IV. Discussion

There is little doubt that the Leinss (1955) equation,

$$\frac{(K-1)\sigma}{P} = \alpha_1+\beta(K-1), \qquad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

can be used to define the failure pressure of a thick cylinder by bursting or yielding by putting σ equal to the ultimate tensile stress σ_u or the tensile yield stress σ_y as applicable. The parameter α_1 is less than unity for most results previously published.

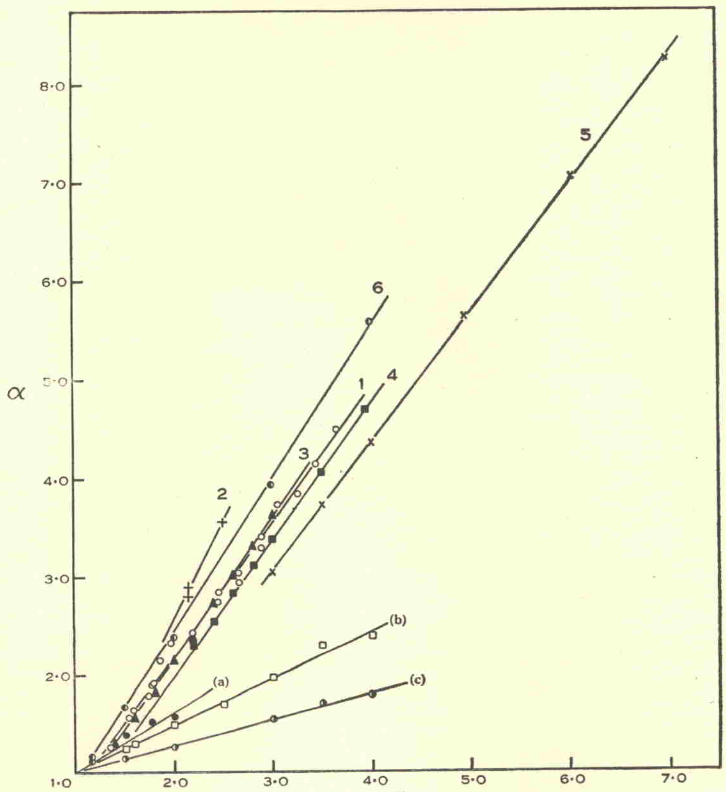

Fig. 4.—α,K plots for cylinders failing by yielding. Numbers on curves identify results in Table 3; (*a*), (*b*), (*c*) are results of present investigation.

The result for cylinder No. 6A of series 2 (Table 2) is of interest. This cylinder had a bore diameter different from that of the others in the series but fitted the correlation between them well. This indicates, as do the results of Crossland and Bones for bore diameters ranging from 0·269 to 0·750 in., the absence of the size effect reported by Cook (1932).

The experimental results obtained in this Laboratory indicate that, for a given material, the slope β of the α,K-line varies smoothly with the yield stress σ_y. The three pairs of values of β and σ_y were fitted to the equation,

$$\beta = A\sigma_y{}^a, \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

giving $A = 1{\cdot}39 \times 10^{-2}$ and $a = 0{\cdot}876$. The maximum difference between experimental and calculated values of β was 6·4 per cent.

Further confirmation of some such relation would enable predictions of yield pressure for cylinders of a particular material to be made from the results of tensile tests alone.

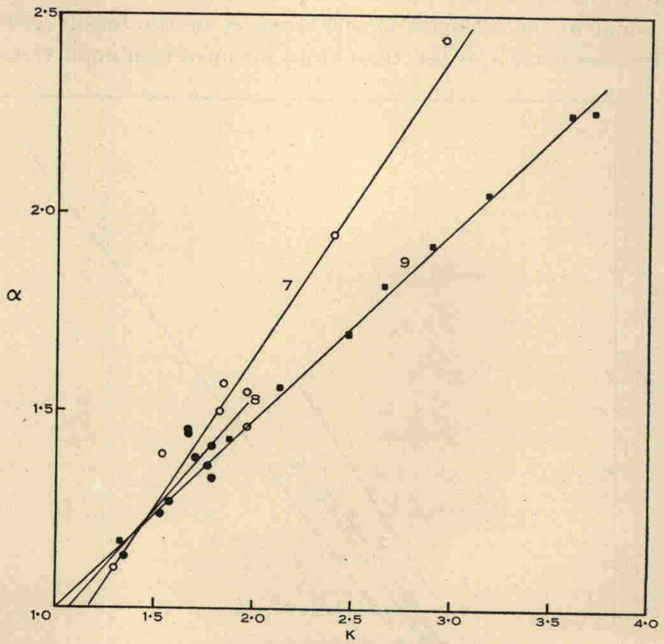

Fig. 5.—a,K plots for cylinders failing by bursting. Numbers on curves identify results in Table 3.

It is perhaps of interest to examine the implications of the Leinss equation (3). It may be transformed to

$$\frac{P}{\sigma} = \frac{1}{a_1/(K-1)+\beta}. \qquad \ldots\ldots\ldots\ldots\ldots\ldots(5)$$

As $K \to \infty$, $a_1/(K-1) \to 0$, and in the limit $P_\infty = \sigma/\beta$, where P_∞ is the failure pressure for an infinitely thick cylinder. If, therefore, $\beta < 1$, $P_\infty > \sigma$, that is, for materials for which β is fractional, the failure pressure for thick cylinders of the material is greater than the relevant tensile stress.

P_∞ can be logically expected to increase with σ and this may be expressed

$$\frac{\mathrm{d}P_\infty}{\mathrm{d}\sigma} > 0. \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

For the form of equation between β and σ chosen (eqn. (4)) the only condition for this is $a < 1$. The experimental results satisfy this condition.

No theoretical justification for the Leinss equation can be offered at the moment. The theoretical analysis of Turner (1910) gives, for a cylinder in which the