No. 768,207. PATENTED AUG. 23, 1904.

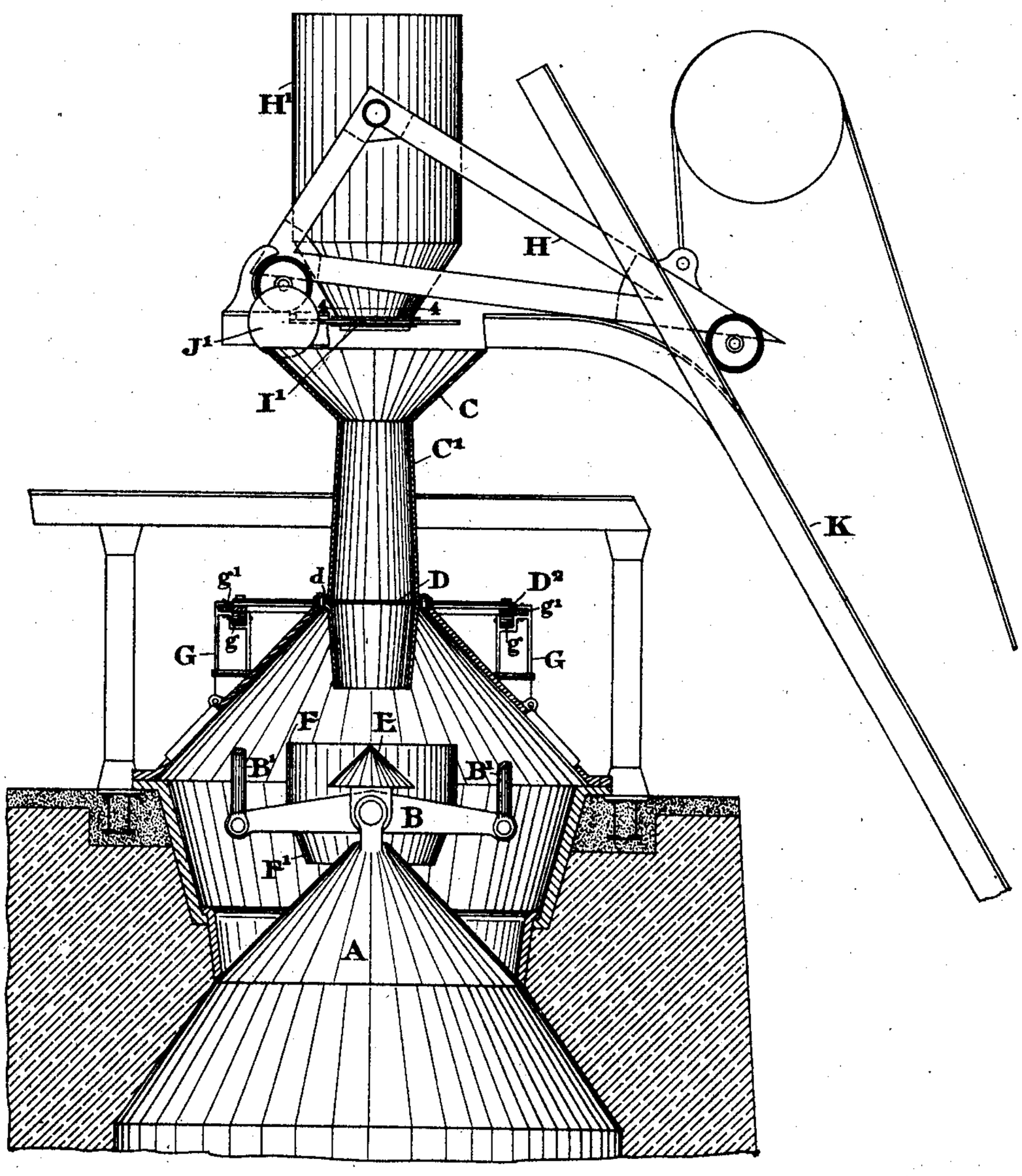
S. W. VAUGHEN, J. B. McCLURE & A. J. BOYNTON.

BLAST FURNACE TOP AND CHARGING DEVICE.

APPLICATION FILED APR. 7, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1



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NO MODEL. 3 SHEETS—SHEET 2.

