

United States Patent

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[54] **BLAST FURNACE TOP**
13 Claims, 6 Drawing Figs.

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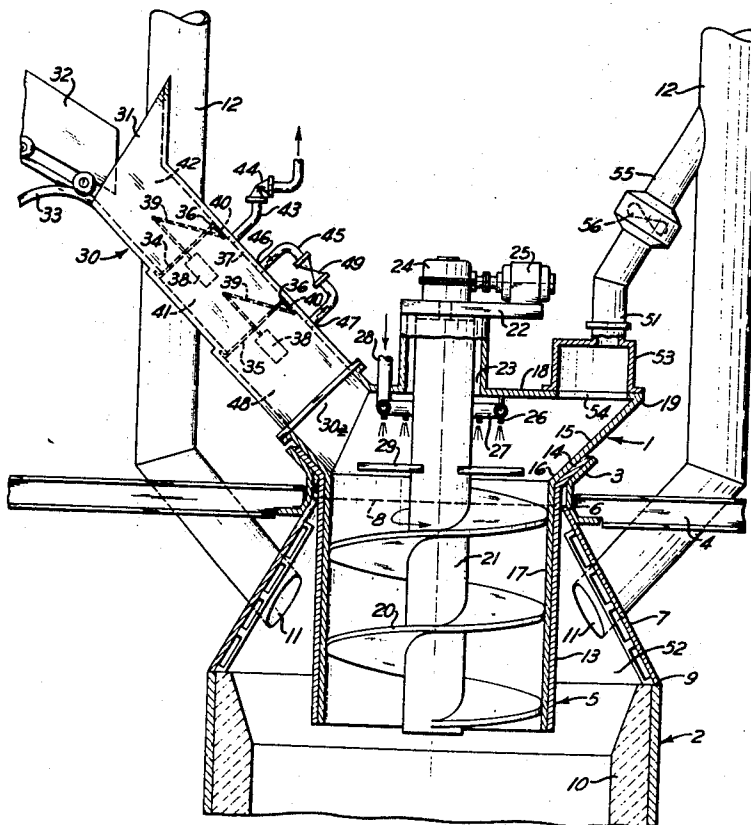
[50] Field of Search..... 214/18,
 18(V), 21, 35; 266/27

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ABSTRACT: A blast furnace top comprising a hopper that provides a gastight cover for upper end of the furnace stack. The hopper is a gas tight enclosure and has a downwardly extending screw conveyor for feeding stock therefrom into the furnace, and a supply chute through which stock is fed thereto from a skip hoist. A pair of valve gates in the chute form a gaslock and operate to control the gravitational movement of stock through the chute into the hopper and to prevent the leakage of blast furnace gas therefrom. A pressure equalizing conduit connects the interior of the hopper with the furnace offtakes to minimize the leakage of blast furnace gas through the screw conveyor into the hopper.



