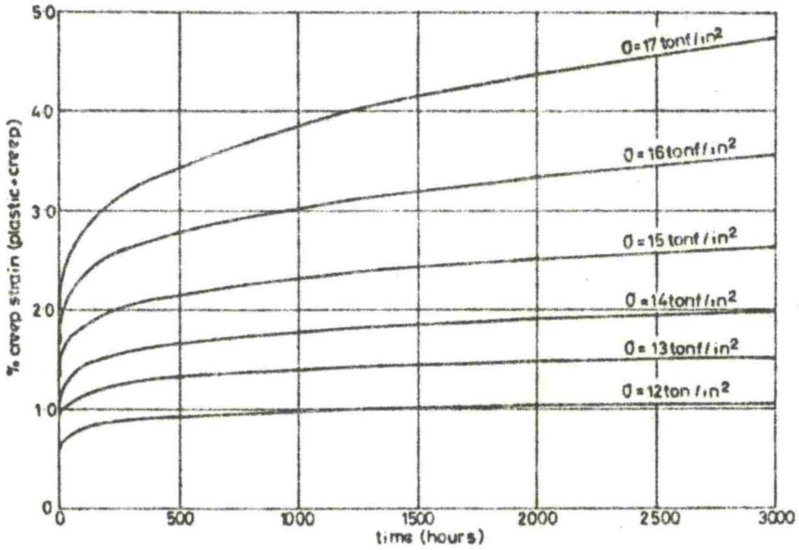

FIG. 7 EXPERIMENTAL TENSION CREEP CURVES FOR 0.18 PERCENT CARBON STEEL AT 400°C

Thereafter, all the time-dependent strain is taken as creep strain. The results of the torsion creep tests are plotted in Fig. 6, the tension in Fig. 7, and the cylinder creep tests in Fig. 8. They are plotted as total strain (i.e., initial plastic + creep) vs. time. Experimental points are not shown as in every case they lay on the smooth curves drawn. It should be noted that the reason for the slight variation in increment of shear stress between each torsion creep test was due to the critical dependence of stress on wall thickness and to the necessity of allowing for the oxide layer formed in the thin-walled tubes.

DISCUSSION AND CORRELATION OF RESULTS

There was some experimental scatter between the curves from one stress level to another, especially in the torsion creep tests, and inasmuch as the torsion data were to form the basis of most of the correlation work, it was deemed necessary, before analyzing it, to eliminate this scatter. This was done by cross-plotting from the torsion creep curves, shear stress-strain curves for various values of time, or what are termed isochronous curves. Smooth curves were drawn through the resulting points and to assist in this it was found helpful to plot the initial curve (t=0) using not only the initial plastic shear strain values but also values taken during the complete loading-up procedure for each test. Some of the isochronous stress-strain curves obtained in the above manner are shown in Fig. 9. From these it was a simple matter to redraw the modified torsion creep curves shown in Fig. 10 with creep shear strain plotted versus time. The shear stresses in the modified curves were chosen with an equal increment of 0.5 tonf/in.^{2} between each, which shows another advantage of drawing isochronous curves.

It can be seen from Figs. 6, 7, and 8 that there was no significant evidence, up to 3,000 h, of tertiary creep, or more specifically an increase of strain rate, in any of the tests so far conducted.

The creep constants in Eq. 7 were then found from the modified torsion creep curves [1] and the following expression was then taken to represent the data:

$$\gamma = 6.74 \times 10^{-8}\ \tau^{4.70}\ t^{0.313} \tag{27}$$

Figure 11 compares the curves predicted by Eq. (27) with the modified experimental ones. A reasonable fit has been achieved for the majority of stress levels, and at worst the deviation for any curve is 10 percent at 3,000 h.

The tension data was also processed in a similar way and the expression found to fit these curves was

$$\epsilon = 9.12 \times 10^{-9}\ \sigma^{4.5}\ t^{0.25} \tag{28}$$