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PROCESS IN THE HEATING OF METAL BILLETS AND AN ARRANGEMENT FOR CARRYING OUT THE PROCESS

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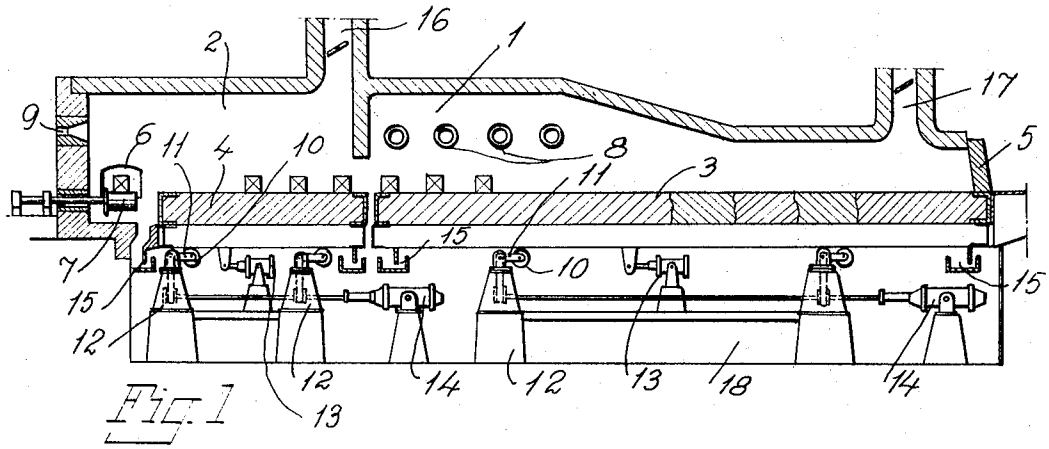


Fig. 1

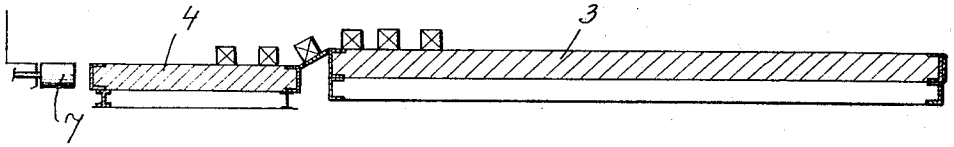


Fig. 2

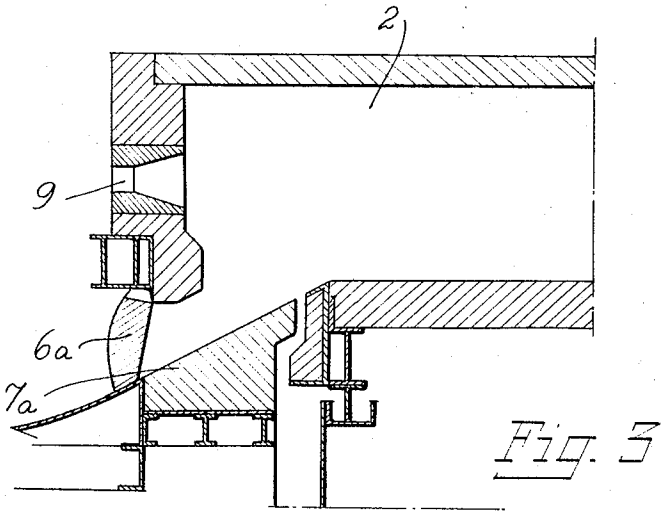


Fig. 3

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PROCESS IN THE HEATING OF METAL BILLETS AND AN ARRANGEMENT FOR CARRYING OUT THE PROCESS

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The present invention relates to a process in the heating of metal billets in a heating furnace with mechanical transport of the billets through the furnace.

Heating of metal billets for subsequent deformation by rolling, pressing or forging, takes place as a rule at temperatures between ten to twenty and two to three hundred degrees centrigrade below the melting point of the metal or metallic alloy to be heated.

During heating, the billets undergo certain inner transformation in addition to which chemical reactions take place on their surfaces. The speed of these surface reactions depends partly on the atmosphere surrounding the billets in the furnace and partly on the temperature at the surface of the material and the time that the material is at the temperature in question. In the great majority of cases, the surface reactions involve an undesirable loss of material or a change in the composition of the outer layer of the material, which effects, in various ways, it has been attempted to limit.

