UNITED STATES PATENT OFFICE.

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FURNACE-TOP DOWN-COMER AND EXPLOSION-PIPE.

Application filed November 13, 1901. Serial No. 82,131. (No model.)

To all whom it may concern:

Be it known that I, PATRICK MEEHAN, a resident of Lowellville, in the county of Mahoning and State of Ohio, have invented a new and useful Improvement in Furnace-Top Down-Comers and Explosion-Valves; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to blast-furnaces, and more especially to the tops thereof; and its object is to provide a construction of blast-furnace top and down-comer whereby the amount of fine ores, coke, &c., carried out by the gases is very greatly reduced and whereby most of that which is carried out will be returned to the stack.

A further object of my invention is to provide a construction of furnace-top whereby liability of damage due to explosions is reduced.

Hereinafter in blast-furnaces it has been the practice to place the gas-outlet ports in the upper portion of the masonry walls of the stack and to connect to the same the down-comer, which down-comer makes a bend just outside the furnace-walls and then takes a downward direction and leads to the dust-collectors. Usually an explosion-valve is located at the bend in the down-comer. In this construction the gas-port is located but a short distance above the stock-line in the stack and the point where the down-comer begins its downward course is not at all, or only a short distance, above the gas-port, so that fine ores, coke, and the like pass out with the gases in very large quantities. In fact, with large-sized modern blast-furnaces as much as one hundred tons per day of fine ores and coke are carried over. Not only is the ore and coke thus carried over wasted, but it must be removed at a considerable expense, and it also gets into the hot-blast stoves, boilers, and other parts of the machinery, causing serious damage and inconvenience.

Furthermore, the explosion-valves in old furnaces constructions are connected with the furnace-chamber by rather crooked or tortuous passages, and in the event of an explosion in the furnace-chamber the gases do not have a free and unobstructed passage to the explosion-valves, so that great pressure is brought on the furnace-top, hopper, and bell, thereby frequently seriously damaging the same.

The object of my invention is to overcome the above difficulties and defects and to provide such a construction of furnace-top that the fine ores and coke which are carried up by the gases will be mostly returned to the stack and also so that the exploding gases will find a free and unobstructed passage to the explosion-valves. To this end I provide the stack with the usual gas-ports, but leading in an upwardly-inclined direction, and preferably extend the same out through the top of the masonry walls. The down-comer is extended from the gas-port in a substantially straight vertical direction to a considerable distance above the furnace-top and then makes an abrupt bend downward, so that the fine ores and coke suspended in the gases have time to settle and most of it will fall back into the furnace-chamber, while that which passes over will fall down the downtake, and thus prevent clogging the down-comer. At some point in the down-comer at a considerable distance above the furnace-top and preferably at the bend the same is enlarged, so as to form an expansion-chamber in which the gases can expand to facilitate the depositing or settling of the fine ores and coke, and I have connected to such expansion-chamber a pipe or fine leading back to the stack and by which the fine ores and coke which settle in the expansion-chamber are returned to the furnace. I also place the explosion-valve at the upper end of the rising portion of the down-comer, so that a straight unobstructed passage is provided from the furnace-chamber to the explosion-valve, and in event of an explosion the gases will not only have a free unobstructed passage to the explosion-valve, but will also expand and lose their force to a considerable extent in the enlarged space provided by the down-comer, thereby saving to a great extent the bell, hopper, and top from injury.

My invention also comprises, in connection with the down-comer and pipe for returning the fine ores and coke to the furnace, a baffle-plate in said expansion-chamber, which will arrest the flow of the fine ores or coke and cause the same to drop into the return dust-pipe.
My invention also comprises the use of certain blast apparatus in connection with such baffle-plate.

My invention also comprises the use of a thimble extending through the walls of the stack and forming the gas-port, which thimble is preferably water-cooled and suitably supported by brackets in the masonry of the shaft and in turn serves to support the hopper-ring.

