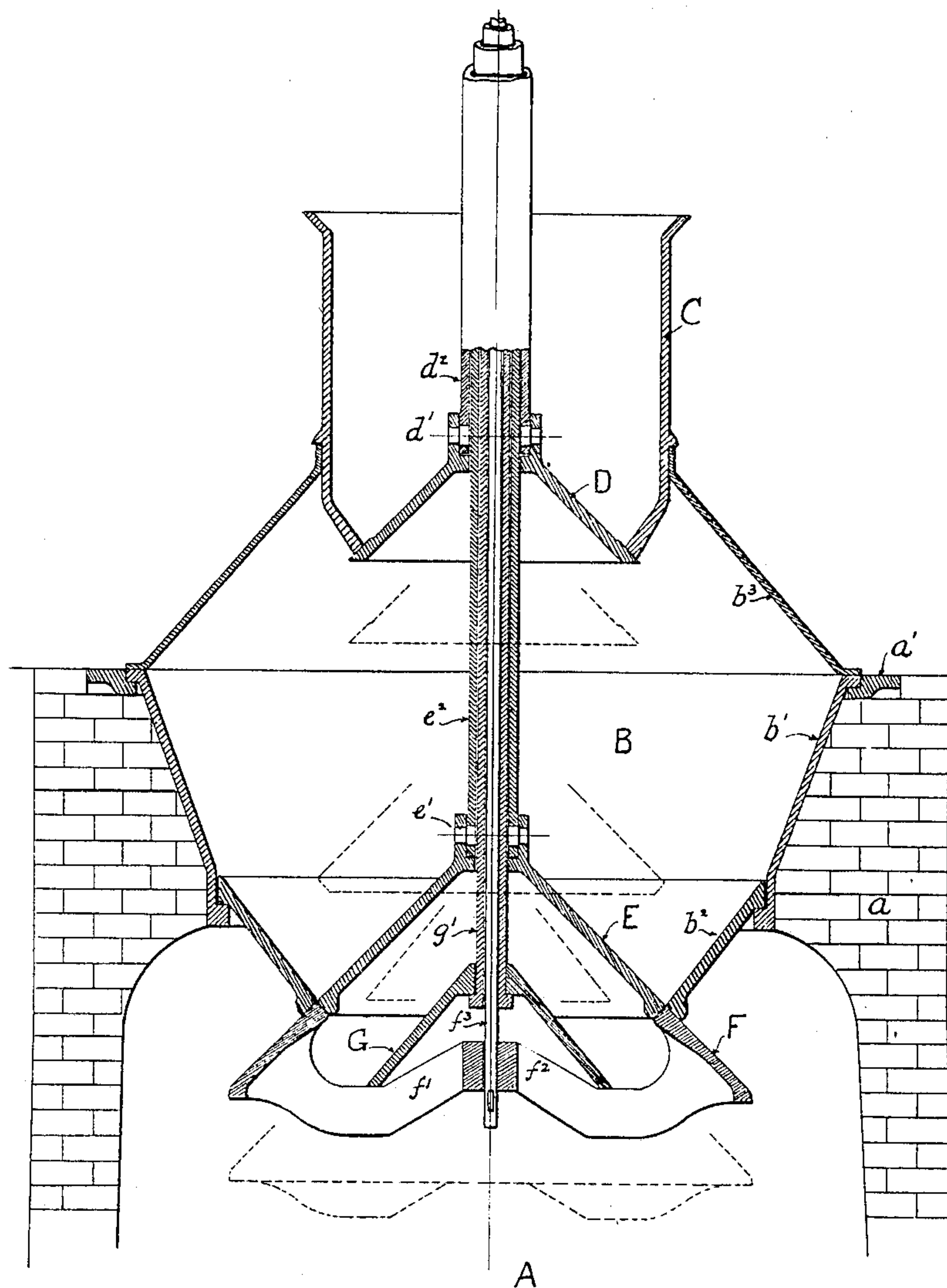


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PATENTED APR. 24, 1906.

