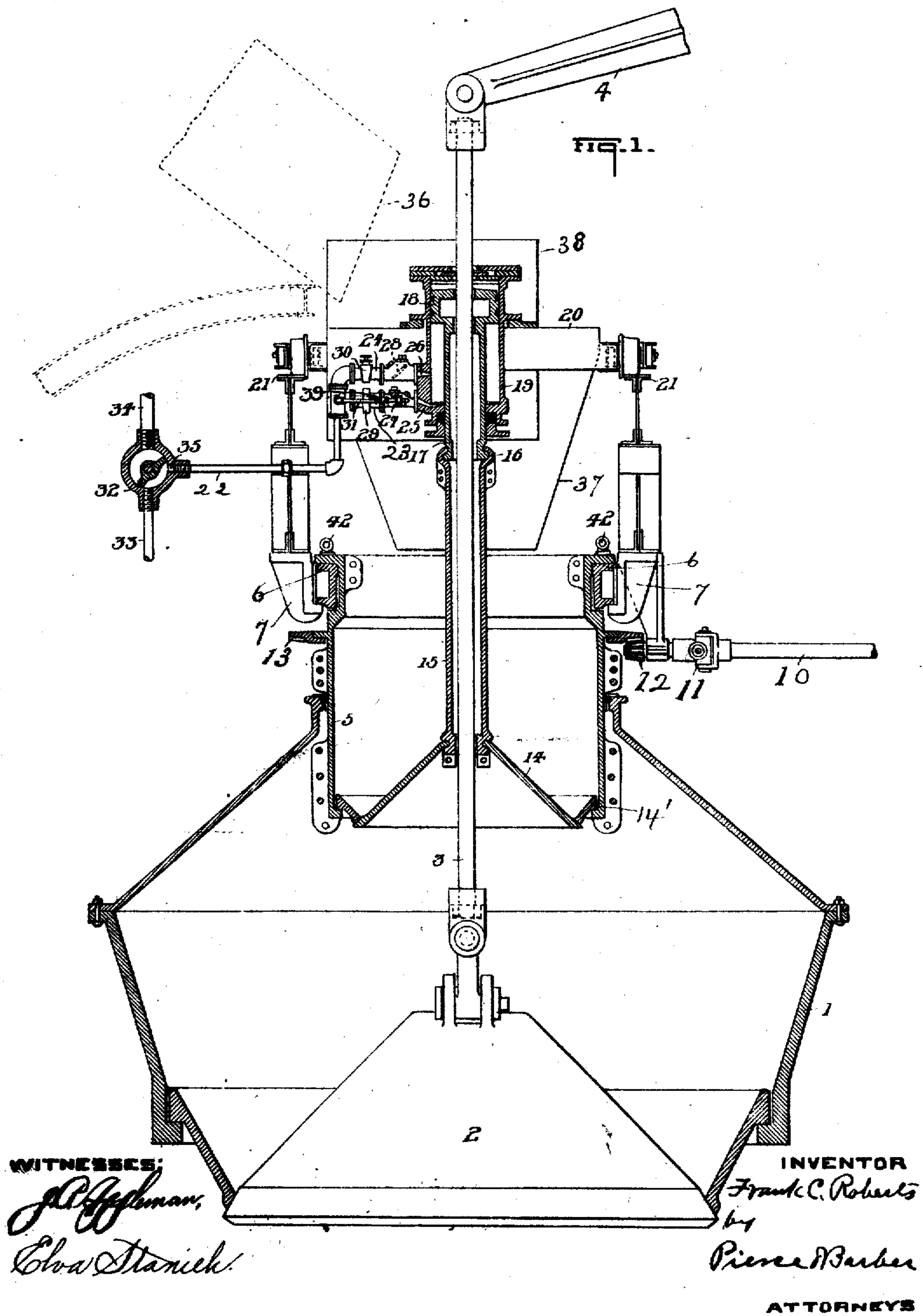


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APPLICATION FILED APR. 2, 1908.

929,631.

Patented July 27, 1909.

