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L. J. ROCHLITZ

OPERATION OF CUPOLA FURNACES

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ATTORNEY.
To all whom it may concern:

Be it known that I, LUDWIG JOSEF ROCHLITZ, citizen of Czechoslovakia, residing at Stuttgart, Wurttemberg, Germany, have invented certain new and useful Improvements in the Operation of Cupola Furnaces (for which I filed applications in Germany, No. 42,168, July 26, 1915; Germany, No. 42,503, Jan. 24, 1916; Germany, No. 42,502, Jan. 24, 1916; Germany, No. 42,606, Mar. 10, 1916); and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in the operation of cupola furnaces of the class in which liquid or gaseous combustibles are used as a fuel for melting and the object of my invention is to provide a new way or method of supplying the hearth of a furnace of the class referred to with material intended for melting by which certain disadvantages heretofore inherent in the melting process with gaseous or liquid combustibles are entirely avoided. Another object of my invention is to provide such improvements in the construction of furnaces of the said class, as may be necessary for carrying out my invention.

In describing my invention I refer to the drawings herewith in which Figure I is a longitudinal section through a furnace adapted for use in carrying out my invention, while Figures II, III, IV, V, VI and VII are similar longitudinal sections through similar furnaces showing certain modifications in construction and illustrating various ways of operation, all this to be hereinafter more particularly described.

As is generally known, three different methods of melting metals may be resorted to, namely, melting by means of crucible furnaces, by means of flame-furnaces and by means of cupola-furnaces, the latter offering certain particular advantages of which the following are specially valued: The heating power may be particularly utilized on the counter-current system or principle; there is no interruption of operations; the charge of a furnace may be put in portions or lots and also in various qualities, it may then be reduced into liquid state and when molten, drawn off through the tap-hole.

Now, there is no difficulty to carry on melting in a way which includes these characteristic features in a cupola-furnace which is heated with solid combustibles, for in this case the charge consists of alternate layers of fuel, as, for instance, coke, and of the material intended for melting, the several layers of the former preventing not only contact of unmolten metal with material which is still in a state of melting and in this way preventing any trouble which might arise out of such contact, but keeping at the same time this half-molten metal separate from metal already entirely molten, only the liquid material being allowed to trickle through.

Where, however, liquid or gaseous fuel is employed, this is different and therefore certain ways must be followed which my invention aims to provide, and, accordingly, the principal feature of my invention is to secure the advantages enumerated by precluding in any of the various ways hereinafter described an automatic forward movement within the furnace, of the material intended for melting and instead thereof of controlling and causing such forward movement only in accordance with the advancing or advanced stages in the process of melting. In this way the hearth is saved from a premature entrance or incursion of the insufficiently pre-heated material and, in addition, the melting may be done in various portions, an interstitial space or distance being provided between the several portions in the process of melting and each next following portion of unmolten material.

My invention will be best understood by referring to the drawings illustrating various forms of furnace for practicing my improved method.

Thus Figure I illustrates a furnace, as referred to, in longitudinal section comprising a hearth h, a shaft or tunnel sch, a wall t, a tap-hole ar, a burner b, inspection-holes so, a slide-rail qr, a gate bm through which to put in the charge, receptacles s, hereinafter referred to, a sole at, supports as and a landing or platform gb. The shaft shows an inclination of about 35 degrees to permit a slipping down of the charge. The
latter I divide into lots or portions which I place in a kind of open boxes or receptacles s, preferably consisting of the same or a similar material as the material intended for melting and insert them, one after the other, through the gate into the inclined shafts in which they are thus allowed to severally slip or glide down, one after the other, their advance movement being controlled and only the lowermost portion permitted to go upon the hearth. When this lowermost portion and the receptacle containing it is melted, the next following portion is bound to follow, while another portion is being put into the shaft sch through the gate on top-end. A sliding railor the like may be provided in the lower portion of the tunnel to halt the respective lowermost receptacle until its turn arrives, when it may be put on the hearth by means of any suitable device or constructive part which may be provided for the purpose, though not visible on the drawing.

Another example of construction of the furnace is illustrated in Figure II, also shown in longitudinal section, this figure indicating again the aforementioned parts, as the hearth, the shaft or tunnel sch, the wall t, the burner b, inspection-opening so, the sliding rail gs, the gate bm, the receptacles s, the sole us, the supports us and the platform gb and, in addition, a feeding or charging device bn. In this case the inclination of the shaft is about 25 degrees only. The several portions of the charge placed again in receptacles of about the same material as the one intended for melting I insert, as in the first described case, in a series, one after the other into the shaft or tunnel, these receptacles to be severally pushed forward with the result that the lowermost portion gets on the hearth, while on top another new charge is being added. As soon as the lowermost portion together with the receptacle containing it is melted, the next adjoining portion may be placed unto the hearth by operating the aforementioned pushing device.