In the accompanying drawings, Figure 1 is a transverse vertical section through the upper part of the furnace, showing my improvement applied thereto. Fig. 2 is a vertical section on the line 22, Fig. 1. Fig. 3 is a horizontal section on the line 23, Fig. 1, and Figs. 4 and 5 are transverse vertical sections showing modifications.

In the drawings, 1 represents the usual stack, which preferably has a metal shell 2, surrounding the masonry 3.

4 is the hopper-ring, which may be of the usual construction, and it supports at its lower end the hopper 5.

6 is the usual bell.

The gas-port is shown at 7, and it is formed in Figs. 1 to 4 by means of a cast-iron thimble 8. This thimble is suitably embedded in the masonry of the stack, and it may extend out through the side of the stack on an incline, as shown in Fig. 4, or extend upwardly through the same, as shown in Fig. 1. When arranged as in Fig. 1, it is preferably provided with shoulders or flanges 10, upon which rests the flange of the hopper-ring 4. This cast-metal thimble extends to the inner face of the masonry wall and prevents the latter from being cut out by the ores and dust and also prevents the cracking away of the masonry around the gas-port due to the great heat. Much inconvenience and annoyance exists in old furnace constructions due to the masonry around the gas-ports being cut out by the ores and dust and cracking away by the heat to such an extent as to greatly weaken the top of the stack and necessitating frequent repairs. The thimble shown and described prevents this, and thus overcomes a source of serious annoyance. The lower flange of the thimble is preferably thickened, as at 11, and cored out, as at 12, to form a passage through which water will be caused to circulate, the water being supplied in any convenient way, as by the inlet and outlet pipes 13 and 14. This will cool the inner end of the thimble and prevent its burning out, which may occur on account of the great heat in the furnace-chamber. It prevents, however, to provide a free and direct exit for the gases from the furnace-chamber and also provide space wherein they may expand, as will hereinafter be fully described.

As a result of this the temperature in the top of the furnace will be greatly reduced, thus not only saving the inner ends of the thimbles, but also the bell, hopper, and other parts of the furnace-top.

The down-comer is connected to the gas-port, and, as shown, it first proceeds upward as a substantially straight vertical pipe 15 to a considerable distance above the furnace-top and then makes an abrupt bend and proceeds downward, as at 16, to the dust-collector. The thimble 8 when arranged as in Fig. 1 must be oval in cross-section, as shown in dotted lines, Fig. 3, in order to get the desired cross-area or capacity, and the portion 15 of the down-comer starts at the bottom of oval shape and then gradually merges into circular shape, as shown. The down-comer at a considerable distance above the furnace-top, preferably at the bend at its upper end, is enlarged to form the expansion-chamber 17, in which the gases will expand, so as to facilitate the depositing of the fine ores and coke carried up thereby. The bottom of this expansion-chamber is open and provided with a hopper or funnel 18, the lower end of which is connected to the dust-pipe 19, which returns the ore and coke to the stack. To facilitate the depositing of the dust and ore into the hopper 18, I preferably divide the expansion-chamber by the baffle-plate 20, which is cut away at its top, as at 21, to allow the gases to pass over, but which is in the path of the gases, so that the fine ores and coke will strike against the same and be knocked down and deposited in the funnel 18. To further aid this depositing of the fine ores and coke, I may employ suitable blast apparatus, such as the steam or air pipes 22, of a suitable number and arranged on either one or both sides of the baffle-plate, as shown, and which serve to direct the gases, with the suspended ores and coke, against the baffle-plate 20 to be thereby deposited into the funnel 18. The dust-pipe 19 leads downward to the stack and may be connected to the same at any convenient place; but I have shown the same as leading to the hopper 5, so that the collected ores and coke are deposited in the hopper and are returned to the furnace-chamber with the next charge of ore. This pipe is preferably provided with valves 23, 24, and 25, which are pivoted to the pipe and counterbalanced by suitable weights 26, so that they will open when a sufficient weight of ore and coke has been deposited on the same and will then automatically return to their closed position. The ores and coke may also be moistened, if desired, to prevent them from scattering or flying about. Any suitable means may be used for this purpose, such as the spray-nozzles 27, projecting into the funnel 18 or other place.

