The alumoborosilicate glasses with a low content of alkali metal oxides and without them require melting and working at higher temperatures in contrast to the glasses with high alkali content. They interact to a greater degree with the heat resistant materials of the glass making furnace, have a small temperature range of working, tend to crystallize, and stratify.

Melting such types of glasses in pot furnaces is not expedient since a rapid deterioration of the ceramic material of the pot occurs. The glass melt then is saturated with refractory stone, cords, and bubbles which significantly lower its optical properties, and also the tendency of the glass melt to crystallize is increased and this undesirable process is hastened during working.

Obtaining alumoborosilicate glasses with high optical indices in tank furnaces with continuous action is also difficult. In the working portion of such furnaces the glass melt temperature, and simultaneously the homogenization is lowered. With the use of contemporary mixing devices this results in mixing of the glass mass currents with different temperatures and consequently to the formation of thermal flaws and inhomogeneities. As practice has shown it is expedient to melt this type of glass in tank furnaces with periodic action.

Figure 1 shows the construction of a three-zone tank furnace with periodic action used to melt high-melting alumoborosilicate glasses. The basin walls and the furnace bottom are lined with quartz beams. The flame space is made of corundum with thermal insulation from high-alumina and ultralight-weight chamotte brick. The 1.5 m wide furnace basin is divided into three zones: melting (3 m²), fining (0.75 m²), and working (2.25 m²). To speed up the melting of the charge, four 44-mm diameter molybdenum rod electrodes are set up in the melting zone. To avoid entry of incomplete melting or melting froth from the melting zone into the working zone a barrier device is placed before the fining zone.

The fining zone of this furnace is made in the form of a highly projecting plate separating the melting and the working zones of the glass mass and permitting a thin layer of clarified melt to be made. Another characteristic of the furnace is the structural solution of the assembly for working the glass mass consisting of a jet feeder made of heat-resisting material in the form of a tube placed in the working zone and having induction heating. In order to avoid entry of inhomogeneous boundary and bottom layers of the glass mass, saturated with refractory rock and gaseous inclusions, into the working stream, the inner portion of
the feeder tube is at a 150 mm distance from the end wall of the basin and at 250 mm from the furnace bottom. A glass mixing assembly to homogenize the glass mass is located over the working zone.

The furnace is fired by natural gas with six vortex gas burners made according to the Institute of Gas, Academy of Science of the Ukrainian SSR. To reduce the specific fuel consumption, the heat of the waste gases was used to heat the air in the metal radiation direct flow-counterflow slit recuperator made according to the same institute. The air was preheated to 350-400°C. The charge was fed into the loading container.

After a time of service the advantages and disadvantages of the furnace were evident. The melted and degassed glass mass moved well from the fining zone to the working zone. A probe analysis showed that the glass mass fining proceeded rapidly in a thin layer. Moreover the glass melt was basically freed from bubbles of diameter above 0.3-0.5 mm. The finer bubbles (seeds) did not escape from the glass mass and were carried into the working zone in which the final degassing of the glass occurred. The use of supplementary electrical preheating permitted the melting of the charge to be accelerated and the productivity of the furnace to be increased by 1.5 times.

The feeding device made it possible to select the most high-grade glass mass directly from the homogenization zone for working.

The temperature in the melting zone was maintained at 1530-1540°C, but its distribution along the length of the furnace was not uniform. Thus, if the maximum temperature (1540°C) was at a distance 150-200 mm from the end of the burners, then in the working zone it was lower by 50-60°C, and even by 90-100°C during mixing, which created certain difficulties for the final degassing of the glass mass.

Because of the large thermal stresses and the absence of cooling devices the quartz beam from which the fining zone was made ruptured after two months of service and the furnace was then used as a single-chamber furnace. Significant destruction of the beam was observed also in the zone of the electrode assembly.

Several structural elements were improved during the reconstruction of the furnace. The three-zone tank furnace of periodic action after reconstruction is shown in Fig. 2. The dimensions of the zones were not changed significantly. The basin width of the furnace remained as before, 1.5 m. The area of the melting section was 2.55 m²; the fining zone, 0.9 m²; and the working section, 2.25 m².

The walls of the basins and the furnace bottom were also made of quartz beam. To decrease thermal losses through the masonry in the flame space the corundum and high alumina refractory materials were replaced by Dinas. To lower the temperature gradient of the glass mass the depth of the melting basin was decreased by 200 mm.

The zone of fining the glass mass in a thin layer underwent several structural changes. Water and air coolers were placed in the bottom portion; this lengthened the furnace's operating period significantly.

Two additional burners constructed according to the Institute of Gas of the Academy of Science of the Ukrainian SSR were put into the working zone; this made it possible to distribute the temperature uniformly along the length of the furnace and when necessary to change the temperature in the working zone within a wide range.