A charging device for blast furnaces includes a storage bin or a lock chamber which is adapted to have a top inlet opening which may be sealed prior to the opening of the lower discharge end to expose the chamber to the pressure of the operating furnace. The lower end of the storage bin is connected through an intermediate sealing ring to the top of a furnace which is to be charged at a location over a distributor bell arranged within the furnace. The intermediate ring portion provides means for mounting a swivel hopper which may be shifted for the purpose of guiding the material into a distributor flow from the storage bin into the chamber of the furnace located above the distributor bell. The lower end of the swivel hopper is closed by one or more plate members which may be moved between an opened and a closed position and the lower end of the intermediate chamber is further sealed in a gas tight manner by a pivotal valve member. The valve member includes a lever which is pivotally supported within an offset portion of the furnace chamber and the valve member with the lever may be pivoted in an opened position to a location at which it is offset from the lower opening of the intermediate chamber in order to permit the material which is dropped from the hopper when it is open to flow downwardly into the furnace without engaging any of the valve parts.

8 Claims, 2 Drawing Figures
CHARGING DEVICE FOR A BLAST FURNACE

SUMMARY OF THE INVENTION

This invention relates in general to a metallurgical furnace construction and in particular to a new and useful material charging apparatus which includes a pivotal hopper arranged to receive the charged material from a storage bin and shiftable for delivering the charged material into an annular space of the furnace defined above a distributor bell and which includes a closeable bottom opening for the hopper and also a second closeable valve member.

The present invention is particularly applicable for use with shaft furnaces which are adapted to be operated at high pressure, particularly for pressure blast furnaces. The system is adapted to include several storage bins which can be sealed alternately from the free atmosphere or from the internal furnace pressure by means of closeable walls or flaps. The means for increasing the output of the blast furnaces of this type involve mainly a few critical points of the blast furnace operation. From a thermal standpoint, it is known to achieve an increase of the air temperature on the blast tuyers, by the addition of oil or natural gas. The increased output which is achieved by cutting out substances which are not involved in the metallurgical process, or which are involved to only a minor extent, can be achieved by the use of pellets. An improvement of the metallurgical reduction process can be achieved by an increased pressure on the furnace top, a finding which has long been available to the man skilled in the art. To provide operation at such pressures, however, requires principally improvements in the mechanical arrangements of the distributor bell and hopper for charging the material.

A number of proposals are known for making the bell and hopper arrangement of a blast furnace more pressure resistant. The known solutions range from a step wise reduction of the furnace pressure by means of two or three superposed bells to special proposals for improving the sealing effect of the bell seats. Because the expenditure for a solution in a system which uses several bells of varying diameters is relatively high, and is in a negative relation to the effect achieved by it, the present invention does not employ a multiple bell system. This finding is based on the fact that the known furnace top bells can be used practically only as a means for distributing the charging material on the charging surface. The furnace top bells must be eliminated, however, as sealing elements because the temperature in the furnace chamber and the fluid dust cause the erosion of such bells, and the manufacture thereof so that they provide adequate sealing presents unsurmountable difficulties.

The problem of providing means for intermittently charging the furnace without great pressure losses is solved by a known sealing flaps arrangement which is so designed that the tuyer latch is formed as a closure plate or sealing flap which may be moved to an opened position in which it lies outside of the stream or path of movement of the charging material. The wear caused by the emission of fluid dust on the sealing surfaces therefore has little effect in practice. An advantage of the known solution is the non-admission of the sealing surfaces by the charging material. The charging material, whether the coke or lumpy ore, or whether in the form of sinter or pellets, has quite different properties of abrasion on itself as well as on the sliding surfaces. Up to the present time, there has been experienced a difficulty in the designing of satisfactory means for intermittently charging a furnace which operates at high pressures especially when the storage bin must be filled several times in order to obtain a charge which is sufficiently great to cover the annular area above the distributor bell of the furnace. One skilled in the art has no means available to adopt the accumulating supply requirement of the charging material to the safe pressure sealing of the furnace.

