No. 864,053. PATENTED AUG. 20, 1907.

T. F. & J. G. WITHERBEE.

CHARGING DEVICE.

APPLICATION FILED JAN. 19, 1906.

3 SHEETS—SHEET 1.

Fig. 1.

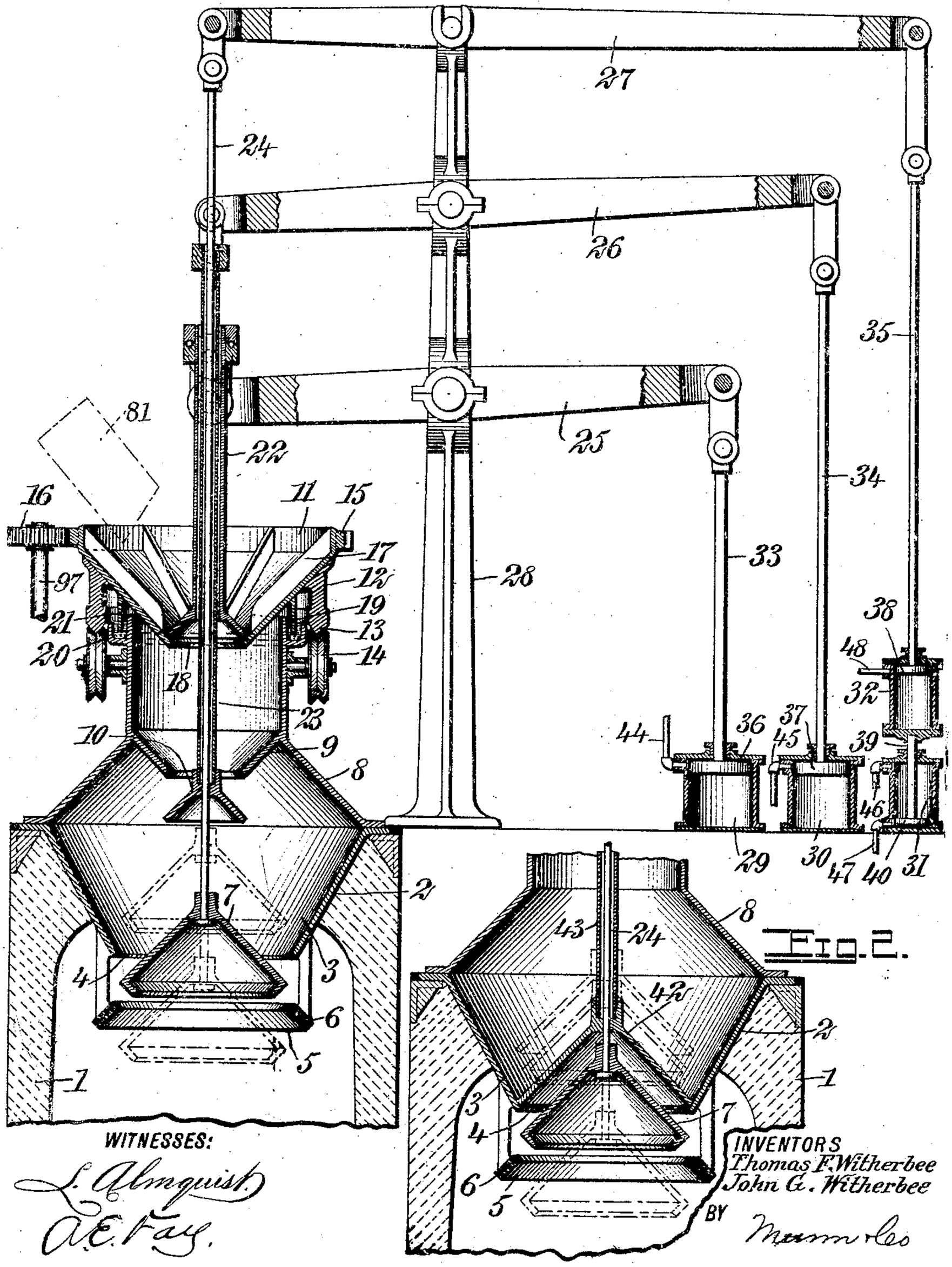

Fig. 2.

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3 SHEETS—SHEET 2.

