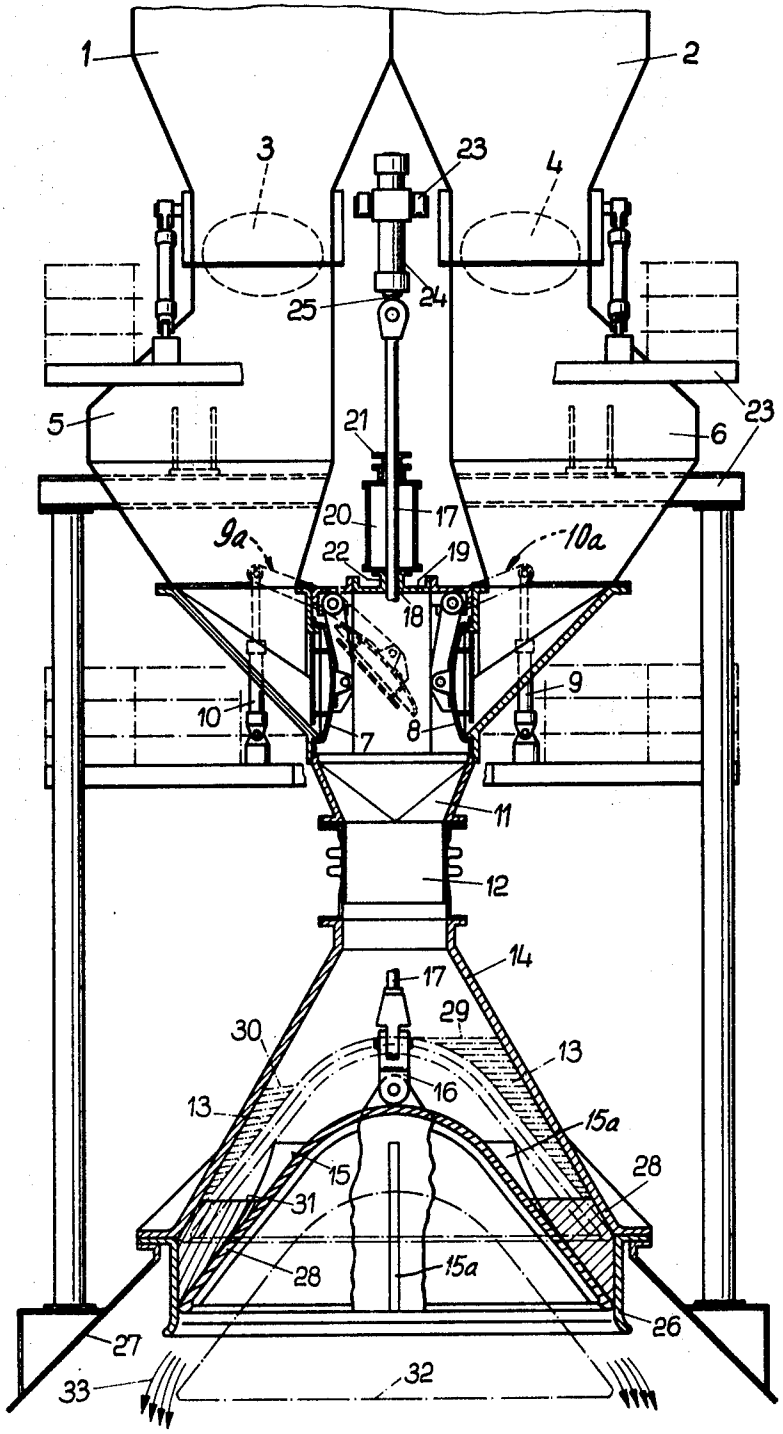
Sept. 20, 1971 M. EUTENEUER 3,606,040

METHOD OF AND APPARATUS FOR CHARGING FURNACES

Filed May 9, 1969



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United States Patent Office 3,606,040 Patented Sept. 20, 1971