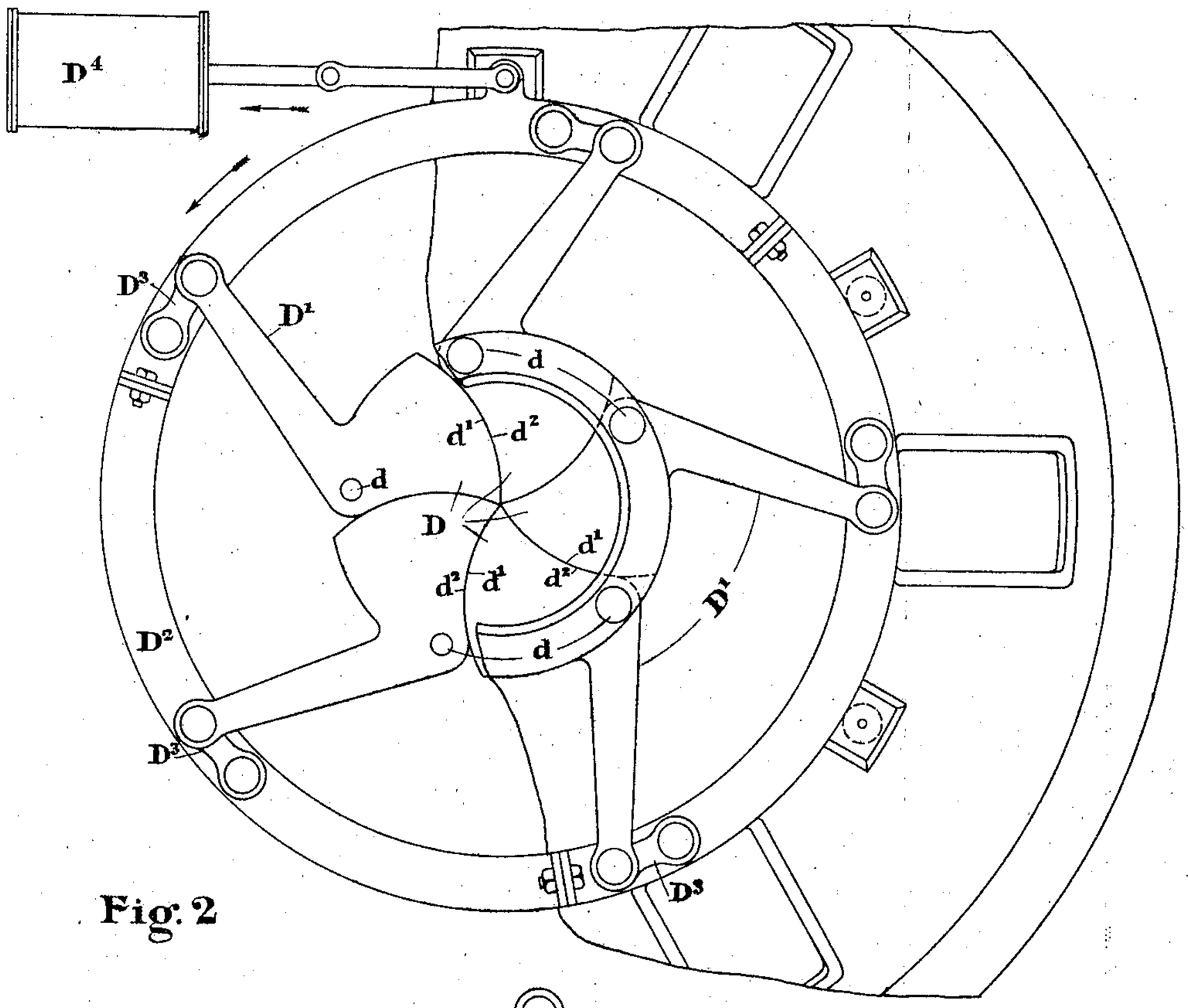

Fig. 2

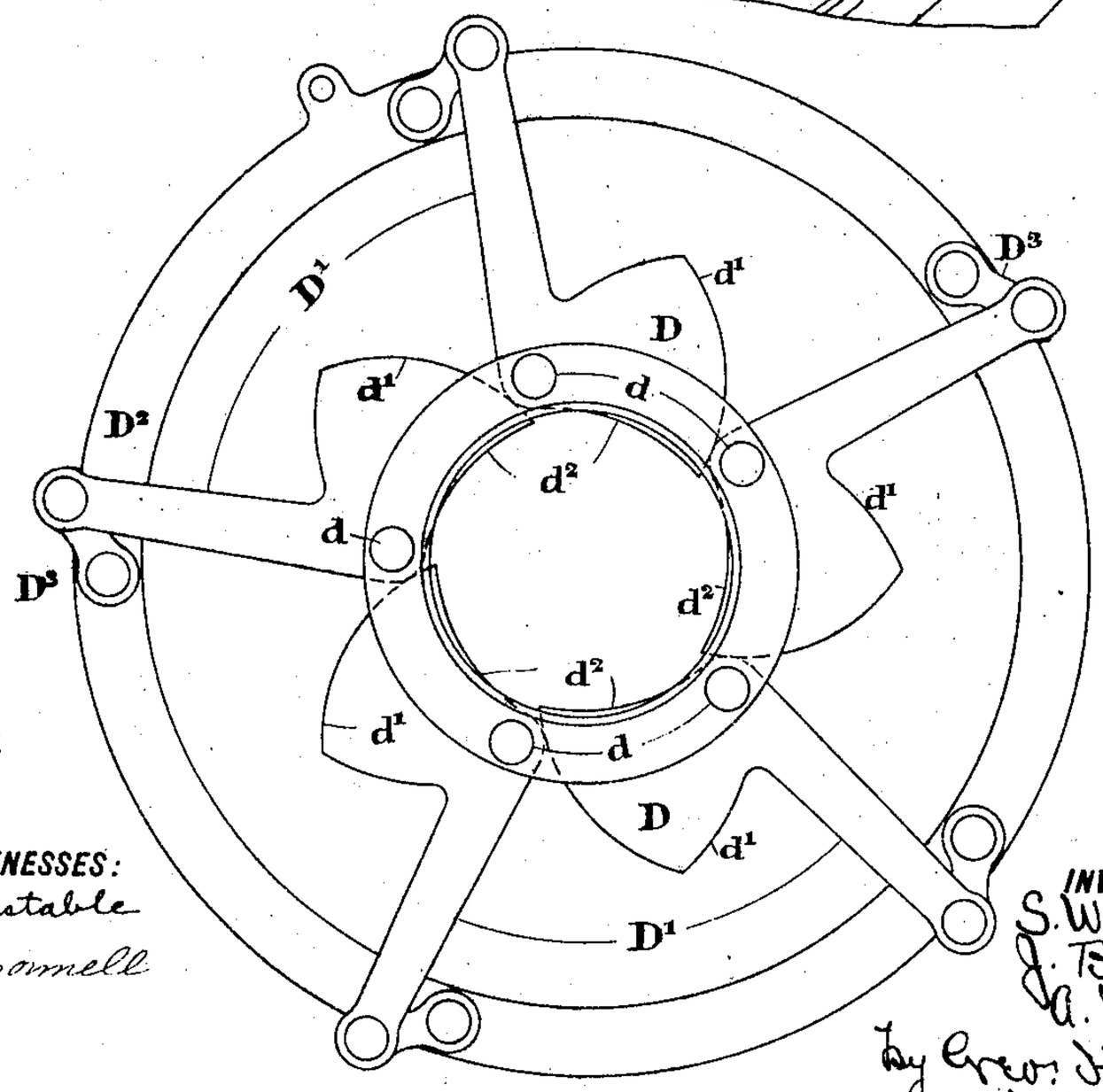

Fig. 3

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NO MODEL. 3 SHEETS—SHEET 3.