In accordance with the present invention, there is provided an improved sealing system of a pressure operated furnace and this is accomplished at the discharge end of the charging hopper and without the use of a distributor bell. With the inventive construction, the outlet of the charging hopper or connection to the storage bin is provided with both a gas sealing valve element and a charge sealing element. The charge sealing element comprises one or more plates which may be shifted between a position blocking the lower opening of the hopper to one completely opening this opening for the discharge of the charged material. The gas sealing is effected by a separate valve member in the form of a plate or flap which is carried on a pivotal lever arm and which may be shifted from an opened position at which the valve member and the arm lie safely outside of the flow path of the charged material to a closed position at which it engages with a seat which is located exteriorly of the seat closed by the charge sealing member. The sealing effect can be achieved by the valve member at a location in which it is not subject to damage by the down flowing material. The arrangement therefore permits satisfactory operation without requiring the use of a bell in the hopper portion of the arrangement.

In a preferred arrangement of the invention the mechanical closing element providing a closure to prevent the flow of material is advantageously in the form of two cover plate halves which are pivoted about horizontal shafts which extend symmetrically to the opening and open into the furnace chamber. The shafts are pivoted by drives which are arranged on the outside of the furnace top and the plates may be oriented substantially downwardly into the furnace chamber in an opened position outside of the flow path of the charged material, or rotated backwardly upwardly into a closed position in which they extend across the bottom opening of the charging hopper. The construction is such that the charging material drops in a regulated flow on the distributor bell which is arranged within a chamber at the furnace top. The driving mechanism for the cover halves comprises a fluid pressure operated drive in the form of a piston and cylinder combination which is pivotally mounted on the housing and is connected through suitable rod members to the rotatable shafts for each closure plate. By use of such a drive the plate elements can be kept at a tightly closed position and the location of the various closure plates can be determined from the outside on the basis of the position of the piston drive. The important driving elements which are subject to wear are arranged freely and are accessible outside of the furnace top.
The closure seal for pressure sealing advantageously includes a pivotal crank arm member which carries a valve plate on a universal pivotal connection and which is connected to a rotatable drive shaft therefore which is located within an offset portion of the top of the furnace. The diameter of the valve plate is greater than the opening closed by the cover halves and it lies downwardly in relation to the furnace to be charged. When the valve mechanism is opened it lies in an offset position out of the flow path so that the charge of material is not hindered in its flow by any projecting elements on any of this sealing member. A special advantage is obtained by the cover plate halves since they cover the protected sealing lips of the valve member so that the charging material can never damage the sealing lips. A further advantage of the construction is that both sealing elements are arranged in a small vertical distance and concentrically under the discharge hopper which is arranged at the outlet of the storage bin. This results in a low overall height which is extremely low compared to the present bell models. The invention therefore is preferably designed so that it can perform several functions. An additional feature is that the parts forming the mechanical closure element for stopping the flow of charging material can also serve as a guide for directing the material in the furnace chamber or at the interior of the top pan of the furnace. The movement of the cover halves, or of a number of parts more than two, which form a cover can be selected for the purpose of directing of the material from one side or the other into the furnace. For this reason the individual cover plates may be separately driven so that the material may be evenly distributed around the surface of the distributor bell arranged in the upper portion of the furnace.

Accordingly, it is an object of the invention to provide an improved furnace charging device which includes a pivotal hopper arranged below a storage bin and which is closed by at least one closure member forming a gas tight seal.

A further object of the invention is to provide a metallurgical furnace construction in which a furnace includes an upper portion having a charging chamber which may be closed by the positioning of a distributor bell which may be raised and lowered therein and which includes an opening at its top which may be closed by a pivotal valve sealing member which is mounted by pivotal movement to a position offset from the opening which it closes so that it will be out of the path of flow of the charging material and which also includes a hopper feeding into the opening which is closeable by one or more movable plates which may be arranged to block the flow of material without forming a pressure seal.

