The directive of the Five-Year Plan for development of the USSR National Economy calls for an increase in the production of low-voltage electrical equipment and instruments by a factor of 2-2.5 with the simultaneous development of new types of equipment with increased technical characteristics.

One of the basic parts having a decisive effect on the reliability of electrical equipment are their contacts. The annual production of SOK15 silver-cadmium oxide contacts in our country amounts to more than 250 million units with a total weight of about 80 t. Owing to the development of automated electric drives and an increase of the capacities of the power systems, there has been an increased demand for electrical contacts, and cermet contacts manufactured by the existing technology have proved to be unsatisfactory.

The presently used technology of manufacture of contacts consists of the following stages: production of powders of metals and compounds with particle sizes of 1-50 \( \mu \text{m} \) by chemical, electrochemical, or mechanical methods; mixing of these powders in mechanical mixers in the required ratios; screening of the mixture through mechanical sieves; measuring out of the mixture; pressing, sintering, repressing, and annealing of contacts.

The existing technology of obtaining the mixture does not secure the required quality of the contacts. The latter depends not only on the composition but also on its manufacture. It has been found that the more homogeneous the distribution of components in one another and the smaller the size of their grains, the higher the quality of contacts [1-6]. It is impossible to obtain a homogeneous, finely dispersed structure of contacts by the existing method of preparing the mixture, even by using finely dispersed starting powders, since during mechanical mixing they lump and produce large conglomerates of separate components.

A chemical method of obtaining the mixture for cermet contacts SOK15M was first tested in 1955 at the Khar'kov State University. This method involves the following: a solution of silver and cadmium nitrates is prepared for the silver-cadmium oxide (SOK) composition. The required quantity of precipitating agent, namely sodium bicarbonate whose anion produces with the ions of silver and cadmium insoluble and thermally unstable salts, carbonates, is added with a minimum quantity of water (at a rate of 1 liter of water per 1 kg of precipitating agent). Then the solution of silver and cadmium nitrates is added to the solution of the precipitating agent through a sprayer. As this solution is added some of the ions of the precipitating agent are bound by the silver and cadmium ions. Solution of the undissolved portion of the precipitating agent occurs. A quite homogeneous and finely dispersed residue of silver and cadmium carbonates settles out. Uniformity of blending of the components was secured by the simultaneous solution of the nitrates of the metals and agitation of the solution by a mechanical mixer. This homogeneity was retained even after precipitation, since the solubility of silver and cadmium carbonates is almost identical.

The obtained precipitate was separated from the solution, dried to a residual water content of 10-11\%, then granulated and roasted at 380-450 \(^\circ\)C for 1 h in air, in vacuum, or in the decomposition products. After this the finished mixture is obtained. The average particle size in the mixture does not exceed 0.03 \( \mu \text{m} \). Figure 1 shows the laboratory device for obtaining a finely dispersed mixture. One 3-h cycle gives 10 kg of salt mixtures. If necessary the device can be enlarged and mechanized.

Contacts are pressed from the chemically obtained mixture at a specific pressure of 10-20 kN/cm\(^2\). The high degree of dispersion of the powders and related high activity of the finely dispersed mixture to
sintering permit using lower pressing pressures and sintering temperatures, and also a shorter holding time in the production of contacts (in comparison with coarsely dispersed contacts).

We see from Fig. 2, which shows the microstructure of the finished SOK15 contacts, that in the case of the finely dispersed contact the structure is substantially finer and more homogeneous. The average particle size in the finished contact is 0.2–0.3 μm. The physicomchanical characteristics of the finely dispersed contacts of silver-cadmium oxide SOK15M and SOK15 are given in the Table, from which it follows that the density, hardness, electrical conductivity, and bending strength of the finely dispersed contacts are higher than those of the coarsely dispersed contacts of the same composition.

The finely dispersed contacts SOK15M were tested on KTF 5043 contacts (rated current 100 A); automatic contact breakers A3120 under short-circuiting conditions (up to 45,000 A) and at rated currents in place of SN30 contacts; on contact blocks of KT 5010 contactors in place of silver contacts; on PKG contactors of the TЭ10 diesel locomotive, where a current of 450 A at a voltage of 12–14 V was switched; on RP intermediate relays in place of silver contacts, where a current of 2 A at 380 V and power factor of 0.4 was switched. The test results showed that the wear resistance of the finely dispersed SOK15M contacts is by a factor of 3 greater than the coarsely dispersed contacts SOK15, SN30, or pure silver.

Our method for obtaining a finely dispersed mixture for silver-cadmium oxide contacts was turned over to the All-Union Electromechanical Research Institute and has presently been introduced at the Moscow Plant of Secondary Precious Metals. In the future it will be necessary to change over to the manufacture of a finely dispersed mixture by the chemical method for silver-copper oxide contacts. We have also developed an industrial method of producing a finely dispersed mixture for these compositions.

According to the data of the All-Union Electromechanical Research Institute, the conversion to finely dispersed SOK15M contacts will save the country 8.5 million rubles per 50 t of contacts owing to an increase of the service life of electrical equipment. At present the method of obtaining a finely dispersed mixture is being introduced at the Khar'kov Chemical Reagents Plant. The first industrial lot of a finely dispersed mixture for silver-cadmium oxide contacts is planned for the second half of the year, which will completely compensate for the additional costs for obtaining finely dispersed contacts.

![Fig. 1. Laboratory device for obtaining finely dispersed mixture.](image1)

![Fig. 2. Microstructure of finished silver-cadmium oxide contacts, x 150: a) Finely dispersed SOK15M; b) coarsely dispersed SOK15.](image2)

<table>
<thead>
<tr>
<th>Type of contacts</th>
<th>Density, g/cm³</th>
<th>Brinell hardness, dkn/mm²</th>
<th>Resistivity, Ω·mm²/m</th>
<th>Bending strength, dkn/mm²</th>
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</thead>
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<tr>
<td>SOK15</td>
<td>9.6</td>
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<td>0.029</td>
<td>10.5</td>
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<tr>
<td>SOK15M</td>
<td>9.9</td>
<td>87</td>
<td>0.025</td>
<td>48</td>
</tr>
</tbody>
</table>

Fig. 1. Laboratory device for obtaining finely dispersed mixture.

Fig. 2. Microstructure of finished silver-cadmium oxide contacts, x 150: a) Finely dispersed SOK15M; b) coarsely dispersed SOK15.