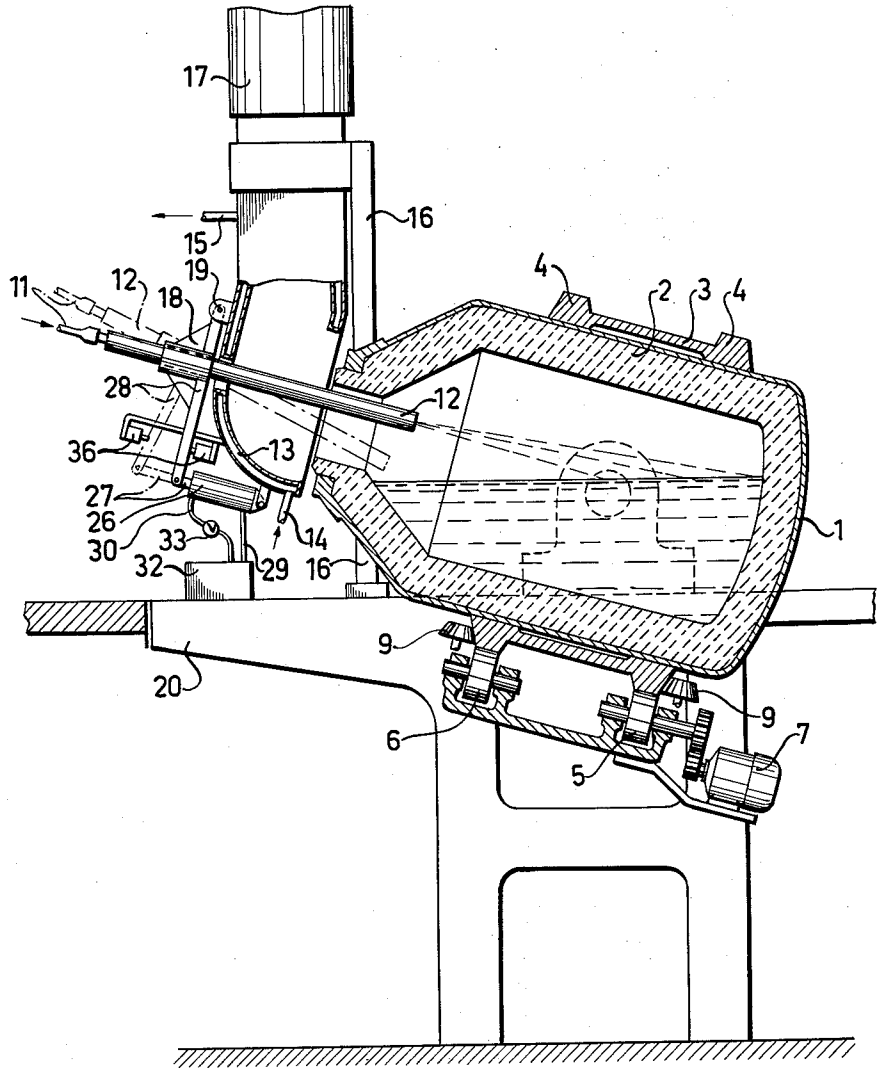
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DEVICE FOR REFINING OF METALS

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DEVICE FOR REFINING OF METALS

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The invention relates to an improvement in refining processes and a device for carrying out such improved processes. It refers more particularly to the refining of pig iron and other iron alloys in furnaces, particularly rotary furnaces, by blowing in a stream of gas rich in oxygen, i.e. containing more than 25%, preferably more than 40% oxygen, through water cooled tuyeres directed against the charge. The invention may, of course, be applied also to other metals and metallic compounds than iron.

The primary object of the invention is, by the aid of the blowing to control in a simple way the metallurgical processes in the refining. The invention has also for its object to eliminate unevenness in attacks upon and wear of the lining of the furnace.

The invention is based on the discovery that in the refining of pig iron into steel by oxygen in a rotary furnace as according to the U.S. Patent No. 2,598,393 the progress of the metallurgical processes and consequently the properties of the steel obtained and even the heat economy are dependent on the inclination of the oxygen jet. Thus, the inclination of the tuyere, on the one hand, influences the mutual order in which carbon and phosphorus are oxidized, and, on the other hand, determines the portion of the carbon monoxide developed that can be burned to carbon dioxide before the gas leaves the furnace. A steeper inclination of the tuyere renders a more vivid reaction and retards the combustion of the carbon monoxide, whereas a smaller inclination has an opposite effect. This has an influence upon the temperature as well as the composition of the melt and inter alia makes it difficult to obtain uniform results from one charge or heat to the other.

Furthermore, because of the fact that the gas jet has a narrow width relative to the surface of the charge and that the portion of the surface that is directly impinged by the jet is raised to a particularly high temperature the furnace lining is subjected to uneven wear, and this unevenness is dependent upon the direction of the oxygen jet. An uneven wear of the lining is disadvantageous because of bad utilization of the lining and increased costs for its repair. The problem is of particular importance in such processes where carbonaceous melts are refined and a considerable portion of the carbon monoxide developed from the melt is burned with pure oxygen gas within the furnace. It has been found that the direction of the oxygen jet has the effect that the attack will be heaviest in that part of the furnace where the oxygen jet impinges the melt.

