

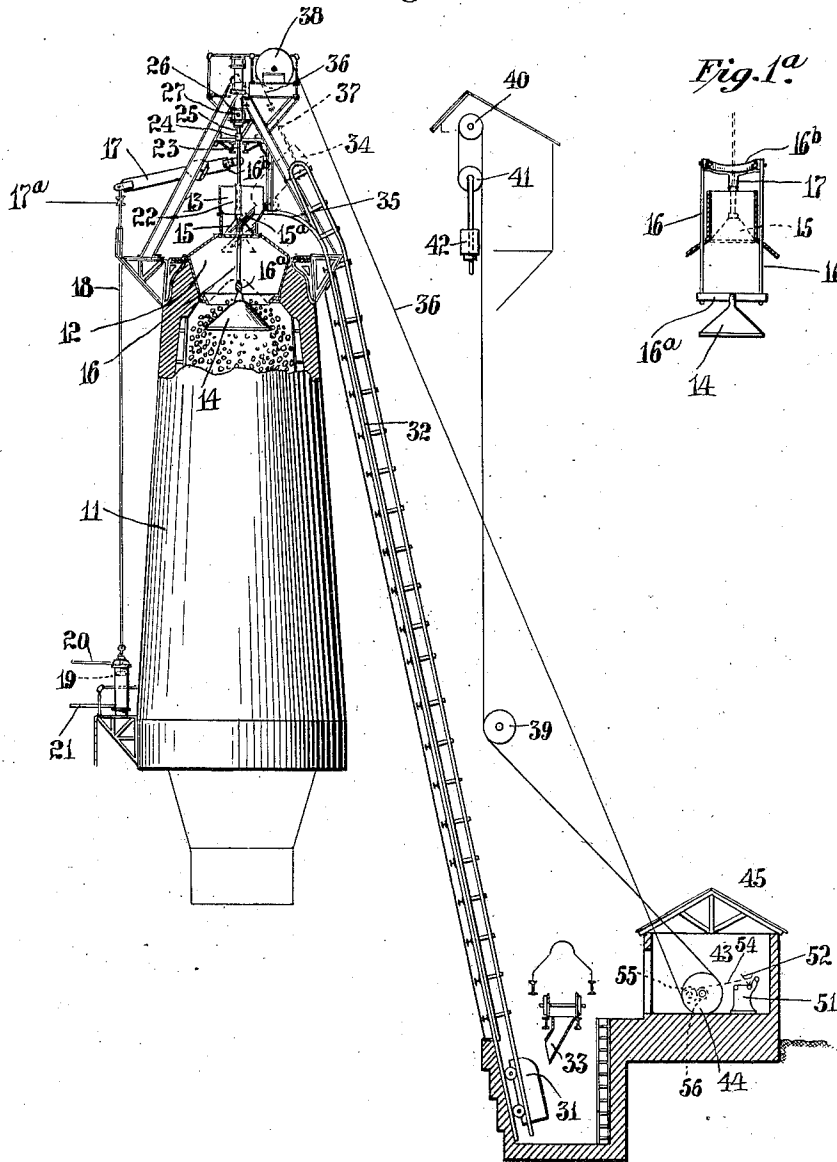
D. BAKER.
 APPARATUS FOR CHARGING FURNACES.
 APPLICATION FILED JUNE 16, 1911.

1,016,539.

Patented Feb. 6, 1912.

4 SHEETS—SHEET 1.

Fig. 1.



Attest:
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Inventor:
 David Baker
 by
 Rogers, Kennedy & Campbell
 Attys

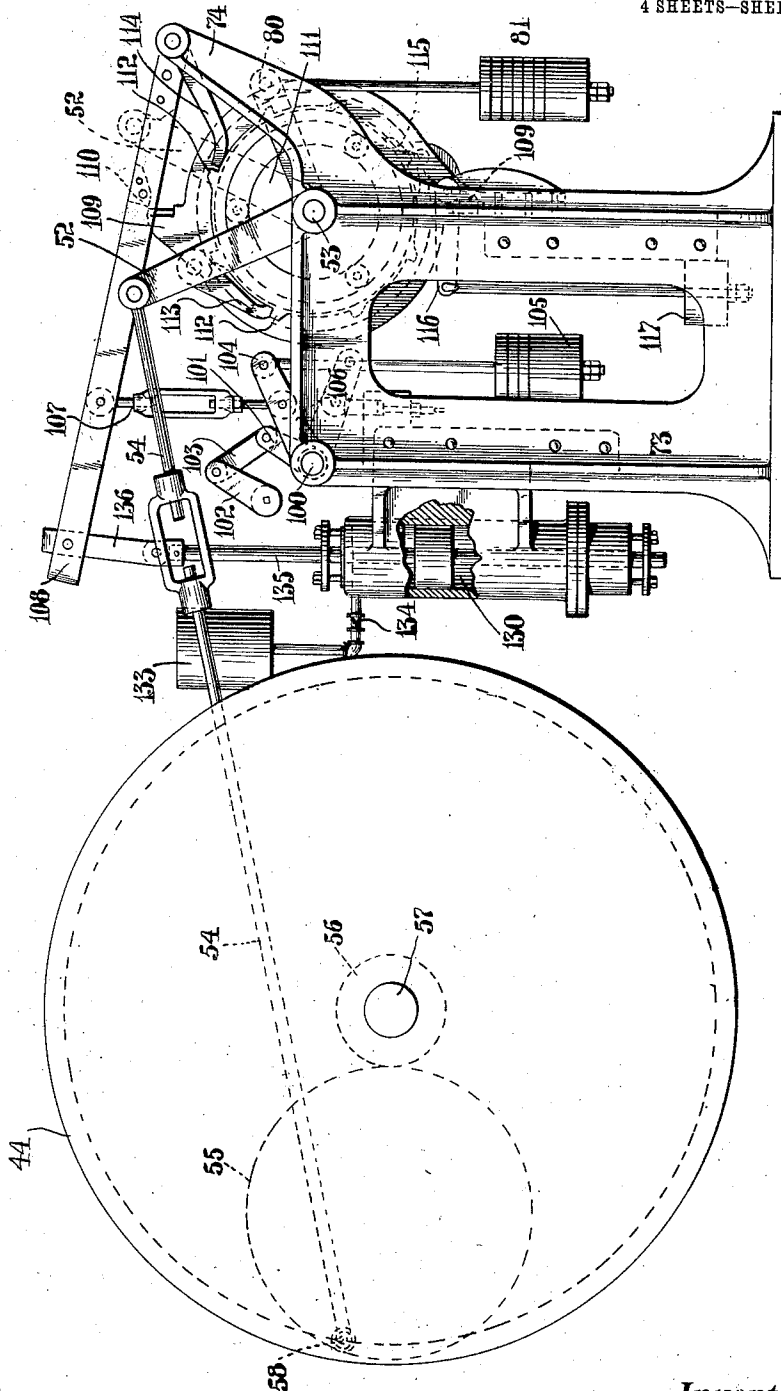
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4 SHEETS—SHEET 2.