J. W. DOUGHERTY.  
BLAST FURNACE CHARGING APPARATUS.  
APPLICATION FILED NOV. 22, 1904.



Witnesses.

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# UNITED STATES PATENT OFFICE.

JOHN WEBSTER DOUGHERTY, OF STEELTON, PENNSYLVANIA.

## BLAST-FURNACE-CHARGING APPARATUS.

No. 818,615.

Specification of Letters Patent.

Patented April 24, 1906.

Application filed November 22, 1904. Serial No. 233,902.

*To all whom it may concern:*

Be it known that I, JOHN WEBSTER DOUGHERTY, of Steelton, in the county of Dauphin and State of Pennsylvania, have invented a new and useful Improvement in Blast-Furnace-Charging Apparatus, of which the following is a full, clear, and exact description.

My invention relates to the charging of blast-furnaces wherein hoppers and bells are used, and is designed to provide improved means for distributing the stock charged into such furnaces as it is discharged by gravity into the furnace into one or the other of three different zones of deposition, whereby the stock may be distributed as may be desired by the person directing the operation into that part of the furnace where it is most needed, my invention being particularly useful for furnaces where the stock is conveyed to the furnace-top by cars, skips, or buckets traveling on fixed tracks or ways to a certain place for discharging the stock, usually automatically, into an upper hopper normally closed at the bottom to prevent escape of gas previous to being deposited into the main hopper upon the charging-bell.

In describing the invention in detail reference is had to the accompanying drawing, forming part of this specification, and wherein letters of reference indicate like parts, in which the figure is a vertical central section through the top of the blast-furnace and hoppers.

In the drawing, A indicates the usual blast-furnace with walls *a a* of ordinary construction.

B is the main charging-hopper, in which the stock is deposited before being charged into the furnace, and it is preferably made up of three sections *b'*, *b<sup>2</sup>*, and *b<sup>3</sup>*, made gas-tight at the joints. The middle section *b'* has slightly-converging sides and is provided with an exterior flange resting on a metal annular casting *a'*, which is supported on the walls of the furnace. The middle section also has an interior flange around the lower part adapted to support the lower hopper-section *b<sup>2</sup>*, which because of its greater exposure to heat is designed for convenient removal and replacement, and also has rapidly-converging sides terminating in a shape adapted to fit the exterior surface of the charging-bell and conjointly therewith prevent the escape of gas. The upper hopper-section *b<sup>3</sup>* is a tight circular metallic shell adapted for closing in

of the hopper and also to provide support to the supplemental hopper C, situated above the main hopper. The supplemental hopper C has practically plain cylindrical sides slightly narrowed at the bottom and adapted to fit the surface of the supplemental bell D, by which the supplemental hopper is closed. The supplemental or upper hopper C, being the receptacle into which the stock is first deposited when discharged from the cars, skips, or buckets employed for conveying stock to the furnace-top, such deposition being usually automatically effected by the arrival of the cars, skips, or buckets at a particular place, is preferably placed considerably above the charging-bell upon which the stock rests while the charge is being accumulated to afford room for a suitable quantity of stock and avoid interference with the operation of the supplemental bell D, which has to be lowered to pass the contents of the supplemental hopper into the main hopper. The supplemental bell D has the usual conical form terminating at its apex in a hub *d'*, which is attached to a tubular hanger *d<sup>2</sup>*, by means of which the supplemental bell D is supported and maintained in desired positions.

The bell which closes the opening at the base of the main charging-hopper B and which constitutes the leading feature of my invention is composed of two sections fitted to each other so that when actuated together the functions of the usual charging-bell are obtained. The central section E of the bell has the usual conical form terminating at the apex in a hub *e'*, to which there is attached a tubular hanger *e<sup>2</sup>*, by means of which said bell-section E is supported and maintained in desired positions. The bell-section F, which comprises the lower part of the charging-bell, consists of an annular ring with upwardly-inclined surface, as a frustum of a cone, its surface corresponding to the inclination of the surface of the central bell-section E and forming therewith a practically continuous cone whose radial planes are substantially uniform from near the apex of the central section E to the outer edges of the annular lower section F, the surface of which fits snugly against the lower edge of the lower lip of the hopper-section *b<sup>2</sup>*. The upper edge of said bell-section F and the lower edge of said bell-section E are fitted to each other to form a good joint, which is so placed that it is practically in line with the inwardly-inclined



