

Jan. 10, 1928.

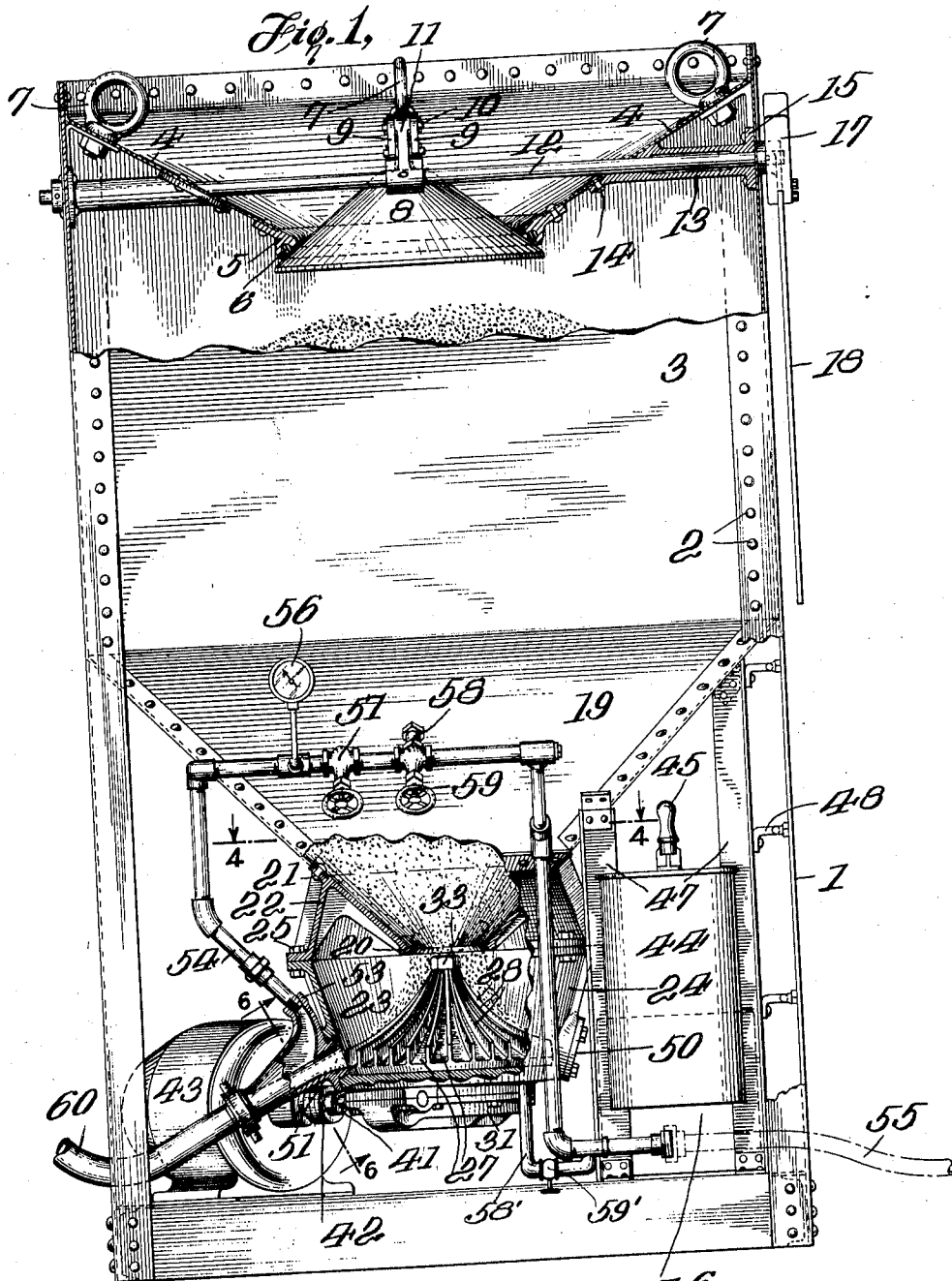
1,655,558

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APPARATUS FOR LINING OPEN HEARTH FURNACES

Filed Feb. 2, 1922

3 Sheets-Sheet 1



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APPARATUS FOR LINING OPEN HEARTH FURNACES

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3 Sheets-Sheet 2