Fig. 2.



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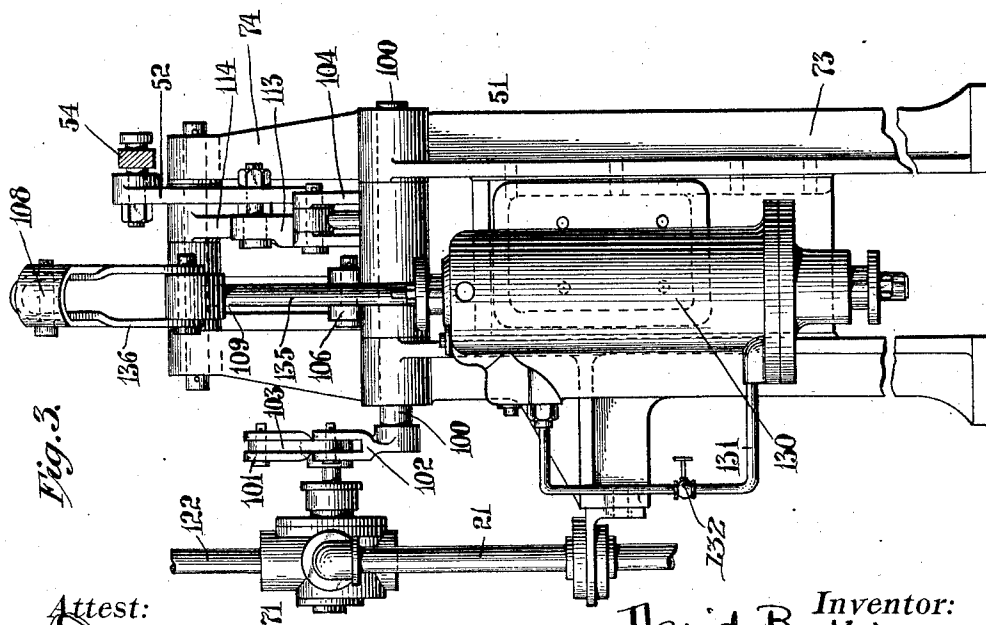
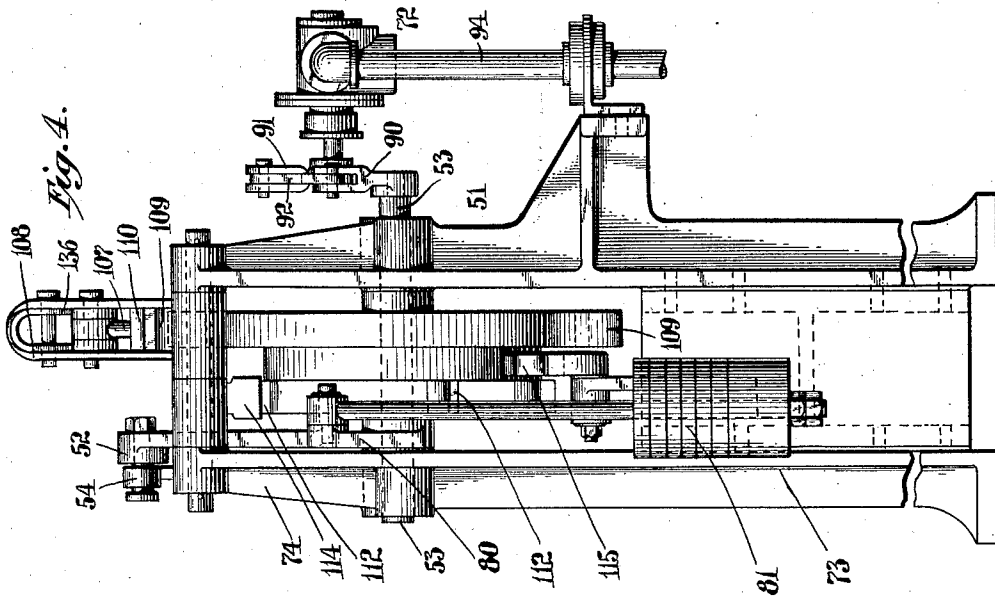
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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