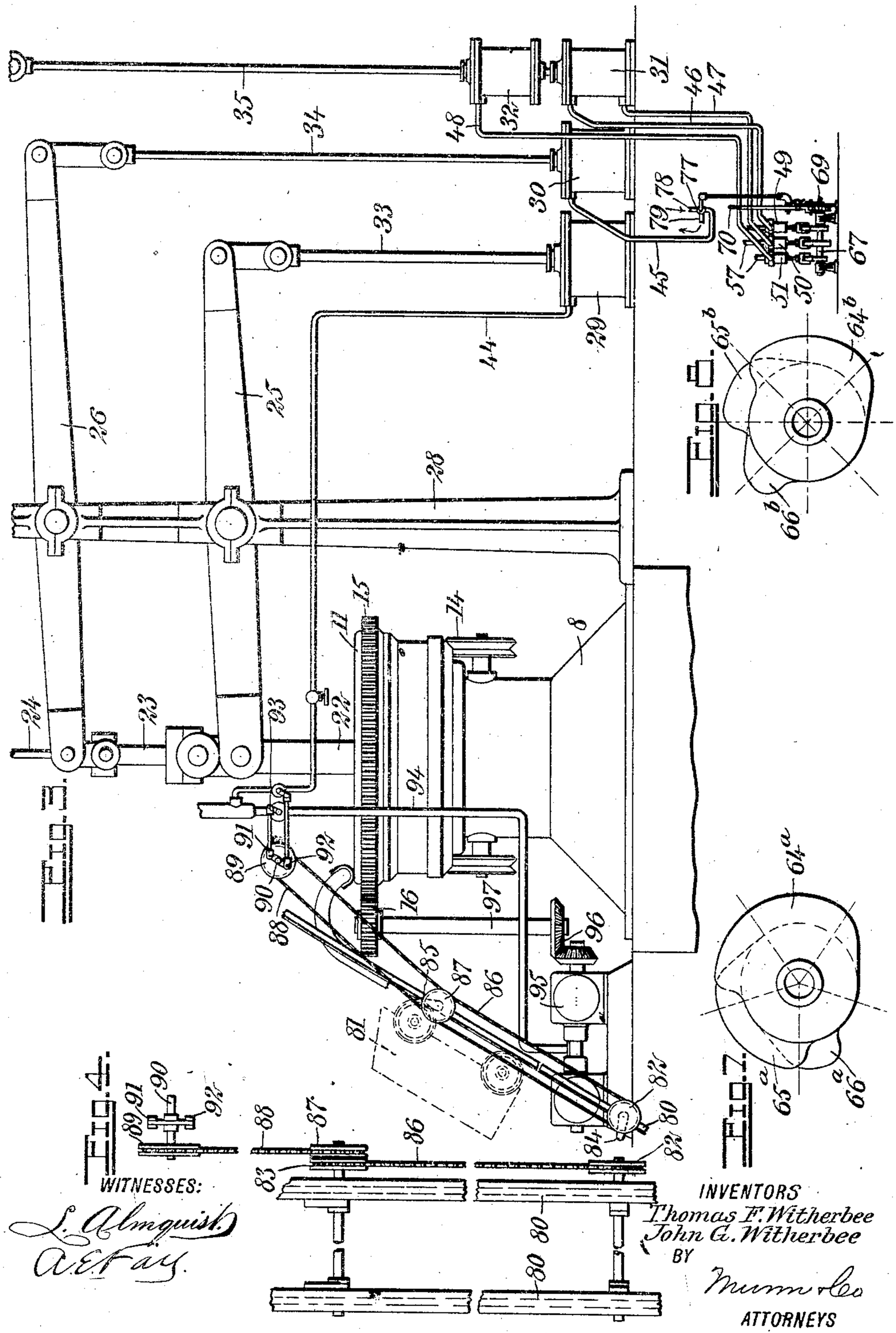

FIG. 5.

FIG. 4.

FIG. 7.

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3 SHEETS—SHEET 3.

