The properties of high-alloy chromium-nickel steels at high temperatures depend to a considerable extent on the character of the crystallization and structure of these steels near the solidus [1, 2].

For 18-8 steels the phase diagrams of the Fe–Cr–Ni and Fe–Cr–Ni–C systems lead to contradictory data on the phase composition near the solidus.

For example, it follows from Krivobock's diagram [4] that these steels are completely austenitic at 600–1300°C even in the presence of carbon, and at higher temperatures are austenitic-ferritic (Fig. 1). However, attempts by different investigators to obtain a completely austenitic structure in these steels containing 0.02–0.005% C by quenching from suitable temperatures have not been successful [5, 6].

![Fig. 1](image1)
![Fig. 2](image2)

Fig. 1. Pseudobinary section of Fe–Ni–Cr–C phase diagram [4]. L is liquid; α and δ are ferrite; γ is austenite; K is carbide; line S–E is the solubility limit of carbides in austenite.

Fig. 2. Pseudobinary section of Fe–Ni phase diagram with 18% Cr [3]. The symbols are the same as in Fig. 1.

<table>
<thead>
<tr>
<th>Steel</th>
<th>Composition, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Kh18N9T †</td>
<td>0.09</td>
</tr>
<tr>
<td>7Kh18N9T</td>
<td>0.08</td>
</tr>
<tr>
<td>Kh18N9</td>
<td>0.069*</td>
</tr>
</tbody>
</table>

* The carbon content was varied (0.068; 0.075; 0.087; 0.155%).
† 0.4% Ti.

At the same time, it follows from the diagram of Kintsel' and Frenks (Fig. 2) that steel with 8% Ni but no carbon is completely austenitic only at 1150–700°C, and above 1370°C to the solidus line has a single-phase ferritic structure.

A pseudobinary section of the phase diagram for 18–8 steel in relation to the carbon content which was proposed in [3] also shows a region (from 0 to 0.02% C) with a single-phase ferritic structure near the solidus.

The confusion concerning the crystallization of these steels is due to contradictory data on the structure of the axes and interaxial areas of dendrites [2, 7].

The present study was undertaken to determine more accurately the phase composition of certain steels at solidus temperatures and below. Plates about 3 mm thick were cut from steels Kh18N9T and 07Kh25N13, the chemical compositions of which are given in Table 1.

The plates were heated in a Kryptol shaft furnace at 1420–1460°C. The temperature was measured with a platinum–platinumrhodium thermocouple. The samples were heated to the given temperature in 2 min. After this time the bottom part of the samples began to melt. Then the samples were quickly removed from the furnace and cooled in brine.

Samples were also cut from the ingots for testing in the IMASh–5M apparatus. In the vacuum chamber of the apparatus the samples were heated to 1000–1360°C by conduction. When the current was turned off the average cooling rate from 1360 to 600°C was 25–32 deg/sec.

On rapid cooling in the IMASh–5M apparatus, and also on quenching, the steels do not have time to reach the characteristic equilibrium condition. The ferrite grains decompose into a fine-grained austenite–ferrite mixture. The area occupied by the transformed ferrite grains gives an idea of the proportion of phases at respective heating temperatures. In the IMASh–5M samples, heated by conduction, there is a gradual change in temperature along the length of the sample, which makes it possible to observe a continuous change of phase composition with increasing temperature.