MODERNIZING A PRESS FOR MAKING REFRACTORIES

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This article describes the design of press 4KF200, which is used to shape a wide range of refractories for the metallurgical industry. The reasons for the failure of equipment on the press are analyzed and measures are proposed to modernize it in order to prolong the service life of the press and increase its load capacity. The modernization is done using the engineering program Autodesk Inventor 11.

The growth of modern metallurgy and certain other sectors of the national economy has been accompanied by a rapid increase in the number of production processes that employ heat. The refractories used in these processes must meet increasingly demanding requirements in regard to their stability under mechanical loads and their resistance to the action of melts and aggressive hot gases. In most cases, these requirements are satisfied by the use of high-alumina and corundum refractories, and the volume of production of these materials is continually increasing. Keeping up with the demand for such refractories requires a corresponding increase in the capacity, productivity, and reliability of the equipment used to make them.

The front-loading variant of four-column screw-type friction press 4KF200 was developed by the Borovichi Refractories Combine. The main advantages of the press are its high energy content and the fact that it is relatively easy to adjust and maintain. Its main shortcoming is that the screw frequently breaks under the torsional stresses to which it is subjected during service. Another problem that causes frequent stoppage of the press for repairs is the rapid wear of the threads in the screw-nut kinematic pair. According to statistical data, the average service life of this pair is five months – which is very short [1].

The advent of new technologies for making refractories with improved physicomechanical properties has brought an increase in the pressing forces that are being used to make these materials. That in turn has increased the dynamic loads on certain elements of the pressing equipment, which has made it necessary to modernize the above-described press in order to increase the strength and wear resistance of its structural elements.

Figure 1 shows the base design of screw-type friction press 4KF200. The drive of the press includes electric motor 1, pulley 2, and a V-belt transmission that moves main shaft 3. Friction disks 4 are attached to this shaft. Shaft 3 is installed in bearing assemblies 5 and is connected to air cylinder 6. All the parts and components of the press are installed on assembled frame 7. The shaft is moved along the axis by air cylinder 6. The disks 4 come into contact with flywheel 8, which is secured by a travelling screw inserted into the top nut of stationary cross-arm 10. The cross-arm 10 is in turn attached to the press’ columns 11. The bottom part of the screw is connected to movable cross-arm 12, which moves along the guide columns 11. The press is mounted on housing 13, which also supports the mold.

The drive shaft and two disks are brought into motion by the electric motor acting through the V-belt transmission. This motion is then transmitted to the flywheel as a result of its contact with the left or right disk. Contact of the flywheel with the right disk results in downward motion of the flywheel-screw system (the working stroke), while contact of the fly-
wheel with the left disk raises this system (no-load stroke). The disks alternatively come into contact with the flywheel as the latter is moved back and forth along the axis of the drive shaft with the disks by the air cylinder. The distance between the distances, rigidly affixed to the shaft, is 5–10 mm greater than the outside diameter of the flywheel. The flywheel is mounted on the cylindrical top end of the screw and is kept from overrunning by a keyed joint. The 4KF200 press has a differential hold-down screw: the screw has a right-handed triple square thread on its top part and a left-handed double thread on its bottom part. The cross-arm moves along guide posts on the housing. The punch is secured in the bottom part of the moving cross-arm and presses the refractory products in the mold. The screw, moving together with the flywheel, screws into the top nut rigidly affixed to the stationary top cross-arm during the working stroke. The bottom nut, secured in the moving cross-arm, simultaneously disengages from the screw. This increases the speed of the punch, the kinetic energy of the operation, and the total pressing force.

Fig. 1. General view of screw-type friction press.

Fig. 2. Stress concentrators acting in the screw and the most heavily loaded cross section: 1) seat with negative allowance (flywheel-screw contact area); 2) fillet; 3) key channel; 4) lines coinciding with the fracture surfaces of the screw; 5) groove for exit of the cutter during formation of the screw thread.