylinders.

6. The Shape, the Structure and the Chemical Attack

Their effects

The attention of the reader will here be drawn to certain effects which often affect pressure vessels and may be dangerous. The effects of the temperature will be separately grouped in the following section for convenience sake, owing to the fact, that some of the phenomena here dealt with, such as corrosion and ageing definitely depend upon the temperature.

When we expounded the theory of the thick-walled cylinder, we only considered the smooth part of the wall, the ends of which we systematically disregarded. Now it is precisely at the ends that shape irregularities are to be found : more or less sudden modifications of the diameter, threads, holes etc. Such irregularities modify the stress field and cause the material to yield locally and precociously. This yielding is not to be considered as a phenomenon capable of doing a lot of harm. On the contrary, it is rather a phenomenon, which it can be taken advantage of, provided it can normally develop. All that hinders a material from easily yielding must consequently be avoided such as the re-entrant corners for instance or especially a material insufficiently ductile because it has been submitted to too severe a hardening.

A material submitted to variable stresses becomes "tired". It is therefore not necessary that the algebraic sign of the stress change, as it is for instance