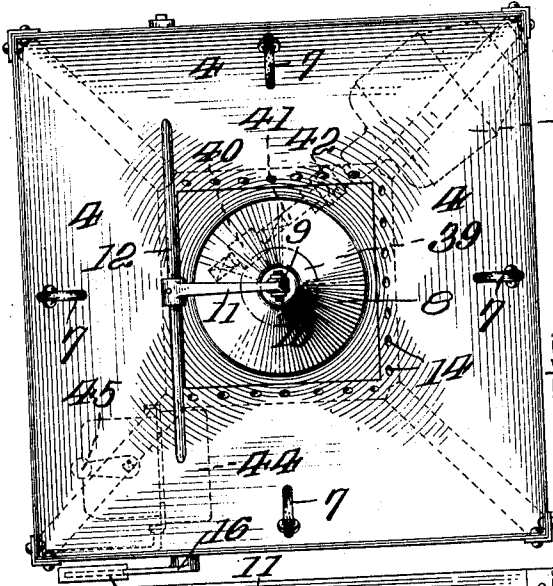


Fig. 3,

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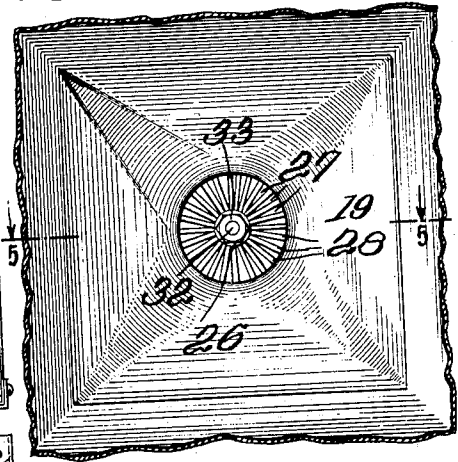


Fig. 4,

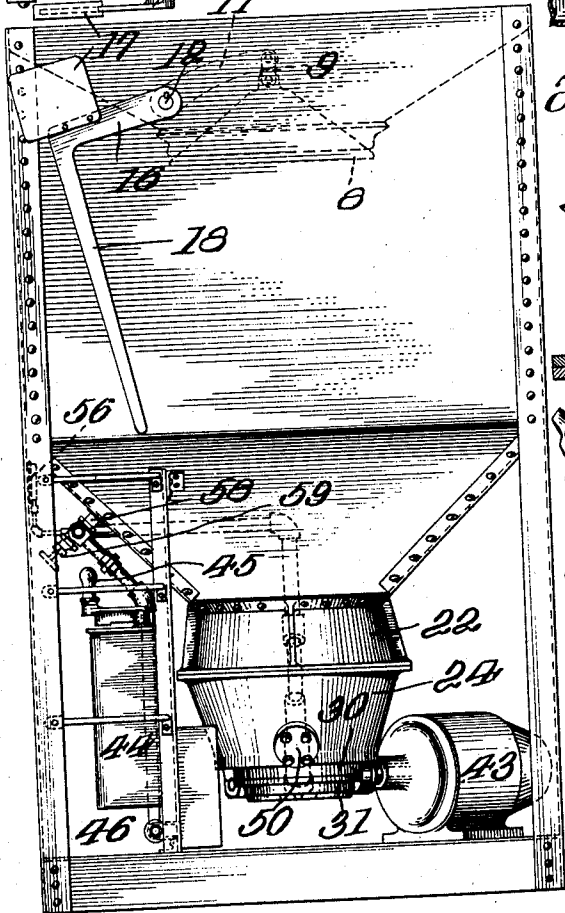


Fig. 2,

Fig. 5,

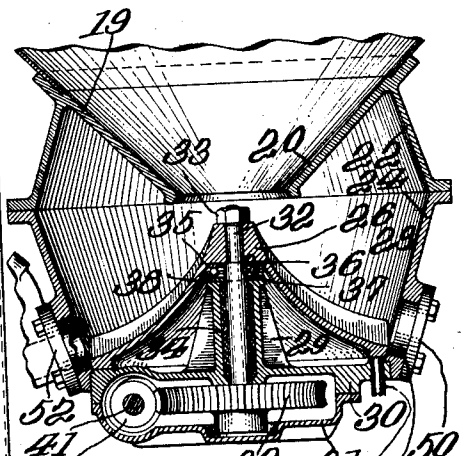


Fig. 6,

Fig. 6,

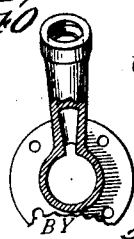


Fig. 6,

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3 Sheets-Sheet 3

Fig. 7.

