July 24, 1951 J. F. DRAKE 2,561,347

CHARGING TOP FOR CUPOLA FURNACES

Filed Aug. 20, 1948

FIG. 1.

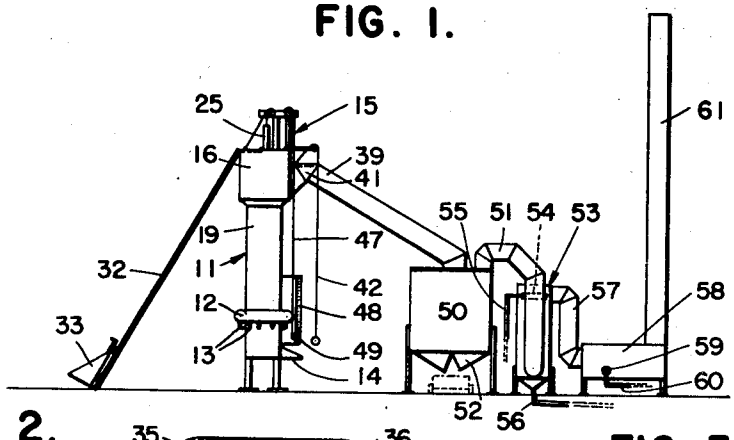


FIG. 2.

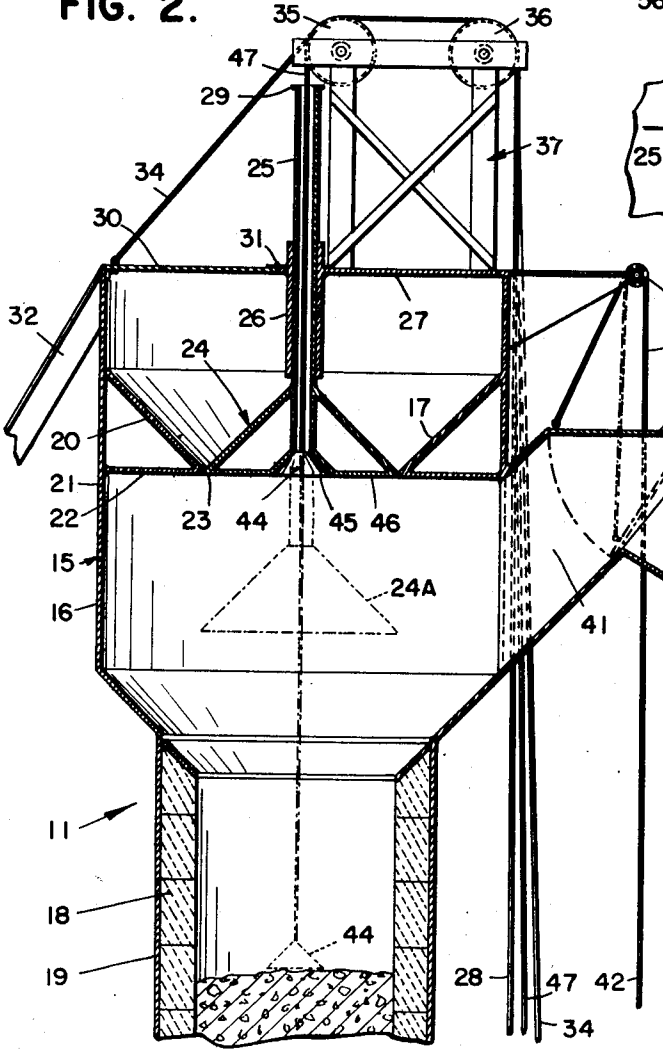


FIG. 3.