Still another example of the construction of the furnace and thus a modified way of carrying out my invention, is represented in Figure III which shows the furnace in longitudinal section and again indicates the hearth h, a wall t, a tap-hole ar, a burner b, a slide-rail gs, a gate bm, a charging device bv, receptacles s, a sole us, supports us and a platform gb. The inclination is in this case about 45 degrees. The several portions of the charge placed again in receptacles, as described, of about the same material as the one intended for melting, I insert, as in the cases already described, through the gate in successive series, but this time detachably fastened to each other, the receptacles being each time suitably lowered, thus getting upon the hearth while another charge is being added on top and a new portion is being forwarded towards the hearth by another lifting-down movement.

All of the foregoing constructions of the cupola furnace and the modes of operation applicable, require, as aforesaid, the feed to be charged in receptacles as described and though there is no difficulty in preparing or dressing the latter, still the ways described for charging the furnaces illustrated require a certain amount of care and attendance and some skill and, besides special devices or appliances, as referred to, can hardly be dispensed with. This drawback may be avoided, however, and the charging of the material intended for melting done in the ordinary, heretofore customary way, by resorting to the modified ways and constructions described hereinafter, where the forward movement of the feed will be effectuated by movements of the furnace itself, or, rather, by oscillating motions of the shaft or tunnel, as more particularly specified below.

Accordingly the constructions shown in Figures IV, V, VI, VII, designed more particularly for furnaces of smaller dimensions and adapted to be taken to pieces, swing on pivots or trunnions and afford, in addition, the advantage that repairs may be made on the inside and parts exchanged, whenever, for any reason, this may be desired.

An example of a construction of this kind is shown in Figure IV, being a view in longitudinal section through such a furnace which shows again the hearth, a shaft or tunnel sch, a pair of tap-holes ar placed opposite each other, inspection holes so, a pivot s and platforms gb placed opposite each other, the hearth having the discussed with a hearth-stone hs.

The forward movement of the charge is in this construction brought about by oscillating the shaft for about 130 degrees, about the pivot z, the shaft when in normal position showing an inclination of 30 degrees, more or less. The hearth h, is of the double-sided type, the sides being alternately employable in the melting process which affords the advantage that the waste heat within the shaft or tunnel, acting in upward direction will alternately benefit the two halves of the vault or ceiling of the furnace.

The dimensions in width of the hearth may, besides, be somewhat smaller than usual and the center fitted out with a hearth-stone, preferably of such shape and so disposed that it permits of cooling from the inside. Thus its capacity will be reduced and so will be the portions of the charge intended each time to be received for melting. The said hearth-stone may also be placed on the bottom, direct upon the sole.
of the furnace which permits the insertion each time and the operation of an iron-bar of suitable width through the respective inspection-hole during the swinging motions to regulate the size of the portions getting upon the side of the hearth intended for the next following melting operation.

There are two preferably closed and rigidly attached burners which may operate simultaneously, the one of the two which is one top serving especially to superheat the respective sides of the hearth, thereby imparting a preliminary heating to the charge within the shaft.

I operate this modified construction as follows: The shaft resting against one of the platforms, I place the charge into the shaft in the usual way and swing it against the opposite platform, as indicated in the figure by dotted lines, the lowermost portion of the charge being by the shaking of the shaft forwarded upon the hearth while another portion may be put in on top through the gate at the same time and the charge thus replenished. As soon as the portion in the hearth is melted, it may be drawn off through the proper tap-hole and by another swing of the shaft against the former, now opposite platform the next following portion may be made to enter the hearth.

Another example of carrying out my invention is illustrated in Figure V which shows another modified construction of my furnace in longitudinal section. Th's figure shows the hearth h, the hearth-stone hs, a shaft or tunnel sch, opposite tap-holes ar, opposite burners b, inspection holes so, a pivot s and opposite platforms gb, the said shaft having in this case alternately disposed interior transverse partitions gw.