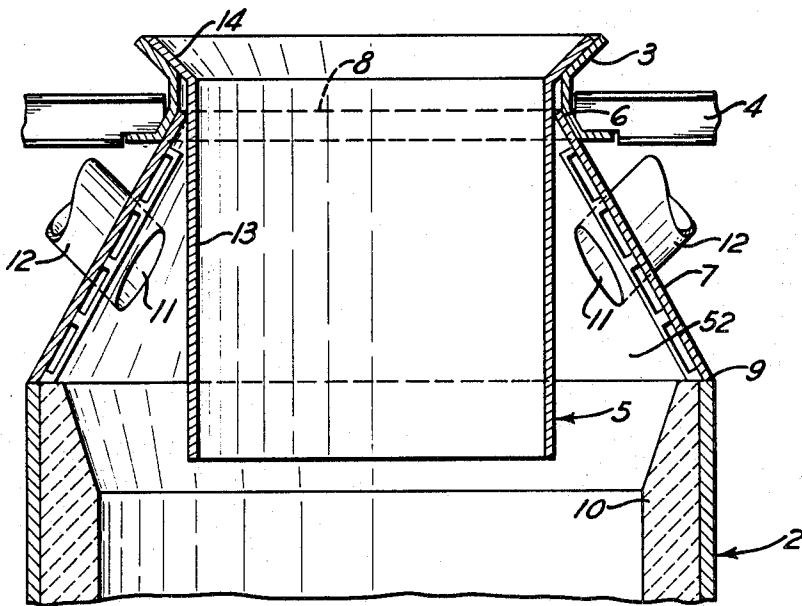


Fig. 2

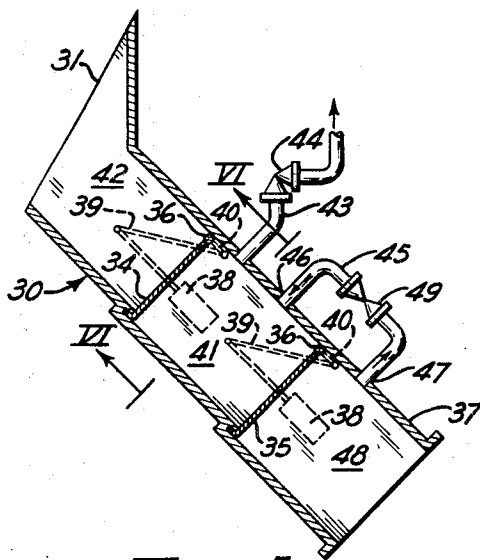


Fig. 5

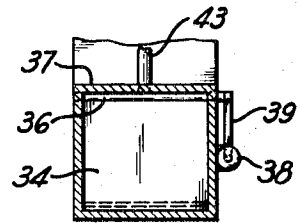
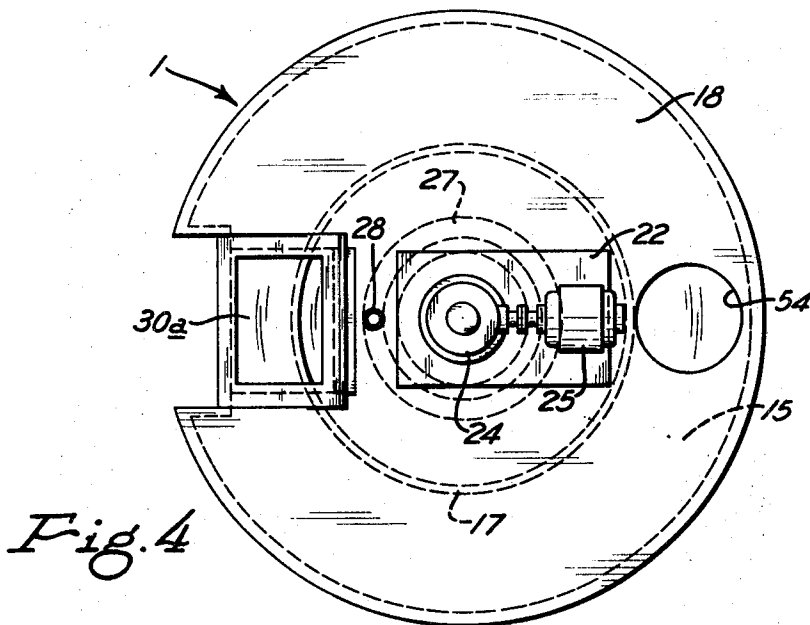
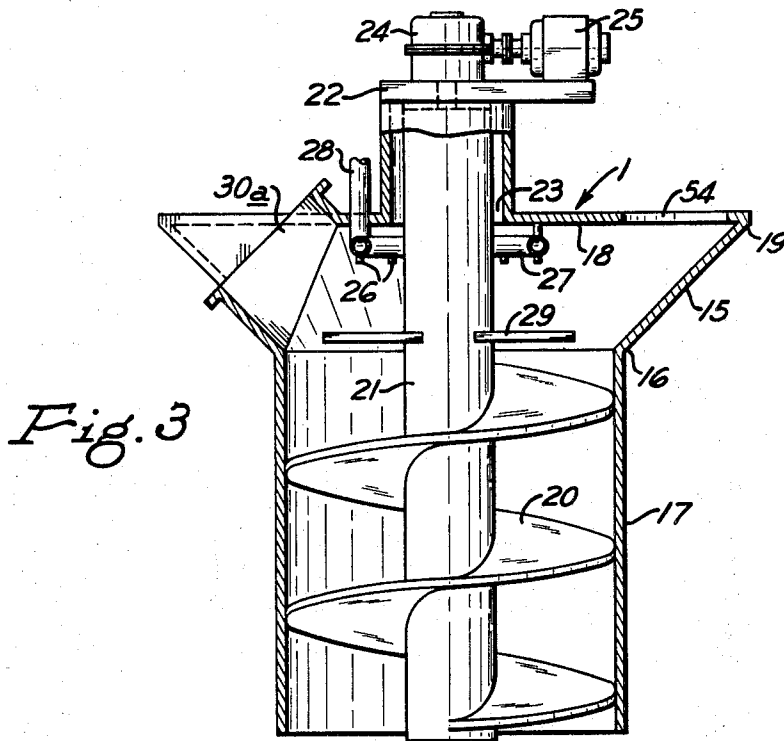