2 SHEETS—SHEET 1

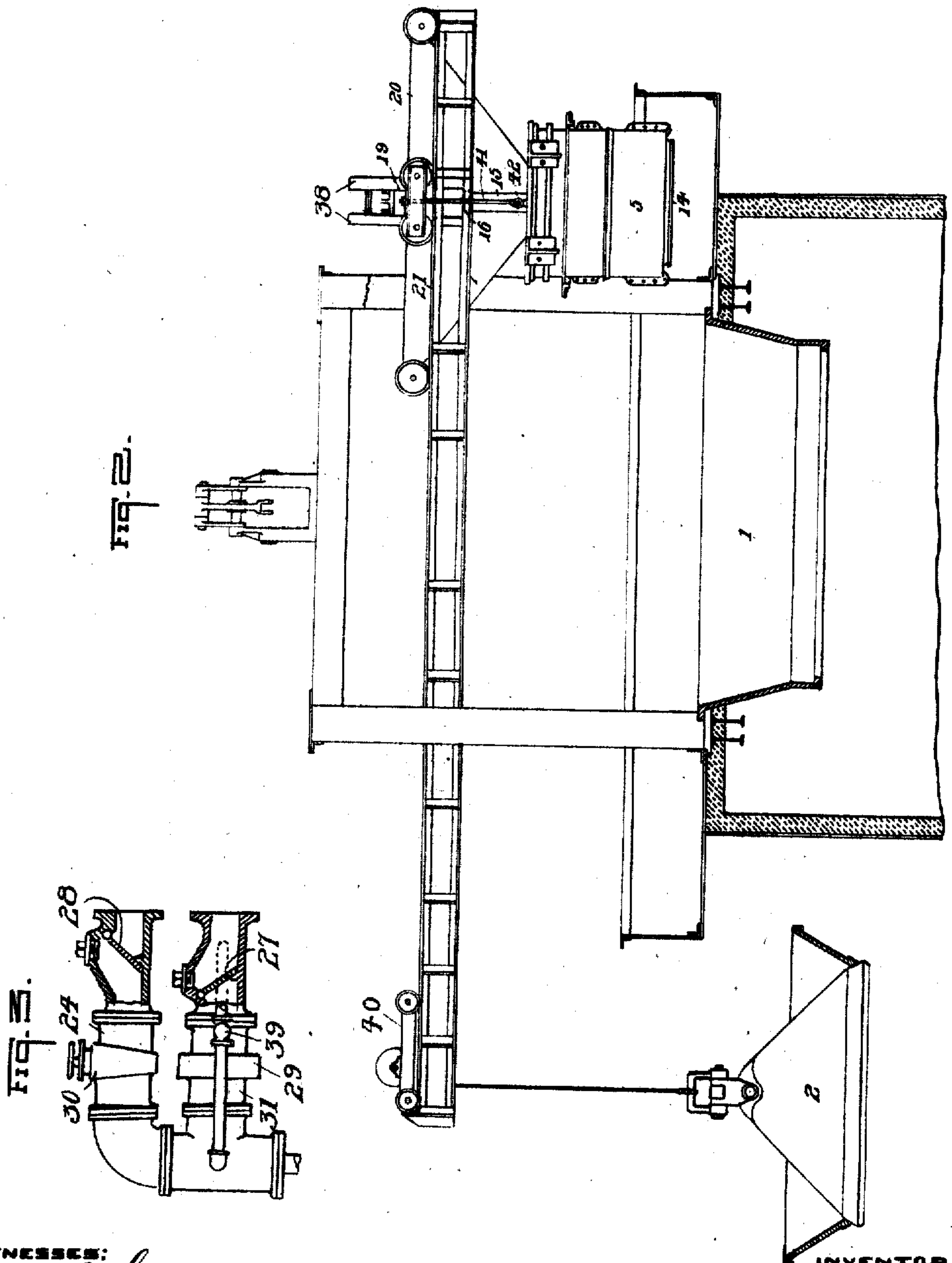


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WITNESSES:
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UNITED STATES PATENT OFFICE.

RANK C. ROBERTS, OF PHILADELPHIA, PENNSYLVANIA

BLAST-FURNACE-CHARGING APPARATUS.

No. 929,631.

Specification of Letters Patent.

Patented July 27, 1909.

Application filed April 2, 1906. Serial No. 309,245.

To all whom it may concern:

Be it known that I, FRANK C. ROBERTS, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented or discovered new and useful Improvements in Blast-Furnace-Charging Apparatus, of which the following is a specification.

My invention relates to apparatus for charging blast-furnaces, and more particularly to those which have a rotatable supplemental hopper.

It is one of the objects of my invention to provide a novel means for supporting and operating the bell or equivalent discharging device for said hopper.

It is a further object thereof to provide for the removal of said hopper from over the furnace-top in order to permit repairs, as, for example, the renewal of the bell or other parts of the main hopper.

Other objects thereof will appear hereinafter.

