Nov. 25, 1952 W. H. MURSCH 2,619,344

STOCK-FEEDING HOPPER FOR BLAST-FURNACES

Filed July 12, 1949 2 SHEETS—SHEET 1

FIG. 2.

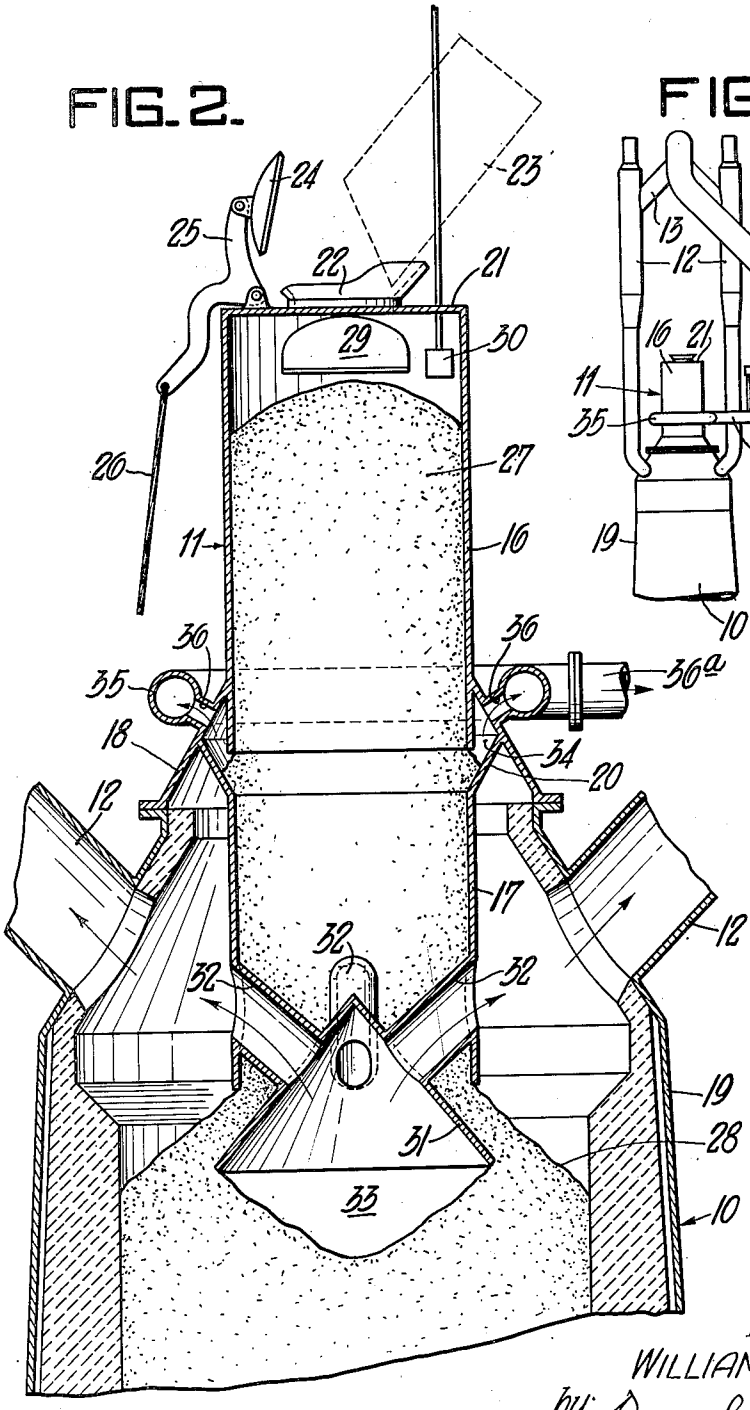

FIG. 1.

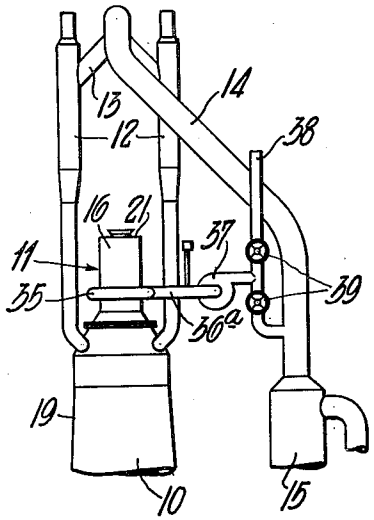

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FIG. 3.

