The quality of the sampling of strata with the testing of wells depends on the reliability of the releasing devices which assure the necessary seal in the space beyond the tube.

For a logical choice of the constructional parameters of the sealing assemblies of the packer it is necessary to have data on the stressed state of the elements of the releasing device of the stratum tester [1-4].

The most critical parts of the packer, i.e., the expansion bearings, consist of six external and six internal segments, forming two concentric sectional funnels. The internal movable funnel is seated on the segment holder in six guiding protrusions of the dovetail type.

Let us investigate the stress-deformation state of the expansion bearings of a packer, using the method of [5]. As a result of the symmetry of the disposition of the grooves and the acting forces, we must consider the interaction between the segment holder, one of the segments, and the wall of the well (the drive pipe).

Let us set up the condition for equilibrium of the segments with a completely covered bore of the well (Fig. 1). With consideration of the equilibrium of the elements of the extension bearings we assume that, depending on the position of the segment holder and the resistance of the releasing device, the stresses in the body of a segment over the height of a groove vary from zero (at the moment of contact between the segments of the walls of the well) to a maximum (the segments occupy extreme positions and are cut into the walls of the bore). Depending on the hardness of the rocks, with exactly the same force acting on a segment, the value of the cutting will not be identical.

Equilibrium sets in in the system with the cessation of the motion of the pair segment holder-segment. In this case, from the condition of the continuity of the deformation of the elements of the extension bearings in a cross section located at a distance \( z \) from the lower end of the segment, we have

\[
z + b_1 + \varepsilon(0) = z - b_2 + \varepsilon(z),
\]

where \( \delta_1 \) is the axial deformation of the cross section of the drive tube or the rock in a section taking in the segments (since, with release of the strata, the deformation of the drive tube or the wall of the bore is very slight, we assume that \( \delta_1 = 0 \)); \( \varepsilon(0) \) and \( \varepsilon(z) \) is the bending deformation of the tips of the cuts of the segments or the casing layer (rubber) in the cross sections \( z = 0 \) and \( z \); \( \delta_2 \) is the axial deformation of a cross section of a segment;

\[
b_2 = \int_0^z \frac{\sigma_2}{E_2} \, dx,
\]

\( \sigma_2 \) is the normal stress in a transverse cross section of the segment; \( E_2 \) is the elastic modulus of the material of the segment.

For a lined segment, the deformation of the soft layer in the cross section \( z \) is [6]

\[
\varepsilon(z) = \frac{8(1 + \nu)}{3E_2} \left( \frac{R - r_1}{R + r_1} \right)^4 R \varphi(z),
\]

the bending deformation of the tips of the cuts of the segments in the same cross section is [5]

\[
\varepsilon(z) = \frac{p(z) S}{E_2},
\]

Translated from Khimicheskoe i Neftyanoe Mashinostroenie, No. 8, pp. 3-4, August, 1978.
Fig. 1. Calculating scheme for the distribution of the loads on the elements of the extension bearings of a packer: 1) wall of bore of well (drive pipe); 2) guiding stem of packer; 3) extension bearing; 4) heel of packer.

where $\mu$ is the Poisson coefficient; $E$, $E_t$ is the elastic modulus of the lining layer (rubber); $R$, $r$ are, respectively, the outside and inside of the radii of the lining layer; $\lambda$ is a dimensionless coefficient characterizing the variable height of the cross section of the segments [7]; $S$ is the spacing of the cuts in the segments; $q_z$ is the intensity of the distribution of the specific pressure over the height of a segment; $p_l(z)$ is the specific pressure at the contact surface between a segment and the drive tube.

To find the stresses $\sigma_2$ we consider an elementary section of a segment at a distance $z$ from the lower end and having a thickness $dz$ (Fig. 2). We write the condition of equilibrium

$$\sum r = 2\pi r f_p (z) \cos a \, dz + \frac{dF \sin a - 2\pi R p_1 (z) \, dz}{2\pi} = 0;$$
$$\sum z = dF \cos a - 2\pi r f_p (z) \sin a \, dz - \pi (R^2 - r^2) \, d \alpha_2 + \frac{2\pi R q (z) \, dz}{2\pi} = 0,$$

where $p(z)$ is the intensity of the distribution of the axial forces over the height of the segment holder; $\alpha$ is the angle of inclination of the contacting surfaces of the segments and the segment holder; $dF$ is the force of friction at the contact surface between the segments and the segment holder.

In accordance with the Coulomb-Amonton law

$$dF = 2\pi r f_p (z) \, dz.$$  

Fig. 2. Scheme of loading of a segment of extension bearings.