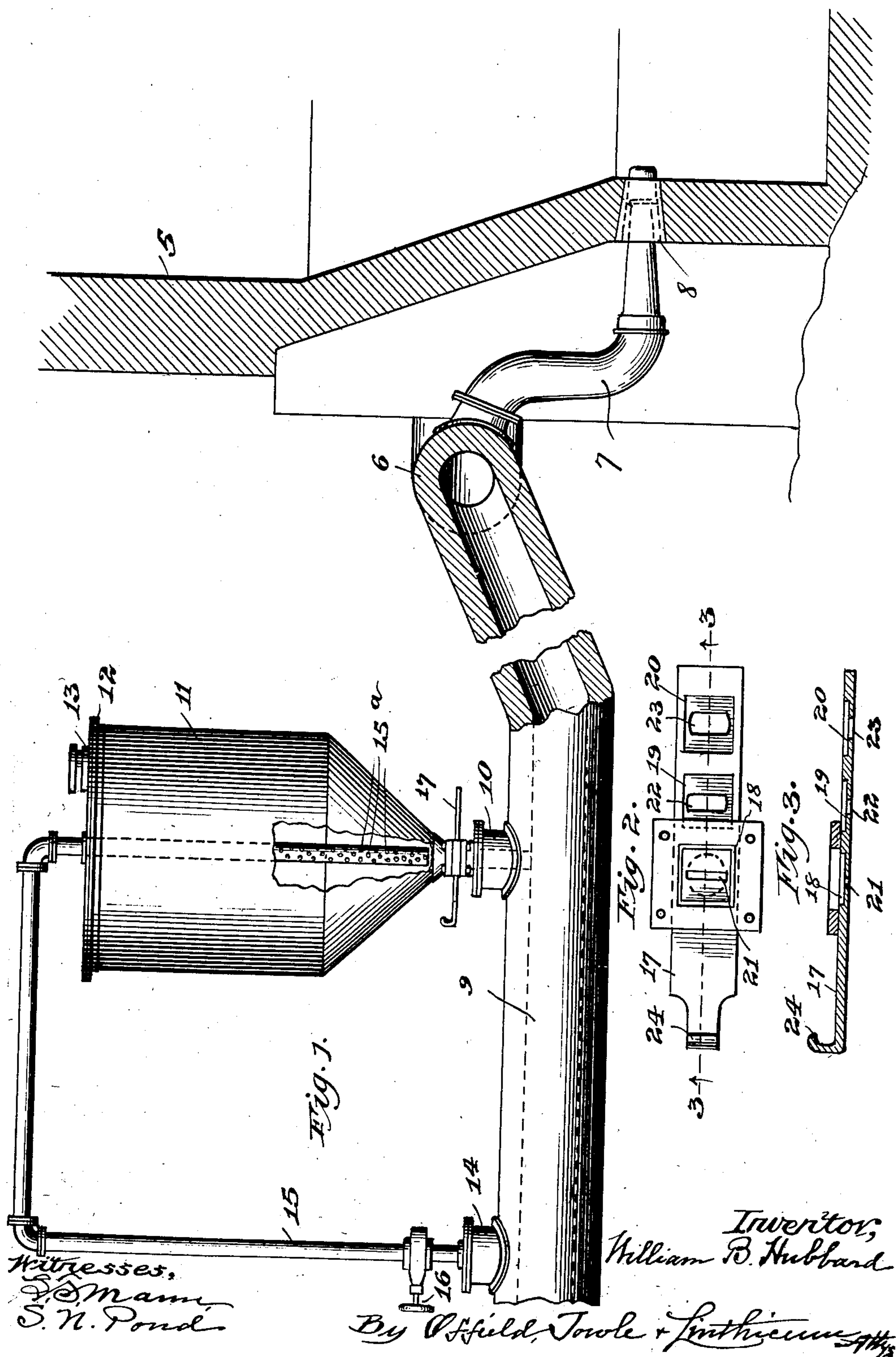


METHOD OF AND APPARATUS FOR RETURNING FLUE DUST TO BLAST FURNACES;

APPLICATION FILED APR. 12, 1908.

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# UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR RETURNING FLUE-DUST TO BLAST-FURNACES.

943,599.

Specification of Letters Patent. Patented Dec. 14, 1909.

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*To all whom it may concern:*

Be it known that I, WILLIAM B. HUBBARD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Methods of and Apparatus for Returning Flue-Dust to Blast-Furnaces, of which the following is a specification.

10 This invention relates to the art of blast furnaces for the reduction of iron and other ores, and has for its main object to effect a pronounced economy in the operation of such furnaces through the saving of what has hitherto constituted a waste product.