A further object of the invention is to provide a metallurgical furnace 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**

In the drawings:

FIG. 1 is a vertical sectional view to the top of a furnace having a charging device constructed in accordance with the invention;

FIG. 2 is a section take along the line 2—2 of FIG. 1.

**GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to the drawings in particular, the invention embodied therein comprises a metallurgical furnace generally designated 50 having a furnace top 1 with an upper part 2 which carries a plurality of flanged rings 3, 4, and 5 which form an intermediate connection or center piece 7 between the storage bin 6 and the upper part 2 of the furnace top. A swivel hopper 8 is pivotally mounted within the center piece 7 and its lower discharge end may be shifted by means of plungers 9 which extend through a wall 7a of the center piece 7 into an appropriate position for directing the charged material as desired into the furnace around the axis 10.

In accordance with a feature of the invention, the charging material accumulates within the swivel hopper 8 and within the storage bin to a charge lever indicated 11 before it is released into the annular spaced 12 defined at the top of the pan 13 and over the distributor bell 14 which is indicated in an upper closed position in the furnace top 1. When the material is accumulated in the storage bin 6 the material rests on two cover halves 15 and 16 which are pivotally mounted on shafts 17 which are arranged symmetrically in respect to the center axis 10 of the furnace. The shaft 17 is mounted in the ring flanges 3 and 4 by means of a tight seal comprising sleeves (not shown). Both cover halves 15 and 16 are moved in synchronism, if desired, to provide a concentric drop of the charging material in such a way that the distribution 18 is obtained. Any irregularities of the deposit of the material in the charging cross section 19 can therefore be compensated by the pivoting of the hopper 8 and by the regulation of the opening of the cover halves 15 and 16 if desired. In order to adjust the cover halves 15 and 16 adjustment may be made in the associated pivot drive mechanisms 23 and 23' for the respective halves. Each piston drive mechanism includes a piston and cylinder combination having a piston rod 24 which is partly shown in dotted lines and which acts on a lever 25 which is connected to a shaft 26, 26' to which each associated plate 15 or 16 is connected.

In accordance with a further feature of the invention a gas sealing means generally designated 20 comprises a valve plate member or sealing flap 27 which is universally pivotally mounted on a ball and socket joint 28 of a pivot arm 29 which in turn has its opposite end secured to a pivot shaft 30 for rotation therewith. As indicated in FIG. 2, in the closed position, the arm 29 includes an angled portion which extends below the intermediate piece 7 to hold the plate 27 in a position such that an annular sealing edge 31 thereof is in sealing engagement with a rim or flange 32 of the center piece 7 to provide a seal which is below and outside of the seal provided at the lower end of the hopper 8.
Driving means (not shown) for the valve sealing mechanism includes a piston and cylinder combination (not shown) which is connected to the shaft 30 for rotating the shaft as desired between the opened and closed position. The pressure in the interior 33 of the furnace therefore presses the flap 27 in a gas tight connection with the ring flange 32 in the closed position indicated in FIG. 2. When the valve member 27 is in the opened position indicated in broken lines in FIG. 2, it is well out of the way of the flow of the material from the storage bin 6 into the furnace.

The mechanism for operating the closure valve member 27 is located between two suspension rods 35 and 36 which are arranged to engage at their lower ends on a bridge member 52 which pivotally mounts the distributor bell 14. The rods 35 and 36 can be moved in synchronism with a uniform driving movement by a chain 37 which extends over a curved lever 38. The lever 38 is rocked or moved by a shaft 54 which is connected to suitable driving mechanism not shown. The suspension of the distributor bell 14 therefore does not interfere with the valve member 27 in any way. The elements for closing off the flow of the charging material, that is the elements 15 and 16 and the elements for gas sealing the connection between the furnace and the hopper, is the valve member 27, do not impair the flow of material through the hopper space 39 in any respect. The lower end of the hopper has a circular cross section 40.