Fig. 6

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BLAST FURNACE TOP

This invention relates to blast furnaces for producing pig iron and, more particularly, to a charging top therefor which, as indicated above, is in the form of an enclosed hopper that forms a gastight cover over the upper end of the furnace stack when mounted thereon and has a screw conveyor for feeding stock therefrom into the furnace.

Blast furnace charging tops at present are equipped with double bells and hoppers for charging iron ore and other stock materials in the furnace and for preventing the leakage of gas therefrom, a third bell and hopper being frequently employed to provide a more effective seal against gas leakage. The bells must be operated in a predetermined sequence and this results in the stock being fed intermittently to the furnace. Operation of the bells to feed stock to the furnace in this manner requires a complicated mechanism in the form of bell beams on the top platform of the furnace, concentric bell rods on which the bells are suspended, and bell hangers and cables connecting the bell rods with the bell beams for actuation thereby. The bells and their operating mechanism are both subject in practice to well-known and troublesome operational and maintenance problems.

One of the principal objects of this invention is to provide a charging top for blast furnaces which eliminates the bell and hopper constructions now used in conventional blast furnace tops, and the intermittent stock charging operation that is had in such constructions. A related object is to provide a charging top which operates to feed the stock continuously to the furnace.

A further object of the invention is to provide a blast furnace charging top in which all essential parts thereof may be preassembled as a unit for emplacement on and removal from the upper end of the furnace stack to thereby facilitate any maintenance and repair that may be required.

Another object of the invention is to provide a charging top which, compared to conventional arrangements employing double bells and hoppers, has a simplified and more compact construction, and provides a more uniform distribution of the stock in a furnace.

To effect these and related ends, the invention contemplates, as indicated generally above, a gastight closure for the upper end of a blast furnace which is in the form of an enclosed hopper for receiving charging from a skip hoist, and a vertically extending screw conveyor for feeding the stock from the hopper into the furnace. The stock charging apparatus of this invention also includes a downwardly inclined chute for delivering the stock from the skip hoist into the hopper, such chute being equipped with a gaslock for preventing the escape of blast furnace gas therethrough. To further minimize the escape of gas, the interior of the hopper is connected by a conduit with the blast furnace offtakes so that the pressure of the gas in the hopper is equalized with the pressure in the furnace to prevent the leakage of gas through the screw conveyor.

Other objects and advantages of the invention will become apparent from the following description.

In the drawings there is shown a preferred embodiment of the invention. In this showing:

FIG. 1 is a vertical sectional view taken in a diametral plane showing the arrangement and having a stock charging opening at its upper end, and a furnace top of the charging top of this invention on the upper end of a blast furnace;

FIG. 2 is a view similar to FIG. 1 with the charging top removed to more clearly show the construction of the adapter sleeve which positions and supports the charging top on a furnace;

FIG. 3 is a sectional view of the hopper shown in FIG. 1 with the supply chute and pressure equalizing conduit disconnected and removed therefrom;

FIG. 4 is a plan view of the hopper shown in FIG. 3;

FIG. 5 is a vertical sectional view of the stock feed chute shown in FIG. 1 which is used to transfer stock from the skip hoist to the hopper; and

FIG. 6 is a sectional view taken substantially along the line VI-VI of FIG. 5.