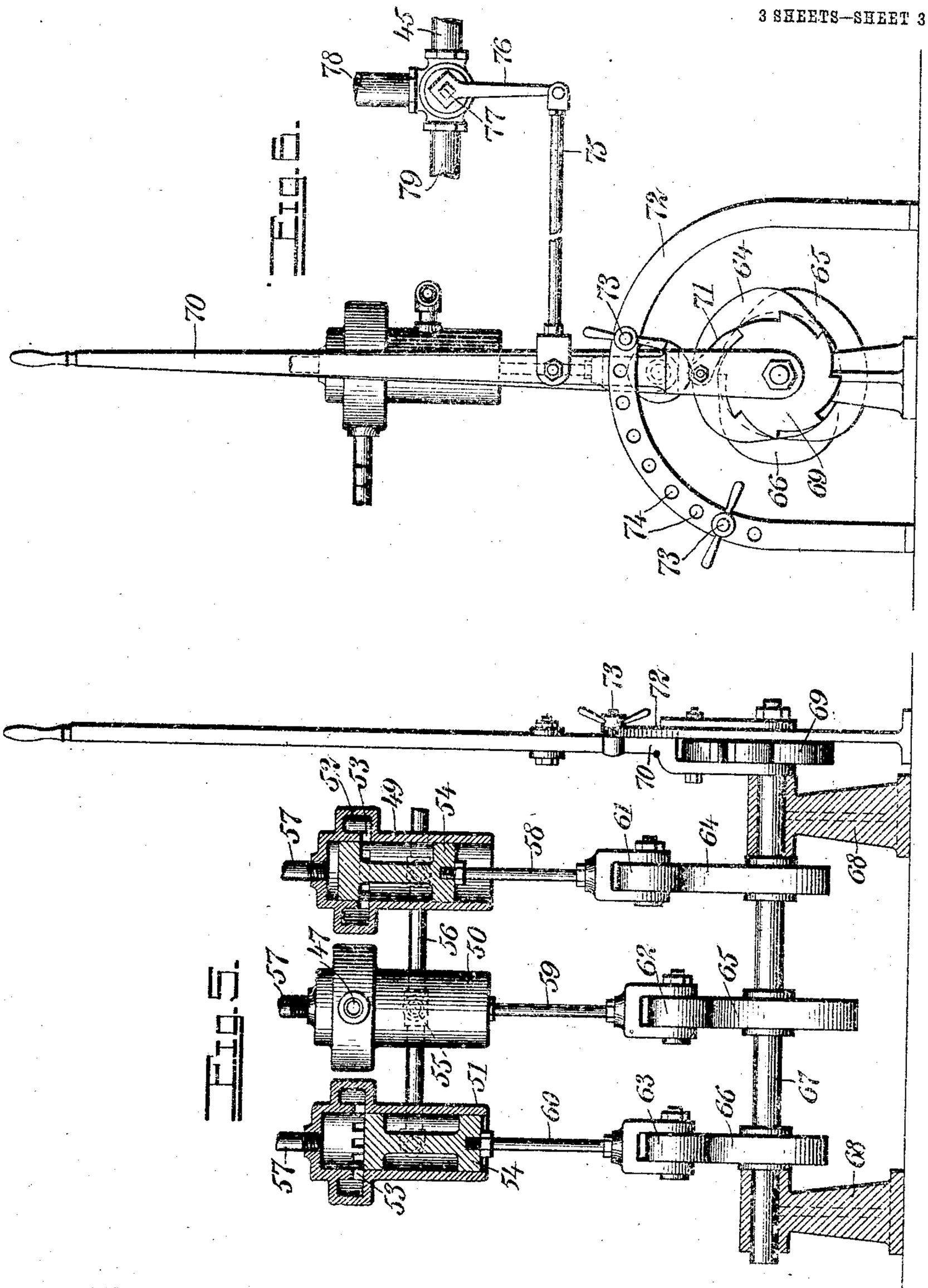

FIG. 5.

FIG. 6.

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UNITED STATES PATENT OFFICE.

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CHARGING DEVICE.

No. 864,053. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed January 19, 1906. Serial No. 296,800.

To all whom it may concern:

Be it known that we, THOMAS FRANCIS WITHERBEE and JOHN GILMAN WITHERBEE, both citizens of the United States, and residents of Durango, in the State of Durango, Mexico, have invented a new and Improved Charging Device, of which the following is a full, clear, and exact description.

Our invention relates to improvements in charging apparatus, and especially to charging apparatus for use on blast furnaces and the like.

The principal objects of the invention are to enable the distribution of the charge to be under more perfect control than has heretofore been the case; also to provide for a more efficient mixing of the elements of the charge, and to provide a gas seal; the apparatus being adapted to the use of the modern skip-hoist.

In the practical working of blast furnaces, especially the larger ones, a tendency has been developed for the ascending gases to "wander", that is, for the gaseous circulation to take irregular and varying channels, at times going up the outside next to the lining, and at other times passing up through the center. In the first case it is very destructive to the fire-brick lining, and in both cases it is fatal to fuel economy and to a good quality of product. Such abnormal conditions of circulation are due to the gases seeking and following the lines of least resistance, such lines being generally due to faulty charging apparatus and lack of a proper mixing of the charge. The damage and trouble does not end with a poor quality of product or a high fuel consumption, but is accompanied by many disadvantages such as dust-throwing, slips, and so-called explosions, the latter not infrequently being accompanied by loss of life and great financial loss.

Most furnaces are equipped with a single charging bell, or with some other form of apparatus not permitting any variation in the distribution of the charge, or any mixing of the materials previous to charging them into the furnace, and when a furnace is so equipped the manager is powerless either to avoid the troubles mentioned above, or to escape the consequences.

Our invention is designed to completely overcome the defects of the single bells and all apparatus with a fixed and unvarying method of distribution. It is designed to locate the charge in several places at the stock line, and also to provide for a perfect mixing of the materials of the charge.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in both the figures.

Figure 1 is a central vertical section of the upper part of a blast furnace, with a preferred form of a portion of our invention applied thereto; Fig. 2 is a similar view of a portion of a charging device, somewhat modified, and also embodying the principle of our invention; Fig. 3 is a diagrammatic side elevation of a part of a furnace plant, indicating certain controlling devices which constitute a part of our invention; Fig. 4 is a fragmentary end elevation of the same; Fig. 5 is a side elevation on an enlarged scale of certain details shown in Fig 3; and Fig. 6 is an end elevation of the parts shown in Fig. 5. Fig. 7 is a diagrammatic side elevation of cams arranged for dividing the cycle into quantities of fifths; and Fig. 8 is a somewhat similar view showing cams 64^b, 65^b, 66^b, so arranged as to distribute three charges in one position of the bell, two charges in the second position, and one charge in the third position.