Referring to the drawings, Figure 1 is a central vertical section, showing my invention; Fig. 2, an elevation partly in section showing the supplemental hopper moved on its truck from over the furnace and a second truck for lifting and moving the main bell and its supporting ring; and Fig. 3, an enlarged view, partly in section showing the branch pipes 23 and 24 with their valves.

On the drawings, 1 represents the main hopper of a blast-furnace top and 2, the bell therefor, which is suspended from the rod 3 pivoted to the lever 4, operated in any desired manner.

5 is the supplemental hopper, which is shown supported directly on the circular casting 6 carried by the brackets 7 secured to the structural work on top of the furnace, but the hopper 5 may be supported on wheels or in any other desired manner. Preferably the casting 6 is seated in a circular recess in the hopper 5 so that the latter can neither rise nor fall independently of the casting. The hopper 5 is revolved by any suitable motor, acting through the shaft 10 having the universal joints 11 (one only shown), the pinion 12, and the circular rack 13 secured to the said hopper, but other means may be used for rotating the hopper.

The bell 14 of the hopper 5 is supported by the hollow rod 15, attached by the wobble joint 16 to the hollow piston rod 17 provided with the hollow piston 18, working

in the steam cylinder 19, the rod 15 being an extension of the piston rod. This cylinder is supported on the truck 20, having travel on the rails 21, so that the supplemental hopper when connected to the truck by the rods 41 (only one shown) and the eyes 42, may be moved to one side as shown on Fig. 2, for the insertion and removal of the main bell 2 or for other purposes. The rod 3 extends up through the rod 15, the piston rod 17, the piston 18, and the upper cylinder head of the cylinder 19.

Steam is supplied to the cylinder 19 by the pipe 22, which has the branches 23 and 24 leading respectively to the inlet port 25 and the exhaust port 26, both opening into the cylinder below the piston 18. The inlet branch contains the check-valve 27 opening toward the cylinder and the exhaust branch a check-valve opening away from the cylinder. The inlet branch is provided with the cock 29 and the exhaust branch, with the cock 30, to regulate the amount of steam passing through the branch pipes. A bypass 31, containing a regulating valve 39, is provided around the check-valve 27. The steam is admitted to and exhausted from the pipe 22 by the 3-way valve 32, whose casing is provided with the inlet pipe 33, the exhaust pipe 34, and the port 35 connected to the pipe 22.

36 represents the skip cars which deliver their charges into the adjustable chutes 37, one on each side of the cylinder 19, the latter being protected from the ore, etc., as they are discharged from the skip-cars by the vertical plates 38, secured to the sides thereof. The parts being as in Fig. 1, the ore, etc. from the skip-cars are dumped upon the chutes, down which they run into the supplemental hopper 5, the weight being sustained by the steam below the piston 18.

The steam passes into the cylinder through the pipes 33 and 22, the branch pipe 23, and the inlet port 25, the check-valve 27 permitting the steam to pass freely. When it is desired to lower the bell 14, the valve 32 is turned so as to connect the pipes 22 and 34. The steam beneath the cylinder escapes by way of the exhaust port 26, the branch pipe 24, the pipe 22, and the exhaust pipe 34, the check-valve 28 permitting the steam to pass freely. As the steam exhausts, the piston and its load drop, the load escaping into the main hopper through the space between the hopper 5 and its lowered bell 14. When the

piston passes the port 26, the steam below it forms a cushion, the check-valve 27 preventing the escape of the steam. The piston is, however, permitted to continue its descent at diminished speed by reason of the by-pass 31 having therein the regulator-valve 39. Owing to the by-pass the piston settles quietly to the bottom of the cylinder. As soon as the supplemental hopper has been discharged, the valve 32 is moved to supply steam again to the cylinder to cause the bell 14 to rise and close the bottom of the hopper 5. After this hopper has been again filled, it is rotated ninety degrees, for example, and discharged as before. The hopper is again filled and rotated one hundred and eighty degrees, for example, and then discharged and so on, in order to provide a uniform distribution of the fine and coarse material in the main hopper and the furnace.

If preferred the hopper 5 may be rotated continually during use, or several charges may be dumped at any quadrant or other point before the rotation of the supplemental hopper to another quadrant or other position.

In revolving the supplemental hopper 5 the piston, the piston rod 17, the piston 18, and the bell 14 all revolve with it, the weight of all with a large portion of the load in the hopper being supported by the steam in the cylinder, thus reducing the friction to a minimum. The wobble joint may be changed to a ball race or roller bearing, so that the piston and piston rod would not revolve with the supplemental hopper.