The charging apparatus shown in the drawings comprises a hopper 1 which, generally stated, forms a closure for the upper end of a blast furnace 2. The hopper 1 is supported on the furnace top ring 3 and platform 4 by an adapter sleeve 5. The top ring 3 and upper edge 6 of the top cone 7 define the usual circular opening 8 at the upper end of the furnace 2 through which the stock materials are charged therein. The lower end 9 of the cone 7 is supported on the upper end of the furnace stack 10. Openings 11 intermediate the upper and lower ends of the cone 7 are connected with gas offtakes 12 for the removal of blast furnace gas from the furnace and its transfer through uptakes and a downcomer (not shown) to gas cleaning apparatus. The adapter sleeve 5 has a cylindrical body 13 which extends vertically downwardly from the furnace top ring 3 and a conical flange 14 at its upper end by which it is supported on the top ring 3.

The hopper 1 has a conically shaped sidewall 15, the lower end 16 of which is supported on the adapter sleeve flange 14. As best shown in FIGS. 1 and 3, a cylindrical sleeve 17 is rigidly connected as by welding at its upper end to the lower end 16 of the conical side wall 15. The upper end of the hopper 1 is closed by a circular plate 18 which has a gastight welded connection around its periphery with the upper end 19 of the conical sidewall 15. The hopper sleeve 17 is part of a screw conveyor through which stock is fed downwardly by a helical conveyor blade or screw 20. The conveyor screw 20 is rotated by a hollow drive shaft 21 which is rotatably supported at its upper end by a housing 22 that forms a gastight closure for an opening 23 in the plate 18 through which the drive for the shaft 21 extends. The drive shaft 21 is driven by a gear reducing unit 24 and drive motor 25 mounted on the top plate of the housing 22.

When needed, water may be sprayed on the stock in the hopper 1 from nozzles 26 at spaced intervals along a pipe 27 which extends circumferentially around the drive shaft 21 at a vertical level adjacent the closure plate 18. Water is fed to the pipe 27 through a supply conduit 28 connected therewith. A plurality of arms 29 projecting outwardly from the drive shaft 21 at a point below the pipe 27 operate to stir the stock in the housing 1 and to prevent it bridging the space above the cylindrical sleeve 17 in a manner which would interfere with its downward flow.

At its upper end the hopper 1 has an opening 30a which is connected with the lower end of the stock supply chute 30. The chute 30 has a rectangular cross section and forms a gastight closure for the opening 30a. At its upper end, the chute 30 has a funnel-shaped enlargement 31 in which stock, such as iron ore, coke and limestone, is received from a skip hoist 32 that travels over a trackway 33. A pair of gates 34 and 35 are arranged at spaced intervals along the length of the supply chute 30 to control the flow of stock therethrough and prevent the leakage of gas from the furnace. The gates 34 and 35 are supported by hinges 36 extending transversely of the upper wall 37 of the hopper 30 for movement from their closed positions shown in solid lines to an open position. The gates 34 and 35 are moved between their opened and closed positions by fluid pressure motors 38 operating through linkage systems 39 that impart a turning movement to cranks 40 on pintle pins that form part of the hinges 36. The space 41 between the gates 34 and 35 functions as a gaslock in which stock is received after having been deposited in the space 42 above the gate 34 by the skip hoist 32. The gaslock space 41 is vented to the atmosphere through a pipe 43 under the control of a valve 44, and is pressurized by a pressure equalizing conduit 45 which has a connection 46 at its upper end with the space 41 and a connection 47 at its lower end with the interior 48 of the hopper 1. A valve 49 controls the pressurizing action of the conduit 45.

The gate motors 38 and pressurizing valves 44 and 49 are operated in a sequential manner, for example, by a suitable control mechanism (not shown), to effect the transfer of stock from the skip hoist 32 into the hopper 1. Prior to movement of the skip 32 to a position in which its contents are emptied into the space 42, the gate 34 is moved by its fluid pressure motor

38 to its closed position, and the valve 44 is operated to vent the space 41 to the atmosphere. After the skip 32 discharges its contents into the space 42, the gate 34 is opened to release the material in the chamber 42 for gravitational movement into the gaslock chamber 41. The valve 44 is then closed and the gate 34 is returned to its closed position. The valve 49 is then opened to equalize the pressure of the gas in the chamber 41 with the pressure of the gas in the hopper 1. The gate 35 is then moved to its open position to release the material in the chamber 41 for movement into the hopper 1. The valve 49 is then closed and the valve 44 is opened to connect the gaslock chamber 41 with the atmosphere. The parts of the hopper 30 are then ready to transfer another load of stock from the skip 32 to the hopper 1. Since one of the gates 34 and 35 is always in its closed position, it will be apparent that the chute 30 and its associated parts are effective to prevent the escape of gas from the hopper 1 at all times.

