The goals of speeding up metallurgical production, improving manufacturing operations, and increasing equipment productivity can be met only by systematically automating production processes, continuous production lines, systems, and equipment. The use of automation in metallurgy—and in casting in particular—increases efficiency, improves working conditions, stabilizes production operations, and optimizes the performance of complex equipment that is subjected to intensive loading.

In particular, the stable operation of continuous casting machines depends in large part on keeping liquid metal in the tundish and the mold at the optimum level. That can be done only by automating the tasks of monitoring and controlling the level of the metal. These tasks are currently carried out with the use of various types of devices, including piezometric, capacitive, acoustic, radiation-type, float-type, and electrocontact level gages and indicators.

The leading metallurgical plants commonly use radiation-type instruments to monitor the level of the melt in steel-pouring ladles and molds. The devices operate on the principle that different amounts of gamma radiation are absorbed by the substance being monitored and the surrounding medium.

Radiation-type level gages employ blocks of gamma-radiation emitters and detectors. The emitters are installed at the level designated for the melt. The emitters are installed on one side of the vessel and the detectors are installed on the opposite side. The dose of gamma radiation absorbed by the detector increases when the melt descends to the lowest allowable level and decreases when it reaches the highest mark. Such changes in radiation dose, recorded by the detection block, serve as a signal to the level-control system to initiate the appropriate control actions and keep the level constant.

Radiation-type gages accurately monitor the level of the metal and are reliable in service. However, they are very complicated to operate and pose a health hazard to operating personnel. Malfunctioning gages can leak radiation, causing several types of occupational illness.

Metallurgical plants also use electrocontact gages to monitor the level of liquid metal (Fig. 1). These instruments contain vertical electrodes 1 and 3 to record the highest and lowest liquid levels. The electrodes are mounted on insulators 2 and are connected to an electronic block 4. The insulators are located in protective metal rings 5 that prevent the generation of false signals and keep interference to a minimum.

However, it is almost impossible to use such units on continuous casters due to the vertical position of the electrodes. Such an arrangement impedes the movement of the molten metal into the tundish. It is also not feasible to install vertical electrodes in the molds, since the electrodes would then be in the path of the metal stream during casting and thus could not be connected to current-conducting devices. In addition, if the electrode cooling system should malfunction, coolant water could fall into the melt and cause an explosion or other serious accidents with possibly grave consequences.

We have designed a new automated control system that is intended for use on continuous casters (Fig. 2).
The system includes a tundish 1 and metal plates 2 and 3 installed horizontally in the linings of the side walls of the tundish and the pouring ladle. These plates are in direct contact with the liquid metal. The system also includes a horizontally positioned mold 4 and electrodes 5 and 6. The mold and the electrodes are located at different levels and the electrodes are insulated from one another.

The electrodes of the tundish and the mold are connected to relays 7 and 8, respectively. The contacts of the relays are in turn connected to hydraulic drives 9 and 10, which activate control slide gates 11 and 12. Slide gate 11 is installed at the outlet of ladle 13, while slide gate 12 is installed at the outlet of tundish 1.