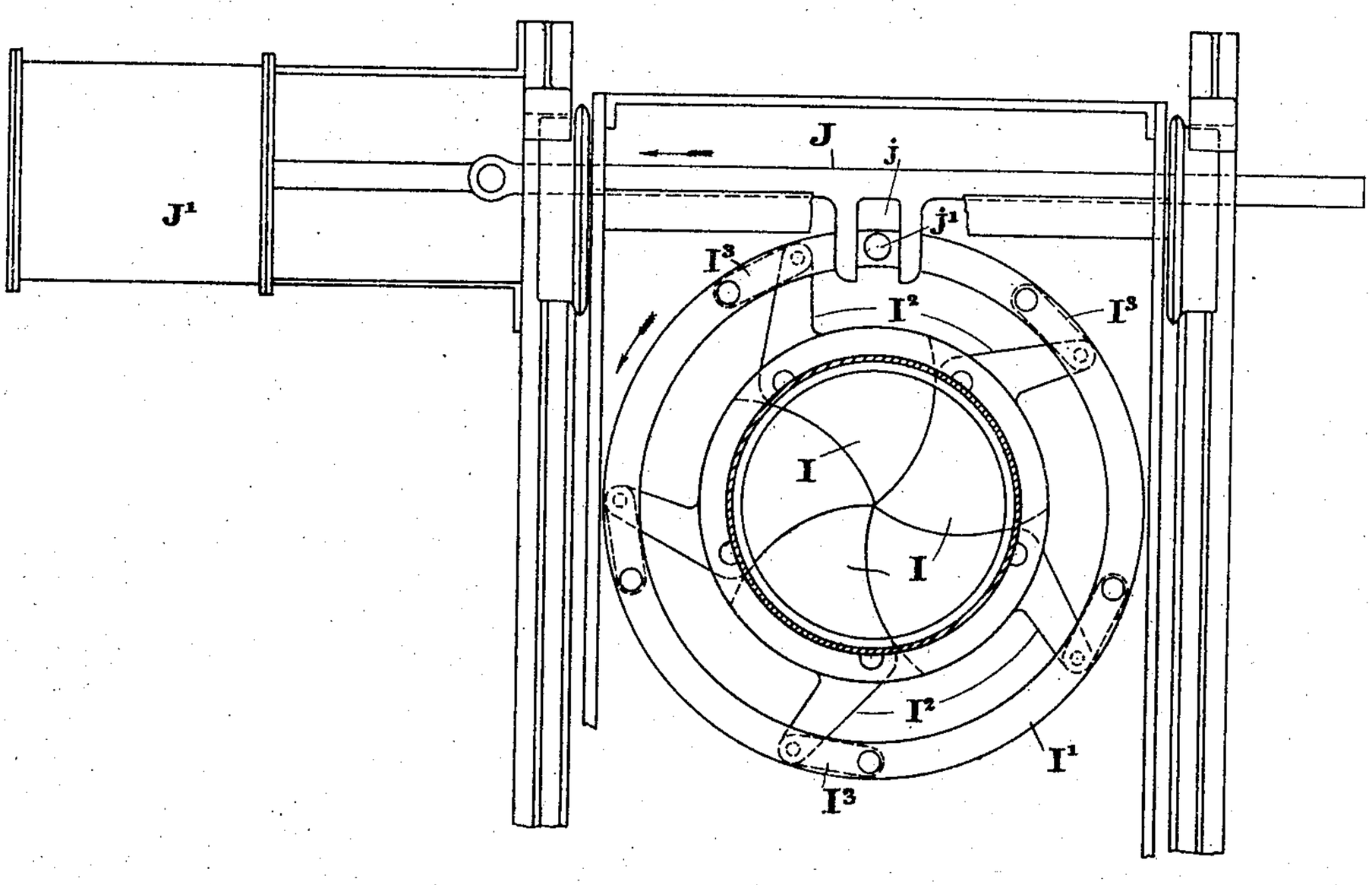

Fig. 4

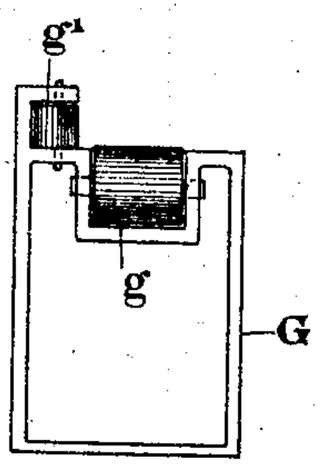

Fig. 5

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No. 768,207. Patented August 23, 1904.

UNITED STATES PATENT OFFICE.

SAMUEL W. VAUGHEN AND JAMES B. McCLURE, OF LORAIN, AND ARTHUR J. BOYNTON, OF ELYRIA, OHIO.

BLAST-FURNACE TOP AND CHARGING DEVICE.

SPECIFICATION forming part of Letters Patent No. 768,207, dated August 23, 1904.

Application filed April 7, 1903. Serial No. 151,505. (No model.)