On account of the increased used of the Mesabi or soft ores in the present state of the art of smelting iron ores, the amount of flue-dust carried away from the blast furnaces by the gases has increased accordingly. In some instances this waste product amounts to as much as 3 per cent. of the total material charged or 5 per cent. of the total ore charged. It is a well known fact 25 that the gaseous products discharged from a blast furnace employed in the smelting of iron ore carry with them as flue-dust a percentage of fine iron ore, coke dust, etc., the amount of metallic iron thus carried off being in some instances as high as 54 per cent. of the total matter passing off with the gases. This waste product, or, as it is known in the art, flue-dust, is driven out of the furnace by the blast, instead of being smelted in the 35 furnace, and represents a waste product the metallic contents of which would become valuable were it recovered; and, so far as I am aware, this has never been successfully accomplished, although attempts have been 40 made to effect its return to and reduction in the blast furnace. Owing to its light and finely divided physical constitution, it cannot be successfully introduced at the top of the furnace and caused to settle therein with the materials as charged against the force of the blast pressure which is introduced at the twyers in the lower part of the blast furnace. The solution of this problem presented by my present invention involves the 45 return of this product to the lower portion of the furnace through the twyer openings by the agency of the hot blast that is led into the interior of the furnace through the twyer openings. In the broadest aspect of my invention this product may be introduced into

the presence of the hot blast by any means or in any manner; but my preferred method of returning the flue-dust consists in subjecting a body of the latter to the pressure of the hot blast, feeding the flue-dust by its own gravity on its way to the furnace. I preferably effect the introduction of the flue-dust into the hot blast main which leads to the bustle-pipe, from which a series of twyer stocks and blow-pipes lead into the side 65 walls of the furnace; but it should be understood that the particular point of introduction of the flue-dust into the presence of the hot blast is immaterial under the broadest aspect of the invention. 70

One means by which I am enabled to effectuate the purposes of the invention, and which I have selected for the sake of illustrating the latter, consists essentially of a flue-dust hopper communicating with the 75 hot blast main or other conducting pipe of the hot blast, and a pipe also communicating with said hot blast main or other conducting pipe of the hot blast, or other source of pneumatic pressure, and leading into said flue-dust hopper so as to create in the latter a pressure substantially equal to that obtaining in the pipe or main through which the hot blast is traveling. Preferably communication of said hopper and the said pipe 85 with the hot blast main or other source of pressure is controlled by valves, in order that the feed of the flue-dust into the presence of the hot blast may be regulated to the most efficient point. 90

My invention will be readily understood when considered in connection with the accompanying drawing, in which I have shown one simple form of apparatus for the carrying out thereof, and in which,— 95

Figure 1 is a side elevation, partly broken out, of my improved apparatus shown as applied to the hot blast main of a blast furnace, a portion of this latter, as also of the hot blast main and bustle-pipe being shown 100 in vertical section. Fig. 2 is a detail top plan view of a graduated valve that may be employed to control the feed from the flue-dust hopper into the hot blast main. Fig. 3 is a longitudinal section on the line 3—3 of 105 Fig. 2.

Referring to the drawing, 5 designates the lower portion of the wall of an ordinary blast furnace employed for the reduction of iron ores, surrounding which is the usual 110



bustle-pipe 6 from which at spaced intervals twyers stocks 7 lead into twyer-openings 8 formed in the side walls of the furnace.

9 designates the usual hot blast main supplied with a blast of hot air from the usual blowers and stoves (not shown). Suitably coupled to a hollow boss 10 on the hot blast main 9 is the lower end of a flue-dust hopper 11, the latter having a cover 12 equipped with a suitable opening indicated at 13 for charging the hopper with flue-dust. Suitably coupled to a similar hollow boss 14 at another place on the hot blast main, is a pipe 15 which passes through the cover 12 of the flue-dust hopper and preferably extends to a point near the lower end of the latter, as shown by dotted lines. The pipe 15 is equipped with a suitable valve indicated at 16, while the bottom of the hopper 11 is also equipped with a suitable valve for controlling the flow of the flue-dust thence into the hot blast main; one form of such a valve being shown in detail in Figs. 2 and 3 and comprising a sliding valve-bar 17 formed in its upper surface with a series of shallow pockets 18, 19 and 20, of the same area as and adapted to register with, the opening in the bottom of the hopper, and said pockets having formed through their bottom walls valve-ports 21, 22 and 23 of varying sizes. The valve-bar 17 may also be equipped at one end with a hook or handle 24 for its convenient manipulation.

In the operation of the apparatus, flue-dust having been put into the hopper 11 and the opening 13 tightly closed, the valves 16 and 17 are then opened, whereby an equilibrium of pressures is established within the hopper 11, the pressure in the main opposing the flow of the flue-dust into the latter being neutralized by the same pressure introduced into the hopper through the pipe 15. The result of this is that the flue-dust flows, under the influence of its own gravity, in a steady and continuous stream (the size of which may be regulated by the valve 17) from the hopper into the current of air or hot blast flowing through the main 9, with which blast it becomes thoroughly commingled and distributed throughout the bustle-pipe 6, whence it passes through the twyer-stocks and twyer-openings 8 into the lower hottest portion of the furnace where a temperature considerably above the melting point of iron is constantly maintained; so that the metallic content of said flue-dust is reduced upon or soon after its introduction into the furnace, and is thus added to the molten metal in the hearth of the furnace.

