C. H. WRIGHT.

APPARATUS FOR CHARGING BLAST FURNACES.

APPLICATION FILED APR. 27, 1911.

1,002,018.

Patented Aug. 29, 1911.

2 SHEETS—SHEET 1.

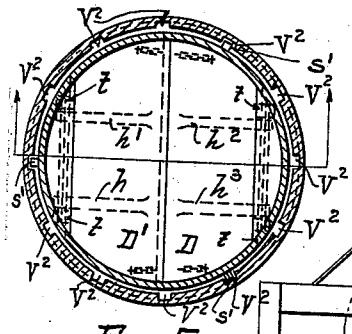

Fig. 5.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Witnesses:

Wm. C. Bolgiano,

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By George C. Ling

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2 SHEETS—SHEET 2.

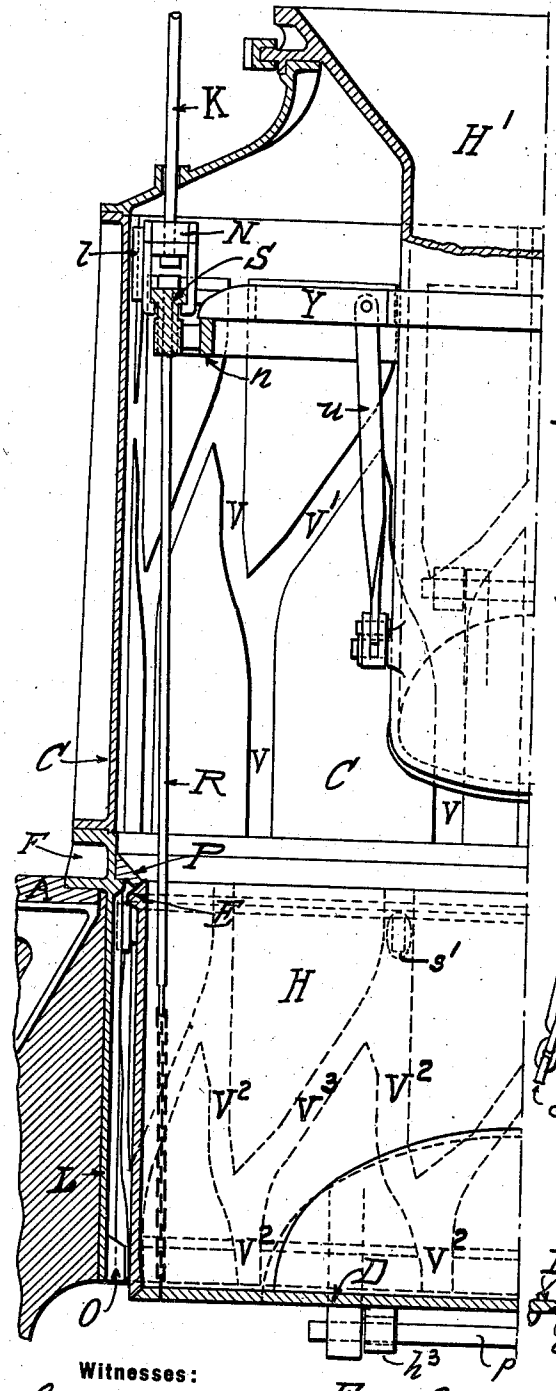

Fig. 6.

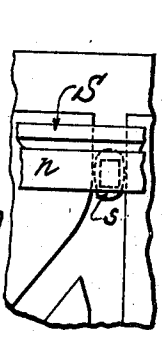

Fig. 10

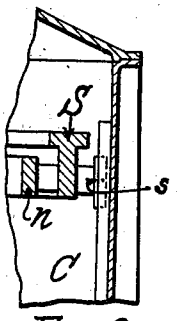

Fig. 9.