The above drawbacks are eliminated if, according to the invention, the jet is caused to move so as to impinge the surface of the molten body of the charge during the refining process at different angles, and preferably so as to impinge the surface at different limited areas or spots thereof. In a rotary furnace the spot of impingement of the jet should with advantage be caused to travel to and fro during the major portion of the refining procedure in the longitudinal direction of the furnace, preferably over so great a part of the charge surface that all portions of the furnace lining situated above the charge become substantially uniformly exposed to the radiation from the travelling impingement area. It is preferred

that the jet is caused to move according to a predetermined program, suitably continuously, with regard to angle of impingement and/or travel of the spot of impingement. It should, of course, be possible to interrupt the travel temporarily, e.g. if one wishes to influence, by way of the blowing, the course of the refining in one way or the other. For warranting a uniform product it is suitable that the travelling program for the gas jet is substantially equal from one heat or charge to the other in the usual batch operation of the steel manufacture.

The device according to the invention comprises a lined melting furnace, suitably a rotary furnace, having one or possibly more tuyeres which project into the furnace and preferably are water cooled. The device is characterized by the fact, that the tuyere is pivoted about an axis and connected to a driving device for the pivotal movement, limit position members being provided for limiting the pivotal movement.

It is particularly advantageous that by a simple manipulation the tuyere can be arrested at any position between the adopted extreme positions, which is sometimes of great value in order that the progress of the heat (charge) can be influenced momentaneously in desired direction. If, for instance, the boiling reaction is too vivid one may incidentally set the tuyere with a small inclination until the reaction resumes its normal intensity. Similarly, by setting the tuyere at a smaller angle, it is possible in the refining of steel more quickly to reduce the excess of oxide in the slag, if the percentage thereof has become so great that the slag assumes a foaming character. At another occasion it may instead be desired to increase the percentage of iron oxide in the slag, for instance in order to accelerate the oxidation of phosphorus, and it may then be suitable incidentally to arrest the oxygen gas tuyere at a more steep inclination.

In the refining with oxygen gas in a sloping rotary furnace according to the above mentioned patent the further advantage is gained from the movable tuyere, that the latter can easily be put in the position most suitable for its introduction into and extraction out of the furnace. Thereby it will be possible to employ a large filling of the furnace.

In order to elucidate how the oxygen gas tuyere can be fitted and controlled in accordance with this invention reference is made to the accompanying drawing showing an embodiment for refining with oxygen gas in a rotary furnace. This embodiment, however, should only be considered as an example.

The drawing shows a vertical section of a sloping rotary furnace **1** adapted for refining pig iron or other metals and provided with a refractory lining **2**. The furnace is surrounded by a frame **3** provided with treads **4** for driving rollers **5** and idle rollers **6**, the former being driven by a motor **7**. Guiding rollers **9** are provided for limiting the axial movement of the furnace. The oxygen-rich gas to be used is supplied through a conduit **11** and a water cooled tuyere **12** secured to the double jacketed exhaust hood **13**, which has an inlet **14** and an outlet **15** for cooling water and through which gases and fumes formed during the reaction are removed to the exhaust line **17**. The exhaust hood is pivoted about a vertical shaft **16** secured to the base **20** so that it can be swung away and make the furnace accessible for charging, sampling and similar operations.

The oxygen gas tuyere **12** is carried by a bracket **18**, which is pivoted on a horizontal shaft **19** fitted on the hood. The tuyere can thus be turned about said shaft **19** into different positions, e.g. between 15° and 40° counted from the horizontal. In the illustrated embodiment this turning is effected by means of a hydraulic equipment comprising a conventional cylinder **26** with double acting piston secured to a piston rod **27** attached

to an arm **28** projecting from the bracket **18**. Pressure medium conduits **29** and **30** connect the cylinder chambers with a pressure medium equipment **32** comprising a pump with motor, reversing valves, change over switches and containers, not shown. In the conduit **30** there is a valve **33** by which the transport of medium can be interrupted. The two extreme positions of the piston are determined by limit position contacts **36** which can be set independently of one another. The limit position contacts act upon magnet valves (not shown) in the equipment **32** which regulate in known manner the supply and exhaust of pressure medium at both ends of the cylinder so that the opening of the oxygen gas tuyere is given a perpetual oscillating movement along a circular arc having the shaft **19** as centre. By means of a simple shutting off device for the pressure medium, here in the form of the valve **33**, the tuyere may be brought to a standstill in an arbitrary position between the two turning positions so that the course of the reaction can be influenced in a favourable direction or the swinging of the tuyere into or out from the furnace can be facilitated.

Instead of the double acting hydraulic cylinder one may also employ known servo motors suited for the above mentioned moving program, e.g. a reciprocating cog rod or an eccentric disc driven in a manner known per se, e.g. by an electric or pneumatic motor.

The invention, in its broadest aspects, is not restricted to the furnace type, the manner of securing the tuyere

and the moving program for the latter described herein above but comprises generally all embodiments in which the inclination of the refining gas jet impinging the surface of the melt is varied so as to obtain desired effects upon the refining results.

What is claimed is:

1. A device for refining iron alloys and other metals and metal compounds comprising a lined rotary melting furnace in a lying position having at least one blast tuyere projecting into the furnace above and directed against the charge to be refined therein, said tuyere being pivoted about an axis and connected to a driving device for the pivotal movement thereof, limit position members for limiting the pivotal movement and means for supplying an oxygen-rich gas to said blast tuyere.

2. A device as claimed in claim 1 in which said driving device is a hydraulic driving device and the limit position members are of the electromagnetic kind.

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