The furnace 1 is as usual provided with an opening 2 in its upper part, in which is located a hopper 3, having a mouth 4 at its lower end. This hopper is provided with a conical distributing ring or shield 5, having water-cooling passages 6 located in its walls. These passages may be formed by coring, casting pipes in the ring, or in any other desired manner, and are intended to be connected with a source of supply by means of which the water is admitted under a very low head. The ring is also provided with a very long outlet leg, so that a suction will be caused to aspirate the water through the ring and eliminate any chance of water entering the furnace as a result of the possible breakage of the ring. The ring is shown as rigidly mounted upon the hopper 2, but it will be understood that it may be made movable and adjustable without departing from the spirit of our invention. The bottom of the hopper is normally closed by a bell 7. This bell is capable of passing through the bottom of the hopper and the ring 5, so that it can assume either one of the two positions shown in dotted lines. When in the upper position shown in dotted lines, material passing into the hopper will flow inwardly toward the center of the furnace, and consequently when it is desired to fill the center of the furnace the bell will be placed in this position. When the bell is in the lower dotted position, material coming from the hopper will strike the surfaces of the bell and will be forced outwardly toward the lining of the furnace. When the bell is in the position shown in full lines, material will slide down the conical surface of the bell, strike the ring 5, and be forced to a still further degree toward the lining. It will be seen that the sole office of the bell is that of a spreader, and it is not intended to act as a gas seal for the hopper.

The hopper 3 is provided with an upper conical portion 8, and these two parts together constitute a by-pass chamber underneath a second hopper 9 into which the material is fed in the manner to be described. The bottom of this second hopper is normally closed by a downwardly-opening bell 10. Above the top of the hopper 9 is a rotary mixer or chute 11 for receiving charges of material from a skip-car or other charging de-

vice. It is provided with a downwardly-extending flange 12, having a track 13 on its lower edge. This track bears upon grooved wheels 14 mounted on the side of the hopper 9 or any other stationary part of the device. The chute is provided with an external gear 15 meshing with a gear or pinion 16, driven in any ordinary or desired manner to provide for rotating the mixer. The mixer is also provided with a series of corrugations or ribs 17 extending radially along the inside conical surface thereof. It will be seen that the rotation of this mixer will result in the carrying of the material around with it to a certain degree on account of the ribs or corrugations 17, and that the material will in this manner be retarded sufficiently so that it will not be too rapidly discharged into the hopper 9. The bottom of the mixer is controlled by an upwardly-opening bell 18. The upper hopper is provided with a flange 19, and with an annular cup 20 the outer edge of which is lower than the upper edge of the flange 19. This annular cup is preferably filled with water or any other liquid, to afford a gas seal between the hopper and the rotary mixer, the mixer being provided with a depending flange 21 entering the liquid throughout its circumference.

For operating the bells 7, 10 and 18, many different kinds of mechanism may be employed. That with which we have chosen to illustrate our invention comprises a hollow tube 22 rigidly connected with the bell 18, a hollow tube 23 rigidly connected with the bell 10 and passing through the tube 22 and extending above it, and a rod 24 connected with the bell 7, passing through the tube 23 and extending above it. Each of these manipulating devices for the bells is pivotally connected with a lever, these levers being numbered respectively 25, 26 and 27, and all of them being pivoted on a stationary standard, as for example 28. The levers are preferably manipulated by means of pressure cylinders 29, 30, 31 and 32, these levers being provided with piston rods 33, 34 and 35, and the piston rods being provided respectively with pistons 36, 37 and 38. These pistons are located respectively in the cylinders 29, 30 and 32. The bottom of the cylinder 32 is provided with a piston rod 39, which is rigidly connected with a piston 40 located in the cylinder 31. The bell 18 is revoluble and turns when in action, for the reason that the fuel in the bottom of the revoluble chute connects the chute with the bell. Owing to the fact that the bell 18 rotates, the danger of clogging and the loss of power from friction are avoided, and the action of the charging apparatus is rendered more satisfactory.

The pistons 36 and 37 work in the ordinary manner to manipulate the bells 18 and 10. As the bell 7 has to be set in three different positions, additional operating means have to be provided. The pistons 38 and 40 are located in the position illustrated, when the bell is in the position shown in full lines. When it is desired to raise the bell, pressure-fluid is admitted above the piston 38 so that said piston is lowered in the cylinder 32. When it is desired to lower the bell from the position shown in full lines, pressure-fluid is admitted below the piston 40, and the cylinder 32 being raised, the rod 35 will be raised to its highest position and the bell lowered. It will be seen that the cylinder 32 acts as a counterpoise to the bell 7, and normally forces it back to the position shown in full lines.