Although the drawings show only a single chute 30 and skip hoist 32 for supplying materials thereto, it will be understood that additional charging chutes 30 and associated skip hoists may be provided at spaced intervals about the hopper 1. In practice, the hopper 1 will be provided with at least two, and preferably three, supply chutes 30 at spaced intervals about its periphery in order to supply sufficient stock to satisfy the requirements of the blast furnace 2.

In operation, the hopper 1 is maintained filled with stock to a level above the agitating arms 29 but below the spray nozzles 26, and rotation of the screw conveyor by the motor 25 operates to continuously feed material downwardly through the sleeve 17 into the furnace 2. In this manner, the space about the interior of the cylindrical sleeve 17 through which the conveyor blade 20 is rotated will be maintained filled with stock, and such stock will be effective to prevent the leakage of substantial quantities of gas upwardly into the hopper 1. Any gas that leaks through the stock in the screw conveyor to the hopper 1 is removed through a pressure equalizing connection 51 that operates to maintain the pressure in the hopper 1 equal to that in the space 52 above the burden in the furnace and in the gas offtakes 12. The connection 51 comprises an expansion chamber 53 which has a gastight connection with an opening 54 in the plate 18 and is connected by a gas removal duct 55 with one of the gas offtakes 12. A fan 56 in the duct 55 removes any gas from the expansion chamber 54 that leaks into the hopper 1 and delivers it through the exhaust duct 55 to the offtake 12.

The stock charging apparatus of this invention may be readily assembled on a conventional blast furnace 2 by the first installing the top ring 3 on the furnace platform 4, and then lowering the adapter sleeve 5 to a position with its flange 14 supported on the top ring 3. Next, the hopper 1 with its screw conveyor is lowered to move the screw conveyor cylinder 17 with a telescoping action downwardly into the adapter sleeve 5 to the position shown in FIG. 1. Assembly of the apparatus is then completed by connecting the pressure equalizing connection 51 with the opening 54 in the hopper cover plate 18 and the gas uptake 12, and by mounting the stock supply chute 30 in position with its lower end connected with the opening 30a in the hopper 1.

In case maintenance and repair of the charging top of this invention is needed, the construction of the hopper 1 and its mounting on the blast furnace 2 facilitates its removal and replacement. Removal may be effected readily by disconnecting and removing the stock supply chute 30 and the gas pressure equalizing connection 51. After removal of these parts, the hopper 1 and screw conveyor may be removed for repair and replacement by elevating them to a position above the adapter sleeve 5.

From the foregoing, it will be apparent that the hopper 1 and its downwardly extending screw conveyor operate to deliver stock continuously to the furnace 2 without the connection of the furnace at any time to the atmosphere. Due to the rotating movement of the screw conveyor blade 20, it will also be apparent that the stock from the hopper 1 is dis-

tributed more uniformly about the furnace 1 than is possible with conventional charging tops employing bells and hoppers, including constructions which are equipped with a third bell and rotating hopper. Attention is particularly directed to the fact that the hopper 1 forms a gastight cover for the upper end of the furnace 2 which confines the blast furnace gas to the space between the top cone 7 and the upper surface of the furnace burden in such manner that it is removed from the space 52 through the gas offtakes 12.

While one embodiment of my invention has been shown and described, it will be apparent that adaptations and modifications thereof may be made without departing from the scope of the appended claims.

I claim:

1. A charging top for a blast furnace comprising an enclosed hopper mounted on the upper end of said furnace and forming a gastight cover therefore, and stock feeding means comprising a tube opening into said hopper and extending vertically downwardly therefrom into said furnace, a helical conveyor element mounted for rotation in said tube, and means for rotating said conveyor element to feed stock from said hopper and through said tube into said furnace, said conveyor element and the stock in said tube operating to restrict the flow of gas from said furnace into said hopper.

2. A blast furnace charging top as defined in claim 1 characterized by a downwardly inclined supply chute having means at its upper end for receiving blast furnace stock from a charging skip and its lower end opening into said hopper, and gaslock means comprising a pair of valve gates along the length of said chute operable to control the gravitational movement of stock downwardly through said hopper into said furnace and to prevent the leakage of blast furnace gas from said hopper.