Also in this furnace the feed may be forwarded by to and from swingings, this time for about 110 degrees, of the shaft, the normal position of the said shaft being at an inclination of about 35 degrees. The burners and the hearth are constructed and disposed approximately as described and shown with reference to the last foregoing modification of my construction and may be used in about the same way. The shaft is, as already mentioned, provided with alternately disposed transverse partitions permitting its operation with charges of various qualities. These charges may one after the other be placed in the uppermost compartment of the tunnel which is inclined against one of the platforms gb and by repeated swingings against and between the two platforms passed gradually through all compartments, so that the portion in the lowermost compartment in due time reaches the hearth while at the same time the uppermost compartment is being supplied with a new charge. When the material received by the hearth is liquefied, it may be drawn off through the proper tap-hole and by new repeated swingings from one platform against the other and back again, the next adjoining portion may be forwarded into the hearth.

In the constructions shown in Figures VI and VII the feed is again forwarded by movements of the shaft, but this time by axial rather than by swingings motions. Also these types are chiefly intended for smaller sizes and may be taken apart, permitting of repairs and the exchange of inner parts.

Accordingly Figure VI is a longitudinal section through a furnace of the last mentioned constructive principle. In this figure h is again the hearth, hs a hearth-stone, sch the tunnel or shaft of the furnace, so are inspection-holes, b are burners, r are rollers or wheels which are provided instead of the pivot mentioned in the last foregoing constructions, ar are tap-holes and gb is the platform. The forward movement of the feed is in this instance effectuated by rotatory oscillations of the furnace for 180 degrees which I bring about by means of mechanism including the said rollers r. The inclination of the furnace in normal position is about 25 degrees. Otherwise the furnace is for the fulfilment of the same duties of the same construction as the furnace described in Figure V except that it has not the partitions referred to in the former. The operation is likewise the same except that instead of swinging turning is resorted to.

Figure VII illustrates a furnace of similar construction as in the example shown in Figure V, the same being also shown in longitudinal section, while h is again the hearth, hs a hearth-stone, sch a shaft or tunnel, ar are tap-holes, b burners, so inspection openings, r rollers, gb is the platform, gw are partitions provided in this instance within the shaft, as in Figure V, these partitions being, in fact, the only feature which distinguishes this construction from the one illustrated in the last foregoing figure. Also in this instance the forward movement of the feed is effectuated by axially reciprocating movements of the furnace, again for 180 degrees, by means of the rollers r, the inclination of the furnace being about 25 degrees. The manner of operation is also in this case as above repeatedly set forth, particularly in describing Figure V, only that the furnace is rotated, as in the last illustrated instance, instead of being swung.

All of the constructions and methods of operation described permit the melting of metals by means of liquid or gaseous fuel with the same effect as may be done in a cupola furnace in which solid combustibles are employed as a fuel and without losing
any of the advantages residing in furnaces of the last-mentioned class.

I do not limit myself to the exact details of operation and the exact constructions and arrangements herein described and shown, as I desire to avail myself of such modifications and equivalents as fall properly within the spirit of my invention.

I claim:

1. The herein described method of operating cupola furnaces employing liquid or gaseous fuel, which consists in subdividing a complete charge into parts, and successively feeding the parts of the charge in an inclined path to the furnace hearth so that one part is completely melted before a succeeding part is fed thereto.

2. The herein described method of operating cupola furnaces employing liquid or gaseous fuel, which consists in subdividing the charge into parts, and imparting motion to the furnace to feed the parts of the charge to the furnace hearth so that one part is completely melted before a succeeding part is fed thereto.

3. A furnace of the character described, comprising an inclined charge feeding shaft, a hearth at the lower end of said shaft, burners adapted to direct liquid or gaseous fuel into said hearth, and means for imparting motion to the furnace to cause the feed of the charge through the shaft.

4. The herein described method of operating cupola furnaces, which consists in continuously feeding a charge towards the furnace hearth and permitting only a definite fraction of said charge to enter into the furnace hearth at a time.

5. The herein described method of operating cupola furnaces, which consists in continuously feeding a charge towards the furnace hearth and permitting a definite fraction of said charge to enter the furnace hearth only after the previous fraction of the charge is completely melted therein.

6. A furnace of the character described, comprising a hearth, a charge feeding path leading thereto, and means for controlling the entrance of said charge into the hearth in definite fractional quantities and at certain determined intervals of time.

7. A furnace of the character described, comprising a hearth, a charge feeding path leading thereto, means for successively feeding charge from said path into said hearth in predetermined fractional quantities, and means operative upon the melting of a fraction of said charge in the hearth for permitting the entrance of the succeeding fractional quantity into the hearth.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

LUDWIG JOSEF ROCHLITZ.

Witnesses:

EUGEN SCHLEICHER,
ERNST ENNENMANN.