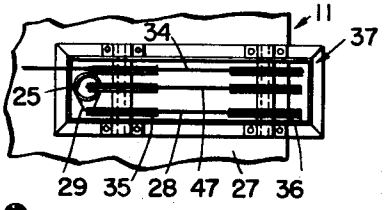
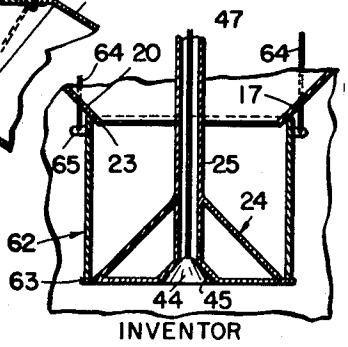


FIG. 4.



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CHARGING TOP FOR CUPOLA FURNACES

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3 Claims. (Cl. 33—126.5)

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This invention relates to shaft furnaces or cupolas, and in particular to the charging thereof, and the elimination of dust and fumes in charging and in operation.

Cupola furnaces are generally provided with a gas, dust and fume discharge stack directly above the cupola structure, and charging of the iron-making ingredients and fuel is made through a side door near the top of the cupola and below the stack, which door is opened at times for receiving the charge. Upon opening the door for charging or inspection of the level of previous charges in the cupola, air is necessarily admitted and the combustible gases from the reacting charge, mainly carbon monoxide, burn around and above the door and generate much useless heat. In addition, the dust and smoke from the charge are carried up the stack by the draft and are discharged to the atmosphere. Even when the door is closed, in practice there is usually enough leakage of air to burn at least a part of the combustible gas, which creates higher than necessary temperatures around the charging door and the lower part of the stack, causing danger and shortening of the life of the equipment. When the gases are not burned, as above described, they are discharged into the air, and constitute a poison gas hazard which is undesirable.

One object of this invention is to provide a cupola furnace which may be charged without ignition of the cupola top gases. Another object is to provide a closed top cupola with a remote stack. Another object is to provide means for removing dust, gases and smoke from the discharge of a cupola furnace. Still another object is to provide means for charging a closed top cupola furnace having a side-take-off pipe for the furnace gases. A further object is to provide means for measuring the position of the charge in a cupola having a charging bell top and side take-off for gas. Another object is to provide a charging bell extension to prevent breaking up the coke, etc., in charging a charging bell type cupola.

These and other objects are attained by my invention which will be understood from the following description and the accompanying drawings in which:

Figure 1 is a side elevational view of a closed top cupola and gas treating auxiliary equipment;

Figure 2 is a vertical cross-sectional view of the closed top cupola;

Figure 3 is a partial top plan view of the cupola top; and

Figure 4 is a partial view, in vertical cross-section, of an alternative form of charging bell.

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In the preferred form of my invention, shown in Figures 1, 2 and 3, a vertical shaft furnace or cupola 11 of the usual type having a bustle pipe 12, tuyères 13 for introduction of air to the charge and a discharge spout 14 from which the slag and molten iron may be removed from the cupola, is provided with a closed top charging device 15. The charging device consists of a cylindrical steel body 16, preferably larger in diameter than the cupola top, and having a conical bottom adapted to rest on the top of the shaft 19 of the cupola above the refractory lining 18. The cylinder is divided at its midpoint vertically by an inverted cone partition 20 extending from the outer cylindrical walls 21 and supported by the apertured disc 22 secured to the side walls of the cylinder and extending inwardly toward the cone which is truncated to leave a central opening 23, through which the charge is discharged to the bottom portion and then into the shaft 19 of the furnace. The opening 23 in the inverted cone 20 and partition 22 is arranged for closing by an erect closing cone or bell 24 which may be drawn up into the opening 23 by means of the stem 25 which extends through a cylindrical shield 26 attached to and extending through the cover 27 of the charging bell 15. The closing cone 24 is adapted to be moved vertically by means of the cable 28 which is attached at the top of the stem 25 to an attachment ear 29 near the top of the stem 25. The lateral movement of the closing cone 24 is prevented by the cylindrical shield 26 which shield also protects the movable stem 25 from abrasion and possible binding when the charging bell is loaded with the charging materials. The cover 27 of the top charging device 15 is provided with a charging door 30 which is hinged by hinges 31, the door being arranged to open from the outer periphery of the cylindrical walls 21 at a point adjacent the track 32 for the skip hoist 33 which carries the charging materials from the ground level to the top of the cupola. The charging door 30 is automatically opened by means of the cable 34 in synchronism with the movement of the skip hoist 33, the door opening as the skip hoist approaches the top of the cupola and automatically closing when the skip hoist starts its return trip to the lower level. Suitable pulleys 35 and 36 are arranged on the frame work 37 mounted on the top 15 of the charging bell to carry the several cables to accessible positions for hand operation or for connection to the skip hoist mechanism. A side take-off flue 39 is attached to the side of the cylindrical walls 21 of the charg-