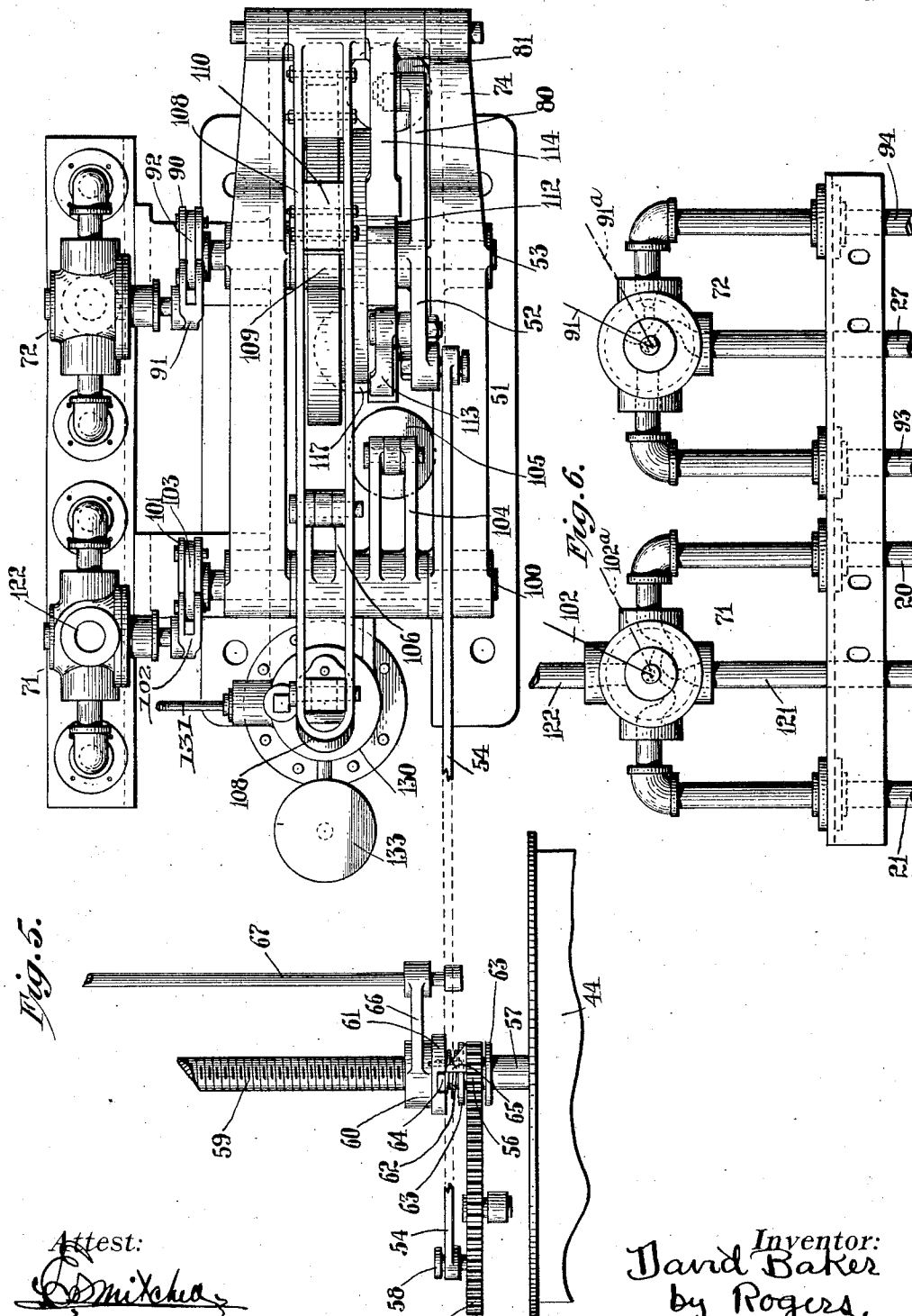


Fig. 5.

Fig. 6.

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UNITED STATES PATENT OFFICE.

DAVID BAKER, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR CHARGING FURNACES.

1,016,539.

Specification of Letters Patent.

Patented Feb. 6, 1912.

Application filed June 16, 1911. Serial No. 633,550.

To all whom it may concern:

Be it known that I, DAVID BAKER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Charging Furnaces, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to charging mechanisms for furnaces, such for example as the blast furnace employed in the smelting or extraction of metal from iron ore; and more particularly to that type of furnace charging mechanism in which a vessel or "skip" is loaded near the base of the furnace and elevated or hauled up an incline to the top of the furnace where the material is emptied so as to fall into a hopper constituting the furnace throat.