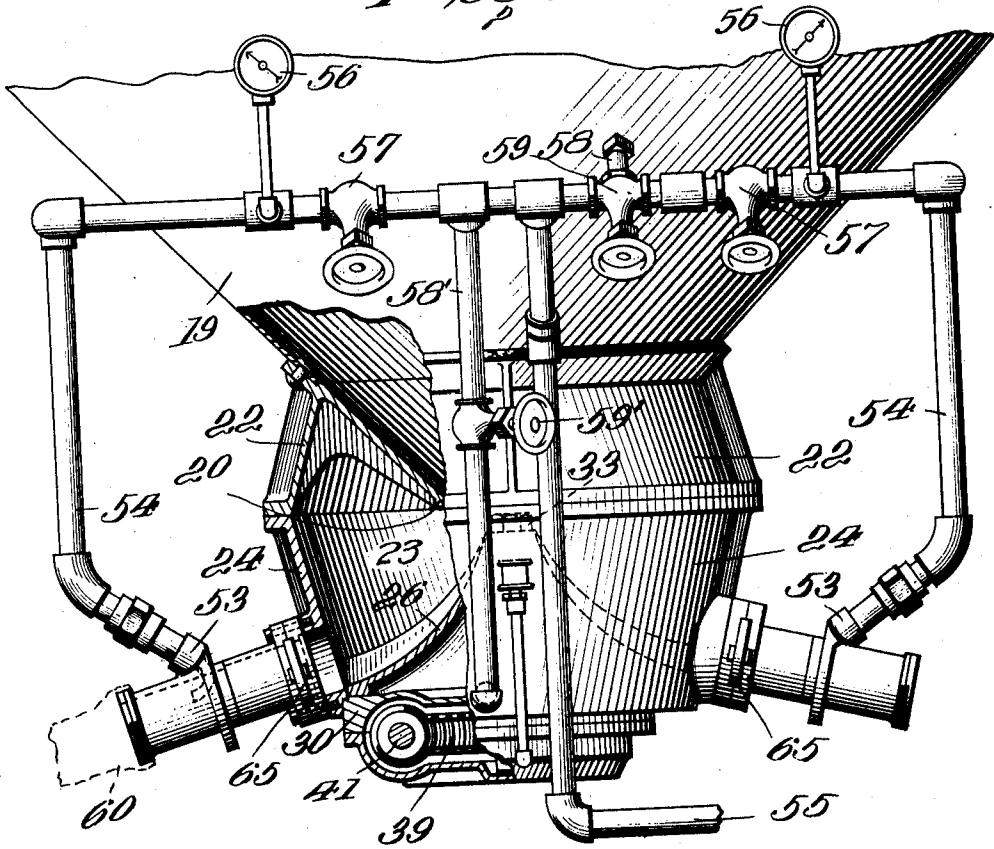
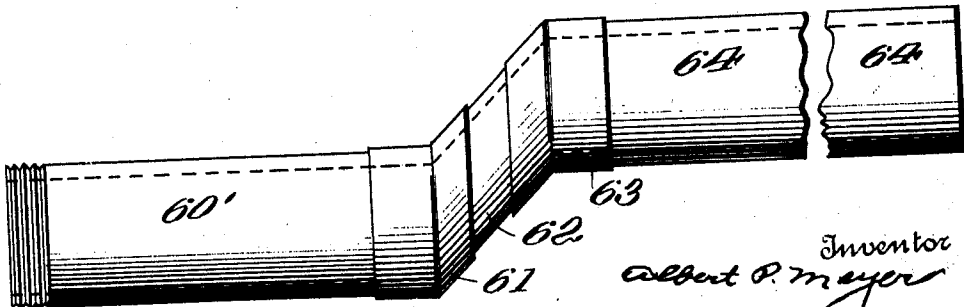


Fig. 8.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR LINING OPEN-HEARTH FURNACES.

Application filed February 2, 1922. Serial No. 533,732.

This invention relates to apparatus for lining open hearth furnaces; and it comprises a certain combination of apparatus elements arranged to convey granular material in a conduit or the like at a low velocity by means of fluid under pressure, whereby the granular material may be delivered to the walls of the furnace under control and without substantial rebound; all as more fully hereinafter set forth and as claimed.