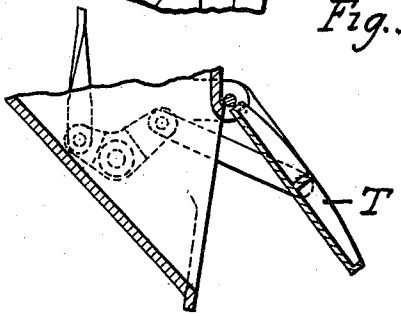

Fig. 8.

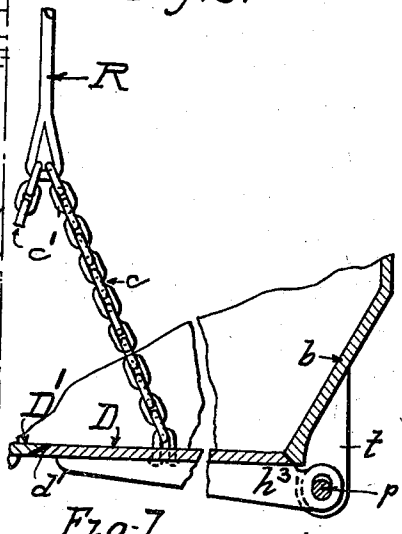

Fig. 7.

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APPARATUS FOR CHARGING BLAST-FURNACES.

1,002,018. Specification of Letters Patent. Patented Aug. 29, 1911.

Application filed April 27, 1911. Serial No. 623,671.

To all whom it may concern:

Be it known that I, CHARLES H. WRIGHT, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Apparatus for Charging Blast-Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of the specification herewith, in which drawings similar parts are designated by similar letters in each case.

My invention relates to and is particularly concerned with the class of top-mechanisms and apparatus for blast-furnaces whereby the charges of stock are successively made up and introduced within the stack. These constructions differ from each other in many special details and functions, but are generally alike in having the familiar bell and hopper arrangement as a controlling characteristic and principle of operation. This arrangement is two-fold, in most equipments of the kind in question, being primarily composed of a receiving hopper or distributer into which the skip-loads are dumped, and a larger chamber, or hopper, below wherein the skiploads are finally collected into the charge that is to be precipitated into the stack beneath. Whether a double or single hopper system is used, any closure of the same against the escape of gas in one direction or material in the other, is invariably effected by a bell which is operatively suspended in the lower end of the hopper, against or away from which it is adapted to be raised or lowered according as an opening or closing of the hopper is to be made. Besides the function of a closure, the bell is also relied on for the equally important function of mixing the various ingredients of a charge, and properly disposing the same with relation to each other preliminary to their discharge into the furnace. This is brought about, in the first instance, by allowing the dumps to occur upon the apex of the bell when in its closed relation to the hopper and thereby to cause the charge to be more or less diffused around the exterior surface of the same at the base. In many cases, however, a bell is used in the lower hopper alone, and the primary hopper,—which is then known as the distributer—is rotary and formed with a chute-like extension at its lower or discharge end eccentrically located with respect to the bell beneath, whereby the loads, instead of being discharged upon the apex of the bell, are discharged in succession at predetermined points at its side until the charge is fully made up. Nevertheless, however carefully the components of a charge are commingled and disposed within the hopper before being precipitated into the furnace, and whatever are the means employed, by reason of the height the charge must fall and the peculiar impetus and direction it receives from the downward slant of the bell, an undesirable re-arrangement and segregation of the particles of the charge, according to their relative weights, sizes and physical conditions, is sure to occur during the fall, with the result that the relative position of the same in their final placing within the crater of the furnace is incalculably different than at the moment they left the hopper. Many efforts to counteract or reduce these characteristic difficulties in the operation of the bell and hopper systems have been proposed, as by employing sectional, subordinate or adjustable opening-bells, deflectors of various kinds, screen arrangements, or, by varying the angle of convergence of the hopper's side, but all without any marked success, so that, under existing methods, no matter how perfectly the stock is distributed around the bell, when the bell is lowered, that distribution is changed or destroyed entirely, and the fine material of the stock is inevitably deposited in rings near the shell of the furnace as before, while the coarser lumps find their places farther within. In consequence of such unequal distribution, the stock line is never uniform, drafts and fusion are irregular, and serious accidents and disappointments in the process of smelting are liable to ensue.