3,606,040

METHOD OF AND APPARATUS FOR CHARGING FURNACES

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Filed May 9, 1969, Ser. No. 823,427
Int. Cl. F27b 11/12
U.S. Cl. 214—37 10 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for charging shaft furnaces particularly blast furnaces which are operated at high pressure includes a plurality of lock chambers which are arranged with their inlet ends connected through lock chamber openings to one or more storage bins and with their discharge ends located for selective discharge into a central distributing chamber. The distributing chamber has a flared lower end which opens into the furnace and which accommodates a distributor bell. The flared end of the distributor is dimensioned so that the distributor bell may be shifted upwardly and downwardly therein for varying the cross sectional area of the material delivered to the top of the bell of distribution downwardly into the furnace. In accordance with the inventive method, the material is delivered on the lock chambers into the central distributing chamber and permitted to pile up in front of the furnace chamber over the bell first on a ring surface with the bell positioned uppermost within the flared end of the distributing chamber and then on an annular surface which is increased in width and reduced in height as the bell is lowered in the distributing chamber.

SUMMARY OF THE INVENTION

This invention relates in general to the construction and operation of metallurgical furnaces and in particular, to a new and useful method and apparatus for charging shaft furnaces particularly blast furnaces which operate at high pressures.

The invention is particularly concerned with those blast furnaces which include a feed system having a lock chamber for sealing the furnace from the atmosphere. The increase of the hearth diameter of the blast furnaces up to ten meters and more brings about problems in the gas treatment and thus in the charging thereof. For example, in German Pat. No. 1,229,566, blast furnaces are described as being charged by a piling method. Large blast furnaces can also be charged according to the pouring method but with some inconveniences. The difficulties of the gas treatment of a rather irregularly distributed charge can be compensated by higher pressures in the throat. To this end the blast furnaces must be packed in order to keep the pressure at about 2.3 times atmosphere and to accomplish this lock chambers are required. The material is supplied, for example, from a skip-charging device and is filled into the lock chamber during the period at which the outlets of the storage bins are closed. Naturally the storage bins have some capacity of material and this results in a greater height of the furnace. The outlets of the lock chambers connect into a distributor which is arranged directly adjacent the furnace chamber. As is known for example, in the publication "Journal of Metals," dated February 1966 on page 233, there is a showing of two charging bells of a conventional design arranged behind the lock chambers. The material flows in a conical feed duct from the lock chambers toward the center of the shafts. It piles up between a first bell and a hopper and after is released the material drops to the underlying bell and to the charging dish proper. Only

then does a suitable ring distribution of the material in the charging dish seem to be realized.

In blast furnaces not operating according to the high pressure method it is known to provide a distributor for skip-charging. The material is supplied on the circumference at one or several points of the throat and it comprises mostly a rotating mechanism. Such a distributor is arranged outside the lock chambers formed by the two bells and hoppers and the charging dishes respectively, because there is no problem of a contamination of the flue gas or of the drive. The conditions are different in blast furnaces which are operated according to the high pressure method and where the material must be distributed through a lock chamber.

In accordance with the invention, there is provided a method and apparatus for achieving a relatively low height of fall of the material and for distributing the material over the shortest path without requiring a design which jeopardizes the sealing affect and thus the operating results.

In accordance with the invention the charging device includes a distribution chamber having a downwardly flaring discharge end terminating in a cylindrical chamber having a circular opening in which is located a distribution bell. The distribution chamber connects through one or more valve openings to one or more lock chambers and material received from the lock chambers is permitted to pile up in front of the furnace chamber. The material is first distributed over the bell when the bell is positioned upwardly in the discharge opening to the furnace. The bell is then permitted to move downwardly gradually so as to effect an increase in the width of the bed and a reduction of the height thereof because of the movement of the bell downwardly to the widest portion of the downwardly flared discharge. The downward movement is carried out until there is a ring surface of the material which may be distributed downwardly around the bell into the furnace. The basic concept is to move the distributing material at a moderate velocity either in a horizontal or vertical direction. The known pouring methods, however, are such that there is a great impact due to the height of fall of the material so that a corresponding large number of stages of the charging bells are required. For example, a three stage charging bell method and apparatus is known as described in the publication, "Journal of Metals." February 1966, on page 231. With the present invention, however, there is disadvantage of a high mechanical stress of the burden.

