LABORATORY – INDUSTRIAL CONDUCTIVE-TYPE ELECTROMAGNETIC APPARATUS FOR MIXING FLUID PIG IRON

V. Z. Vdovin, I. R. Ved'kalov,
M. G. Golubenkov, M. G. Geras'ko,
V. I. Doronin, V. A. Kurganov,
V. V. Lesovoi, V. F. Omel'yanenko,
I. L. Povkh, and B. V. Chekin

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The laboratory–industrial conductive-type electromagnetic apparatus described here allows intensive mixing of fluid pig iron with various pelletized or pulverized reagents, for the purpose of refining, modifying, and alloying the metal. With slight design changes, it becomes possible to use also liquid slags as such reagents. The apparatus has the following technical characteristics: power requirement 120 kW and productivity 120 tons/h. The total length of the metal carrier is 3800 mm.

A laboratory–industrial conductive-type electromagnetic apparatus for mixing fluid blast-furnace pig iron in the tilter spout in a foundry has been developed at the Donets Scientific-Research Institute of Ferrous Metallurgy, in collaboration with the V. I. Lenin Donets Metallurgical Works.

The apparatus allows for intensive mixing of fluid pig iron with various pelletized or pulverized reagents for the purpose of refining, modifying, and alloying the metal. With slight design changes, liquid refining slags can also be used here as reagents.

A high assimilability of reagents and their lower consumption rate are ensured by a uniform distribution of particles and by local eddies throughout the metal volume, such eddies being generated where electromagnetic forces act in opposition to gravity forces [1] or where eddy layers follow one another in ducts with alternating zones of heavy-burdened and light-burdened metal (with the result of lengthening the time of contact between reagent and metal) [2].

The advantages of this apparatus are that the heat loss from pig iron during transport to the tilter can be compensated by Joulean heat, and that the fluid metal with a free surface can be mixed with any reagent lighter than the metal.

The apparatus (Fig. 1) consists of a feed system A for pelletized reagents, a feed system B for pulverized reagents, a metal carrier C, and two electrodes D-E.

The feed system for pelletized reagents consists of a bin 1 with reagent and a capacity of 0.25 m^3, located above the metal carrier, a rocker feeder 2, and a pipe 3 carrying the reagent into the melt. It is quite evident here that the pellets fall freely through the pipe and through a hole in the lid of the metal carrier onto the surface of metal ahead of the mixing zone. The feeder regulates the supply of reagents over the range from 0 to 10 kg per ton of molten metal.

The feed system for pulverized reagents ensures the supply of reagent to a metal layer through a pneumomechanical metering device operated at a pressure of 3 atm [3] from the compressed-air system installed in the factory.

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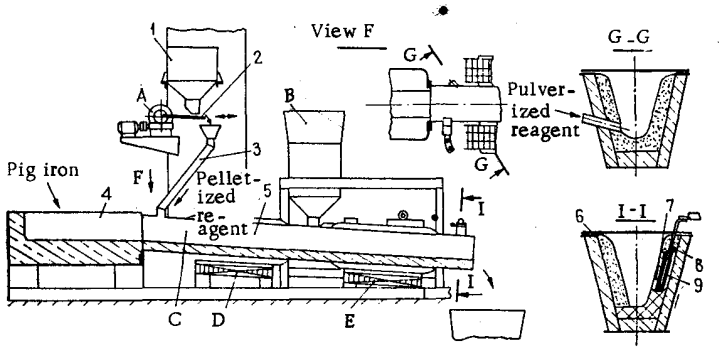

Fig. 1

The metal carrier C consists of a receptacle 4 and two halves of spout 5 with lids. The jacket for the spout halves is made of grade 1Kh18N9T stainless steel 10-mm thick. The receptacle and the spout halves are lined with successive layers of asbestos sheet ($\delta = 5$–8 mm), fireclay brick, and flame-resistant material. The total thickness of the spout lining is 120 mm.

In order to prevent possible splashing of metal during mixing, covers of nonmagnetic cast iron or steel have been installed above along the entire duct length, locked against the spout by means of fast removable stopper wedges.

For electromagnetic operation in the light-burdening mode, two graphite electrodes have been installed 3.5 m apart in the bottom of the lining for sending electric current through the iron. For producing alternate heavy- and light-burdened layers, several pairs of graphite electrodes are installed along the duct. A reliable contact between electrode 7 and a metal lug 8 connecting it to the supply source is ensured by a liquid lead bath 9 filling the cavity under the lateral surface of this electrode.

The temperature of pig iron in the receptacle and at the outlet from the active zone is checked by two thermocouples which have been installed in the spout flush against the lining.

The metal carrier is placed in the airgap between two dc electromagnets on the tilter base. The pole shoes are 900-mm long and 100-mm high; the total mixing zone is 3500-mm long, allowing for leakage flux paths. The magnetic induction in a gap 300-mm wide is equal to 0.3 T.

The basic parameters of the apparatus are: productivity 120 tons/h, total height of metal carrier 3800 mm, and power requirement 100 kW for the electromagnets, 20 kW for the duct.

The electromagnets are energized through welding-grade VKSM-1000/60 rectifiers, the duct is energized through VKSM-3000/60 rectifiers. The current is regulated by means of ballast rheostats in the supply circuit.

It may be possible to use the apparatus described here for deoxidizing and alloying fluid steel and to incorporate this operation into a continuous-cycle metallurgical process [4].

LITERATURE CITED

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