While the pressure-equalizing pipe 15 may be led into the hopper at any point thereof, yet I have determined by experiment that the best and most satisfactory results are secured by leading the said pipe to a point at or near the bottom of the hopper and of

the charge of flue-dust therein, as is indicated in the drawing. Lateral holes may also be introduced at various points in that portion of the equalizing pipe 15 lying within the hopper, as indicated at 15<sup>a</sup>. This may be done in order to secure a better equalization of pressure in the flue-dust hopper than where the discharge is wholly through the lower open end of said pipe. While I have shown these means for effecting the introduction of the flue-dust into the presence of the air supplied to the hot blast main near the junction of the latter with the bustle-pipe, and in practice prefer to apply it at that point, yet it will be manifest that the flue-dust introducing means might be applied elsewhere without any variation in or departure from the principle of operation involved. Also, while I have shown the neutralizing pressure admitted to the flue-dust hopper as drawn from the hot air blast, it will be evident that this pressure might be drawn from an independent source so long as it is substantially equal to the pressure of the hot blast. Obviously, also, the structural and mechanical details of the apparatus may be varied as desired or found convenient without involving any departure from the invention or sacrificing any of the advantages thereof. Hence, it should be understood that the invention is by no means limited to the apparatus illustrated and described in the carrying out of the same, except to the extent clearly indicated in specific claims.

I claim:

1. The herein described method of effecting the return of flue-dust to a blast furnace, which consists in introducing said flue-dust into the presence of the hot blast on its way to the twyer openings of the furnace, substantially as described.

2. The herein described method of effecting the return of flue-dust to a blast furnace, which consists in subjecting a confined body of flue-dust to a pressure substantially equal to that of the hot blast, and permitting the flue-dust to flow under the influence of gravity into the presence of the latter, substantially as described.

3. The herein described method of effecting the return of flue-dust to a blast-furnace, which consists in introducing into the presence of a confined body of flue-dust a body of air drawn from and having substantially the pressure of the hot blast, and permitting the flue-dust to flow under the influence of gravity into the presence of the latter, substantially as described.

4. In an apparatus for effecting the return of flue-dust to a blast furnace, the combination with an air-blast conducting pipe leading into the furnace, of a flue-dust hopper mounted thereon and communicating therewith, and means for creating in said hopper a pressure substantially equal to that exist-



ing in said air-blast conducting pipe, substantially as described.

5. In an apparatus for effecting the return of flue-dust to a blast furnace, the combination with an air-blast conducting pipe leading into the furnace, of a flue-dust hopper mounted thereon and communicating at its lower end therewith, and a pipe connecting said air-blast conducting pipe with the interior of said hopper at a point above the communication of the latter with said air-blast conducting pipe, substantially as described.

6. In an apparatus for effecting the return of flue-dust to a blast furnace, the combination with an air-blast conducting pipe leading into the furnace, of a flue-dust hopper mounted thereon and connected at its lower end therewith, means for creating in said hopper a pressure substantially equal to that existing in said air-blast conducting pipe, and a valve in the connection between said hopper and air-blast conducting pipe and controlling the communication therebetween, substantially as described.

7. In an apparatus for effecting the return of flue-dust to a blast furnace, the combination with an air-blast conducting pipe leading into the furnace, of a flue-dust hopper mounted thereon and connected at its lower end therewith, means for creating in said hopper a pressure substantially equal to that existing in said air-blast conducting pipe, and a graduated valve in the connection

between said hopper and air-blast conducting pipe and controlling the flow of flue-dust from the former into the latter, substantially as described.

8. In an apparatus for effecting the return of flue-dust to a blast furnace, the combination with an air-blast conducting pipe leading into the furnace, of a flue-dust hopper mounted thereon and communicating at its lower end therewith, and a pipe leading from said air-blast conducting pipe through the cover of said hopper and terminating at a point near the bottom of the latter, substantially as described.

9. In an apparatus for effecting the return of flue-dust to a blast furnace, the combination with the hot-blast main of the furnace, of a hopper mounted on and communicating at its lower end with said hot-blast main, a valve controlling said communication, a pressure-neutralizing pipe leading from said hot-blast main into said hopper and terminating at a point near the bottom of the latter, and a valve in said neutralizing pipe, substantially as described.

In testimony that I claim the foregoing as my invention, I have hereunto subscribed my name in the presence of two witnesses.

WILLIAM B. HUBBARD.

Witnesses:

SAMUEL N. POND,  
MATTIE B. BLISS.