In operation, the gear 15 is provided with a number of teeth not exactly divisable by the number on the pinion 16, so that the same relative positions may not frequently be repeated between the chute and the receiving hopper. The chute is intended to have a slow rotative motion until the skip-car is at a suitable distance from the top, when the skip-car by means of suitable trip motion to be described increases the rotative speed of the chute. This speed is maintained while the skip-car is discharging into the chute, so that the contents of the car will be evenly distributed in the chute, and until the skip-car has nearly reached the bottom of the skip, when it is again returned to its slower motion, preferably by automatic mechanism constituting a part of the present invention. Meanwhile, by hand manipulation, or automatically, as desired, pressure is being admitted to the top of the piston 36 in such a way that the bell 18 will be slowly raised in order that the contents of the chute may be slowly discharged into the hopper 9. This is done so that the materials may be evenly distributed in the hopper through the rapid rotation of the chute.

By the use of an upwardly-opening bell in the chute, the materials are caused to converge to the center of the hopper below, on account of the converging sides of the chute. The bell 10, being lowered through the operation of the piston 37, causes the materials to be deflected to the lower part of the hopper 2 if the spreader bell 7 is in its raised position, or if it is in its lower position it scatters them into the small annular ring. If this bell is in its central position it scatters them onto the ring 5 and so distributes them in a large circle in the furnace. It will thus be seen that the materials are constantly being mixed through their descent into the furnace, and so by means of the apparatus as a whole, proper mixing and a perfect distribution are provided to suit the regular or varying conditions of furnace operations.

It will be readily understood that there are many modifications which our invention may take, and that it is not limited to the construction described above. One of these modifications is shown in Fig. 2, in which the hopper 9 and bell 10 are dispensed with, and instead an upwardly-opening bell 42 is provided for closing the opening 4 in the hopper 3. This bell is connected with a tube 43 which is substantially similar to the tube 23, and the other parts are connected up in the same way as before. In this construction the materials are fed as in the other form, from the rotating chute directly onto the surface of the bell 42, which is raised as desired to drop the materials into the furnace. The bell 7 operates in the same manner as before, being raised, if desired, into the position shown in dotted lines, and carrying with it the bell 42.

We will now describe the means which we have illustrated in Figs. 3, 5 and 6, for manipulating the levers 25, 26 and 27 in a predetermined manner in such a way that it can be accomplished by unskilled labor. The cylinders 29, 30, 31 and 32 are supplied with fluid under pressure through pipes 44, 45, 46, 47 and 48, the pipes 46 and 47 leading respectively to the upper and lower parts of the cylinder 31.

We will first describe our preferred means of controlling the admission of fluid through the pipes 46, 47 and 48. These three pipes lead from three valves 49, 50 and 51 of the piston type. Each valve is provided

with an annular chamber 52, which communicates through ports 53 with the main portion of the valve. Each valve is supplied with a double piston 54 which takes pressure in the center and is consequently balanced. Through the inlet 55 all of the valves take pressure from a common supply pipe 56. Each valve is supplied with an exhaust-pipe 57. When the piston 54 is in the position shown in the left-hand valve 51 in Fig. 5, the supply pipe 56 communicates with the interior of the valve between the two portions of the piston, but is shut off from the ports 53 in an obvious manner. When, however, the piston is raised to the position shown in the valve 49 at the right, the pressure is admitted through the ports 53 to the annular chamber 52, and from there it is freely admitted to the pipe 46 with which this chamber is connected. Upon the return of the piston to the original position the valve and pipe are free to exhaust through the pipe 57. For operating these valves the three pistons are connected in any desired manner with piston rods 58, 59 and 60. These rods are provided with rollers 61, 62 and 63 adapted to be operated by cams 64, 65 and 66 respectively. These cams are all mounted at different angles upon a shaft 67 mounted in bearings 68. Upon the shaft rigidly mounted with respect to the cams is a ratchet wheel 69, and an operating lever 70 is also provided. This operating lever is provided with a pawl 71 for controlling the ratchet in an obvious manner. A guide 72 is also provided, having a pair of stops 73 adapted to be placed in any desired one of a series of perforations 74 in the guide. The three cams being set at the desired angle to each other and being provided with the requisite shape in order to produce the desired manipulations of the bell 7, it will be necessary for the operator to merely rotate the shaft 67 by means of the operating lever 70 by a step-by-step motion through the operation of the ratchet-wheel 69, and this will cause the bell to assume the three different positions and retain them for the length of time desired. The operation of this part of our invention is as follows: Supposing the furnace manager to have decided to place three consecutive charges next to the furnace walls or on the outside, then three intermediate charges, and finally two in the center, the whole number of charges forming a cycle of eight in a series of three, and one of two. Each of the cams would in this case be designed to have its circumference divided into eight parts, of which the cam 64 would have a continuous circular surface at a maximum distance from its center equal to three of these parts, or three-eighths of the circumference. The cam 65 could be constructed in the same manner but would be located so that the first one of these divisions would be adjacent to the last one of the divisions of the other cam. The cam 66 would be provided with two divisions of a similar nature, and would complete the cycle. The cams illustrated in Fig. 6 are designed in this way. The parts being fixed in this manner, the operation of the lever 70 eight times in order to rotate the ratchet-wheel 69 to a complete revolution, would hold the distributing bell 7 in its normal full-line position shown in Fig. 1, during three movements of the lever, while three charges were introduced into the furnace in a large annular ring next to the lining. As soon as the valve 49 is closed by the rotation of the cam 64, the cam 65 is in position to operate on the roller 62 and open the valve 50 so as to introduce pressure through the pipe 47 to the lower part of the cylinder 31. This will bring the bell 7 into the lower dotted position. When three charges have been delivered in this manner at a point intermediate between the center and circumference of the furnace, the cam 66 will be ready to act upon the roller 62, and, admitting pressure to the top of the cylinder 32, causes the bell 7 to rise to its upper dotted position and distribute the next two charges in the center of the furnace. In like manner any cycle desired can be produced by substituting proper cams. Thus a five-charge cycle should have cams divided into fifths distributed among three cams 64^a, 65^a and 66^a, shown in Fig. 7, in the desired manner. In all cases the number of cam lengths should be evenly divisible by the number of charges forming the cycle.