At the upper end of the pipe 15 is the usual explosion-valve 28, which may be of any approved form.

The down-comer is preferably lined with fire-resisting material 29.

The number of gas-ports and down-comers
may be varied, as desired or necessary. For instance, in Fig. 1 I have shown two such gas-ports and down-comers, while in Fig. 4 only one is shown; but the cross-sectional area of the latter is larger in proportion to the size of the furnace-chamber than in Fig. 1 in order to give it the desired capacity for carrying off the gases. In Fig. 4 also the thimble 8 is not oval, and as a consequence the entire length of the pipe 15 is circular in cross-section.

In Fig. 5 the furnace is shown as provided with a globe or dome-shaped top 30, through which the gas-port 7 passes. The thimble 8 is omitted, and the furnace is shown provided with automatic feeding means 31 above the hopper. The pipe 15 in this figure is connected to the portion 16 of the down-comer by the inclined pipe 32 and without any specific enlargement thereof to form an expansion-chamber. The dust-pipe 19 is also omitted.

The furnace will be operated in the usual way, receiving at intervals the proper charge of ores, coke, etc., and the gases will pass through the gas-port 7 and down-comers in the usual way and of course will carry with them more or less of the fine ores and coke. By reason, however, of the said down-comer rising in a substantially vertical direction to a considerable height above the top of the furnace the heavier and larger particles of said ores and coke will naturally drop back into the furnace-chamber, and it is upon this fact that the form shown in Fig. 5 depends for its efficiency. Such portions, however, as are not deposited in the straight pipe 15 will pass with the gases into the expansion-chamber 17, where said gases will expand and decrease in velocity, so that the ores and coke will fall into the hopper 18. Their deposit is facilitated by striking against the baffle-plate 20, and the deposit may be still further facilitated by the blast 22 driving the gases, with the ore and coke, against the baffle-plate. In the hopper 18 the fine ores and coke are moistened by the spray 27, and when a sufficient weight of said ores has been deposited in the hopper the valves 23 will automatically open, allowing the deposit to fall down into the dust-pipe 19 and if sufficient weight has accumulated to open the valves 24 and 25 and drop into the hopper 5, whence they will be returned to the stack with the next charge. Only a very inconceivable quantity, if any, of the lightest dust will reach the downtake 16; but this cannot clog the down-comer for the reason that the latter makes the abrupt bend, so that the dust which is carried over will fall down the downtake. In case of an explosion in the furnace-chamber the gases will have a practically straight unobstructed passage from said chamber upward through the pipe 15 to the explosion-valve 28, and, furthermore, the pipes 15 and the expansion-chamber 17 provide a space in which the exploding gases can expand. As a result the furnace-top, hopper, and bell will be relieved of a great amount of pressure due to the explosion.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A blast-furnace having a shaft and top provided with a gas-port leading from the furnace-chamber, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then leading downwardly, and a dust-pipe connected to said down-comer above the furnace-top and leading back to the stack.

2. A blast-furnace having a shaft and top provided with a gas-port leading from the furnace-chamber, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then leading downwardly and being enlarged above the furnace-top to form an expansion-chamber, and a dust-pipe leading from the expansion-chamber back to the stack.

3. A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then leading downwardly and being enlarged above the furnace-top to form an expansion-chamber, and a dust-pipe connected to said down-comer above the furnace-top, and a dust-pipe connected to the dust-catcher and leading back to the stack.

4. A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then making a sharp bend and leading downwardly, a funnel formed in the bottom of said bend, and a dust-pipe leading from said funnel back to the stack.

5. A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer being enlarged to form an expansion-chamber, a transverse baffle-plate in said expansion-chamber, and a conduit connected to said expansion-chamber at the lower end of said baffle-plate and leading back to the stack.