ing bell, a bleeder valve plate 40 being arranged in the reducer 41 to cover the upper end of the take-off pipe so that when it is necessary for a man to go inside the shaft furnace, the bleeder valve plate 40 is lowered over the end of the side take-off pipe 39 leaving an opening in the reducer 41 through which the man may enter the cupola. The bleeder valve plate 40 is preferably of the hinged type, and is actuated by means of a cable 42 which leads over a pulley 43 so that the bleeder valve plate may be operated from the ground level.

In order to measure the level of the charge in the cupola, since this cannot be observed directly from the charging door, as in the usual practice, an indicator is provided in the form of a weight 44 preferably of conical shape adapted to fit in a conical recess 45 in the closing wall 46 of the closing cone 24, the cable 47 being attached thereto and arranged to pass through the hollow stem 25 and over the pulleys 35 and 36 to an indicator scale 48 arranged conveniently above the ground level so that the operator of the furnace may at any time measure the position of the top of the charge in the cupola by lowering the weight 44 until it rests upon the top of the charge and then reading the position of the marker 49 on the indicator scale 48. When the weight is not in use, it is drawn up into the cone recess 45 of the closing cone 24, thus preventing the discharge of any furnace gases through the stem 25, and to prevent it from being covered by new charging material.

The gases, dust and fumes discharged from the cupola are carried by the take-off pipe 39 to a dust collecting chamber 50 which is relatively much larger in cross-sectional area than the take-off pipe so that the velocity of the gases is decreased to the point where most of the solid dust particles are deposited by gravity, the partly purified gases being carried out of the dust collecting chamber 50. A hopper bottom 52 is provided on the dust collecting chamber 50 from which the collected dust particles may be removed from time to time as required. The pipe 51 conveys the partly cleaned gases to the bottom of a water scrubber 53 where the discharged upwardly flowing gas is met by a spray of water from the sprayer 54 connected to a source of water supply through the pipe 55. The water and collected dust are discharged through the discharge pipe 56 at the bottom of the scrubber 53 and are carried to waste. The cooled and scrubbed gases which normally contain combustible gases, mainly carbon monoxide, are carried from the top of the scrubber by the pipe 57 into a furnace 58 in which the combustible portion of the gas is burned. For gas of low combustible content, it is sometimes necessary to pre-heat the furnace 58 for which purpose a burner 59 is shown leading to a fuel supply through the pipe 60. The completely burned gases from the furnace 58 are discharged through the stack 61, which is made high enough to provide the necessary draft to prevent any back pressure at the top of the cupola.

In Figure 4 is shown an alternative device for discharging the charge in the charging bell, resting on the conical bottom 17. The closing cone 24 attached to a stem 25 is arranged to close the lower end of a cylindrical bucket 62 which is interposed between the inverted cone opening 23 and the closing cone 24 which, for this adaptation, is provided with an outer flange 63 upon which the bucket 62 rests. The bucket is held in position and raised and lowered by means of supporting cables 64 attached at eyes 65 on the outer periphery of the bucket, the cables being carried through the top of the charging bell over separate pulleys (not shown) to the ground control station, and manipulated as described below.

