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BLAST FURNACE CHARGING APPARATUS.

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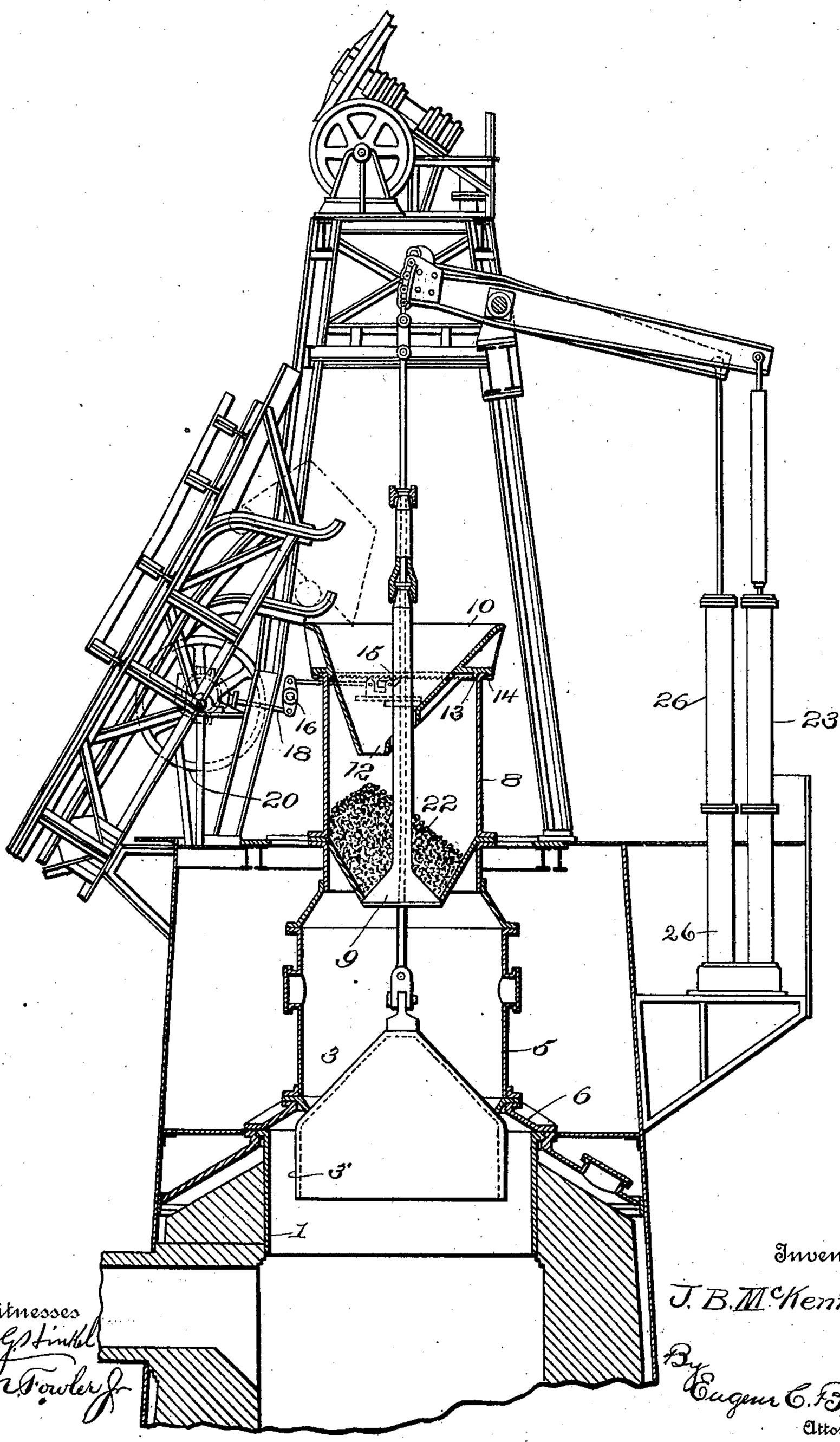
980,811. Patented Jan. 3, 1911.



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BLAST-FURNACE-CHARGING APPARATUS.

980,811. Specification of Letters Patent. **Patented Jan. 3, 1911.**

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To all whom it may concern:

Be it known that I, JACOB B. McKENNAN, a citizen of the United States, residing at Pueblo, in the county of Pueblo and State of Colorado, have invented new and useful Improvements in Blast-Furnace-Charging Apparatus, of which the following is a specification.