It is the object of the present invention to provide an apparatus for use in the field of industry to which the bell and hopper type of mechanism belongs, but which, as compared with the latter mechanism, among other things, shall materially reduce the distance of the hopper from the stock-line, provide for a vertical instead of a deflected descent for the charges, and insure a more satisfactory placement of the loads within the hopper preliminary to the final step in the charging process.

In the drawings, Figure 1 is a vertical

longitudinal section of the apparatus as a whole. Fig. 2 is a horizontal cross-section in the direction of the arrows on the line *x x* in Fig. 1. Fig. 3 is a vertical longitudinal section of the distributer shown in Fig. 1, with a special extension piece therefor in place. Fig. 4 is a vertical cross-section through the under side of said distributer and said extension piece looking in the directions of the arrows in Fig. 3. Fig. 5 is a horizontal cross-section looking down through the lines *y y* in Fig. 1. Fig. 6 is a vertical longitudinal section of a portion of said apparatus and of the furnace-top, through the line *z z*, and looking in the direction of the arrows in Fig. 2. Fig. 7 is an enlarged side view of a lower broken portion of the hopper employed, and of a door as hinged thereto. Fig. 8 is an enlarged cross-section of the mouth of the distributer shown in other views, and of the lid or door as connected thereto. Fig. 9 is an enlarged horizontal section of the hopper-suspension ring and adjacent parts on the line *w w* in Fig. 2, and, Fig. 10 is a side view of Fig. 9.

In the drawings A is a furnace top of the usual type which supports the apparatus under consideration and to which the same is tributary. The mouth or throat of the furnace itself is circular, and contains a cylindrical metal casing of fixed hopper L therein that engages over and rests upon the floor plates of the top A along the lower flange of a channel-shaped rim F around the upper edge of said hopper. On the interior of this rim, opposite to said lower flange, are projections upon which rests a separate downwardly inclined annular mouthpiece or lip-ring P, whose inner face or edge is beveled to meet and form a seal with the upper beveled surface of a corresponding projection E on the upper edge of the movable hopper H to be described. The projection E is oppositely beveled on its under surface.

The hopper H is a metal receptacle having plain cylindrical sides that are flattened inwardly and downwardly, however, through opposite limited portions *b* and *b'* of the same at the bottom. Said hopper has a slightly shorter diameter than the fixed hopper L that surrounds the same, but is of substantially the same height. The lower end of the hopper H is provided with two equal and opposite flap doors D and D' that are adapted to be diametrically closed against each other along reversely beveled edges on the same, as indicated by *d'*, to form a gas-tight joint or seal. The inward slope of the sides above referred to is an expedient for the preferable method of hinging the doors shown in the figures. This is effected by using a pair of transverse stiffening ribs *h*, *h'*, and h^2, h^3 as the respective door members of the hinges, and connecting these up by pins *p* with corresponding vertical hinge-supports *t*, on said opposite sloping spaces. In order to insure a gas-tight joint around the doors D and D' when closed, the edge of said doors are also beveled to meet and fit against a correspondingly inclined face on the lower edge of the hopper H.

At the limit of downward travel for the hopper H, and as a stop to the same, a ring O projects inwardly around the hopper L, with its upper edge suitably chamfered to fit the bevel of the under surface of the annular projection E when the latter has been lowered into bearing against the same.

