At present the agricultural sector of the Republic of Kazakhstan in the cultivation of crops applying No-till techniques and direct seeding drills of various abroad firms "Amazone", «John Deere», «Gherardi», «MASCHIO-GASPARDO», «Kuhn», «Köckerling», «Horsch» and others are widely used. Drills are equipped with disk, chisel and tine coulter and neighboring countries seeders mainly are equipped with disc openers. Chisel and tine chisel coulters are reliable and easy to set planting depth, well-maintained and deepened at constant planting depth either [1]. But, they badly cut the plant remains, leading to clogging of interploughshare space.

Practice shows that the single-disc coulters do not always cut crop residues and not completely hide the furrow, and in the wet and heavy soils a packed furrow is formed. Double disc coulters although don’t have the above drawbacks, but in drought periods have uneven progress of the working parts and deepening the working part to the desired depth of seeding the soil requires effort up to 200 kg. This in its turn requires the installation of the individual cylinder for each coulter, which leads to an increase in mass of the drill and to its expensiveness.

Based on a search of experimental and theoretical assumptions we offer direct sowing with the following configuration options for openers:

- **Option 1** installation disk and chisel openers in two rows: one of them is chisel, and in another - disc, ensuring high throughput and low tractive resistance at work after cereal raw backgrounds;
- **Option 2** - installation disc and tines with distribution of seeds for sowing a wide belt (belt drill seeding), providing high throughput, low driving resistance and high yields.

According to the programming and methodology of research in view of the proposed options experimental samples disk and chisel coulters with suspension mechanisms were made, Figures 1 and 2.

For the energy assessment of working parts the theoretical research was done and the traction resistance of the structural and technological parameters of chisel and disc coulter dependences are set. Thus, the traction resistance of chisel coulter is defined as [2, 3]:

\[
R_{PT} = (B\phi \cdot h + h_{sp}^2 \cdot \tan \psi_{ck}) \cdot (K_{QT} + K_{UP} + K_{UK})
\]

Where

- \( K_{QT} = 0.5 \cdot m_v \cdot A_{\alpha_o} \cdot A_1 \cdot \gamma \cdot h \cdot g \) - factors that take into account the cost of energy to overcome the pressure of the soil layer at the bit opener;
- \( K_{UP} = m_v \cdot A_{\alpha} \cdot A_1 \cdot C \cdot \cos(\varphi) \) - coefficient taking into account the energy costs of the destruction of the soil layer at the bit opener (\( A_\alpha = A_{\alpha_o} \));
- \( K_{UK} = A_{\psi} \cdot \gamma \cdot p \cdot v^2 \) - coefficient taking into account the energy cost of the informing and change of the movement speed direction along the chisel opener (\( A_{\psi} = A_{\psi_o} \)).
Components of disc coulter resistance are determined by taking into account the soil cutting resistance forces by the blade of a flat disk $F_p$, the horizontal components of the soil deformation resistance force is defined by the disk tip $F_{dx}$, force of dynamic resistance of soil formation $F_k$, soil friction forces $F_m$ and effort on the ground crumpling $F_c$.

As a result, the traction resistance of disc coulter is defined as [4]:

$$F_{Tx} = F_{Xm} + F_{Xp} + F_{Xk}$$

(2)

Where $F_{Xm} = K \cdot h \cdot b(\cos \beta + \cos \gamma + \tan \phi \cdot \cos \beta)$, $F_{Xp} = K_C \cdot h \cdot b \cdot \rho \cdot V^2$, $F_{Xk} = 0.5 \cdot g \cdot h^2 \cdot b$ - resistance, respectively, to overcome friction and soil formation pressure on the opener, the destruction of the reservoir and to the informing and change the speed of the formation direction of movement along the wedge.

Analysis of the obtained formula (1) and (2) shows that the tractive resistance of the coulter depending on the depth and processing speed varies depending on the parabolic dependence.

For research with experimental openers laboratory apparatus was made and highly technical measuring instruments and equipment were used.

To verify the theoretical calculations to determine the traction resistance of chisel opener in accordance with the established methodology, laboratory experiments in the soil at a depth of sealing channel from 4 to 7 cm. and with moving at a speed of 0.87 to 3.1 m/s were conducted.

The results of theoretical and experimental research in the form of dependency change of the traction resistance of the chisel opener speed at a depth $h = 4$ cm are presented in Figure 3.

**Figure 3** - The theoretical $R_{CF}$ and experimental $F_e$ dependences of the resistance of the traction of the chisel opener speed $V$ when working at depth $h = 4$ cm.

Similarly laboratory experiments in soil channel for disc coulters were conducted. Tests at different depths seed and fertilizer from 4 to 10 cm were carried out with a change in movement speed from 0.87 to 3.1 m/s. The results of theoretical and experimental research in the form of dependency change of the traction resistance of the speed of the disc coulters are shown in Figure 4.

**Figure 4** - Theoretical and experimental $F_x$ depending on the traction resistance of the disc coulter speed $V$ when working at depth $h = 7$ cm.

According to the schedule 4 we have that an increase in speed from 0.87 to 3.1 m/s theoretical $F_{xh}$ and experimental Fe dependences increase depending on a parabolic pattern. In addition, the disc coulter parameters are justified which are: disc diameter of 375 mm, the angle between the discs $\alpha = 100$, the position of the vanishing point drives $\beta = 400$ and the distance between axes of 115 mm discs. For chisel opener with the mechanism of suspension the following parameters are justified: length of leashes $l_{CD} = 300$ mm and $l_{CF} = 300$ mm, width 20 mm chisel. Although experimental values exceed the theoretical but in general, they are supported by common methodological research position. In order to obtain reliable results and findings on the justification of parameters of working bodies are planned for further laboratory and field studies using experimental working bodies and drills with combined openers.

**References**