Using a unit for the semicontinuous casting of steels the metallurgical factory "Red October" has, in recent years, developed a technology for casting stainless steels which is distinguished by the fact that the surface of the metal in the crystallizer is covered with a layer of liquid slag (Fig. 1).

The introduction of the technique has improved the quality of the metal and given substantial savings [1]. One of the drawbacks of semicontinuous casting using synthetic slag is the fuming of titanium of titanosteels as a result of its oxidation and passage into the slag. With the aim of preventing or reducing the oxidation of the titanium of the steel, it was proposed to use longer nozzles in place of the short ones normally used. The long nozzles allow us to insulate the metal jet during casting from the synthetic slag.

High-alumina nozzles and zirconia nozzles (made of zirconium-dioxide) [2] proved to be the most wear-resistant for casting stainless steels.

The service conditions of long nozzles during the casting of steel under synthetic slag are heavier than those normally used since the former do not come into contact with the slag. Therefore, it is of interest to study the slag resistance of specimens of various materials.*

The tests were made by immersing the specimens in molten slag. This is more accurate than the crucible technique [3].

Specimens were made from high-alumina, zirconium dioxide (stabilized zirconia), zircon, alumina-silicon-carbide, alumina-graphite and fireclay-kaolin compositions.

The compositions of the bodies are given in Table 1.

* Nozzles were prepared from these bodies in addition to fireclay-kaolin.

T. M. Vysokaya-Kvitko and N. L. P'yanykh took part in the work.
Specimens 80 mm high, 36 mm diameter were pressed at 500 kg/cm². On one end of the specimen, before firing, indentations were made to fix it into the holder for testing.

Slag-resistance tests were made at the factory in a 120-kg arc furnace (Fig. 2) designed for melting slag which is used in the continuous casting unit for casting stainless steel. The specimen was fitted in a special device, then immersed in the slag for 15, 45, or 60 min. The tests were carried out in some degree to reflect the conditions of service of the long nozzles in synthetic slag.

The synthetic slag was prepared from 51% feldspar, 22% silicate bloom, 10% quartz sand and 17% lime. The fusion temperature of the slag in the furnace was 1220–1250°C.

The fireclay-kaolin specimen (Fig. 3a) was corroded intensely, especially on the side turned to the electrode of the furnace, where the fluidity of the slag was high. In 15 min the maximum erosion of the specimen reached 10 mm at the side. Investigation confirmed the results obtained earlier for fireclay-kaolin nozzles, which were intensely corroded or completely destroyed when casting steel under synthetic slag [2].

High-alumina specimens withstood 15 and 60 min in the synthetic slag. Corrosion occurred intensely owing to the action of the upper layers of slag (Fig. 3b). The maximum erosion of the specimen during a period of 15 min was 5–6 mm. The lower part of the specimen immersed in the deeper layers of synthetic slag was eroded much less (about 1 mm on the side). With the high-alumina specimen soaked in slag for an hour, the erosion was more intense — 10 mm.

Slag erosion of zircon specimens occurred more uniformly over the depth than in the high-alumina specimens. After 15 min in the slag, the specimen was eroded 2–4 mm and after 60 min — 8 mm.

High slag resistance is possessed by specimens from stabilized zirconium dioxide (Fig. 3c) which with a 15-min soak were not eroded, and after an hour’s soak developed holes up to 10 mm deep and 2–3 mm in diameter.

Alumina-silicon-carbide specimens at 45 min soak were eroded with slag to a depth of 0.5–1 mm. Their surface was coated with droplets of hardened slag.

The alumina-graphite specimens soaked for 15 min in slag eroded 0.1–0.2 mm (Fig. 3d), with a 45 min soak the specimen was eroded somewhat more, especially by the upper layers of slag.

The best results in regard to slag resistance were shown by zircon, alumina-silicon-carbide and alumina-graphite specimens.

At the experimental factory of UNIIIO they prepared zirconia, alumina-graphite, alumina-graphite alumina-silicon-carbide nozzles and also high-alumina, zircon and alumina-graphite nozzles with a high content of graphite.

The raw materials for making the specimens and the long nozzles were de-ironed zircon (65% ZrO₂), zirconia (98% ZrO₂), commercial alumina (97.9% Al₂O₃) silicon carbide (92% SiC), Proyanov kaolin (30% Al₂O₃), Chasov-Yar fireclay (31.7% Al₂O₃ + TiO₂) and KLZ-1 graphite.