Jan. 16, 1934. F. B. ALLEN 1,943,780

APPARATUS FOR DISCHARGING AN ASH HOPPER

Filed Sept. 15, 1930 4 Sheets-Sheet 1

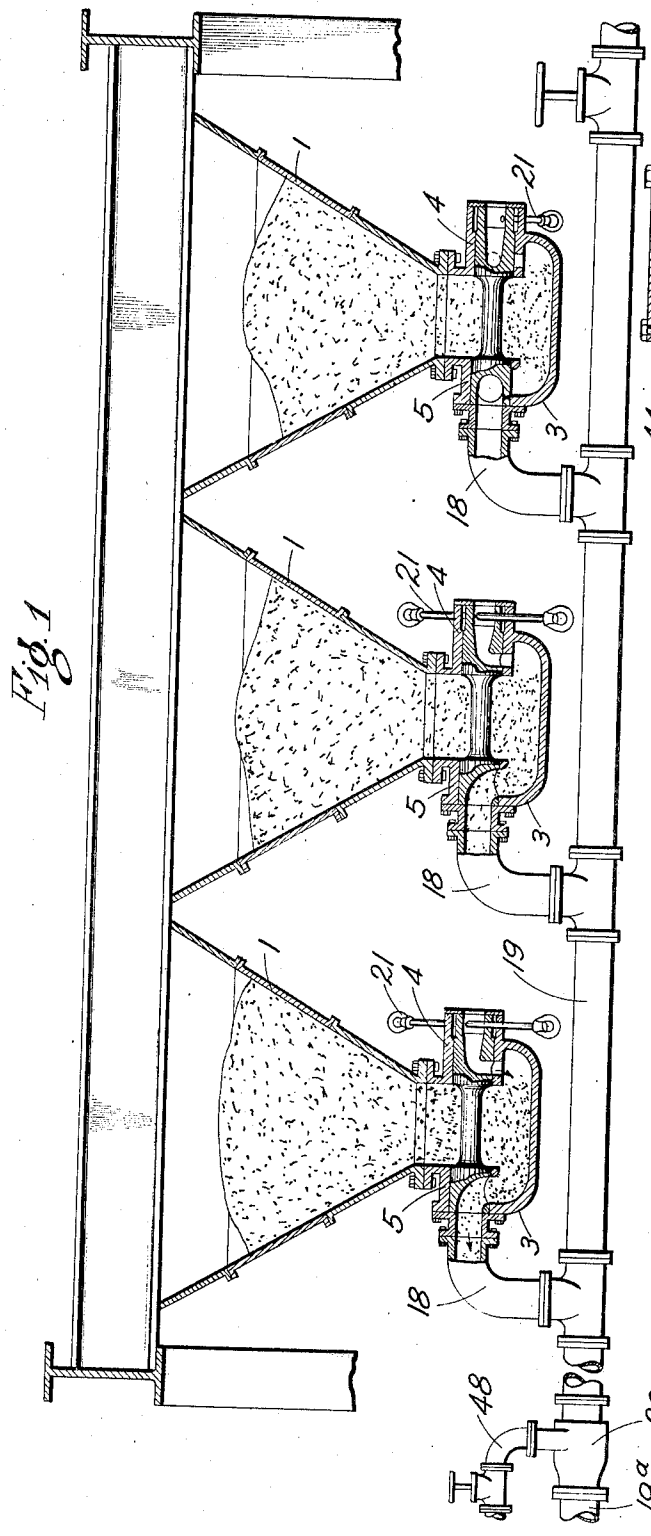


Fig. 1

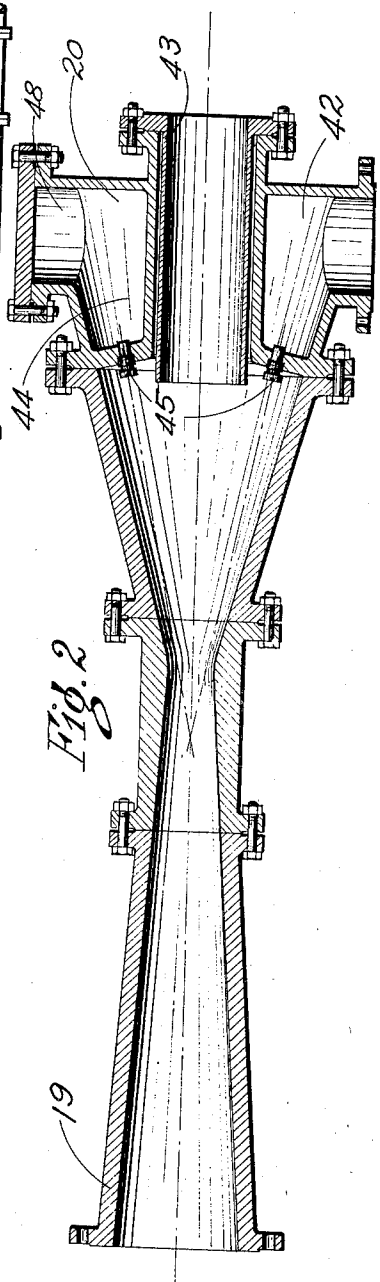


Fig. 2