The manner of operation of the cupola will be evident from the above description of the parts. The skip hoist 33 carries a charge of coke, pig iron, scrap iron, limestone, and alloying ingredients such as manganese or silicon briquets to the top of the charging device and as the skip approaches the top, the charging door 30 is automatically opened by the cable 34, and the skip dumps its charge into the inverted cone partition portion with the closing cone 24 held in place against the opening 23. As the skip hoist starts its downward journey, the charging door 30 is closed and the closing cone 24 is lowered to the position shown as 24A (Figure 2) which allows the charge to fall into the top of the cupola. The top of the cupola is closed at all times so that the gases, dust and fumes are carried off through the side take-off pipe 39. The closing cone or bell 24 is restored to its position against the opening 23 as the skip hoist 33 proceeds on its downward course. The gases, including dust and fumes, are carried to the dust collecting chamber 50 and then through the water scrubber 53 and into the furnace 58 where the scrubbed cooled gases are completely burned and dust-free gas is removed by the stack 61. This stack creates a draft to remove all gases from the system.

When the extension bucket 62 is used between the closing cone 24 and the inverted cone partition 20, the bucket and cone are lowered by means of the cable 64 until it rests on the charge in the cupola. The cables holding the bucket are then raised a short distance until the contents are discharged and slide off the cone 24. This arrangement prevents the falling of the charge which frequently causes shattering, particularly of coke and as is well known, this crushing and shattering of the coke tends to clog up the cupola furnace and prevents its efficient operation. After the discharge of the material from the bucket, both parts are raised by the cables to the upper position, closing the partition 20.

The advantages of my invention will be apparent. The operating temperature at the top of the cupola adjacent the charging apparatus is reduced to a relatively low temperature because the gases discharged from the reacting charge in the cupola are not ignited by the air which normally enters through the charging door. In my arrangement, the charging top is sealed off at all times and the combustible gases are removed through the side take-off pipe. Because of the lowered temperature, the charging bell and other parts of the charging device may be operated for long periods of time without destruction by heat and oxidation. The provision of the stock line indicator gives the operator immediate information on the top level in the cupola to determine whether or not additional charge is required. The discharge from the cupola is cleaned first of solid particles and fumes, and is then burned after cleaning so that the discharge from the auxiliary furnace not only eliminates combustible gases but also does not discharge objectionable dust or smoke. The arrangement described permits, with a minimum amount of auxiliary equipment, the operation of a small or medium sized cupola even in congested areas where dust and smoke fumes are not tol-

erated because of the surrounding other activities.

I claim:

1. In a cupola having a closed top and a charging bell with an actuating tubular stem extending through said top, level indicating means for the top of the charge in said cupola comprising a tubular extension of said stem through said bell, a cable extending through said stem and extension, a weighted member on the end of said cable below said bell, a visual scale for the outer end of said cable, and guide means for said cable outside said cupola adapted to position the outer end of said cable on said visual scale to indicate the top level of the charge.

2. In a cupola having a closed top and a charging bell with an actuating tubular stem extending through said top, level indicating means for the top of the charge in said cupola comprising a cable extending through said tubular stem and said bell, a weighted member on the end of said cable below said bell, a visual scale for the outer end of said cable, and guide means for said cable outside said cupola adapted to position the outer end of said cable on said visual scale to indicate the top level of the charge.

3. In a cupola having a closed top and a charging bell with an actuating tubular stem extending through said top, level indicating means for the top of the charge in said cupola comprising a cable extending through said tubular stem and said bell, a conical shaped weighted member

attached by its apex to the end of said cable below said bell, and adapted when in contact with said bell to seal off said stem to prevent the escape of gases, a visual scale for the outer end of said cable and guide means for said cable outside said cupola adapted to position the outer end of said cable on said visual scale to indicate the top level of the charge.

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