The characteristic of the material which issues from a lock chamber outlet requires a directed flow and this results in a certain difficulty in distributing the material on the distributing device. According to another feature of the method of the invention it is therefore suggested that the material be supplied for filling alternately in opposite partial pourings. A certain compensation can be achieved by supplying the material simultaneously to several points on the circumference so that the distribution can be even further faciiltated.

In order to ensure the safety of the furnace top a very simple distribution device is employed in the invention which comprises a bell and hopper arrangement. The construction includes a discharge duct or hopper which has an outwardly flaring lower discharge end which is closed by a bell. The bell moves within the hopper and it is arranged within the path of the material. The bell forms with the hopper walls material chambers accommodating material of ring cross section and the vertical movement of the bell provides for a change in the size end or form of the ring cross section of the material which is piled thereon.

In contrast to the known distributing devices there is cooperation between only one body and one stationary

shaft wall. The possibility of trouble of operation of such a bell and hopper arrangement is far less than the known arrangements. In addition there are far fewer parts which can be subjected to wear and the arrangement does not affect the safety of operation. The bell and the discharge conduit or hopper arrangement is preferably designed low so that the path of the charging material from the lock chamber outlet to the distributing device is shortened. A simplification of the high pressure bell and hopper arrangement proves advantageous because increased temperatures appear at higher pressures so that the parts are even more stressed inside the furnace chamber than in the known devices.

The practical realization of the invention includes a central distributing duct which is arranged to receive the material from the lock chambers and which includes a downwardly and outwardly flaring portion terminating in a cylindrical discharge. The outer periphery of the bell is dimensioned to permit it to be moved upwardly in the cylindrical discharge so that in its uppermost position the space between the surface of the bell and the walls of the discharge portion of the distributor duct are relatively narrow. The downward movement of the bell effects an ordering, or distribution, of the charged material over the bell surface and the change of the dimensions thereof in view of the change of the annular dimensions around the bell due to its lowering into the cylindrical portion of the distribution duct from the conical portion. The further downward movement effects the release of the material around the periphery of the bell and since the discharge movement of the material takes place in the same direction as the downward movement of the bell the supply of a large quantity of charging material is possible. In accordance with the invention the cone bell may be formed to a conical bevel similar to the downwardly flaring conical bevel of the distributor duct but somewhat flatter.

The construction of the invention provides a safely sealed material distribution system for the high pressure operation of the furnace. The closing bell is centrally suspended from a central tie rod which passes upwardly through a seal of the roof of the distribution hopper and between two adjacent lock chambers and passes through a pressurized sealing chamber to a fluid drive. The use of a single lifting rod limits the movement of the diameter of the rod and this therefore may be kept very small. In addition there are less difficulties in packing the passage of the rod through the upper portion of the distributing chamber and through a pressurized sealing cylinder.

As far as the pouring is concerned it is advantageous that the material be directed around the tie rod so that the flow of the material is not impaired. The tie rod which supports the bell therefore is guided through a pressure cylinder at the top of the distributing chamber and centrally between the discharge opening of the lock chamber on each side of the distributing chamber. Since there are no pressure losses in the furnace chamber and no additional packing points appear, any flow resistance inside the central filler tube is eliminated. Because the material can be charged through a distributing duct having a much larger circumferential wall area the bell and the distributing duct carry vertically arranged radially extending guide walls. In some instances the distribution is enhanced by rotating the bell or the distributing duct or both. For such purposes the downward discharge movement of the bell can be effected simultaneously with a rotary movement, so that a sufficiently accurate distribution will take place before the release of the material for placing it on the charging surface.