In the heat treatment range, excellent results have been obtained by the use of shielding gas atmospheres adapted to the nature of the material in order to limit or eliminate the undesirable surface reactions. However, normal heat treatment usually takes place at lower temperatures and in smaller furnace units than is the case in heating. In high productive large heating furnace units therefore, use of shielding gas in the heating furnace has not been undertaken to any great extent, to a certain degree because of technical reasons but primarily for reasons of economy. This, however, does not exclude the possibility of such a measure gaining increased significance as a means of preventing suface reaction in heating furnaces as well, especially during the latter part of the heating period until the final temperature has been reached, as the speed of the surface reaction in furnaces not supplied with shielding gas rises exponentially with the temperature.

The present invention does not assume the use of shielding gas. It relates to a process by which, despite the presence of free or bound oxygen in the furnace atmosphere, a considerable reduction of the surface reaction can be attained compared to what can be obtained with corresponding manpower in known types of furnace. In addition, the process has been developed with a view to its use preferably for steel and steel alloys.

With knowledge of the reaction speed at different temperatures for the material to be heated, the process involves dividing the heating into at least two successive temperature stages, the duration of the different stages being adjusted in such a way that the surface reactions are limited as far as possible with regard to the demands placed upon the heated material concerning the necessary uniformity of temperature for the subsequent deformation.

When heating, for example steel billets or steel alloys, it may be an advantage to raise the temperature in the first temperature stage to about 750° C., i.e., somewhat above the transformation point for the material in question. At the said temperatures, the speed of the surface reactions is still comparatively low, the surface reaction thus being less powerful if transformation in the whole billet takes place at a lower furnace temperature in the first stage and at a higher temperature in a subsequent stage.

Heating in the second and the possible subsequent temperature stages, takes place at a higher temperature and the transport at a higher speed than in the stage immediately preceding in order, while retaining thorough through-heating, to limit the surface reactions by making the duration of the stage in question as short as possible.

For heating the billets to temperatures suitable for various hot-deformation processes, use is made partly of batch furnaces, e.g., chamber furnaces, carriage-furnaces and pit-furnaces, partly of more or less pronounced continuous feeding furnaces, e.g., push-through-furnaces, furnaces with rotating hearths, walking beam furnaces and in certain cases roller-hearth furnaces. The present invention relates only to the use of continuous furnaces.

In continuous furnaces of the kind mentioned above, division of the furnace into different temperature stages can be made by dividing the furnace space, from the receiving end to the discharge end, into more or less sharply defined zones, the temperature stages coinciding with these furnace zones.

The greater the surface area of the billet that is exposed to convection and radiation, the more quickly heating takes place. It is therefore of great importance that the billets be separate from each other during transport.

In the conventional pusher furnace, it has not been possible to satisfy this requirement in that part of the furnace where the billets are pushed forward lying close to each other. In certain embodiments this part extends throughout the length of the furnace, which means that the speed at which the billets are advanced is not changed when they approach the final temperature. In other embodiments the billets are mechanically pushed forward into a part of the furnace and thereafter manually rolled, using crow bars, with a certain distance between them, through the final heating zone to a discharge aperture arranged frontally or in the side wall of the furnace. In this method of procedure, the above mentioned conditions for effective and speedy heating exist at least in the distance that the billets are rolled. In that the rolling speed can be varied, the surface reactions can also be lower than for a push-through furnace with the push-through distance extending throughout its length. The arrangement according to the invention, however, relates to mechanical transport throughout the entire furnace. The push-through furnace also has certain disadvantages in that it cannot be completely emptied without considerable manual work.

Furances with rotating hearths, at least so called ring-furnaces, offer the possibility of dividing the furnace into zones corresponding to the temperature staged stated above. During transport from the receiving aperture to the discharge aperture the billets are more or less separate from each other. Transport from the receiving to the discharge apertures is completely mechanical. The furnace has, moreover, the advantage that it can be easily emptied if so desired, completely or partially, using the mechanical means, installed for normal transport of the billets. However, owing to the basic construction of the furnace, it is not possible to vary the transport speed during passage of the billets through the furnace.

The invention will be further explained below with reference to the attached drawing in which a walking beam furnace is diagrammatically illustrated, and in connection with this, further characteristics will be set forth.

FIGURE 1 shows a longitudinal section of a walking beam furnace according to the invention.

FIGURE 2 shows a modification of the walking beam arrangement according to FIGURE 1, likewise in longitudinal section.

FIGURE 3 shows an example of how a frontal discharge chute with a discharge aperture can be arranged.

The furnace shown in FIGURE 1 consists principally of two furnace chambers, **1** for preheating and **2** for final heating. The hearth in the preheating part consists of one or more parallel movable walking beams **3**, and longitudinal fixed beams situated between them. The number of parallel beams is determined by the billet-length of the material to be heated in the furnace. In the final heating part **2**, the hearth is also constructed as a walking beam system **4**, suitably with the same number of beams as in the preheating part.

