safety is much better taken into account. Personally, we have recourse to Tresca's hypothesis, when we design new apparatuses.

Eq. (15) shows, that it is little advantageous to choose a k ratio above 3. The wall elastic resistance is only increased by 5%, when one passes from $k = 3$ to $k = 4$, whereas the weight of the cylinder is increased by 87%.

We will tackle now the problem of an overstrained cylinder. In the first place we will make our readers acquainted with an elementary solution, which can be expressed algebraically and owing to this advantage, completes Lame's formulae. We will then briefly describe a more refined solution elaborated by Manning and necessitating numerical integrations. Both theories, on which above-mentioned solutions are based, assume, that the plastic front obeys the law of the cylindrical symmetry. The elementary solution is based on Cook's hypothesis : the axial stress is equal to the arithmetical mean of the other main stresses : $\sigma_z = \frac{1}{2}(\sigma_t + \sigma_r)$ as well in the elastic zone of the wall as in the plastic zone of it; it is to be noted, that eqs. (9) to (12) of table 1 can be used, when the solution of the problem is based on Cook's hypothesis, although obviously the whole axial load exerted on the wall is not borne by the elastic zone of the latter. Cook's hypothesis is thus at least audacious and one must make sure, that it does not lead to contradictions. The inner radius of the wall is indicated by r_1 the outer radius by kr_1, the radius of the plastic front, by mr_1 and any variable radius, by lr_1 (see fig. 7).

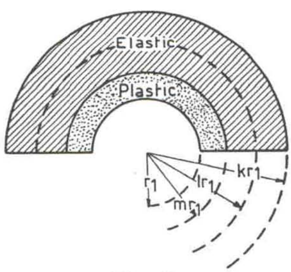

Fig. 7.

The zone, which remains elastic, will be first dealt with. Its diameter ratio is $kr_1/mr_1 = k/m$ the variable radius is in this region comprised between mr_1 and kr_1. The variations of the quantity l are thus comprised between m and k. As pressure p_m at $l = m$ reaches its yield value this value may be extracted from eq. (15), provided that p_{1y} is replaced by p_m and k by k/m

$$p_m = \left(1 - \frac{m^2}{k^2}\right) \tau_y. \tag{15}$$

Eqs. (9) to (13) are now applicable to the elastic zone by putting down $p_2 = 0$ and by replacing p_1 by above-mentioned p_m value, k by k/m and l by l/m. One forms thus eqs. (16) to (20) of table 2.

TABLE 2

Elastic zone ($m \leqslant l \leqslant k$)

$$\sigma_r = m^2 \left(\frac{1}{k^2} - \frac{1}{l^2} \right) \tau_y \tag{16}$$

$$\sigma_t = m^2 \left(\frac{1}{k^2} + \frac{1}{l^2} \right) \tau_y \tag{17}$$

$$\tau = \frac{m^2}{l^2} \tau_y \tag{18}$$

$$\sigma_z = \frac{m^2}{k^2} \tau_y \tag{19}$$

$$Eu = \left(\frac{1 - 2\nu}{k^2} + \frac{1 + \nu}{l^2} \right) m^2 \, l r_1 \, \tau_y \tag{20}$$

Plastic zone ($1 \leqslant l \leqslant m$)

$$\sigma_r = \left(\frac{m^2}{k^2} - 1 \right) \tau_y + \left(\log \frac{l^2}{m^2} \right) \tau_y' \tag{21}$$

$$\sigma_t = \left(\frac{m^2}{k^2} - 1 \right) \tau_y + \left(2 + \log \frac{l^2}{m^2} \right) \tau_y' \tag{22}$$

$$\tau = \tau_y' \tag{23}$$

$$\sigma_z = \left(\frac{m^2}{k^2} - 1 \right) \tau_y + \left(1 + \log \frac{l^2}{m^2} \right) \tau_y' \tag{24}$$

The plastic zone has a diameter ratio equal to $mr_1/r_1 = m$. The variable radius of this region is comprised between r_1 and mr_1, so that l varies between l and m. All that we know about the stresses in this zone is that $\sigma_t - \sigma_r = 2\tau$ and $\sigma_t + \sigma_r = 2\sigma_z$. This is however a valuable information, because following equalities may be written : $\sigma_t = \sigma_z + \tau$ and $\sigma_r = \sigma_z - \tau$ and because the stress configuration appears to be a combination of hydrostatic stress σ_z with a pure shear stress. Under these circumstances, we know from Crossland's experiments, that the plastic yield is not modified by σ_z and