The method of operation of the bell and hopper elements constructed in accordance with the invention is as follows:

An upper sealing flap, not shown, of the storage bin 6 is opened after the pressure in the storage bin 6 is atmospheric pressure. Then the charging material is introduced into the storage bin and the upper flap for the bin 6 is closed to seal the storage bin. The charging material 11 which accumulates within the bin rests on the closing elements 15 and 16 and the flap 27 seals the lowermost connection of the intermediate piece 7 and the storage bin from the furnace. After the pressure between the storage bin 6 and the interior of the furnace has been equalized the valve member 27 is turned and opened into the position shown in dotted lines in FIG. 2. Thereafter the cover halves 15 and 16 are opened to the dotted line position shown in FIG. 1 at which the extend downwardly into the furnace. The charging material flows downwardly and it may be guided by the swiveling of the hopper 8 into the annular pile 12 at the top pan 13 to accumulate the level 18 in the manner indicated. The process is repeated until a sufficient amount of charge is located above the distributor bell 14.

Thereafter the distributor bell is lowered by rocking the lever 38 to permit the downward movement of the chain 37 and the suspension rods 35 and 36 and the charging material is distributed on the charging surface in the furnace chamber itself which is arranged below the parts illustrated in the drawings.

What is claimed is:

1. A device for charging a furnace which is operated under pressure particularly a pressure blast furnace, having a furnace top with a charging chamber in which a distributor bell is positioned to close off the lower portion of the chamber and permit the accumulation of charging material in the charging chamber, comprising a storage bin adapted to contain a charge of material and to be sealed after the charge is received and having a delivery hopper at its lower end with a lower discharge which is adapted to be connected into the charging chamber of the furnace, first means for closing off said hopper discharge against the flow of charging material comprising first and second plates pivotally mounted at respective opposite sides of the lower discharge and being pivotal to a substantially horizontal position to support the charging material thereabove and to close said discharge and being pivotal downwardly toward each respective side to open said discharge, and second means for pressure sealing the discharge of said hopper comprising at least one valve plate, and pivot mounting means offset laterally from the lower discharge pivotally mounting said valve plate, said valve plate being pivotal on said mounting means between a position in which it closes said discharge and a position in which it is moved out of the discharge flow stream and opens said discharge.

2. A device, according to claim 1, wherein said first means includes a rotatable shaft arranged on each side of said discharge concentrically in respect to the axis of said hopper and wherein said first and second plates are connected to respective ones of said shafts, said plates being rotatable with said shafts to open said discharge, and means on the exterior of said furnace for driving said shafts.

3. A device, according to claim 2, wherein said means for driving said shaft comprises a fluid pressure operated piston and cylinder combination connected to each of said shafts and means pivotally mounting each of said piston and cylinder combinations and the exterior of said furnace.

4. A device, according to claim 1, wherein said valve plate has an annular lip an intermediate piece connected between said bin and said furnace and defining an annular flange with a sealing surface which is engaged by said lip to provide a gas tight seal for the discharge of said hopper at a lower location than the seal provided by said first means.

5. A device, according to claim 4, wherein said valve plate has a diameter which is greater than the diameter of the discharge of said hopper at the location of said first means for closing off said hopper.

6. A device, according to claim 4, wherein said second means includes a pivotal lever member connected to said valve plate and a rotatable pivot shaft, said furnace including a chamber having an offset portion in which said pivot shaft extends, said valve plate and said pivot arm being displaceable from a closed position below the discharge of said hopper to an opened position at which it is in said offset chamber out of the flow path of the material from said hopper.

7. A device, according to claim 1, wherein said first and second plates are selectively partially or fully openable or closeable for regulating the flow of material out of said hopper and deflecting it into said furnace.

8. A device, according to claim 1, wherein the lower end of said delivery hopper includes a swivel hopper portion, and means for pivotally mounting said swivel hopper portion so that the discharge may be shifted for facilitating the direction of the discharge of the material from the hopper.

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