surface of the lower hopper-section  $b^2$ , so that when the central bell-section E is raised the inner edge of the lower bell-section F will not interfere with the sliding of the stock from the surface of lower hopper-section  $b^2$ . The lower bell-section F is provided with a spider, consisting of a set of radial arms  $f'$  and hub  $f^2$ , which is attached to and carried by a hanger  $f^3$ , which extends upwardly through the tubular hangers above mentioned to the mechanism employed for actuation of the charging-bell.

In charging the furnace the stock is first deposited in the supplemental hopper C and then charged into the main charging-hopper B by lowering the supplemental bell D, the main charging-bell being in position to prevent the stock from passing into the furnace, also preventing escape of the gas through the main hopper. When a sufficient quantity of stock has been accumulated in the main charging-hopper B, the furnaceman will proceed to operate the charging-bell in such manner as to cause the deposition of the stock into that part of the furnace-stack where it is wanted. By the simultaneous lowering of the hangers  $e^2$  and  $f^3$  both sections of the charging-bell—viz., E and F—descend together, thereby providing an opening between same and the lower edge of the hopper-section  $b^2$ , through which annular opening the stock will drop and by sliding over the inclined surface of the charging-bell will be deflected toward the walls of the furnace. After the stock has been thus discharged into the furnace the charging-bell is returned to its first position, closing the main charging-hopper.

It is obvious that when the stock charged into a blast-furnace in the usual manner consists mainly of lumps, whereby the gases and products of combustion may pass freely through the interstices of the stock, the process of smelting may be successfully prosecuted, although the stock has all been deposited near the walls of the furnace and the center of the furnace filled by self-adjustment of the stock after being thus deposited. It has been found, however, that when much fine ore is used it is extremely important to have the stock more uniformly distributed when deposited, so that the surface of the stock after deposition in the furnace may be as nearly level as practicable. It is also found sometimes to be important to be able to deposit the finer ores near the center of the furnace and deposit the most lumpy portions of the ore nearest the walls of the furnace in order to avoid the difficulties that arise when fine ore partially smelted sticks to the walls of the furnace. When the stock charged into a blast-furnace was hoisted up by vertical elevator or inclined plane in cars or barrows, which were then wheeled by manual labor to the furnace-

hopper and dumped therein, it was practicable to a considerable extent, to regulate the disposition of the stock in the furnace by having certain portions of the stock dumped in certain parts of the hopper, according to the judgment of the furnace manager; but when the modern methods of stocking are employed and the stock is automatically dumped from the cars, skips, or buckets into a supplemental hopper the place of deposition in the main charging-hopper is not under control, and it becomes, therefore, of great importance to be able to control the deposition of the stock into the furnace proper. Those skilled in the art will appreciate the importance of my improvement, whereby I am enabled, after the stock has been delivered into a charging-hopper normally closed at the top, therefore rendering it impracticable to exercise control of the position the stock will take in said hopper whenever it is desirable, to effect the deposition in the central zone of the blast-furnace of the entire contents of the charging-hopper, which central deposition I effect in the following manner: After the main charging-hopper B has received, through the supplemental hopper, as above mentioned, the requisite quantity of stock when central deposition of the charge is desired the operator will raise the upper section E only of the charging-bell, not moving the lower section F. In this manner there will be provided an annular opening at the bottom of the main hopper between same and the lower edge of the bell-section E, through which the stock will drop and by sliding over the inclined surface of lower hopper-section  $b^2$  and the edge of the lower bell-section F will be deflected toward the center of the furnace, passing between the radial arms  $f^2$  of the lower bell-section E, which arms have preferably a deep vertical cross-section, but of little breadth, by which to avoid undue obstructions of the stock as it passes down into the furnace.