To all whom it may concern:

Be it known that we, SAMUEL W. VAUGHEN and JAMES B. McCLURE, both of Lorain, and ARTHUR J. BOYNTON, of Elyria, in the county of Lorain, State of Ohio, have invented a new and useful Improvement in Blast-Furnace Tops and Charging Devices, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

To secure the proper uniform distribution of stock in the furnace has been one of the most troublesome problems in modern blast-furnace practice. The solution of this problem has been sought in various ways; but heretofore the most satisfactory attempts have either been but partially corrective of the evils sought to be overcome or else they have attained the desired object by means which in practical operation are too expensive to warrant their general use. By uniform distribution is meant not only a distribution in which the bulk of the stock is deposited in the furnace symmetrically with respect to its vertical axis, but also a distribution in which every vertical section taken through the center of the column of stock will show a similar proportion and admixture of ore, coke, and limestone and also similar proportions of fine and coarse material and of different kinds of ore. The difficulties which result in practice from the failure to secure a distribution of this kind are too well known in the art to require their statement here.

Our present invention is designed to provide a construction and arrangement of blast-furnace top and charging devices which will overcome the difficulties heretofore experienced and by means of which a proper distribution may be obtained at a cost not to exceed that of the cheapest systems now in use.

In our application Serial No. 151,507, of even date herewith, for a stock-collecting car or lorry, and in a second application of the same date, Serial No. 151,506, for an improved skip-car, we have had in view the collection and delivery of the stock in a manner to greatly facilitate this distribution, and the best results will be obtained when the present invention is used in conjunction therewith, although its use on any furnace and with other methods of collecting and handling the stock will be found useful.

In the usual practice the stock is carried to the top of the furnace in a skip-car, which discharges into the furnace-hopper by a side-tipping motion. This manner of discharge tends to throw the bulk of the material to the front or opposite side of the furnace, and especially the coarser portions thereof, and is a considerable factor in causing uneven distribution. It has also been generally customary to employ one or more bells for delivering the material into the furnace with actuating-rods therefor extending up through the receiving-hopper. The employment of these rods makes necessary a larger diameter of hopper in order to give the desired capacity and is another cause of unequal distribution, since not only does the material not have as great an opportunity to mix together in falling therethrough, but the slope at which it comes to rest therein is manifestly longer the larger its diameter, so that the difference in the distribution of the mass at the opposite sides thereof is greater. If bell-beams are used instead of rods, their usual arrangement is such as to divide the stock, so that it is not delivered centrally upon the apex of the bell.

Our invention consists in providing the furnace-top with a receiving-hopper having a long discharge-spout of relatively small diameter, at the lower end of which is a centrally-opening valve or diaphragm, which is arranged to drop the stock centrally onto the apex of a small bell, surrounded by what we term a "collecting-hopper." This small bell and also the collecting-hopper are mounted above the usual lower bell, which closes the furnace, and are carried by the beam which actuates said bell, the collecting-hopper being so arranged as to correct any error of distribution which would otherwise be caused by the stock striking the said beam and to discharge it upon the apex of the main bell. By the arrangement described we obviate the use of bell-rods extending through the re-

ceiving-hopper. In combination with this arrangement and construction of the furnace-top we provide a centrally-bottom-discharging skip-car, which drops the stock centrally into the receiving-hopper, and thus avoids the errors of distribution due to side discharge.

Our invention also consists in the novel construction and arrangement of the valve or diaphragm above referred to, which controls the discharge of the receiving-hopper. It also consists in certain other novel features of construction, arrangement, and combination of parts, all as hereinafter described, and pointed out in the appended claims, reference being had to the accompanying drawings, in which—

Figure 1 is a view, partly in vertical section and partly in side elevation, showing a furnace-top and charging devices embodying our invention. Fig. 2 is a partial plan view of the furnace-top with the receiving-hopper removed and showing the centrally-opening valve or diaphragm in its closed position. Fig. 3 is a plan view of the said valve or diaphragm partially opened. Fig. 4 is a plan view showing the skip-car in its discharging position and the means for actuating its valve, the stock-receptacle of the car being partially cut away on the line 4 4 of Fig. 1. Fig. 5 is a detail view.

The letter A designates the usual bell, which closes the top of the furnace and controls the admission of stock thereto.

B is the beam for operating said bell, actuated by rods B′, which are connected to a motive device. (Not shown.)

C is the receiving-hopper, which has an elongated discharge throat or funnel C′, of comparatively small diameter, in which is placed the centrally-opening valve or diaphragm D. Said throat or funnel is preferably made so that its diameter increases somewhat from the bottom of the hopper to the said valve, while below the valve its diameter decreases. This construction enables the stock to readily free itself in falling from the hopper to the valve and in falling from the valve to be directed centrally onto the apex of the small bell E, which is placed a short distance below it. This small bell E is secured to the beam B and is surrounded by the collecting-hopper F, which is also carried by said beam. This hopper F is formed with a contracted or funnel-shaped lower portion F′, which surrounds the apex of the bell A.