Above and around the fixed hopper L and bolted to the upper flange of the U-shaped rim F, is an upright cylindrical metallic cage-like structure C. It is closed at the top by a sloping section that has a central opening through which a rotatory feed-hopper or distributer H', is mounted near its upper and flaring end. This hopper is of the type known as the "Brown distributer" being formed with a chute-like lateral extension or spout at its lower or discharge end, and is arranged centrally over the furnace so as to bring the spout at one side or eccentric of the hopper's axis of rotation. As a departure from that type, and an improvement in the same, as shown in the drawings, I make the portion of the Brown distributer that is above the lateral spout, funnel shaped, by interposing between the flaring top of the same and the spout, a vertical tubular section that shall serve to straighten out the line or direction of the flow and equalize the velocities of the loads at the moment of their discharge from the spout. Without such vertical section there is a tendency in the loads to overshoot or undershoot their normal line of deposit, according as the line of the flow from the skip, and the direction of the lateral spout referred to, are in or out of conjunction with each other. In the one relation, the load rushes downwardly through the spout without check, and is carried unduly beyond said line; in the other, the side of the distributer being in opposition to the skip, the load spends its velocity against the same before it passes out of the spout, and will, therefore, fall short of and fail to reach its destined place in the charge. Suitable mechanism for rotating and feeding the distributer, as well as for actuating the apparatus in other respects are sufficiently indicated in the figures. As a further structural addition to the form of distributer referred to, I show a useful detail, in Figs. 3 and 4 for adjustably varying the length of the spout itself. It consists in the elliptical part or piece G adapted to be hung, or otherwise movably connected to the under side of said spout, so as to project in front of

and thereby elongate the same. Any suitable means of adjustably attaching the piece may be used, as by hanging the same in guides provided for the purpose on the spout, and passing retaining pins between the parts thus brought into juxtaposition in the manner indicated in the figures.

As a means of suspending the hopper H within the furnace top and controlling its movements and those of its related parts, I provide, within the cage C near the top thereof, a hopper-suspension-ring S. Said ring is of T-section, and has a diameter that is approximately the same as the hopper. It is itself movably suspended by hanger-rods K (Figs. 1, 2 and 6) that severally engage the ring S through hanger-blocks N, and which are connected above to ropes r, r that pass over sheaves k, in an overhead framework, and downwardly therefrom to the source of power. Said hanger-blocks N are each made up of a pair of oppositely related radial clamp-like parts or jaws, whose inturned lower edges extend beneath the head of the ring S, and serve as a trackway and support for the same. Upon the outer face of the blocks are upright guide-blocks l that enter and are adapted to travel within corresponding guides m that extend within the cage C vertically throughout its length. Rods R and R′ are severally fastened to the ring S at diametrically opposite points on the same and extend downwardly into the hopper H, where they are each joined with chains c and c', whose lower ends branch out and are respectively fastened to the inner faces of the doors D and D′ of said hopper. The combined length of said chains must, of course, be equal to the distance between the doors to which they are fastened when the same are open, although, inasmuch as the door D, is to close up against the beveled edge on D′, the chain c may be made longer than c', to provide the requisite sequence of movement in the operation.