The invention is particularly useful in delivering granular material for lining and repairing furnaces such as basic open hearth furnaces and the like and in such use it is the object to secure a deposition of the material in the furnace rather than a violent projection, or projectile action. To this end the air and column of material are kept moving through the conduit at a rather low velocity, a velocity insufficient to cause a violent projection of the material. The column is formed by material projected into the moving air current at a rather high velocity. This gives the solid material a start, so to speak, and it can be kept moving by an air current which would be too gentle to start it from a position of rest or overcome its inertia. The means for delivering the solid material to the conduit operates so that the feed of material delivered to the conduit is uniform; the solids are so distributed through the moving air that a continuous uniform deposition of solids can be attained without the irregularity inevitable where the solids travel, for instance, as a series of spaced plugs. The mixture in the delivery tube or conduit may be considered as like an emulsion; it is a coarse-grained, uniform aerial suspension. In effect I establish and maintain a current of air or other fluid under pressure through a tubular conduit which best should have an unobstructed nozzle and I transmit the granules into the conduit and into the air current advantageously at a greater rate of speed than the speed of travel of the material at the exit end of the conduit. In effect I am compounding the energy of granules and air that are in the conduit, until at the exit end, the air merely suffices to keep the granules moving and permits the mixture to expand at and beyond the nozzle outlet where the air velocity is no longer sufficient to keep the granules moving and whereby the granules simply drop. In this way the conduit or the nozzle end of it may be moved from place to place and the lining of the open hearth formed in situ or parts of the lining may be patched as the exigencies of any particular case demand. The granular material is delivered as a steady flowing stream.

The provision of a simple and efficient machine for delivering granular material has long been a desideratum in the art to which this invention relates. Attempts have been made to provide machines for mixing and delivering materials, such as cement and the like, but these machines have usually been complicated in construction and operation and are subject to several disadvantages. One main disadvantage of these types of machines is the tendency for them to become clogged and the difficulty of uniform feeding. This is due, primarily, to what may be termed the distributing means between the source of supply and the nozzle, such distributing means usually consisting of a perforated or pocketed wheel through which the material is forced by air before it reaches the nozzle. Particularly with granular material, the wheel becomes clogged.

Among other objects of my invention is the elimination of the disadvantages referred to and the provision of a simple, compact and easily operated machine for delivering powdered or granular material and the provision of a machine in which, when desired, relatively low pressure may be used to convey material to a distant point so that the material may be put in place, rather than "shot" in place.

In the accompanying drawings, I have shown one form of apparatus within my invention.

Fig. 1 is a front elevation, partly in section, of the complete machine;

Fig. 2 is a side elevation on a somewhat smaller scale;

Fig. 3 is a top plan view of Fig. 2;

Fig. 4 is a horizontal section along the line 4-4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is a vertical section along line 5-5 of Fig. 4;

Fig. 6 is a section along line 6-6 of Fig. 1 looking in the direction of the arrows;

Fig. 7 is a view partly in section showing a modification including an air inlet at a

point immediately below the distributor and showing the details of the sliding valves; and

Fig. 8 is a detailed elevation of one form of nozzle which may be used.

Referring to the drawings in the several views of which similar reference numerals designate corresponding parts, 1 indicates the standard or frame of the machine which is preferably of angle iron construction. Attached to the upper part of this frame by means of rivets 2 or otherwise, is the main receptacle 3 shown as rectangular, but when high pressures are used it is best circular in cross section. The downwardly slanting roof 4 of this receptacle is provided with a central opening. Around this opening is riveted the bearing ring 5 carrying the gasket or packing 6. The roof is further provided with a plurality of rings or eyes 7 for engagement of hooks or the like by means of which the machine may be moved from place to place. The slanting roof in effect constitutes a small hopper or funnel by means of which the material may be delivered into the main receptacle 3. Normally and in use, the opening is closed and sealed by means of the bell 8 which is suspended by means of the pivoted arms 9 connected to the shaft 10, on which is mounted the link 11. This link is keyed to the shaft 12 which passes through journals 13 riveted at one end 14 to the roof and at the other end 15 to the walls of the receptacle. To the shaft there is also keyed at one end the lever arm 16 having the weight 17 and handle 18. This construction permits lowering the bell through outward movement of the handle 18 and the automatic closing of the bell and sealing of the receptacle through the weight 17.