3. A blast furnace charging top as defined in claim 1 characterized by a gas-bleed conduit connecting the interior of said hopper with the blast furnace offtakes and operating to maintain the pressure of the gas in said hopper at the pressure of the gas in the upper end of said furnace.

4. A blast furnace charging top comprising, the combination with the top cone of a blast furnace, gas offtakes connected with said cone at points intermediate its upper and lower ends, and a stock charging opening at its upper end, of an enclosed hopper mounted on the upper end of said cone and forming a gastight cover for said opening, a tube opening into said hopper and extending downwardly therefrom through said charging opening, said tube being concentric with respect to said cone and charging opening, a conveyor screw mounted for rotation in said tube, and means for rotating said screw to feed stock from said hopper downwardly through said tube into said furnace.

5. A blast furnace charging top as defined in claim 4 characterized by means including a downwardly inclined chute and gaslock for delivering stock to said hopper.

6. A blast furnace charging top as defined in claim 4 characterized by means for equalizing the gas pressures in said hopper and furnace comprising a pressure equalizing conduit connecting the interior of said hopper with said blast furnace offtakes.

7. A blast furnace charging top comprising, the combination with the top cone of a blast furnace having a stock charging opening at its upper end, of an enclosed hopper mounted on the upper end of said cone and forming a gastight cover for said opening, a tube opening into said hopper and extending downwardly therefrom through said charging opening, said tube being concentric with respect to said cone and charging opening, a conveyor screw mounted for rotation in said tube, and means for rotating said screw to feed stock from said hopper downwardly through said tube into said furnace.

8. A blast furnace charging top comprising, the combination with the top cone of a blast furnace having a stock charging opening at its upper end, and a furnace top ring mounted concentrically with respect to said opening, of means forming a gastight enclosure for said opening comprising a cylindrical

adapter sleeve supported on said top ring and depending therefrom through said charging opening into said furnace, an enclosed hopper having a downwardly extending cylindrical tube received in said sleeve with a telescopic fit, a conveyor screw mounted for rotation in said tube, and means for rotating said screw to feed stock from said hopper downwardly through said tube into said furnace.

9. In a charging top for a blast furnace having a top cone with a charging opening in its upper end and its lower end supported on the stack of said furnace, the combination comprising an enclosed hopper mounted on the upper end of said cone and forming a gastight cover for said charging opening, a tube opening into said hopper and extending downwardly therefrom through said charging opening, said tube being concentric with respect to said cone and charging opening, a conveyor screw mounted for rotation in said tube, and means for rotating said screw to feed stock from said hopper downwardly through said tube into said furnace.

10. A blast furnace charging top as defined in claim 9 characterized by the upper end of said tube and said charging opening being at the same vertical level.

11. A blast furnace charging top as defined in claim 10 characterized further by said tube having an axial length such that its lower end terminates at a vertical level adjacent the lower end of said top cone.

12. In a charging top for a blast furnace having a top cone with a charging opening in its upper end and its lower end sup-

ported on the stack of said furnace, the combination comprising a hopper in the form of a conical shell extending upwardly from the said upper end of said top cone, said shell having an opening in its lower end concentrically arranged with respect to said charging opening and at the same vertical level, means for feeding stock from said hopper into said furnace including a tube having its upper end connected with said conical shell about the said opening therein, a conveyor screw mounted for rotation in said tube, and means for rotating said screw to feed stock from said conical shell downwardly through said tube into said furnace, said tube having an axial length such that material discharged therefrom is fed into said furnace at a vertical level adjacent the lower end of said cone, and means including a cover over the upper end of said hopper rendering it effective as a gastight enclosure to prevent the leakage of blast furnace gas through said top cone charging opening.

13. A blast furnace charging top as defined in claim 12 characterized by means for feeding stock to said hopper comprising a downwardly inclined chute having its lower end opening into said hopper through said conical shell, means at the upper end of said chute for receiving blast furnace stock from a charging skip, and gas lock means comprising a pair of valve gates along the length of said chute for controlling the gravitational movement of stock from said stock receiving means into said hopper and for preventing the leakage of blast furnace gas from said hopper.

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