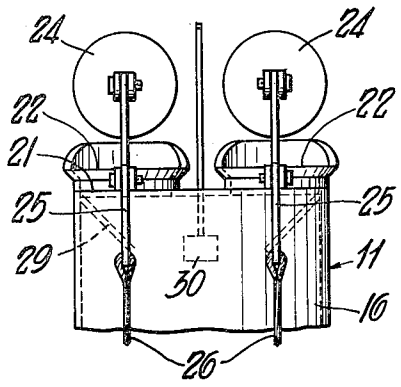


FIG. 4.

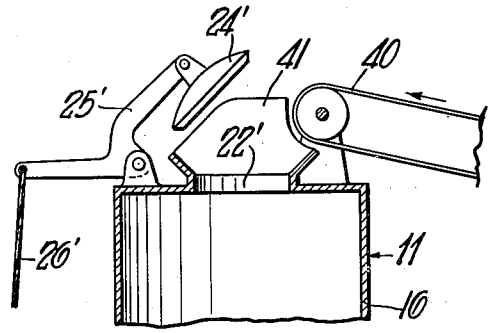
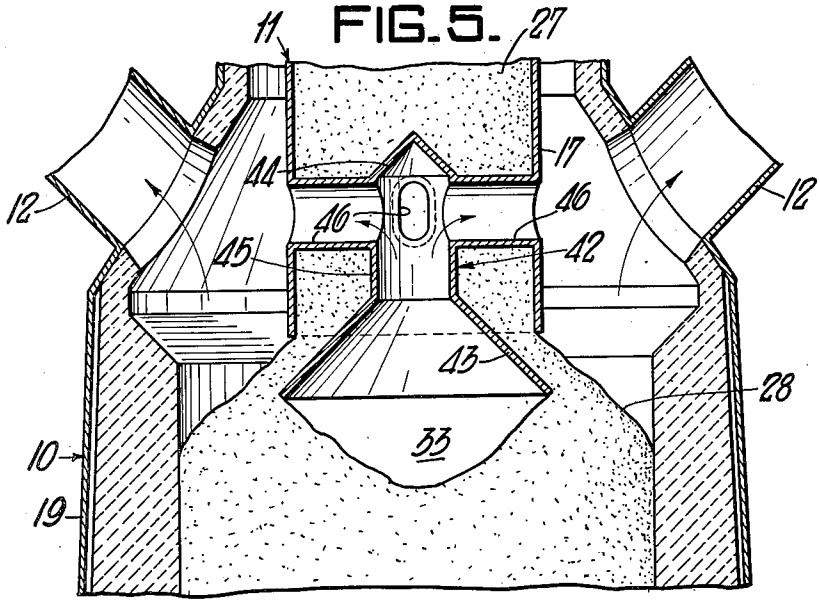


FIG. 5.



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Patented Nov. 25, 1952

2,619,344

UNITED STATES PATENT OFFICE

2,619,344

STOCK-FEEDING HOPPER FOR BLAST FURNACES

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Application July 12, 1949, Serial No. 104,237

4 Claims. (Cl. 266—27)

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This invention relates to an improved apparatus for feeding stock into a blast-furnace and, more particularly, to a novel hopper adapted to be mounted on the furnace top for maintaining a column of the stock being charged from a skip-hoist, conveyor or like charging means, so that it feeds itself into the stack as the stock line falls.

The double-bell-and-hopper mechanism which has been installed in the tops of blast-furnaces in recent years is complicated, expensive and difficult to maintain, to say nothing of numerous other disadvantages. It is accordingly the object of my invention to provide a simple stock-feeding apparatus without moving parts which is relatively cheap to construct and requires little or no maintenance, as well as a method for maintaining a column of stock for more or less continuous flow into the furnace stack. Other objects and advantages of the invention will become apparent from the following detailed description or will be specifically pointed out hereinafter.

I maintain a column of stock in the top of the stack, extending thereabove and resting on the furnace burden, of sufficient height to prevent the escape of a substantial quantity of furnace gases. As stock descends from the feeding column into the stack by gravity, I replenish the column from the top. I also maintain a suction around the girth of the column about midway of its height to carry away any small amount of air and furnace gases which may seep through the stock in the column. I distribute the stock flowing from the hopper into the furnace around the circumference thereof and provide passages for the escape of gases from the space below the column to the usual gas uptakes.