Accordingly, it is an object of the invention to provide an improved method of charging shaft furnaces by distributing a material over the surface area defined between a depending bell and a downwardly and outwardly flaring distributor chute, and wherein the material is distributed first on a ring surface over the bell and wherein the width of the material is increased and the height of the material reduced as the material is released downwardly into the charging area.

A further object of the invention is to provide an apparatus for charging of furnace which includes a distributor duct arranged centrally between one or more lock chambers and which includes a downwardly and outwardly flaring discharge which is closed by a bell member which is arranged for vertical movement therein and which in an upper position closes the end of the distributor duct but which in a downward position opens the end for the discharge of a material therefrom.

A further object of the invention is to provide a charging device which is simple in design, rugged in construction, and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The only figure of the drawing is a vertical sectional view through the wall of a charging device for a shaft furnace constructed in accordance with the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, in particular, the invention embodied therein comprises a storage bin **1** and **2** which receives charging material from an inclined elevator (not shown) such as a skip-charging device, for example. The bins **1** and **2** connect at their lower ends into the upper ends of lock chambers **5** and **6** through closeable lock chamber openings **3** and **4**. The lock chambers **5** and **6** are filled with sealing flaps **7** and **8**, at their lower ends, closed. Before the sealing flaps **7** and **8** can be opened against the furnace chamber pressure a pressure equalization is effected in the lock chambers **5** and **6**. This pressure equalization is produced by a pressure rise which is effected through gas pressure connections (not shown), which permits the delivery of purified flue gas at furnished pressure into the lock chambers **5** and **6**. After this is effected the sealing flaps **7** and **8** can be opened by means of hydraulically operated cylinders **9** and **10** which are connected through associated linkages generally designated **9***a* and **10***a* respectively, to the sealing flaps **7** and **8**, respectively.

In accordance with a feature of the invention, the lock chambers are arranged on respective opposite sides of a cenetral hopper or distributing duct **11** having a lower extension **12** with a conical discharge portion **14** which connects downwardly to a cylindrical discharge portion **26**. A distribution bell **15** is suspended on a pivot joint **16** through a tie rod **17** which extends upwardly through a roof **19** of the hopper **11**. The bell **15** has a maximum diameter slightly less than the interior diameter of the cylindrical discharge portion **26** and it may be raised upwardly to the dotted line position to define an annular slot or reception area **13** between the bell surface and the interior surface of the conical portion **14** for the reception of the charging material. The bell **15** includes vertically and radially extending guide walls **15***a*.

In accordance with a further feature of the invention the tie rod **17** is packed at **18** at its passage through the sealing wall or roof **19** and it extends through a tubular pressure chamber **20** which is filled with a back pressure gas and which also serves as a guide for the tie rod at respective ends **21** and **22**. A charging platform **23** located between the lock chambers **5** and **6** carries a piston drive **24** having a piston rod **25** which is articulated to the tie

rod **17**. The piston drive **24** is such that the bell **15** may be raised and lowered and also rotated.

In accordance with the method of the invention the material is directed selectively from each of the lock chambers **5** and **6** by the opening of the flap **7** and **8** into the distributing duct **11**. The material accumulates in a pile in the annular space **13** and during the lowering of the tie rod **17** with the bell **15** the material is accommodated within a larger space which becomes defined between the distributor bell and the shaft wall **14**. This means that the charging material is uniformly distributed on this annular surface. The cylindrical part **26** is held between the furnace top **27** and the shaft conical portion **14**. The free pouring of the charging material into the furnace is effected only after the distributing bell **15** occupies the bottom position indicated in broken lines **32**. When this occurs the material will pour around the periphery of the bell as indicated by the arrows **33**. In the intermediate solid line position of the bell **15**, the material is accommodated in a larger ring surface **28** which widens particularly to the inside. It is immaterial whether the charging surface **30** of the material is bevelled or not since a plane level **31** will be established during the lowering of the distributor bell **15** so that the charging material will be moved along the circumference. The ordering and the distribution the charging material can thus be effected with the inventive method by a simple movement of the distributor bell **15**.