The lower part of the main receptacle is provided with the tapering bottom 19 which may be riveted or bolted in place and which is open at its end 20. This serves to form a restricted opening and sustain the weight of the material in the receptacle 3. Attached to the receptacle 3 by means of the rivets or bolts 21 is the upper half 22 of a subreceptacle or chamber 23, the lower half 24 being bolted in position by bolts 25. This chamber I term the rotor chamber.

Mounted in the rotor chamber is the rotor 26 consisting of a substantially conical body provided with a plurality of passages, pockets or channels 27, preferably deeper at the base than at the top. The surface of the conical body may be slightly curved inwardly. The passages or channels 27 may be formed by means of a plurality of blades 28, curved to correspond to the face of the rotor. These permit guiding the material to the wall of the rotor chamber. The rotor is advantageously supported in position on the upper part of the sleeve 29, which is at-

tached to part 30 of an oil casing. The other part 31 of the casing may be secured in position by means of rivets or the like. The rotor is keyed to a shaft 32 and held in position by means of the nut 33. Such shaft passes through the sleeve 29 provided with packing 34. Resting on the upper part of the sleeve is a thrust collar 35 having the ball bearings 36, the upper plate 37 rotating with the rotor and the lower plate 38 remaining stationary on the sleeve. The lower end of the shaft carries the gear 39 meshing with the worm 40 on the shaft 41 connected to the flexible connection 42 leading to a motor 43. The motor may be controlled from the controller box 44 (electrical connections not being shown) and the controller handle 45. The controller box is mounted in cage 46 in which the operator may stand and is carried by the irons 47 suitably supported and braced by the spacers 48.

The lower portion of the chamber 23 is provided with two openings 49 to which the injector nozzle may be attached. When not in use, they may be covered by plates 50. The injector nozzle comprises the nozzle head 51 having a flange 52 by means of which it is secured around the opening 49. Branch 53 is connected to the nozzle at a point outside the chamber and is in communication with a source of fluid (advantageously, air under pressure). Pipe 54 leads by means of a flexible connection 55 to a compressor or the like. This pipe or line 54 is provided with the pressure gage 56 and valve 57 for the purpose of observing and controlling the pressure to the nozzle. The line 54 is further provided with the inlet line 58 leading into the receptacle 3 and with line 58' leading to the rotor chamber 24 in order that the pressure therein may be balanced against the pressure in the nozzle and to prevent any back pressure into the chamber 23. As shown in Fig. 7 it may be provided with valved line 58' leading to a point where the rotor rotates above the top of the oil casing 30. This construction is useful for carrying away particles of material tending to deposit at such a point. This construction may also be used to balance the pressure in the receptacle and the line 58' may be used as auxiliary to or in the place of line 58. The pressure in the receptacle also assists in the feeding of the material downwardly. Valve 59 serves for controlling pressure in the receptacle 3 and valve 59' for controlling pressure above the oil casing 30. This receptacle is air tight.

The operation of the machine is as follows: Assuming basic open hearth furnaces to be lined with a granular refractory lining—a material particularly well handled by the present device—the receptacle 3 is loaded with the material through the lowering of

the bell 8 and the machine is conveyed in proximity to the furnace. Usually I swing the machine on a flat car or the like running on tracks near the furnace. The operator then opens the valves 57, 59 and 59' and starts the compressor or establishes communication between the compressor and the line 55, whereupon the air passes into the receptacle 3 and through the line 54 to the injector nozzle 53. The motor 43 is immediately started through the controller handle 45 and operated to revolve the rotor, or distributor 26. The restricted opening 20 permits free feeding of the material on to the rotor 26 while, at the same time, sustaining the weight of the material in the receptacle 3. The granular material flows upon the rotor into the channels or passages and descends, partly by gravity and partly through the centrifugal force of the rotor. Since the speed of the rotor can be controlled through the motor, the force of delivery may be regulated. The granular material is discharged with any desired force through the opening in the chamber 23 into the nozzle head where it is met outside the chamber 23 by the air, under pressure from the branch 53 flowing in the same general direction as that in which the material is projected. The distributor or rotor therefore takes the material from a state of comparative rest and delivers it into the nozzle head 51, overcoming the inertia of the material. In fact the material is moving at considerable velocity in the conduit before it is picked up and carried forward by the fluid under pressure. The hose 60 conveys the material to the point of application which, in the instance mentioned, may be the interior of a basic open hearth furnace. Since the speed or amount of material delivered to the hose may be controlled and since the pressure of the air through the line 54 may be controlled the granular material may be deposited in place at any rate and in any quantity desired, and furthermore with any degree of force. The construction of the rotor permits steady delivery of the material in a regular way. There are no pockets or holes through which the material must be forced and the distributor or rotor does not revolve between the source of compressed air and the nozzle thus giving it an intermittent feed which is the objection to some types of the machine.