In Fig. 8 is illustrated another set of cams 64^b, 65^b and 66^b, in which three charges are distributed in the first position of the bell, two charges in the second, and one in the third. The number of teeth on the ratchet-wheel 69 corresponds with the number of divisions into which the cams are divided, there being eight in the form shown in Figs. 5 and 8, and five in the form shown in Fig. 7. The object of the stops 73 is to adjust the movement of the lever 70 to suit the ratchet-wheel. In practice it is best to allow the lever to move the wheel about one and a half ratchet lengths in order not to miss picking up the next tooth. The advantage of this device for automatically locating the spreader bell 7 is that it does not depend upon the memory or faithfulness of the man who actually charges the material into the furnace, but is necessarily made to operate automatically in accordance with the judgment and predetermined plan of the furnace manager. The lever 70 is also provided with attachments by which the control of the cylinder 30 and the bell 10 is provided in a similar automatic manner. A link 75 is connected with the lever and with another lever 76 which operates a three-way valve 77. This valve is provided with an admission-pipe 78, an exhaust pipe 79, and is connected with the pipe 45 so as to automatically control the admission of pressure fluid to the cylinder 30.

The operation of the cylinder 29 is controlled in another manner, which will now be described. A track 80 for a skip-car 81 is located in the usual manner near the furnace, and may be of any desired kind and construction. Near this track are located a pair of sprocket-wheels 82 and 83, having arms 84 and 85 respectively. These wheels are connected together by a sprocket chain 86, and the arms are located in such position as to be readily operated by the wheels of the skip-car when it reaches the proper position so as to turn the sprocket-wheels for a purpose to be described. A second sprocket wheel 87 is rigidly mounted with respect to the sprocket-wheel 83, and is connected by a chain 88 with a sprocket-wheel 89. The last-mentioned sprocket-wheel is mounted on a shaft 90 and is provided with two arms 91 and 92. The second of these arms is connected with a cock 93 in the supply-pipe 44, and it will be seen that the operation of the wheel of the skip-car in turning the arm 85, will rotate the shaft 90 sufficiently to open the cock 93 and admit pressure to the cylinder 29 so as to open the bell 18. The other arm 91 is connected by a link 92 with a valve 93 in a supply-pipe 94 which controls the admission of

steam to an operating engine or motor 95. This engine may be of any desired kind and character, but I prefer a pair of Westinghouse standard engines of the inclosed type coupled with cranks at 90 degrees. They transmit power to the pinion 16 through gearing 96 and a shaft 97.

The operation of this part of our invention is as follows: If the rotary mixer 11 is in slow rotation caused by the engines running on a by-pass valve (the engines having fixed eccentrics), when the skip-car arrives at the point indicated in Fig. 3 the forward car-wheel encounters the arm 85, depressing it, and throws the arm 91 to admit more steam to the engines and thus accelerate the rotation of the chute. The same action of the wheel of the skip-car operates the arm 92 and admits pressure to the cylinder 29, and it also moves the arm 84 upwardly into such position that when the skip-car returns it will be hit by the rear wheels of the skip-car and return to its normal position, actuating the other parts in an obvious manner to bring them to the positions in which they originally were. These operating devices have been illustrated and described as convenient for accomplishing the desired results, but it is to be understood that they may be greatly modified or replaced by equivalent devices in order to carry out the invention within the scope of the appended claims.