My invention relates to certain improvements in blast furnace charging apparatus and has for its object a construction and arrangement of apparatus by which the distribution of the coke, ore and limestone in the furnace can be regulated and a more even distribution effected.

This invention is more particularly applicable to that class of centrally filled furnaces which are equipped with skip-hoists for delivering the material into the charging apparatus and wherein a seal is effected by means of double bells. In furnace charging apparatus of this type it has been customary to distribute each skip-load of furnace stock as it is delivered around the vertical axis of the upper bell. It has been found that this procedure results in the separation or classification of the material delivered, the relatively moist and fine particles being constantly delivered in one neighborhood, while the coarse, drier and more lively moving lumps were delivered to another neighborhood. The effect of this was to produce a zone or portion of the column of stock contained in the furnace more easily penetrated by the ascending gases, which caused caprices in the descent of the stock and in the reduction of the ore, and many attendant ills well known to those familiar with the operation of blast furnaces.

To overcome the defects above mentioned it has heretofore been proposed to deliver the furnace stock into the receiving hopper in a series of overlapping piles surrounding the axis of the hopper, the stock being delivered by means of a distributing funnel or hopper which was moved or shifted after each skip-load. In this manner the entire charge of perhaps six skip-loads was deposited in a ring of compact piles in the receiving hopper, the piles overlapping somewhat at their bases. In this manner it was intended that when the bell of the receiving hopper with its complete charge was lowered, each pile should move down with slight spreading onto the bell and sides of the main hopper, and that the components of any one pile should be prevented from spreading by the components of the adjacent piles. This method of distributing the stock gave rise to certain very objectionable features in the distribution within the furnace. For instance, if the charge contained only one skip-load of lime, this would all be deposited on one side of the furnace, since as above noted, the very purpose of the distribution was to prevent the shifting of the individual piles deposited in the receiving hopper, as they moved downward when the bells were lowered.

Now it is the object of my invention to overcome all of the defects in the prior methods of distributing the charge and to produce a substantially even distribution of each complete charge and of the several charges in the furnace. Instead of depositing each skip-load in a pile upon one side of the receiving hopper and depositing the complete charge of several loads upon the main hopper, I distribute each skip-load so that the greater proportion of the bulk thereof will be eccentric to the central axis of the receiving hopper and lower the bell thereof after each skip-load and simultaneously shift the distributing funnel or hopper.

My invention will be more fully understood from the following description taken in connection with the accompanying drawings, in which the drawing is a sectional elevation of the upper portion of a blast furnace having my improved charging apparatus applied thereto.

I provide an annular metal stock guide 1, which forms a vertical lining for the opening at the throat of the furnace and protects the furnace wall from abrasion. I also construct the stock bell 3 with an apron 3^1, depending vertically. When the bell is lowered the apron and the stock-guide cooperate to form the inner and outer walls of an annulus which guides the descending material, compelling it to drop vertically in annular rings and preventing the material from striking the furnace walls. With an ordinary bell, the material is discharged toward the furnace wall and in most furnaces some of the material strikes the wall and rebounds. As perhaps 1500 tons of material is charged into a modern furnace per day, the abrasion causes the brick work to wear away and in the course of a few

years it is not uncommon for a furnace to be two or three feet larger in diameter just below the bell than it was originally.

The main or stock hopper 5, surmounts the furnace opening and is preferably carried by an annular casting 6, mounted upon the furnace top. The bottom of the hopper converges toward the central discharge-opening and forms a seat for the bell 3. The receiving hopper 8 is mounted above the stock hopper and is provided with a converging lower portion normally closed by the bell 9.

The distributing funnel or hopper 10, provided with a spout 12 eccentric to its axis is rotatably mounted above the receiving hopper. The funnel may conveniently be carried upon the rim of the receiving hopper and be retained thereon by a depending flange 13. For the purpose of rotating the distributing funnel, it is provided with an annular rack 14, which is engaged by pawls 15 upon opposite sides carried by a rock shaft 16, reciprocated by means of the link 18, connected to a cam on one of the sheaves 20 of the cable hoists which operate the skip cars. The distributing funnel or hopper will thus be shifted through a partial rotation between each skip-load.