A blast furnace is a continuously operating apparatus in which as the contents sink, slag and iron being drawn from the hearth or crucible below, new material (usually coke alternated with a mixture of ore and limestone) is supplied above, there being an upward air blast (usually hot) maintained through the furnace shaft and the material therein. The mouth or upper end of such a furnace is normally maintained closed against the exit of gases, by a valve-like device termed a bell capable of being vertically shifted to admit charges of ore, flux and fuel to the interior, the gases being drawn off through a special outlet or take-off to be usefully employed in one way or another. In addition to this first or main bell a second or smaller bell is sometimes employed, it being for example in the nature of a distributing device for admitting to and distribute upon the main bell the material which has been received from the skip, the main bell being opened at an appropriate time, usually while the distributing bell is closed, to dump the charge into the furnace interior. In this class of furnace the skip in which the material is hoisted is power operated, it for example passing to and fro between the top of the furnace and a chute, by which chute the respective materials, ore, flux and fuel, are conducted from bins to the empty skip preparatory to the weighing thereof and ele-

vation to where the material may be emptied into the furnace.

An object of the present invention is to provide an effective power applying and controlling mechanism not only for actuating the skip, as by a hoisting engine, but also serving to control in the first place the operation of the main bell, and in the second place the operation of the second or smaller or distributing bell.

Other and more specific objects will appear in the following description and specification of one instance or embodiment of my invention.

The present invention consists in the novel devices, mechanisms and combinations hereinafter illustrated and described.

In the accompanying drawings, Figure 1 is a general elevation of an apparatus embodying my invention in which the furnace shaft or stack is shown only conventionally, and in which some parts are shown in section. Fig. 1^a is a detail. Fig. 2 is a front elevation of the controller or regulating machine which is diagrammatically indicated in Fig. 1. Fig. 3 is a left-hand, and Fig. 4 a right-hand, elevation of said controlling machine, while Fig. 5 is a top plan view thereof. Fig. 6 is a front view of the fluid or steam valves shown in Figs. 3, 4 and 5.

The improvements hereof while they are applicable to many species of apparatus coming within the general description hereinabove set forth, are shown in the drawings as applied to that general type or species of furnace charging mechanism illustrated and described in my prior Patent No. 909,049, patented Jan. 5, 1909, and so far as details may be omitted from the present specification they may in some cases be ascertained or provided by reference to my said prior patent.

A stack 11 is indicated as representing any desired type of stack, the upper part being shown in cross-section and the mountings of the lower part, hearth, etc., being omitted, these *per se* forming no part of the present invention. A gas take-off will be understood at an appropriate position in the upper part of the stack.

At the throat or mouth of the furnace is a charging hopper 12 and above this is a second hopper 13, each of the hoppers being

opened and closed by a valve device or bell such as the bell 14 for the hopper 12 and the bell 15 for the hopper 13. It will be understood that either hopper may be opened to
 5 dump its load by the lowering of its bell.

For raising and lowering the main or lower bell there may be employed a yoke 16^a and two rods 16 suspending the bell, said rods extending upwardly to a yoke 16^b at-
 10 tached to the inner end of a double lever 17 of the first class whose other end extends out beyond the stack where it is connected, for example through yoke 17^a and a rod 18, with the piston of a cylinder 19, operated by
 15 steam or other fluid in at least one direction and preferably in both directions through admission pipes 20 above the piston and 21 below it. The further description of the operation of the main bell will be reserved for
 20 a later point. A second or upper bell which may be termed a distributing bell may be suspended by a central rod 22 extending upwardly to where at 24 it is connected by a
 25 universal joint to a piston rod 25 that extends into a cylinder 26 which has an admission pipe 27 for steam or other fluid below the piston, gravity being relied upon for causing downward movements of the piston and upper bell. A further description of
 30 the operation of the upper bell will be given at a later point herein.

A skip or car 31 of any desired type and capacity is adapted to be run upwardly and
 35 downwardly along a guide or track-way 32 between a lower position adjacent a chute 33 convenient for filling the skip, and an upper position as indicated in dotted lines at 34 in which the contents of a skip are being
 40 dumped into the hopper 13, the dumping being effected in any convenient manner as for example by the curved rails 35 serving to lead the front wheels of the skip inwardly while the rear wheels when hoisted
 45 continue substantially in the general direction of the track-way 32.

The hoisting rope 36 for the skip car is shown as acting upon the latter near its rear so as to permit the side-tracking of the front wheels as above described, and said rope is
 50 shown as extending from the car or from a looped bail 37 (that extends on both sides and around the front of the car) to and around a sheave 38 mounted in the upper part of the framework of the apparatus,
 55 and thence downwardly around the drum of a hoist engine or motor and thence if desired to an idler or auxiliary sheave 39 whence it passes around an elevated sheave 40 conveniently located and housed as may
 60 be desired, and thence to the pulley 41 of a counterweight 42, the pulleys 40 and 41 if desired constituting a block and tackle so that a comparatively small rise and fall of counterweight 42 will suffice for the full up-
 65 ward and downward travel of the skip car.

The hoisting motor or engine 43, including the drum 44 thereof, and the controller or regulating machine 51 may for convenience be housed together in the housing 45, the latter having suitable means for the pas-
 70 sage of the hoisting and other ropes that may be employed in connection with the apparatus. Substantially any type of hoisting engine may be employed and as its details will be well understood it is only diagram-
 75 matically indicated sufficiently fully to explain the present invention and the operation thereof.