By the means just explained, it will be seen that, by slacking or paying out the ropes r, r at the source of power, the hopper-suspension-ring S, guided by the guide-blocks l within the vertical guides m, will descend within the cage C, to any point desired, and that, simultaneously with such movement, the hopper H, suspended to said ring by the rods R and R′, will move away from its sealed contact against the lip-ring P, and descend through the throat of the furnace until the annular projection E, on its lower face, comes into bearing against the projection O, and the hopper is wholly supported thereby within the stack. In this condition, as the suspension ring S is further lowered, the doors D and D′ will open downwardly about their hinge-pin p, and permit the charge to fall directly to the stock beneath. If the process were now simply reversed and the hopper H raised to its initial position, a highly satisfactory charging cycle, so far as the main features of the process are concerned, would thereby be completed, but, with a view to insuring as nearly a level stock-line as possible, I have conceived the further idea of utilizing the return movements of the hopper H, after each charging act, to bring about a certain rotatory movement of the hopper itself, that will result in the next ensuing charge being deposited in a different axial relation than the last preceding one. To this end I provide a system of parallelly related main and connecting guides within the cage C and the fixed hopper L, and corresponding guide-blocks s and s' on the ring S and the hopper H, to enter and be directed thereby. In the illustrations herewith, there are twelve of these main guides, denoted by V, that extend from the top to the bottom of said cage, and the same number, denoted by V^2, correspondingly arranged in the hopper L. Said main guides are equidistant from each other throughout their entire course, which, in the drawings, is directly vertical from the top for a predetermined distance when the course changes from its initial direction and, curving forwardly across that direction, finishes on a line that is parallel to the same. This latter and lower portion of said path or course, however, is extended upwardly and then laterally from the point where it first changed into secondary diagonal guides V′ and V^3, respectively, that lead to and connect with the next adjacent member of the series in each case, near its top terminal. Y-shaped systems of inter-connecting guides are thus made up upon the inner surfaces respectively of the cage and the fixed hopper, that are identical in every respect with each other, except that the guides V, in the cage-system, are longer below their junction with the laterals, than the guides V^2.

I provide an automatic arrangement for sealing the distributer H′ against the escape of gases when the doors of the hopper H are opened, by hinging a lid or door T to said distributer so that it will fall against and close the spout or discharge end of the same when not opened by the lever and bell-crank arrangement indicated. This opening is effected, in the device shown by the drawings, by means of an upright lever u that is pivotally connected, at one end, to a suitable bell-crank mechanism to operate the lid, and, at the other, to a yoke Y that extends around and at opposite sides of the distributer H, centrally of the ring S, and at a suitable height and in suitable relations to said mechanism to actuate the same and raise the door T when said lever is itself actuated and lifted into a horizontal position. Concentrically with this ring, and

joined to the same below the yoke Y, is a lever-actuating ring *n*, which is adapted to encounter the yoke Y on the finish of each upward movement of the suspension-ring S, and lift the same into a horizontal position. The lever *u* is of course thereby actuated, and the door T, through the bell-crank connections, pushed away from its sealed and closed position, after the sealing of the furnace top below. When the door T, of the distributer H′, is duly opened in this manner, and the ring S is in its uppermost or normal position, the hopper H will be in a corresponding position, with its annular projection E thereon fitting closely against the lip-ring P in a seal, and its doors D and D′ tightly shut along their beveled edges. The skip-car may now dump a load into the flaring top of the distributer H′, which will fall downwardly through its elongated throat and laterally therefrom into and off the center of the movable hopper H. The skip next descends, in the regular course, to the source of supply, and returns with and dumps within the distributer, a second and successive loads, rotating said distributer, upon each descent, a predetermined extent in the customary way, until, by such procedure, the charge is fully made up within the hopper H. The ropes *r r*, attached to the hanger-blocks N, may then be paid out, whereupon the latter, together with the suspension-ring S slidably carried thereby, will be lowered along their respective guides *m*, and V to the limit of their travel at the furnace-top, the door T, upon the withdrawal of the ring S from beneath the yoke Y, falling by its own weight against and thereby sealing the distributer H′. In the meantime the hopper H, with its load, being in suspension from the ring S by the rods R, R′, will of course sink through the fixed hopper L along the guides V^2 therein, until the under-face of the annular projection E brings up against the annular stop O in a seal, and the hopper H, and load, are held thereby, immediately above the stock-line, in the stack. As the ring S finishes its descent to the furnace-top, the rods R and R′ must correspondingly descend with relation to the hopper H, and, in consequence, the doors of the hopper be opened downwardly and the charge allowed to fall therethrough to its final place of deposit below. The operation is reversed by winding up the ropes *r*, whereby the hanger-blocks N will travel upward in the guides *m*, and the ring S will in like manner follow the guides V^2 in their upward course. The first effect of this movement will be to draw the doors up into a closed and sealed relation to the hopper H, and thereafter to raise the hopper itself, through the fixed hopper L, to a firm position against the lip-ring P. In so doing, however, by reason of the consonance of the two guide-systems described, and the fact that the upper surface of the branch or connecting guides V′ and V^3 at the lower junction points, in every case lies immediately above and across the upward path of the main guides, the guide-blocks *s* and *s*′, respectively, will encounter such surface, and, instead of finishing their upward travel along the particular guides V and V′ in which it was begun, must each be diverted therefrom into branch guides V′ and V^3, and finally, into the next adjacent main guide members of the series in each case. It of course, results that, by this arrangement, the necessary upward lifting movement of the parts concerned is utilized to rotate the hopper H axially into a new relative discharging line, when the doors are next swung downwardly on their hinges to drop the charge.

