which introduced into eqs. (6) and (7) change the latter into eqs. (9) and (10) of table 1. Constant C depends upon how the wall is obturated. For instance fig. 6b represents a wall, closed by plugs, which transmit to the latter an axial thrust. The axial forces equilibrium, which has yet not been envisaged leads to the following equation :

$$\pi p_2 (kr_1)^2 + \pi\sigma_z (k^2 r_1^2 - r_1^2) = \pi p_1 r_1^2$$

and consequently to eq. (12) of table 1. Fig. 6c shows a wall, closed by plugs and only submitted to an internal pressure. This case, which often occur in the engineering practice, is described by eqs. (9) to (12) of table1, provided

TABLE 1

$$\sigma_r = \frac{p_1 - k^2 p_2}{k^2 - 1} - \frac{p_1 - p_2}{k^2 - 1}\frac{k^2}{l^2} \tag{9}$$

$$\sigma_t = \frac{p_1 - k^2 p_2}{k^2 - 1} + \frac{p_1 - p_2}{k^2 - 1}\frac{k^2}{l^2} \tag{10}$$

$$\tau = \frac{p_1 - p_2}{k^2 - 1}\frac{k^2}{l^2} \tag{11}$$

$$\sigma_z = \frac{p_1 - k^2 p_2}{k^2 - 1} \tag{12}$$

$$Eu = \left[(1 - 2\nu)\frac{p_1 - k^2 p_2}{k^2 - 1} + (1 + \nu)\frac{p_1 - p_2}{k^2 - 1}\frac{k^2}{l_2}\right] lr_1 \tag{13}$$

that p_2 is equal to zero in these equations. Finally, fig. 6d shows a wall, which has not to withstand an appreciable axial thrust ($\sigma_z = 0$), because on one side this thrust is transmitted to a rigid support and on the other side to a counterbalanced piston. This is the case of a press and a pressure balance. The same equation $\sigma_z = 0$ applies to the more exceptional case of a wall, closed on both sides by counterbalanced pistons, provided that friction effects between the wall and the piston packing are neglected. Table 1 has been completed by eq. (11), giving the value of the shear stress $\tau = \frac{1}{2}(\sigma_t - \sigma_r)$ and by eq. (13) giving the analytical expression of the displacement of radius lr_1. Considering that $\varepsilon_t = u/r = u/lr_1$ and making use of eqs. (4a), (9), (10) and (12), one easily finds eq. (13). This last equation is an interesting one, because the displacement u_2 of the outer radius ($l = k$) can be easily measured by means of an extensometer, when the external pressure is nil. After carrying out some measurements under growing pressures p_1, one can extract from eq. (13), the value of E and this one of ν pertaining to the material in question and such values can be said to be fully as good as values obtained by other methods.

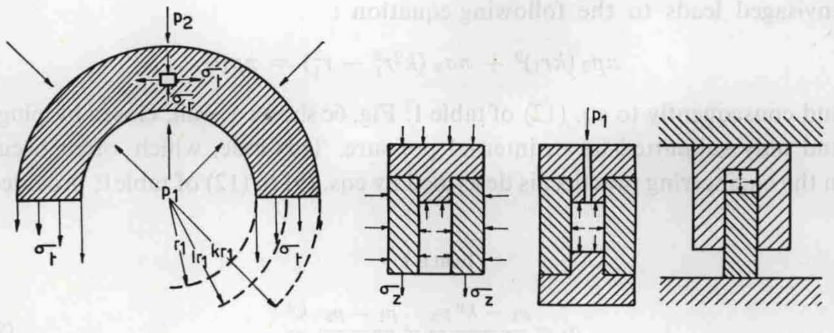

Fig. 6.

It is essential to carefully examine the eqs. (9) to (12) :

(a) The stresses result from the superposition of a stress of a hydrostatic nature equal to σ_z and of a pure shear stress τ, which depends on the sole difference of the applied pressures.

(b) The shear stress τ, which is of prime importance in the wall overstraining process, as shown in section 5, can be diminished by forcing an inner wall into an outer one with a view to increasing the resistance of said inner wall to a pressure applied on its inner surface. In order to achieve this aim, the inner wall is machined so that its outer diameter is a little bit greater than the inner diameter of the outer wall, which will be heated to a temperature much higher than the inner wall's one, before compounding. By cooling down the outer wall is pressed against the inner one under a pressure equal to p_2, when the temperatures of both walls have reached the same level. This is the classical compounding by shrinkage, which is an expensive and delicate wall resistance reinforcing process, because the walls must be machined by means of high precision machines and also because it may happen, that in course of carrying out this process, both cylinders stick together so strongly, that it is impossible to fully insert the inner cylinder into the jacket. As MANNING [1947] made it clear, it must be noted that defaults due to faulty workmanship may considerably lower the shrinkage efficiency. The cylinders of pumps and compressors are often reinforced with steel jackets with a view to reducing the risks of fatigue cracks.