I will now describe the operative connections between the hoisting engine and the
 80 controller or regulating machine. The operating member of the latter is shown as an oscillating operating arm 52 fast upon an oscillating shaft 53. The oscillation of these parts is effected at certain times from
 85 the hoisting engine through a connecting rod or link 54 extending from the upper or swinging end of the operating arm 52 toward the rear part of the hoisting engine where its other end is connected as follows,
 90 referring to Figs. 2 and 5. In these figures there will be seen to be a large gear 55 and a small gear or pinion 56, the latter being mounted on the shaft 57 of the hoisting engine and engaging the large gear 55 so as
 95 to cause a slow rotation of the latter whenever the small gear is actuated. A pin 58 on the rear face of gear 55 connects with one end of the connecting rod 54 so that a partial revolution of the gear 55 will cause
 100 a movement of the pin 58 and a throw of the rod 54 for the purpose of oscillating the operating arm 52. The pinion 56 does not rotate continuously with the shaft 57 of the hoisting engine, but on the contrary only
 105 operates when the skip car is in certain positions. As will be described the actuation of the pinion 56 and the oscillations of the operating arm 52 take place in this embodiment of my invention when the skip car is
 110 at or near its bottom position. To this end the following clutch mechanism may conveniently be employed. An extension 59 of the hoisting engine shaft is screw threaded for a suitable distance to permit movements
 115 therealong of a traveling nut 60, it retreating away from the pinion 56 while the skip is being hoisted and said nut advancing toward the pinion 56 when the skip is descending. The parts are so timed that the travel-
 120 ing nut 60 in a brief interval before the skip has reached its bottom position, comes in contact with a sliding collar 61 which is keyed to, so as to rotate with, the shaft 57. Said collar is capable of sliding along the
 125 shaft from the position shown to a position somewhat farther removed from the pinion 56, there being a helical spring 62 under compression between the collar 61 and one
 130 of the pair of fixed collars 63, 63 between

which the pinion 56 is loosely mounted. Two lugs, 64 upon the sliding collar 61, and 65 upon the pinion 56, are shown in engagement with each other, the parts being shown in that position occupied by them when the skip is at the bottom of its trackway. Any convenient device may be employed for preventing the rotation of the nut 60, such for example as the rod 66 connected at one end to the nut and at its other end traveling for convenience along a guide 67.

It will be understood that normally while the nut 60 is traveling back and forth on the screw threaded extension 59, the lugs 64 and 65 will be out of engagement by reason of the spring 62 forcing the sliding collar 61 from the fixed collars 63 so that the shaft 57 rotates freely within the pinion 56, the latter taking no movement therefrom because loosely mounted between the collars 63. When, however, the skip has descended nearly to its bottom position, the nut 60 engages and causes the forward sliding of the collar 61 so that the lug 64 is brought into engagement with the lug 65 as shown, and thereafter the pinion 56 rotates with the shaft 57 for a few complete turns, thereby effecting a partial revolution of the gear 55, namely through an angle sufficient to cause the operating arm 52 to swing from the position shown in full lines in the figures to the dotted position indicated in Fig. 2. When the skip is again hoisted by the reversal of the shaft 57, the reverse rotations of pinion 56 and gear 55 are permitted until they have resumed their normal position and the spring 62 causes the separation of the lugs 64 and 65 so that the shaft 57 may thereafter freely rotate without actuating the pinion and gear.

The means for actuating the regulating machine for controller 51 having been described, I will now describe the details of that machine and show in what manner it effects the control of the operations of both of the bells 14 and 15 in harmony with each other and with the movements of the skip. To the rear of the mechanism shown in Fig. 2 are the valves for controlling the flow of steam or other fluid, these being seen in the end and top views of Figs. 3, 4 and 5, and shown more in detail and in front view in Fig. 6. The left-hand of these valves 71 is for controlling the main bell, and the right-hand valve 72 for controlling the upper bell. The fixed frame parts 73, 74 of the regulating machine or controller 51 need not be specifically referred to.

It has before been stated that the oscillating arm 52 constitutes the operating member of the controller, this arm being secured to a shaft 53 and the arm and shaft having an oscillating movement to the extent indicated between the full and dotted line positions of said arm in Fig. 2. The previously

described operation of the hoisting engine serves to pull the operating arm 52 to the left-hand or full line position at the proper times, and in order to insure the prompt return to the right-hand or dotted position a second arm 80 is secured to shaft 53 and a heavy counterweight 81 hung therefrom.

The oscillating shaft 53 actuates the valve 72 and while said shaft might be connected directly to the valve stem, I prefer an indirect connection comprising a forked arm 90 on the shaft 53, a similar forked arm 91 on the valve stem, and a link 92 connecting said forked arms; the details of this connection being identical with the corresponding connection for the valve 71 hereinafter to be described and more clearly seen in the front view of Fig. 2.

The valve 72 for the upper bell is of a type in which the valve arm 91, indicated diagrammatically by radial lines, has two positions. In the full line position the passages are in the positions indicated in dotted lines by which steam is admitted from the steam supply pipe 93 to the pipe 27 that leads to the bottom of the cylinder 26 before referred to, so that the piston therein is raised and the upper bell is in its raised or closed position. When the valve arm 91 is swung to the dotted position 91^a by the oscillation of operating arm 52 from left to right, the passages within the valve will change so that the steam is then cut off, and the pipe 27 leading to the upper bell operating cylinder is connected to an exhaust pipe 94, which permits the escape of steam and the dropping of the upper bell. By this arrangement it will be seen that whenever the skip comes to its bottom position and the operating arm 52 is swung from right to left, the valve 72 is caused to operate to throw steam into the cylinder 26, so as to lift and close the upper bell; and when the skip starts on its upward travel and the operating arm 52 swings back to right-hand position, the valve 72 is shifted and the cylinder 26 exhausted so that the upper bell is opened or dropped before the skip with its load has reached the top of its travel for dumping the materials into the upper hopper and upon the upper bell.