In the operation of my furnace charging apparatus each skip-load is delivered through the distributing funnel 10 into the receiving-hopper 8, the material being deposited eccentrically around the central axis as indicated at 22. Immediately thereafter the valve mechanism of the power cylinder 23 is actuated to lower the bell 9, allowing the load of material to drop upon the bell 3 of the main hopper, after which the bell 9 is raised to close the bottom of hopper 8. During this interval the hoisting mechanism is raising another skip car and the funnel 10 is being shifted to another position by means of the rack and pawl 14, 15. The eccentricity of the next skip-load deposited around the central axis of the hopper 8 will be slightly different in position and each succeeding load will be advanced by the same amount.

In practice I propose to deposit nine skip-loads of material in each furnace charge, made up of six loads of coke, two of ore and one of limestone, these being hoisted preferably in the order mentioned. To effect a practically even distribution in the furnace of successive charges, I prefer to adopt seven positions for the distributing funnel and to cause the funnel to shift 2/7 of a revolution after each skip-load has passed through it. With this arrangement it will appear that in seven furnace charges each skip-load of the nine which make up a complete charge, has been put through the funnel while it was in each of its seven positions. Of course, any other number of skip-loads to a complete charge could be adopted and the even distribution be effected by changing the number of positions assumed by the funnel. Again, the degree of movement of the funnel could be decreased or increased slightly from the exact fraction corresponding with the number of positions assumed, so that an additional change of position could be gradually effected. After the full number of skip-loads required to make up the furnace charge has been deposited in the main hopper 5, the valve mechanism of the lower cylinder 26 is operated to lower the bell 3. The material sliding down the inclined sides of the bell will be compelled to pass through the vertical walls of the annular channel between the stock-guide 1 and the cylindrical extension or depending apron 3^1 of the bell. This vertical-walled annular channel causes the material to descend into the furnace in solid annular rings. It will be observed that I form the throat of slightly smaller diameter than the furnace immediately below the stock-guide so that the vertically descending rings of material will not touch the furnace walls.

Inasmuch as the material passing through the vertical-walled channel of the furnace throat cannot strike the furnace walls and rebound, as in the usual arrangement, but must drop vertically, the destructive abrasion of the walls which commonly occurs is entirely prevented. This feature of my invention is of great importance and effects a large saving in the cost of maintaining the furnace. Moreover when the materials strike the wall of the furnace and rebound, the amount of which depends upon the character of the material such as hard ore, soft ore, etc., the distribution is caused to be very irregular. My invention entirely obviates these difficulties and insures a regular distribution.

The many advantages accruing from my invention will be apparent to engineers and others familiar with the operation of blast furnaces. The distribution effected by my charging apparatus will be far more regular than that produced by those prior devices which are arranged to deposit the several skip-loads which make up a charge, in a series of little piles around and just over the outer edge of the gas-sealing bell in the receiving hopper. The very serious defects of such constructions have been pointed out. By my construction, each separate skip-load is first deposited in the receiving hopper, so that it will eccentrically surround its central axis and is then lowered upon the bell of the main hopper, until the entire charge has been thus evenly distributed in the main hopper. Then again the construction by which I discharge the materials of the complete charge into the furnace, causing it to drop vertically in a solid annulus, maintains

the proper distribution previously effected and also prevents the abrasion of the furnace walls.

It will be evident to those skilled in this art that changes may be made in the structural features above described without in any manner departing from the scope of my invention.

Having now particularly described my invention and the manner in which it may be embodied, I claim:—

1. A blast furnace charging apparatus having a main hopper and bell, a receiving hopper, means for delivering each skip-load of material into the receiving hopper so that the greater proportion of the bulk of the load will be eccentric to the central axis of the receiving hopper, means for annularly distributing the charge of each skip-load about the central axis of the main hopper, and means for lowering the bell of the main hopper after the full complement of loads constituting the charge has been deposited therein.

2. A blast furnace charging apparatus having a main hopper and bell, a receiving hopper and bell, a distributing funnel arranged to deliver each skip-load of material into the receiving hopper so that the greater portion of the bulk of the load will be eccentric to the central axis of the receiving hopper, means for shifting the position of the funnel horizontally about such central axis, and means for raising and lowering the bells.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JACOB B. McKENNAN.

Witnesses:
JAS. H. ROBINSON,
F. E. PARKS.