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

1. In a charging device, the combination of a hopper for receiving material, a bell for controlling the discharge of material therefrom, a rotary mixer for leading the material to said hopper, said mixer being provided with radial projections upon its inner surface, and means for rotating said mixer.

2. In a charging device, the combination of a by-pass chamber, a bell for partially closing the lower end thereof, means for moving the bell to positions above and below said lower end, a distributing ring located below the lower end of the chamber, a hopper located at the upper part of said chamber, a bell for controlling the discharge of material from said hopper, a mixer located above said hopper, and an upwardly movable bell for controlling the discharge of material from the mixer to the hopper.

3. In a charging device, the combination of a by-pass chamber, a bell for partially closing the lower end thereof, means for moving the bell to positions above and below said lower end, a distributing ring located below the lower end of the chamber, a hopper located at the upper part of said chamber, a bell for controlling the discharge of material from said hopper, a mixer located above said hopper, an upwardly movable bell for controlling the discharge of material from the mixer to the hopper, a gas seal between said hopper and mixer, and means for rotating the mixer.

4. In a blast furnace charging apparatus, the combination of a by-pass chamber, a bell for partially closing the lower end thereof, and means for moving the bell to positions both above and below the lower end of the chamber, said means comprising a lever connected with the bell, a piston connected with the lever, a movable cylinder in which said piston is located, a second piston rigidly connected with the cylinder, and a stationary cylinder in which said second piston is located.

5. In a blast furnace charging apparatus, the combination of a by-pass chamber, a bell for partially closing the lower end thereof, and means for moving the bell to positions both above and below the lower end of the chamber, said means comprising a lever connected with the bell, a piston connected with the lever, a movable cylinder in which said piston is located, a second piston rigidly connected with the cylinder, a stationary cylinder in which said second piston is located, a hopper above said by-pass chamber, a bell for controlling the discharge of material from the said hopper, to the by-pass chamber, and means for operating said last-mentioned bell, comprising a lever connected therewith, a piston connected with the second lever, and a cylinder in which said last-mentioned piston is adapted to operate.

6. In a blast furnace charging apparatus, the combination of a by-pass chamber, a bell for partially closing the lower end thereof, means for moving the bell to positions both above and below the lower end of the chamber, said means comprising a lever connected with the bell, a piston connected with the lever, a movable cylinder in which said piston is located, a second piston rigidly connected with the cylinder, a stationary cylinder in which said second piston is located, a rotary mixer adapted to discharge material into said by-pass chamber, an upwardly-opening bell for controlling the discharge of material from said mixer, and means for operating said last-mentioned bell comprising a lever and a power-cylinder connected with the lever.

7. In a blast furnace charging apparatus, the combination of a by-pass chamber, a bell for partially closing the lower end thereof, means for moving the bell to positions both above and below the lower end of the chamber, said means comprising a lever connected with the bell, a piston connected with the lever, a movable cylinder in which said piston is located, a second piston rigidly connected with the cylinder and a stationary cylinder in which said second piston is located, and means for controlling the admission of pressure-fluid to said cylinders, said means comprising a series of valves and means for operating the valves.

8. In a furnace charging apparatus, the combination of a bell, a movable rod connected with the bell for operating it, a piston connected with the rod, a movable cylinder in which said piston is located, a second piston connected with said cylinder, a stationary cylinder in which said last-mentioned piston is mounted, a plurality of valves for controlling the admission of fluid-pressure into the first cylinder and into the upper and lower portions of the second cylinder, a series of cams for operating said valves, a shaft upon which said cams are rigidly mounted, and means for simultaneously operating the cams.

9. In a furnace charging apparatus, the combination of a bell and means for moving the bell comprising a pair of cylinders having pistons therein, a plurality of valves for controlling the admission of fluid-pressure to said cylinders, a cam for operating each valve, each of said cams being provided with a surface having a radius equal to the maximum throw of the cams, the sum of said surfaces on all the cams being substantially equivalent to a complete circle and the cams being set at such an angle to each other that one of them is always in position to cause a maximum throw.

10. In a furnace charging apparatus, the combination of a bell and means for moving the bell comprising a pair of cylinders having pistons therein, a plurality of valves for controlling the admission of fluid-pressure to said cylinders, a cam for operating each valve, each of said cams being provided with a surface having a radius equal to the maximum throw of the cams, the sum of said surfaces on all the cams being substantially equivalent to a complete circle and the cams being set at such an angle to each other that one of them is always in position to cause a maximum throw, a ratchet-wheel mounted with respect to said cams, an oscillating lever having a pawl for the engagement of said ratchet-wheel, and a guiding and limiting device for the lever.

11. In a furnace charging apparatus, the combination of two bells, a pressure cylinder for operating one of them, two pressure cylinders for operating the other, a series of valves for controlling the admission of pressure-fluid to said pair of cylinders, a valve for controlling the admission of pressure-fluid to the other cylinder, a series of cams for controlling said first-mentioned valves, a lever for controlling the last mentioned valve, and means for simultaneously operating said cams and lever.