In a preferred embodiment, my improved stock-feeding hopper comprises a stationary tubular body having a closed top provided with charging ports. These ports are fitted with removable covers or doors. The hopper is open at the bottom and is so mounted on the furnace stack that its lower end depends thereinto. A spreader cone is fixed in the bottom of the hopper so as to leave an open space between it and the hopper entirely around the circumference of the latter. An annular exhaust chamber surrounds the hopper about midway of its height. A suction ring communicating therewith is connected to an exhaust fan for taking away air and furnace gases seeping through the stock in the hopper under normal operating conditions.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating apparatus for carrying out the present preferred practice. In the drawings,

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Figure 1 is a diagrammatic elevation of the top of a blast-furnace having my improved hopper incorporated therein;

Figure 2 is a partial vertical section through the axis of the furnace in a plane parallel to that on which Figure 1 is projected;

Figure 3 is a partial elevation of the top of the hopper such as would be seen by viewing Figure 2 from the left;

Figure 4 is a partial section similar to Figure 2 showing a modified charging port; and

Figure 5 is a further partial section similar to Figure 2 showing a modified form of spreader cone.

Referring now in detail to the drawings and, for the present, particularly to Figure 1, the upper portion of the stack of a blast-furnace, indicated at 10, is surmounted by my improved stock-feeding means or hopper 11. Uptakes 12 extending upwardly from the furnace top are connected by a junction pipe 13 from which a downcomer 14 leads to a dust-catcher 15.

The hopper 11 is shown in detail in Figures 2 and 3. It comprises coaxial tubular upper and lower portions 16 and 17, each of which is substantially a right-circular cylinder. The upper cylinder 16 is positioned above the top of the furnace while the lower cylinder 17 depends thereinto. The hopper and associated parts about to be described are conveniently fabricated from steel plate. The upper cylinder 16 has a frusto-conical skirt 18 adjacent the lower end thereof adapted to rest on and be secured to the top of the shell 19 of the furnace. The lower cylinder 17 is spaced from the upper cylinder, being suspended on a frusto-conical wall 20 extending inwardly and downwardly from the skirt 18.

The upper cylinder 16 of the hopper has a top wall 21 provided with charging ports 22 each adapted to receive stock from a charging skip 23. Covers 24 for the ports 22 are mounted on pivoted levers 25 to which operating cables 26 are attached. The covers are normally held in open position so that the hopper is open to the atmosphere through the ports 22. Stock elevated from storage bins by the skips 23 is charged into the ports 22 alternately until a column of stock indicated at 27 is built up within the hopper resting on the main mass of the furnace burden, indicated at 28. Deflector plates 29 on opposite

sides of the upper portion of the hopper prevent segregation of the material charged. A stock-line recorder **30** rests on the top of the column **27** in the hopper.

As the burden **28** descends in the normal operation of the furnace, stock flows from the hopper into the furnace proper. A spreader cone **31** is spaced below the bottom of the lower cylinder **17** with its vertex extending upwardly thereinto. Vent connections **32** extending from the interior of the cone through the wall of the lower portion of the hopper suspend the former on the latter and also permit the escape of any gases accumulating below the cone through the uptakes **12**. As will be evident from Figure 2, the downward flow of stock from the hopper through the space between the lower edge of portion **17** thereof and the cone **31** tends to form a void **33** below the latter as a result of the angle of repose of the material composing the charge.

The hopper **11** is of sufficient height so that the column **27** prevents the escape of substantial quantities of furnace gases under the slight positive pressure in the top of the furnace. This pressure amounts to only a few feet of water and, despite the granular character of the stock, a column thereof capable of preventing objectionable loss of gas may be maintained within a hopper having a reasonable over-all height, say ten feet. Because of the granular character of the stock, there will inevitably be a small amount of gas seepage upwardly through the column confined in the hopper. I accordingly utilize the circumferential duct **34** defined by the upper portion of the frusto-conical skirt **18**, the lower end of the wall of the upper cylinder **16** and the frusto-conical wall **20** at the upper end of lower cylinder **17** as an exhaust manifold. A suction ring **35** extending around the hopper at about the level of the manifold is connected thereto by circumferentially spaced outlet ports **36**. As shown in Figure 1, the ring **35** is connected by pipe **36a** to a suction fan **37**. The fan discharges into a bleeder pipe **38**, the lower end of which communicates with the downcomer **14**, the upper end being open to the atmosphere. Valves **39** in the pipe **38** on opposite sides of the intersection of the fan-discharge pipe, permit gases withdrawn from the hopper to be discharged into the atmosphere or into the downcomer at will. The suction maintained by the fan in the exhaust manifold together with atmospheric pressure on top of the column in the hopper will cause a certain amount of air to be drawn through the stock in the upper cylinder **16** of the hopper, along with the furnace gases which seep upwardly through the stock in the lower cylinder **17**.