I may employ special means as the conduit 60' shown in Fig. 8 for controlling the force of delivery of the material.

In Fig. 8 I have shown more or less diagrammatically a side elevation of the nozzle which may be used. Section 60' is attached to the section 60 of Fig. 1 and any length of section may be used. At the extremity of the section 60' of this nozzle I attach L 61 which is advantageously a 45 degree L and

I then insert the nipple 62 which may be one inch long. Next I attach the L 63 which may be a 45 degree L and which is best oppositely disposed with respect to the L 61. At the end of L 63 I may attach one or more sections 64 constituting the delivery end of the nozzle. This construction permits me to slow down the velocity of the material in the conduit by the provision of the L's 61 and 63. The material going through conduit 60 and 60' may be at a greater force than desired. It is slowed down by having to make the turn in the L 61 and is further slowed down by having to make the turn in the L 63.

It is particularly advantageous to use a special delivery end for the nozzle; this end should not be restricted, but should be of the same interior cross section throughout its length whether curved or straight, since a tapered interior would cause choking of the line and a flared interior would cause spraying of the material. The delivery mouth should be of the same cross section interior as the delivery end of the hose.

Two or more conduits may be operated at the same time or only one may be used, through provision of the gate valves shown in Fig. 7. These may be slide valves 65 both of which may be open or one of which can be closed or opened depending upon which one of the conduits is to be used.

What I claim is:—

1. A machine for delivering granular or powdered material comprising a sealed receptacle for the material, means for storing a fluid under pressure therein, a rotor under said receptacle and provided with a plurality of radial channels open at the periphery of the rotor, means for supplying material from the receptacle to the channels, an encircling wall preventing centrifugal discharge of the material from the channels except at one point which is open, a conduit in communication with the channels at the said point through the opening and means for delivering a current of fluid under pressure into said conduit to convey the material to a distant point.

2. A machine for delivering granular or powdered material, comprising an open bottom sealed receptacle, means for storing fluid under pressure therein, a rotor arranged under the receptacle and adapted to receive the material discharged therefrom and to convey it laterally, a conduit arranged to receive the material as it is discharged from the rotor, and means connected to the conduit for supplying some fluid under pressure to convey the material along said conduit to a distant point.

3. A machine for delivering granular or powdered material, comprising a main receptacle having an open bottom, a chamber under the main receptacle, a conduit con-