It should here be explained that the upper bell and cylinder are preferably of a type, and are intended to be represented herein as of a type, similar to what is shown in my aforesaid prior patent, and reference to Figs. 1, 4 and 9 of said patent is hereby made for further details which therefore do not need to be fully illustrated herein. Suffice it to say that the upper bell is of a type having an inclined deflecting plate 15^a which extends from the upper part of the bell toward one side of the hopper 13 so as to cause the material dumped from the skip to be diverted toward the other side in pass-

ing through the upper hopper to the main hopper so that such load will rest within the main hopper and upon the main bell at one side thereof; and the steam cylinder 26 for raising and dropping the upper bell is of a type having a piston which not only rises and falls as actuated by the steam, but which rotates for example on each upward movement and descends without rotation so that each upward and downward movement of the bell 15 causes said bell to rotate and thereby causes the deflecting plate to take a different radial position in the hopper for each successive skip load. In this way a number of skip loads dumped successively into the upper hopper and falling into the lower hopper will be evenly and regularly distributed around the latter in a manner fully explained in my said prior patent.

I will now describe how the operation of the main bell 14 is effected automatically and in harmony with the operation of the upper bell, that is to say in this instance so that each four skip loads dumped into the upper hopper and thereby distributed around the main hopper and bell, will be held and accumulated upon the main bell until all such four loads are in place when the main bell will be dropped or opened at a time while the upper bell is closed so as to admit the entire charge consisting of four skip loads into the furnace.

Strictly speaking a full charge or a round consists not only of the four or other number of skip loads of coke, but also a corresponding amount of mixed ore and limestone; but for convenience the several loads of coke are first distributed and accumulated in the main hopper and then admitted to the furnace followed by the proper number of loads of mixed ore and limestone. This part of the operation of course and the relative weights of the respective ingredients are controlled by the mechanism or the operators at the chute from which the skip car is loaded. The employment of the present invention is not restricted to any given proportions of ingredients but is directed to the automatic control of both of the bells in harmony with each other and with the skip movements, and to the construction of the controlling machine to carry out these ends.

Referring now again to Figs. 2 to 6, 100 represents an oscillating shaft which corresponds with oscillating shaft 53 to this extent that it at its rear end is provided with connections for operating the valve 71 while shaft 53 operates the valve 72 as previously described. The connection between shaft 100 and the valve stem of valve 71 may be identical with the connection between shaft 53 and valve stem of valve 72, namely a forked arm 101 mounted at the rear end of shaft 100, a similar forked arm

102 mounted on the valve stem, and a link 103 connecting said forked arms. Mounted on said shaft 100 and corresponding to arm 80 and counterweight 81, is a double arm 104 supporting a counterweight 105 tending to return said arm 104 from the full line position of Fig. 2 to the dotted line position, oscillating the shaft 100 and the valve stem of valve 71 with it. For oscillating said shaft in a reverse direction against the influence of the weight 105, is another double arm 106 seen in Fig. 2 in dotted lines behind arm 104, said arm 106 connected by an adjustable link 107 to a long lever 108 which consists of a bar bent double so as to render said lever double or two-sided. The two extremities of said lever, namely at the right-hand side of Fig. 2, are connected together and pivoted at the upper end of the frame part or extension 74 so that said lever may oscillate upwardly and downwardly around its right-hand end. From the described connections it is clear that the lifting of the lever 108 will cause the left-hand oscillation of the shaft 100 and vice versa.

In order to effect the movements of the lever 108 a movable cam 109 is employed co-operating with a lug 110 fixed on the lever 108 and located between the two sides thereof. The cam 109 may for convenience be mounted upon a rotating cam plate 111 which in turn is loosely mounted on the shaft 53 so as to rotate freely with respect thereto. As a matter of fact two cams 109 are on said cam plate so that the operations will take place twice in every complete rotation of the latter.

I prefer to rotate the cam plate 111 by a pawl and ratchet device and when the main bell is to be opened on each four operations of the upper bell there will be four pawl and ratchet movements for each of the cams 109. Thus the cam plate 111 is indicated as having eight tooth-like projections which coöperate with in the first place a pawl 113 moved to and fro by the oscillations of arm 52, and a fixed pawl 114 which prevents backward movement of the cam plate. A brake 115 bears upon one part of the periphery of the cam wheel and is constantly pressed against it through a lever 116 and weight 117 to prevent over movement from momentum or other causes.