6. A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and being enlarged above the furnace-top to form an expansion-chamber, a transverse baffle-plate in said expansion-chamber, and a dust-pipe connected to said expansion-chamber at the lower end of said baffle-plate and leading back to the stack.

7. A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then making a sharp bend and leading downwardly, a funnel formed in the bottom of said
bend, a transverse baffle-plate in said bend and projecting downwardly into the funnel, and a dust-pipe leading from said funnel back to the stack.

5 A blast-furnace having a shaft and top provided with a gas-port leading from the furnace-chamber, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then leading downwardly and being enlarged to provide an expansion-chamber, a dust-pipe leading from said expansion-chamber back to the stack, a transverse baffle-plate in said expansion-chamber, and a blast pipe or pipes projecting inwardly into the chamber and directed toward the baffle-plate.

10 A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then leading downwardly, a dust-pipe connected to said down-comer above the furnace-top and leading back to the stack, and valves in said dust-pipe.

15 A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then leading downwardly, a dust-pipe connected to said down-comer above the furnace and leading back to the stack, and a spray-pipe for moistening the dust in said pipe.

20 A blast-furnace having a shaft and top provided with a gas-port, a down-comer connected to said gas-port, said down-comer projecting upwardly and extending above the furnace-top to a considerable distance and then making a sharp bend and leading downwardly, a funnel in the lower side of said bend, a dust-pipe connected to the funnel and leading back to the stack, and a spray-nozzle projecting into said funnel.

25 A blast-furnace having a shaft and top provided with a gas-port leading from the furnace-chamber, a pipe connected to said gas-port and projecting upwardly in a direct course, said pipe being enlarged to form an expansion-chamber, an explosion-valve at the upper end of said pipe, a down-comer connected to said pipe, and a dust-pipe leading from the expansion-chamber back to the furnace-top.

30 A blast-furnace having a masonry shaft, a feeding-hopper and bell in the top thereof, a gas-port extending through the masonry shaft with its inner end in position to receive the discharge of ore from the hopper, and a cast-metal thimble in said gas-port with its inner end projecting to the furnace-chamber, whereby the discharge of ore is prevented from wearing away the masonry.

35 A blast-furnace having a masonry shaft, a cast-metal thimble embedded in the masonry at the top of the shaft to form a down-comer, said thimble having its inner end provided with a cored-out flange, and water connections thereto to cool the same.

40 A blast-furnace having a masonry shaft, a thimble embedded in the masonry at the top of the shaft, brackets supported by the shaft and connected to the thimble to support the same, and a down-comer connected to said thimble.

45 A blast-furnace having a shaft and top provided with a gas-port leading from the furnace-chamber, a pipe connected to said gas-port and projecting upwardly in a direct course, said pipe being enlarged to form an expansion-chamber, an explosion-valve at the upper end of said pipe, a down-comer connected to said pipe, and a dust-pipe leading from the expansion-chamber back to the furnace-top.

50 A blast-furnace having a masonry shaft, a feeding-hopper and bell in the top thereof, a gas-port extending through the masonry shaft with its inner end in position to receive the discharge of ore from the hopper, and a cast-metal thimble in said gas-port with its inner end projecting to the furnace-chamber, whereby the discharge of ore is prevented from wearing away the masonry.

55 A blast-furnace having a masonry shaft, a cast-metal thimble embedded in the masonry at the top of the shaft to form a down-comer, said thimble having its inner end provided with a cored-out flange, and water connections thereto to cool the same.

60 A blast-furnace having a masonry shaft, a thimble embedded in the masonry at the top of the shaft, brackets supported by the shaft and engaging shoulders on the thimble to support the same, said thimble being also provided with shoulders to support the hopper-ring, and a down-comer connected to said thimble.

In testimony whereof I, the said PATRICK MEEHAN, have hereunto set my hand.

PATRICK MEEHAN.

Witnesses:
F. W. WINTER,
ROBERT C. TOTTEN.