In case the steam power is sufficient, it is evident that all the weight of the supplemental hopper and its contents may be taken from the casting 6, and may even cause the lower shoulder of the circular slot in the hopper to bear up against the under side of the ring, but the principles of my invention would be present even if the steam power were sufficient only to keep the bell 14 up against the hopper 5 without any lifting effect on the hopper. Inasmuch as the contents of the hopper 5 rest on the bell and the usual lip-ring 14', it is clear that, when the piston raises the bell and lip-ring, it will also raise the contents of the hopper, and will lift or partially support the weight of the hopper 5, owing to the friction between the wall of the hopper and the said contents, which being ore have a great specific gravity. It will be seen, therefore, that I have provided means whereby the friction of the rotating parts may be very largely removed.

I have shown a carriage 40, by which the main bell and hopper-ring may be lifted and carried to or from their normal places in the furnace-top, the truck 20 being for the time moved to one side with the supplemental hopper depending therefrom, as shown in Fig. 2, without dismantling the furnace.

I do not limit myself to the precise details shown and described, but desire to include within the scope of my claims all apparatus which involves fair equivalents thereof.

I claim--

1. In a blast-furnace charging apparatus, a rotatable hopper, a closure therefor, and a fluid pressure cylinder centrally located above the closure which is suspended over the piston in the cylinder to support the closure and the whole or a portion of the weight of the hopper together with the whole or a portion of the weight of its contents.

2. In a blast-furnace charging apparatus, a rotatable hopper, a closure therefor, a fluid pressure cylinder centrally located above the closure which is suspended over the piston in the cylinder to operate said closure and to support the weight of the closure and such portion of the weight of the load as is borne thereby.

3. In a blast-furnace charging apparatus, a rotatable hopper, a closure therefor, a fluid pressure cylinder centrally located above the closure which is suspended over the piston in the cylinder to support and operate the closure and to reduce or remove the friction of the rotating hopper.

4. In a blast-furnace charging apparatus, a main hopper, a closure therefor, an operating rod for said closure, a supplemental hopper, a closure therefor, a piston and a piston rod secured to the closure for the latter hopper, the piston and piston rod in closing the said operating rod.

5. In a blast-furnace charging apparatus, a hopper, a bottom closure therefor, a fluid pressure cylinder, having an inlet and an exhaust port, a motor piston therein connected to said closure to raise and lower the latter, and means including said piston for forming a cushion for the piston as it approaches the bottom of the cylinder.

6. In a blast-furnace charging apparatus, a hopper, a bottom closure therefor, a piston connected thereto to sustain the weight thereof and the load thereon and to raise and lower the closure, a fluid pressure cylinder to contain said piston, a fluid pressure pipe, exhaust and inlet branch pipes connected to said pipe and said cylinder, and a check-valve in the inlet-pipe to prevent the escape of the fluid therethrough as the piston descends, the exhaust pipe being cut off by the piston so as to leave a cushion between the piston and the inlet-pipe.

7. In a blast-furnace charging apparatus, a hopper, a bottom closure therefor, a piston connected thereto to sustain the weight thereof and the load thereon and to raise and lower the closure, a fluid pressure cylinder to contain said piston, a pipe, exhaust and inlet branch pipes connected to said pipe and said cylinder, a check-valve in the inlet-

pipe to prevent the escape of motor fluid therethrough as the piston descends, and a by-pass around the check-valve, the exhaust pipe being cut off by the piston so as to leave a cushion between the piston and the inlet-pipe.

8. The combination with a blast-furnace, of main and supplemental hoppers, a bottom closure for each hopper, a hollow piston, a hollow piston-rod therefor secured to the closure of the supplemental hopper, a rod in the hollow piston rod and connected to the closure of the main hopper to operate said closure, a cylinder for said piston, and a truck for said cylinder, whereby the supplemental hopper may be moved from above the furnace.

9. The combination with a blast-furnace,

of main and supplemental hoppers, a bottom closure for each hopper, a hollow piston, a hollow piston-rod therefor secured to the closure of the supplemental hopper, a rod in the hollow piston rod and connected to the closure of the main hopper to operate said closure, a cylinder for said piston, a truck for said cylinder, whereby the supplemental hopper may be moved from above the furnace, and a second truck to support and carry the main closure or other part.

Signed at Philadelphia, Pa., this 24th day of March A. D., 1906.

FRANK C. ROBERTS.

Witnesses:

RANDOLPH H. MILLER,
L. KRYDER LACHMAN.