The lever 108 is shown in its raised position, it normally being in its lowered position so that normally the arms 104 and 106 are in the dotted positions indicated in Fig. 2. Normally therefore the stem of valve 71 is oscillated to its right-hand or dotted position indicated at 102^a. In the raised position shown of the lever 108, the valve arm will be swung to the full line position 102 of Fig. 6, and the passages will be as indicated in dotted lines. Said valve 71 has a

connection 20 to the upper end of the steam cylinder 19 which operates the main bell, and connection 21 to the lower end of said cylinder 19, and exhaust pipe 121 and the steam admission pipe 122. In the normal position of the parts the steam supply will be connected with the upper end of the main bell cylinder and the lower end of the main bell cylinder will be connected to the exhaust, but in the abnormal position, the one which is shown, the steam supply is connected to the lower end of the main bell cylinder through the pipe 21, while the upper end of said cylinder is connected through the pipe 20 with the exhaust 121. Therefore in the normal position the piston in cylinder 19 is lowered and the main bell is raised or closed, while in the other position, namely when lever 108 is raised, the piston has been forced upwardly and main bell lowered to open the main hopper and discharge its contents into the furnace, this being the position in which the parts are shown.

As an auxiliary device in order to secure a quiet and easy operation of the valve 71 an oil cylinder 130 may be employed containing a piston, said piston being perforated with small holes or else the cylinder having a by-pass 131 regulated by a cock 132, there being an oil tank 133 and check valve 134 for maintaining the supply of oil in the cylinder. The piston rod 135 is shown extending upwardly to where at its upper end it is pivoted to a link 136 whose other end is pivoted to the left-hand extremity of the lever 108. In this way any violent movement of said lever is prevented and consequently the desired quiet action of valve 71 is secured.

The parts are shown in Fig. 2 in a position that they will have after four skip loads have been dumped into the upper hopper and accumulated on the lower bell, and after said lower bell has been dropped or opened by the action of cam 109 to dump the charge into the furnace, the upper bell and hopper being at this instant closed and the cam 109 and lug 110 shown as having just passed or being about to pass out of engagement to permit the dropping of the lever 108 and the resumption of the closed position of the main bell and hopper.

The operation of the above described apparatus may be as follows. With the conditions shown in the drawings the skip car is at the bottom; the main bell and hopper are open and in the act of delivering a charge to the furnace while the upper hopper and bell are closed. Starting with this the following operations will take place. (1) The cam 109 and lug 110 disengage allowing lever 108 to drop and the valve 71 to shift to normal position, thereby causing the raising and closing of the main bell. (2) The skip car loaded with coke for example, starts up-

wardly which causes the clutch parts 64, 65 to separate or open, thus releasing the pinion 56 and allowing the operating arm 52 to oscillate to the right-hand or normal position, which in turn causes the shifting of valve 72 so as to exhaust the steam from cylinder 26 and permit the upper bell to drop and thus open the upper hopper which remains open until after the skip load is dumped thereinto. (3) The loaded car reaching the top dumps its load into the upper hopper and the bell thereof being in lower position the deflecting plate 15^a directs the load toward one side of the main hopper. (4) The emptied skip car then descends to the bottom of its track-way. (5) As the car completes its descent the clutch on the hoisting engine reengages so as to actuate the gears 56, 55 and cause the operating arm 52 of the controller to swing to the left which operates the valve 72 so as to admit steam to the cylinder 26 and cause the upper bell to lift. (6) During or after this the empty skip car is being filled with a further load of the same material. (7) The skip car then starts to ascend which again causes the clutch to open, which in turn causes the upper bell to again drop to lower or open position, it, however, on this operation taking a position a quarter revolution removed from the previous position so that the deflecting plate may direct the succeeding load to a new point in the main hopper. (8) The car reaches the top and dumps its load into the upper hopper which as explained directs the load to the second point of distribution in the main hopper. (9) There will then be a repetition of operations (4), (5), (6), (7) and (8), the load this time being directed to the third point of distribution in the main hopper. (10) There will then follow another repetition of the same actions, the load this time being directed to the fourth and last point of distribution, thus supplying the main hopper with material equally on all sides. (11) Again the skip car descends to the bottom. (12) Again the clutch engages causing the lifting and closing of the upper bell. By this time the pawl and ratchet device 112, 113 cause the cam wheel 111 to come around to that point where the cam 109 engages the projection 110 to raise the lever 108 and thereby quietly admit steam to the lower end and exhaust from the upper end of cylinder 19, whereby the main bell is dropped so as to open the main hopper and dump the entire load into the furnace. This completes the cycle of operations which is followed by the lugs 109, 110 disengaging with a repetition of the entire cycle, preferably this time with a mixture of ore and limestone so as to alternate with the four skip loads of coke constituting the previous charge.

The reversals of the hoisting engine may

be caused in any desired or well known manner, for example either by hand control or automatically, in the latter case the car itself if desired serving to cause a reversal at the proper point of time.

It is manifest that the details of the construction described may be variously modified without departing from the limits of the invention, provided the mode of operation is substantially as indicated or the equivalent, and it is to be understood that the invention is not limited to any particular form or construction of parts, devices or mechanisms except in so far as specified in the claims.

What I claim is:

1. An apparatus for charging furnaces comprising in combination a bell for opening and closing the furnace mouth, a skip or car for carrying material to the furnace mouth, a motor for causing travel of the skip, and automatic means operated in harmony with the skip movements for causing operation of said bell.

2. An apparatus for charging furnaces comprising in combination a bell for opening and closing the furnace mouth, a skip or car for carrying material to the furnace mouth, a motor for causing travel of the skip, and automatic means operated by said motor for causing operation of said bell.

3. An apparatus for charging furnaces comprising in combination a lower bell for opening and closing the furnace mouth, an upper bell, a skip or car for carrying material to the furnace mouth, a motor for causing travel of the skip, and automatic means operated in harmony with the skip movements for causing operations of said upper and lower bells in harmony with each other, substantially as described.