Having thus described my said invention and shown the same as embodied in a concrete construction, what I claim and desire to protect by Letters-Patent is:—

1. The combination with a cylindrical furnace-top, a movable cylindrical hopper in the mouth of the same, and suitable means for moving said hopper vertically, and at the same time rotatively therein, substantially as shown and described.

2. The combination with a furnace-top, of a fixed cylindrical hopper within the mouth of the same, a movable cylindrical hopper within said fixed hopper, an inclosed chamber above said fixed hopper, and suitable means for moving said movable hopper vertically, and at the same time rotatively within said fixed hopper, substantially as shown and described.

3. The combination, with a furnace-top, of a movable hopper within the mouth thereof, an inclosed chamber above and opening into said hopper, a charging-receptacle extending into said chamber—and means for moving said hopper vertically within said mouth, substantially as shown and described.

4. In an apparatus for charging blast-furnaces, the combination with a furnace-top having a receiving hopper movably supported within the mouth of the same, and an inclosed chamber above said mouth that opens into said receiving hopper, of a rotatory feeding-hopper having a straight section therein and a laterally projecting spout, extending into said chamber, and suitable means for rotating said feeding-hopper, and for moving said receiving hopper vertically within the mouth of said furnace-top, substantially as shown and described.

5. In an apparatus for charging blast-furnaces, the combination with a stock-distributer having inwardly-converging sides at the top and a straight section below the same that inclines downwardly at its lower

end to a discharge opening at the side, of an adjustable extension-piece, as described, beneath said lower end.

6. The combination, with a furnace-top, of a fixed cylindrical hopper within the mouth thereof having an annular interior projection at the lower part of the same, a movable cylindrical hopper within said fixed hopper having an annular exterior projection at the upper part of the same, and oppositely related downwardly opening doors at the bottom, an inclosed chamber above and opening into said last named hopper, a rotatory feeding-hopper extending centrally therein, a vertically movable ring or supporting-part within said chamber, suspension rods connected to said doors and to said ring or supporting-part, a door for closing the discharge orifice of said feeding-hopper, and suitable means for raising and lowering said ring or supporting-part within said chamber, and at the same time or respectively, opening and closing said door of said feeding-hopper, substantially as shown and described.

7. The combination, with a furnace-top, of a fixed cylindrical hopper within the mouth thereof having an annular interior projection at the lower part of the same, a movable cylindrical hopper within said fixed hopper having an annular exterior projection at the upper part of the same, and oppositely related downwardly opening doors at the bottom, an inclosed chamber above and opening into said last named hopper, a rotatory feeding-hopper extending centrally therein, a vertically movable ring or supporting-part within said chamber, suspension-rods connected to said doors and to said ring or supporting-part, a door for closing the discharge orifice of said feeding-hopper, and suitable means for lowering and rotatively raising in unison said ring or supporting-part within said chamber and said movable hopper within said fixed hopper, and, at the same time, for respectively closing and opening said door of said feeding-hopper, all substantially as shown and described.

CHARLES HERBERT WRIGHT.

In presence of—
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WILLIS L. WESTCOTT.