The centrally-opening valve D, which forms an important feature of our invention, is shown in detail in Figs. 2 and 3. It consists of a circular diaphragm divided on curved radial lines into a plurality of irregular sector-shaped or curved triangular sections D, each of which is pivoted at the point *d*. These pivotal points *d* lie near the outer circumference of the diaphragm-circle and are all equally distant from its center, the convex curved edge *d′* of each section being on a line struck from the center of its pivot *d*, while its concave edge *d²* is formed by a curve whose center is the axis of the pivot of the next adjacent section. Each section has a radially-extending lever-arm D′, and these arms are all connected to an annulus D² by means of links *d³*. Also connected to said annulus is a motive cylinder D⁴ or other suitable means for moving the same. It is supported upon antifriction-rollers *g*, carried by brackets G, and is centered and guided by similar rollers *g′*, which bear against its outer periphery.

It will be readily seen that when the annulus D² is moved in the direction of the arrow, Fig. 2, the links D³ will pull upon the arms D′ to move the sections D upon their centers *d* and that said sections will also swing outwardly from the center without interference with each other until their curved edges *d²* are nearly coincident with the circle passing through the said centers. Fig. 3 shows the position of the sections as they approach this position. It will be further noted that during this movement the opening formed by the outward recession of the sections is symmetrical with respect to the vertical center of the throat C′ and that its diameter increases equally in all directions from such center. It is this feature which distinguishes our present valve from all others which have been used for discharging blast-furnace stock, and the term "centrally-opening" as used herein and in the appended claims is to be construed as meaning a valve having this mode of operation as distinguished from those valves used heretofore composed of one or more hinged dropping or sliding leaves, which move away from the center in opposite directions, but wherein the opening formed by their recession simply widens in one direction. The advantage of the present form of valve will be readily understood when it is considered that the object in view is to discharge the stock centrally upon the apex of the bells below in such a manner that it shall be distributed equally over the entire surface of said bells. This cannot be accomplished with any form of valve which in opening tends to give a thrust of the stock toward one side or the other, nor by any valve in which the valve-opening simply widens in one direction, since with such valves more of the stock will obviously be discharged through the end portions of the openings thus formed and upon two sides of the bell. We do not, however, wish to limit ourselves to the particular form and construction of valve herein shown, as it may be modified in various ways and still perform the same function.

H designates a skip-car arranged to travel on the usual track K and having its bucket H′ hung on trunnions in the frame of the car, so that it will always maintain its vertical po-

sition. This bucket is provided with a discharge-valve I at its bottom, and this valve is also of the centrally-opening type above described and is preferably similar in construction to the valve D, as shown in Fig. 4. The valve-sections I are connected to the annulus I′ by the levers I^2 and links I^3. For the purpose of actuating this valve we provide at the top of the furnace a sliding bar J, actuated by a motive cylinder J′, (or any other suitable means.) This bar is formed with a jaw *j*, which is arranged to engage a pin or projection *j*″ on the annulus I′, so that when the bar is actuated to an endwise movement in the direction of the arrow the annulus will be moved to open the valve. The purpose of this valve I is the same as that of the valve D—*i. e.*, to secure a central discharge of the stock into the receiving-hopper. The skip-car shown forms the subject-matter of our application, Serial No. 151,506, above referred to, and it is not claimed herein, except broadly, in combination with the furnace-top.

The stock is discharged from the skip-car through the valve I into the receiving-hopper and onto the valve D. The throat C′ being unobstructed by bell-rods and of comparatively small diameter, the stock comes to rest therein at very nearly a level or with its surface in a cone whose vertical axis coincides with that of said throat. The valve D now being opened and the pressure of this uniform column of stock being equal about this axis, it is discharged centrally upon the small bell E. Any division of the stock due to the bell-beam E is largely corrected by the receiving-hopper F, and it finally comes to rest equally distributed around the bell A and is dropped into the furnace in that condition. In passing through the hopper C C′, over the bell E, and through the hopper F the different portions of the stock are also further mixed together and interdistributed, so that the stock finally reaches the furnace in condition to give the best results.