4. An apparatus for charging furnaces comprising in combination a lower bell for opening and closing the furnace mouth, an upper bell, a skip or car for carrying material to the furnace mouth, a motor for causing travel of the skip, and automatic means operated in harmony with the skip movements for causing operations of said upper bell and for causing operation of said lower bell after a given number of operations of the upper bell.

5. An apparatus for charging furnaces comprising in combination a bell for opening and closing the furnace mouth, a skip or car for carrying loads of material to the furnace mouth, a motor for causing travel of the skip, and automatic means actuated by said motor for causing opening of said bell after a given number of skip loads have been received upon it.

6. An apparatus for charging furnaces comprising in combination a bell for opening and closing the furnace mouth, a skip or car for carrying loads of material to the

furnace mouth, a motor for causing travel of the skip, means for distributing successive skip loads around said bell, and automatic means actuated by said motor for causing opening of said bell after a given number of skip loads have been received upon it.

7. An apparatus for charging furnaces comprising in combination a lower bell for opening and closing the furnace mouth, an upper bell, a skip or car for carrying loads of material to the furnace mouth, a motor for causing travel of the skip, means for distributing successive skip loads around said lower bell, and a controller actuated in harmony with the skip movements for causing opening of said lower bell after a given number of skip loads have been received upon it and for closing said upper bell whenever said lower bell may be opened.

8. An apparatus for charging furnaces comprising in combination a normally closed lower bell, a combined upper bell and distributor device, a skip or car for carrying loads of material to the furnace mouth, a motor for causing the skip's travel, and a controller actuated in harmony with the skip movements for operating said combined device after each skip load and for opening said lower bell after a given number of skip loads.

9. An apparatus for charging furnaces comprising in combination a normally closed lower bell, a combined upper bell and distributor device, a skip or car for carrying loads of material to the furnace mouth, a motor for causing the skip's travel, and a controller actuated in harmony with the skip movements for operating said combined device after each skip load and for opening said lower bell after a given number of skip loads; said controller having in connection therewith fluid valves and pistons through which it effects its operation.

10. For an apparatus for charging furnaces a controller comprising in combination an operating part or arm, a lower bell valve, an upper bell valve, independent parts for shifting the respective valves, connections between said operating part and said upper bell valve shifting part, and connections for actuating said lower bell valve shifting part after a predetermined number of actuations of the upper bell valve.

11. For an apparatus for charging furnaces a controller comprising in combination two valves, a shifter for the first valve, a shifter for the second valve, an operating part for actuating the first valve shifter and a step by step wheel for operating the second shifter after a predetermined number of operations of the first.

12. An apparatus for charging furnaces comprising in combination a motor for causing the travel of a skip, a controller having an operating arm, and a clutch intermediate

the motor and controller for oscillating said arm at a given part of the skip's travel.

13. An apparatus for charging furnaces comprising in combination a motor for causing a skip's travel, a controller having an operating part actuated from said motor, a valve shifted by said operating part's movement, a rotary part moved intermittently by said operating part, a second valve, and means operated by said rotary part for shifting said second valve after a given number of operations of the first valve.

14. An apparatus for charging furnaces comprising in combination a motor for causing a skip's travel, a controller having an operating part actuated from said motor, a valve shifted by said operating part's movement, a rotary part moved intermittently by said operating part, a second valve, and means operated by said rotary part for shifting said second valve after a given number of operations of the first valve, a main bell having an operating cylinder controlled by said second valve, and a distributing bell having an operating cylinder controlled by said first valve.

15. An apparatus for charging furnaces comprising in combination a skip or car, a motor for causing the skip's travel, a main bell, a distributing or upper bell, and a controller, the same comprising a first valve for the upper bell, a second valve for the main bell, a first oscillating shaft for shifting the first valve, a second oscillating shaft for shifting the second valve, and connections from the motor actuating the controller.

16. An apparatus for charging furnaces comprising in combination a skip or car, a motor for causing the skip's travel, a main bell, a distributing or upper bell, and a controller, the same comprising a first valve for the upper bell, a second valve for the main

bell, a first oscillating shaft for shifting the first valve, a second oscillating shaft for shifting the second valve, a rotary cam member, a pawl and ratchet for advancing said member step by step operated from said first shaft, a cam on said member; a part or lever actuated periodically by said cam for actuating the second shaft, and connections from said motor for actuating the first shaft.

17. An apparatus for charging furnaces comprising in combination a skip or car, a motor for causing the skip's travel, a main bell, a distributing or upper bell, and a controller, the same comprising a first valve for the upper bell, a second valve for the main bell, means operated from said motor for shifting the first valve on each skip trip, a cam member advanced step by step by said first valve shifting means, and means operated periodically by said cam member for shifting said second valve.

18. An apparatus for charging furnaces comprising in combination a skip or car, a motor for causing the skip's travel, a main bell, a distributing or upper bell, and a controller, the same comprising a first valve for the upper bell, a second valve for the main bell, means operated from said motor for shifting the first valve on each skip trip, a cam member advanced step by step by said first valve shifting means, means operated periodically by said cam member for shifting said second valve, and a retarding cylinder for slowing the action of said second valve and main bell.

In testimony whereof I affix my signature in presence of two witnesses.

DAVID BAKER.

Witnesses:

LOUISE B. MORRIS,
WALTER S. MYERS.