Figure 4 illustrates a slightly modified form of charging port **22'** adapted to receive stock from a belt conveyor indicated diagrammatically at **40**. As illustrated, the port **22'** has side walls **41** with which the cover **24'** cooperates to confine the material being charged as it leaves the belt and falls into the hopper. The lever **25'** on which the cover **24'** is mounted is shaped differently from the lever **25**, as shown, in order to facilitate holding the cover in the illustrated position.

Figure 5 illustrates a modified form of spreader cone. This cone, designated **42**, includes a lower frusto-conical portion **43**, an upper conical portion **44** and a cylindrical intermediate portion **45**. Radial vent connections **46** extend horizontally from the cylindrical portion **45** through the wall of the lower portion **17** of the hopper.

It will be evident from the foregoing that the hopper of my invention has numerous advantages over the conventional double-bell-and-hopper which have been installed in the tops of blast furnaces heretofore. In the first place, the apparatus involves no moving parts but the cover-operating levers. These are actuated only when the furnace is banked or after a serious slip but the ports normally remain open. The cost of my improved hopper is much less than that of conventional equipment. Little or no maintenance is required. In addition, the operation of the furnace is improved, fewer slips and smaller pressure fluctuations are experienced because of the relatively continuous flow of material from the hopper into the furnace. The improved hopper, furthermore, is well-adapted to conveyor charging.

My invention has the advantage that there is no leakage of furnace gases as is experienced with the double-bell-and-hopper when the bells become warped. Flue dust is minimized because there is no sudden descent of material, as when the large bell of the conventional structure is lowered, but only a slow substantially continuous downward flow thereof. This also reduces wear on the lining of the furnace adjacent the stock line. A stock column can be maintained within a hopper of reasonable height which is capable of restricting the loss of gases by seepage to the neighborhood of 1% so that the disposal thereof presents no serious problem.

The absence of gas-sealing surfaces eliminates the possibility of damage as a result of excessive temperatures. The usual revolving distributor is unnecessary, thus getting rid of the problem of maintaining the gas-sealing surfaces thereof. The entire apparatus takes up no more space than the conventional furnace top including the two bells and the usual revolving distributor.

I claim:

1. In a blast-furnace, a stack, a hopper on the top of the stack adapted to hold a column of stock, said hopper comprising coaxial upper and lower tubular portions spaced apart vertically with a circumferential clear space between the bottom of the upper portion and the top of the lower portion, the lower portion depending into the stack and the upper portion extending upwardly above the stack, said stack having a gas offtake adjacent the top at a level intermediate the ends of the lower portion, a spreader cone spaced below the lower end of the lower portion and fixedly mounted thereon, pipe connections extending from the cone to the wall of the lower portion, effective to vent to said offtake any gases collecting under said cone, means defining an outlet passage circumferentially of said tubular portions and communicating with the clear space therebetween and means for withdrawing from said passage any gases seeping upwardly through the stock in the lower portion.

2. A blast-furnace as defined by claim 1 characterized by said last-mentioned means including a suction pipe ring around one of the tubular portions, and said passage having ports communicating with said ring.

3. In a blast-furnace, a stack, a hopper on the top of the stack, said hopper comprising a lower tubular portion, extending downwardly into the stack and an upper tubular portion upstanding above the top of the stack, said stack having a gas offtake adjacent the top at a level intermediate the ends of the lower portions, said portions being disposed coaxially in vertically spaced re-

lation, their combined heights being adapted to hold a stock column substantially blocking the flow of gases from the top of the furnace through the hopper, spreader means suspended below the hopper effective to divert descending stock toward the periphery of the stack, exhaust ports spaced circumferentially of the hopper communicating with the space between said tubular portions, a suction ring connected to said ports for disposal of any gases seeping through said column, and a frusto-conical skirt extending downwardly from the upper portion and bearing on top of the stack, said exhaust ports extending through said skirt.

4. A blast-furnace as defined by claim 3 characterized by an inverted frusto-conical wall extending downwardly and inwardly from said skirt and suspending the lower portion, said wall and skirt forming an annular chamber surrounding the hopper adjacent said space.

WILLIAM H. MURSCH.

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