12. In a furnace charging apparatus, the combination of two bells for controlling the admission of a charge to the furnace, a movable rod connected with each bell, a pressure-cylinder having a piston connected with one of the rods, a pair of pressure cylinders having a piston con-

nected with the other rod, means for admitting a fluid to the first cylinder, means for admitting a fluid to the pair of cylinders, means for controlling said first-mentioned means comprising a three-way cock, means for controlling the means for admitting a fluid to the pair of cylinders comprising a plurality of valves and a plurality of cams for operating the valves, and means for simultaneously operating said cams and said three-way cock.

13. In a furnace charging apparatus, the combination of two bells, two movable rods one connected with each bell, a piston connected with one of said rods, a cylinder in which said piston is located, a piston connected with the other rod, a movable cylinder in which said piston is located, a third piston connected with the movable cylinder, a stationary cylinder in which said third piston is located, means for controlling the admission of fluid-pressure to the second and third cylinders comprising a series of valves and a series of cams for operating the valves, means for controlling the admission of fluid-pressure to the first-mentioned cylinder comprising a cock and a lever for operating it, a second lever, and connections from said second lever to the first-mentioned lever and to the cams.

14. In a blast furnace charging apparatus, the combination of a by pass chamber, a bell for partially closing the lower end thereof, means for moving the bell to positions both above and below the lower end of the by pass chamber, said means comprising a lever connected with the bell, a piston connected with the lever, a movable cylinder in which said piston is located, a second piston rigidly connected with the cylinder, a stationary cylinder in which said second piston is located, a rotary mixer adapted to discharge material into said hopper, an upwardly-opening bell for controlling the discharge of material from said mixer, means for operating said last-mentioned bell comprising a lever and a power-cylinder connected with the lever, and means for controlling the admission of operating fluid to the last-mentioned cylinder and to the other two cylinders.

15. In a blast furnace charging apparatus, the combination of a by pass chamber, a bell for partially closing the lower end thereof, means for moving the bell to positions both above and below the lower end of the by pass chamber, said means comprising a lever connected with the bell, a piston connected with the lever, a movable cylinder in which said piston is located, a second piston rigidly connected with the cylinder, a skip-car, a rotary mixer means for rotating the mixer, and means controlled by the movement of the skip-car for controlling the rotation of the mixer.

16. In a blast furnace charging apparatus, the combination of a rotary mixer, a motor for rotating the mixer, a valve for controlling the admission of pressure-fluid to the motor, a skip-car track located adjacent to the furnace, a bell-operating cylinder having a valve, an arm located adjacent to the skip-car track and adapted to be operated by a skip-car on the track, and means for transmitting motion from said arm to said valves for controlling them.

17. In a blast furnace charging apparatus, the combination of a rotary mixer, a motor for rotating the mixer, a valve for controlling the admission of pressure-fluid to the motor, a skip-car track located adjacent to the furnace, a bell-operating cylinder having a valve, an arm located adjacent to the skip-car track and adapted to be operated by a skip-car on the track, and means for transmitting motion from said arm to said valves for controlling them, said means comprising a sprocket-wheel connected with the arm, a second sprocket-wheel, a chain for connecting the sprocket-wheels, and means for connecting the second sprocket-wheel with said valves.

18. A furnace charging device comprising a movable mixer, a valve for controlling the motion of the mixer, a bell within the mixer, a valve for controlling the motion of the bell, a skip-car track located adjacent to the furnace, a pair of arms located in the path of the wheels of the skip-car, a pair of sprocket-wheels with respect to which said arms are rigidly mounted, said arms being set at an angle to each other, a chain for connecting said sprocket-wheels together, a second pair of sprocket-wheels one of which is rigidly connected with one of the first pair, a chain for connecting the second pair, a link connecting one of said second pair of sprocket-wheels, with one of said valves, and a link for connecting the same sprocket-wheel with the other valve.

19. A charging apparatus, comprising a movable mixer, a valve for controlling a motion of the mixer, a movable bell in the mixer, a valve for controlling a motion of the bell, and means for simultaneously operating said valves.

20. A charging apparatus, comprising a hopper having an open lower end, a distributing bell, a distributing ring located below the lower end of said hopper, and means for moving said bell to positions above and below said distributing ring.

21. In a charging device, the combination of a by-pass chamber, a bell for partially closing the lower end of said by-pass chamber, means for moving said bell to positions above and below said lower end, a distributing ring located below the lower end of said by-pass chamber, a hopper located above said by-pass chamber, a rotary mixer located at the upper end of said hopper, and a bell for controlling the discharge of materials from said rotary mixer into said hopper.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

THOMAS FRANCIS WITHERBEE.
JOHN GILMAN WITHERBEE.

Witnesses:
C. H. BURNY,
LUIS MENA.