It should be appreciated that the configuration of the distributor bell **15** is not limited to the represented configuration. It may be shaped in order to provide cooperation with the conical discharge portion **14** to provide an infinite number of variable cross sections so that the charging material may be distributed during the lowering and/or the rotation of the distributing bell **15**. It is desirable however, that the accumulation area drops during the lowering so that the material is distributed uniformly over all portions of the charging surface.

What is claimed is:

1. A method for charging shaft furnaces particularly blast furnaces which are operated at high pressures and where the charging material is conducted out of a lock chamber, which seals the furnace from the atmosphere, and into the furnace chamber, comprising permitting the material to feed out of the lock chamber and to pile up above the furnace chamber in an accumulating pile of substantially ring surface distribution, gradually increasing the width of the bed and reducing the height of the accumulated bed of the material, and releasing the material around the periphery of the ring surface for delivery to the furnace.

2. A method, according to claim **1**, wherein the material is supplied alternately and in opposite partial pourings into the accumulating pile.

3. A method for charging shaft furnaces particularly blast furnaces which are operated at high pressures and where the charging material is conducted out of a lock chamber which seals the furnace from the atmosphere and into the furnace chamber and wherein a distributing duct is arranged to connect to the lock chambers and it includes a downwardly flaring discharge end in which there is located a bell which may be vertically moved, comprising permitting the material to feed out of the lock chamber and to pile up above the furnace chamber in an accumulating pile of substantially ring surface bell in the area between the bell and the distributing duct wall, and gradually lowering the bell in the duct wall while the same is maintained at a position to block the discharge thereof to gradually increase the width of the bed and reduce the height of the accumulated bed of material, and continuing to lower the bell until the bell effects the annular opening of the lower end of the distributing duct and the release and discharge of the material into the furnace.

4. A furnace charging device comprising a duct adapted to be connected at its top end to a pressure lock chamber for the supply of a charging material thereto and having a lower discharge end oriented to discharge into a furnace, and a distributor bell movable within said duct and closing the discharge end when in the uppermost position therein, means for moving said discharge bell to an uppermost position and to a lowered position in which said bell opens the bottom of said duct for discharging material from said duct, said bell and said duct being of a configuration such that they define therebetween; starting from an uppermost position into a lowered position at which the bell opens the bottom of said duct, a ring cross section for receiving material, the ring cross section varying during the movement of said bell.

5. A furnace charging device, according to claim **4**, wherein said duct includes an intermediate conical portion adjacent said discharge end and a lowermost cylindrical portion between said conical portion and the bottom of said duct, said distributor bell having a minimum diameter substantially equal to the interior dimension of said cylindrical portion and being movable upwardly and downwardly in said cylindrical portion.

6. A furnace charging device, according to claim **5**, wherein said bell is of substantially conical configuration and has a cone bevel which is flatter than the bevel of said conical portion of said duct.

7. A furnace charging device, according to claim **4**, including a lock chamber connecting into said duct from each side thereof, sealing means for each of said lock chambers, a tie rod connected to said bell and extending through a wall of said duct between said lock chambers, and lifting driving means connected to said tie rod located exterior of said duct.

8. A furance charging device, according to claim **7**, including a pressure equalizing cylinder located above the wall of said duct through which said tie rod extends, said pressure equalizing cylinder having packing at each end for sealing said tie rod and the end of said duct to the pressure of the furnace.

9. A furnace charging device, according to claim **4**, wherein said bell includes vertically and radially extending guide walls for guiding said bell for movement within said duct.

10. A furnace charging device according to claim **4**, including means permitting rotation of said bell.

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U.S. Cl. X.R.

214—152; 266—27