- nected to the chamber, means connected to the conduit for supplying fluid under pressure, and a conical rotor having its apex in proximity to the opening of the main receptacle and its base in proximity to the point of connection of the conduit, whereby the material delivered on the rotor is projected into the conduit and propelled therein by the fluid under pressure.
- 10 4. A machine for delivering granular or powdered material, comprising a sealed receptacle for the material, means for storing fluid under pressure therein, means for supplying the material to a rotor, a rotor revoluble on a vertical axis and arranged to receive the material and deliver it radially, a chamber in which the rotor operates, means in connection with the chamber at a point in the wall thereof in proximity to the periphery of the rotor to receive the material as delivered by the rotor, and means connected outside the chamber with the last named means for supplying fluid under pressure to convey the material to a distant point.
- 20 5. A machine for delivering granular or solid material, comprising a chamber, means for supplying material thereto, a substantially conical rotary receiver acting as a distributor located in the chamber, and having a base occupying substantially the entire bottom of the chamber, means on the receiver for conducting the material from its apex to its base, and to confine such material while acquiring rotary movement, a conduit in communication with the chamber and arranged to receive material centrifugally projected from the base of the receiver, and means for supplying fluid under pressure to the conduit for receiving and continuing the motion of the projected material and conveying it to a distant point.
- 30 6. A machine for delivering granular or powdered material, comprising a main sealed receptacle adapted to store fluid under pressure open at the bottom, but sealed by contained material, an orificed chamber beneath the main receptacle, a rotary distributor in the said chamber, said distributor provided with channels arranged to receive material falling through the opening of the main receptacle, means for rotating said distributor, means in communication through the orifice with the said chamber for receiving the material from the distributor, and means in said last named means for admission of fluid under pressure to propel the material and convey it to a distant point.
- 40 7. A machine for delivering granular or powdered material, comprising a sealed receptacle containing fluid under pressure for such material, means for supplying the material to a rotor, a substantially conical shaped rotor provided with a plurality of substantially radial channels arranged to receive the material and means for operating the rotor, means connected to the receptacle at the periphery of the rotor for receiving the material as it is discharged therefrom, and fluid pressure supply means connected to the last named means, whereby the material may be conveyed to a distant point.
- 50 8. In a machine for delivering granular or powdered material for the relining of furnaces, means forming a source of supply of the material and means therebeneath forming a delivering conduit for the material, combined with a vertically mounted rotor located between the two said means for conveying the material from the source to the delivering conduit, said rotor comprising a substantially conical shaped body portion, the face of which is provided with a plurality of radial channels, a shaft carrying the rotor and means for revolving the shaft.
- 60 9. In a machine for delivering or conveying granular or powdered material, a chamber, a distributor in the chamber, said distributor comprising a substantially conical shaped hollow member with its base in proximity to the bottom of the chamber, a sleeve extending from the bottom of the chamber inside said conical member, a bearing member on top of said sleeve and supporting the said conical member, a shaft in the sleeve to which the conical member is secured, an oil chamber below the first said chamber, into which said shaft extends, and driving means in said chamber connected to said shaft for rotating said distributor.
- 70 10. In a machine for delivering or conveying granular or powdered material, a chamber provided with an upwardly extending sleeve, an oil chamber beneath said first chamber carrying driving mechanism for a shaft, a shaft connected to said driving mechanism and extending upwardly through said sleeve, a distributor carried by said shaft at a point beyond said sleeve, said distributor being hollow and conical in shape and surrounding the said shaft and said sleeve.
- 80 11. The combination with a vertical receptacle for storing granular furnace lining material to be delivered to a distant point, of a rotor therebeneath and in communication therewith, said rotor comprising a substantially conical shaped member having a plurality of radial channels, and being revoluble on a vertical axis, a chamber for the rotor, and a conduit in communication with the chamber for receiving the material from the rotor.
- 90 12. The combination with a vertical receptacle for storing granular furnace lining material to be delivered to a distant point, of a rotor therebeneath and in communication therewith, said rotor comprising a substantially conical shaped member having a plurality of radial channels formed by a series of spaced blades, and being revoluble

on a vertical axis, a chamber for the rotor, and a conduit in communication with the chamber for receiving the material from the rotor.

5 13. The combination with a vertical receptacle for storing granular furnace lining material to be delivered to a distant point, of a rotor therebeneath and in communication therewith, said rotor comprising a substantially conical shaped member having a plurality of passages extending from the apex to the base, and being revoluble on a vertical axis, a chamber for the rotor, and a conduit in communication with the chamber for receiving the material from the rotor.

10 14. A machine for delivering solid material comprising a main sealed receptacle provided with a funnel bottom, a chamber under the receptacle into which the funnel extends, a distributing device arranged to rotate in said chamber and having a part located in proximity to the mouth of said funnel and provided with means for delivering material from the mouth of the funnel toward the wall of said chamber, conveying

means in proximity to the delivery point of said distributing device, and means for supplying air to said conveying means for conveying therethrough the material supplied by said distributing device.

15 15. In apparatus of the character described a main receptacle having a funnel outlet at its bottom, a second receptacle part of which encloses the funnel outlet of the first receptacle, a feeding device located in the second receptacle and arranged to rotate therein, such feeding device extending near the outlet of the first receptacle and provided with pockets arranged to deliver material from the outlet of the first receptacle downwardly and laterally as isolated streams, means in communication with the second receptacle through which material from the pockets may be delivered and means in proximity to the delivery point of said material for propelling delivered material through said receiving means.

20 25 In testimony whereof, I have hereunto affixed my signature.

ALBERT P. MEYER.