Heating of the furnace takes place in the case chosen by way of example, by oil burners or gas burners or combination burners mounted as side burners **8** in the preheating part and as gable burners **9** in the final heating part. The fumes from all burners are led away from the furnace through the fume outlet **17**. On lighting the oven, and when operation of the roller mechanism is interrupted, the fume outlet **16** is used for the final heating zone and the outlet **17** for the preheating zone.

The beams rest on carrier wheels **10** which are mounted on bell-crank levers **11**. The bell-crank levers are in turn mounted on bearing pedestals **12** standing on concrete bases. By means of hydraulic lift cylinders **14**, one for each walking beam in the beam system in each of the preheating and final heating parts respectively, which cylinders are connected to the levers by pull rods, the movable beams can be raised and lowered in a known manner. In both beam systems, the movable beams can be moved forwards and backwards in a purely horizontal direction by means of hydraulic carrier cylinder **13**, during which movements the movable beams roll on the carrier wheels **10**. The extreme positions for the raising and lowering movement as well as the backward and forward movement are adjustable so as to be adapted in the most suitable manner to the dimensions of the billets for which the furnace has been constructed.

The time interval between two successive beam cycles, raising—moving forward—lowering—moving backwards, can also be varied within wide limits. The desired distance between the billets can herewith be simply adjusted. The position of rest is where the movable beams are in the retracted and lowered position. To seal the beam system against air penetrating from the beam machinery space **8** under the furnace and for collecting oxide scales and/or slag dropping from the material, there are water seals **15**, assembled with cleansable oxide throats and slag chutes.

The billets are moved into the furnace through the receiving aperture **5**, either by the movable walking beams which possibly extend outside the aperture, as shown in FIGURE 1, or by frontal insertion means, or from the side, e.g., on a roller conveyor. The billets are advanced on the beam system in the preheating zone in steps through the zone so that on exit from this zone they will be automatically moved to the beam system in the final heating zone and finally delivered from the walking beams to a discharge toller conveyor **7** and leave the furnace through the discharge aperture **6** in one of the longitudinal sides of the furnace as is evident from FIGURE 1. In certain cases, with regard to the placing of the furnace in relation to the rolling mill and transport path between the furnace and mill, it can be more advantageous to have frontal discharge from the furnace. FIGURE 3 shows

an example of how a discharge chute **7***a* and discharge aperture **6***a* can be arranged in such a case.

Both the walking beam systems can be arranged at the same horizontal level, i.e., that in adjusted end position for raising and lowering they are at the same level, as is evident from FIGURE 1. In this case, the beam systems are not driven completely independently of each other. Synchronization is therewith carried out in such a way that when the movable beam system in the preheating zone executes a forward feeding cycle the movable beam system in the final heating zone executes the same cycle. After the former beam system has reached rest position, the synchronization is stopped and the latter beam system can execute a desired number of forward feeding cycles while the beam system in the preheating zone remains at rest.

In FIGURE 2 an alternative embodiment is shown where both the beam systems are at different levels and are separated, wherefore transfer of billets from the first movable beam system to the second is carried out by means of a short chute, on which the billets, owing to the force of gravity, slide from the one system to the other. In this case, both beam systems can be driven independently of each other.

By adjusting the length of the forward movements (stroke length) and the time interval between the forward movement cycles of the different beam systems according to the nature of the material of the billets to be heated, the arrangement described presents an excellent and flexible means of carrying out the process according to the invention.

Having now described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A method of heating steel billets to a desired high temperature in an oxygen-containing atmosphere comprising passing the billets through a preheating zone to heat the billets uniformly to a moderate temperature below which no substantial surface reaction occurs, immediately transferring the billets to a final heating zone, and passing the billets through said final heating zone rapidly to further heat the billets uniformly to the desired high temperature in the shortest possible time so that surface reactions are minimized.

2. Apparatus for heating steel billets to a desired high temperature comprising a moderate-temperature preheating chamber open to oxygen-containing atmosphere, walking beam conveyor means for advancing individual billets through said preheating chamber, a high-temperature final heating chamber open to oxygen-containing atmosphere, walking beam conveyor means for advancing the billets through said final heating chamber, means for transferring the billets directly from the conveyor means in the preheating chamber to the conveyor means in the final heating chamber, means for driving the conveyor means in the final heating chamber at a faster advancing speed than the conveyor means in the preheating chamber, and means to proportion the advancing speeds of the two conveyor means to reduce the duration of passage of each billet through the final heating chamber to the shortest time needed for through-heating of the billet to the desired high temperature.

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