In case of some furnaces of specially large diameter it may be found desirable to cause a portion of the stock charged to be deposited in an intermediate annular zone between the central zone, in which deposition of the stock will be effected by the means last above described, and the exterior zone near the walls of the furnace, in which deposition of the stock will be effected by the means first above described. Therefore I employ a deflector G, placed below the charging-bell, attached to tubular hanger  $g'$ , by means of which it is supported and maintained in desired position. During the operation first above described for depositing the charge in the exterior zone near the walls of the furnace the deflector G may remain in the position indicated in the figure, where it will not interfere with the lowering of the charging-bell. In the operation for depositing the



charge in the central zone, as above described, the deflector G will, prior to the raising of the upper bell-section E, be raised up close to said bell-section E and be kept in close proximity thereto, as indicated by dotted lines, by further upward movement while the hopper is being discharged. As the deflector is not used in that operation for central deposition, it is simply necessary to have its upward movement sufficient to keep its lower edge as high as the edge of bell-section E.

Whenever it is desired to deposit the charge of stock in the intermediate zone between the central zone and the exterior zone near the walls of the furnace, the deposition in the intermediate zone is effected by first placing the deflector G approximately in the position shown in the figure, which is best accomplished by letting it rest on the arms of the lower bell-section F, then raising the central bell-section E, as in the operation for central deposition above described, without lowering the lower bell-section F, whereupon the descending stock sliding from the inclined surface of the lower hopper-section  $b^2$  and falling on the deflector G will be deflected from the center of the furnace and deposited in an intermediate annular zone surrounding the central zone above mentioned and inside of the zone of the deposition effected by the combined operation of bell-sections E and F.

I have not shown appliances by which the several hangers—viz.,  $d^2$ ,  $e^2$ ,  $g^2$ , and  $f^3$ —are operated and receive the force necessary for their respective movements in the actuation of the parts above mentioned, as the details of the appliances or mechanism to be employed would necessarily be various, and such would be indicated by the nature of the power to be applied in the particular instance—whether electricity, compressed air, steam, &c.—but in a general way I assume that the upper termination of said hangers will be provided with projections adapted for passing by each other without interference and making substantial connections to suitable moving parts, by which the power derived from the prime mover may be employed for movement of the parts described, and therefore will not in this specification give the details of such moving parts and appliances.

I claim as new and desire to secure by Letters Patent of the United States—

1. A charging apparatus for furnaces having in combination a feed-hopper, a two-part bell having an upper conical portion and a lower frusto-conical portion forming a continuation of the conical portion to close the lower end of said hopper, and a deflector adapted to be positioned within the opening at the lower end of the hopper when the conical portion of the bell is lifted, substantially as described.

2. A charging apparatus for furnaces having in combination with a hopper a two-part bell having an upper conical portion and a lower frusto-conical portion forming a continuation of the conical portion, a spider in the frusto-conical portion, two concentric independently-operable hangers, one secured to the conical portion of the bell and the other to the spider, and a deflector operable between any position of the parts of the two-part bell, substantially as described.

3. A charging apparatus for furnaces having in combination, a hopper, a two-part conical bell, a hanger secured to the upper conical part, a spider to support the lower frusto-conical part, a hanger connected to the center of the spider, a deflector between the conical upper part of the bell and the spider and a hanger therefor, all of said hangers concentric and independently operable, substantially as described.

4. A charging apparatus for furnaces having in combination, a supplemental hopper, a bell to close the same, a main charging-hopper below the same, a conical bell to close the main hopper, a separate continuation of said conical bell, the meeting edges of the two when closed at the lower edge of the main hopper, a deflector contained within the conical bell and its continuation, a separate hanger for all of the bells, the deflector and the continuation of said conical bell, all of said hangers concentric and independently operable, substantially as described.

In testimony whereof I have hereunto set my hand.

JOHN WEBSTER DOUGHERTY.

Witnesses:

C. H. STEELE,  
WM. E. ATTICK.