We do not wish to be limited to the precise construction, arrangement, and combination of parts herein shown and described, since various changes may be made in the details thereof without departing from the spirit and scope of our invention as defined in and by the following claims.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a blast-furnace top, a receiving-hopper having a centrally and horizontally opening discharge valve or diaphragm formed in three or more sections.

2. In a blast-furnace top, a receiving-hopper having a contracted downwardly-extending throat or funnel, and a centrally and horizontally opening discharge valve or diaphragm therein formed in three or more sections.

3. In a blast-furnace top, a receiving-hopper having a contracted downwardly-extending throat or funnel, and a centrally-opening discharge valve or diaphragm therein, said throat or funnel being of increasing diameter from the hopper to the said valve, and of decreasing diameter below the said valve.

4. In blast-furnace top and charging mechanism, the combination with a receiving-hopper, of a car or hoist arranged to be moved over the said hopper, and having a centrally-opening valve in its bottom.

5. In blast-furnace top and charging mechanism, the combination with a receiving-hopper, of a car or hoist arranged to be moved over the said hopper, and having a centrally-opening valve in its bottom, and means for actuating the said valve.

6. In a blast-furnace top, the combination with a lower vertically-movable bell which closes the top of the furnace, a beam for actuating said bell and connected directly thereto, and a second and somewhat smaller bell carried by the said beam and over the central portion of the same.

7. In a blast-furnace top, the combination of a main bell, a beam for actuating the same, a second and smaller bell carried by said beam, a hopper surrounding the smaller bell, and a receiving-hopper above said bell.

8. In a blast-furnace top, the combination of a main bell, a beam for actuating the same, a second and smaller bell carried by said beam, a hopper surrounding the smaller bell and also carried by said beam, and a receiving-hopper arranged to discharge upon the apex of said smaller bell.

9. In a blast-furnace top, the combination of a main bell, means for actuating the same, a second and smaller bell above the said main bell, and a receiving-hopper having a centrally-opening valve arranged to discharge upon the apex of the smaller bell, the said actuating means for the main bell being entirely exterior to the receiving-hopper.

10. In a blast-furnace top, a main bell which closes the top of the furnace, a second and smaller bell above the top of the main bell, and a collecting-hopper surrounding the smaller bell, said smaller bell and collecting-hopper being carried by and movable with the main bell.

11. The herein-described valve for discharging blast-furnace stock from one receptacle into another consisting of a horizontally-arranged circular diaphragm divided on curved radial lines into a number of sections each of which is pivoted near the circumference of the diaphragm, and means for actuating the said sections simultaneously.

12. The herein-described valve for discharging blast-furnace stock from one receptacle into another consisting of a circular diaphragm composed of a plurality of pivoted triangular sections, two edges of each of said sections

being formed by curved radial lines, and means for simultaneously moving the said sections.

13. The herein-described valve for discharging blast-furnace stock from one receptacle into another consisting of a diaphragm composed of a plurality of pivoted sector-shaped sections, each of which has a convex edge formed by a curve whose center corresponds with the axis of its pivot, and a concave edge formed by a curve whose center is the axis of the pivot of the next adjacent section, and means for actuating the said sections.

14. The herein-described valve for discharging blast-furnace stock from one receptacle into another, consisting of a diaphragm composed of a plurality of pivoted sections, lever-arms connected to said sections, and a circularly-movable actuating member to which said arms are loosely connected.

15. The herein-described valve for discharging blast-furnace stock from one receptacle into another, consisting of a diaphragm divided on curved radial lines into a number of sections each of which is pivoted at a distance from the center of the diaphragm, lever-arms extending radially from the said sections, a circularly-movable annulus surrounding the diaphragm and to which said arms are loosely connected, and means for moving the said annulus.

16. In a blast-furnace top, the combination with a receiving-hopper, of a valve in the throat thereof composed of a plurality of pivoted centrally-opening sections, radial lever-arms for actuating said sections, a circularly-movable annulus supported on the furnace-top and to which said arms are loosely connected, means for moving the said annulus and antifriction-bearings therefor.

17. A valve for discharging blast-furnace stock from one receptacle into another, consisting of a horizontal diaphragm formed in three or more sections, and means for actuating the said sections to cause them to simultaneously move outward from a central axis.

In testimony whereof we have affixed our signatures in presence of two witnesses.

SAMUEL W. VAUGHEN.
JAMES B. McCLURE.
ARTHUR J. BOYNTON.

Witnesses:
WILLIAM JAMES TASMAN,
ROBERT J. ASPIN.