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Fig. 3

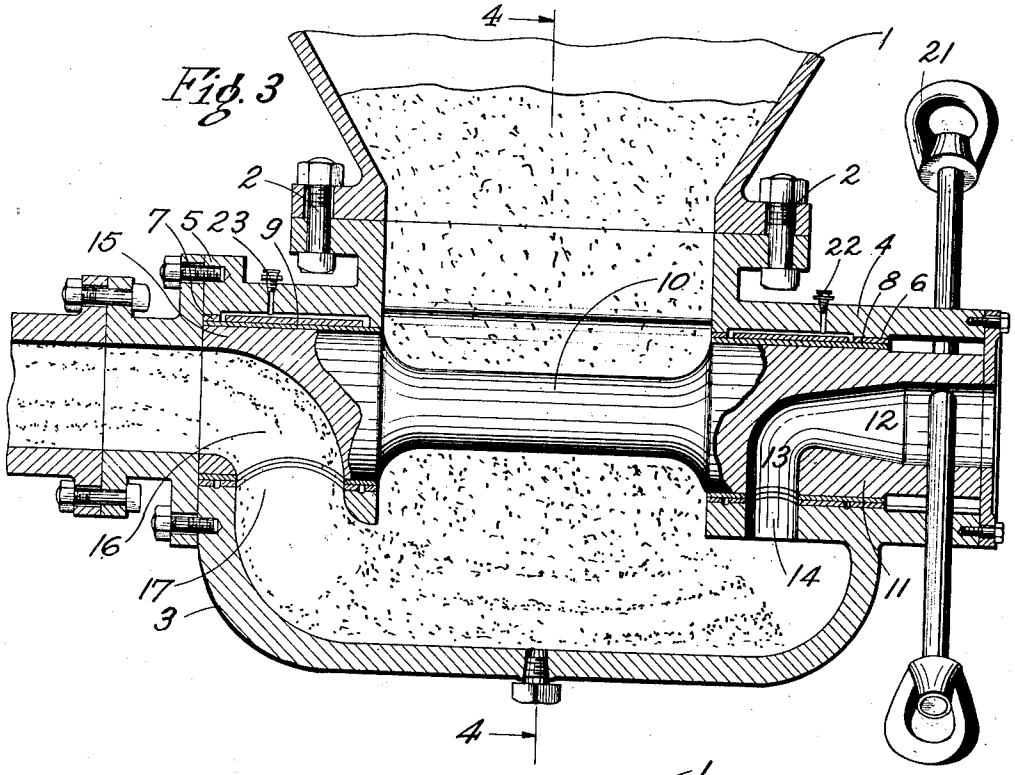
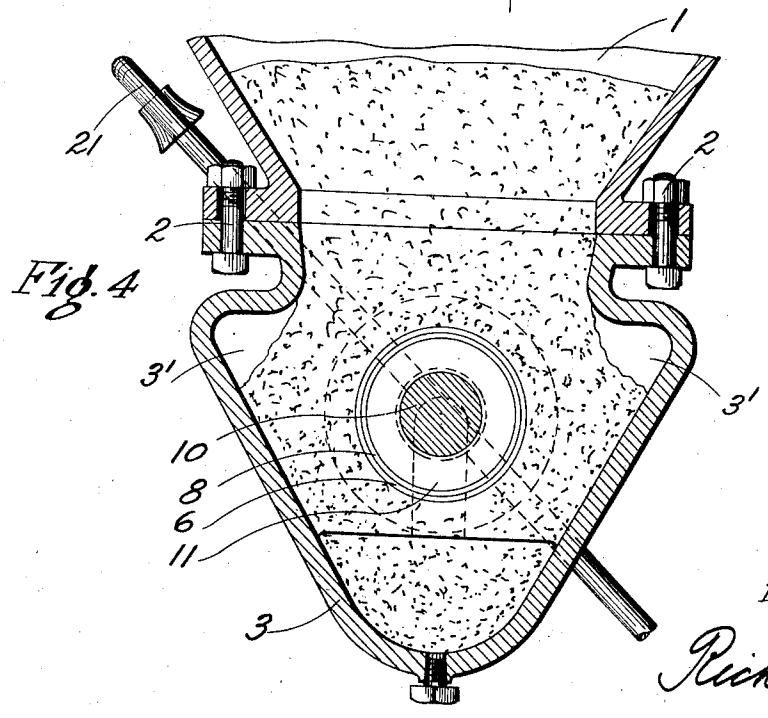


Fig. 4



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Fig. 5

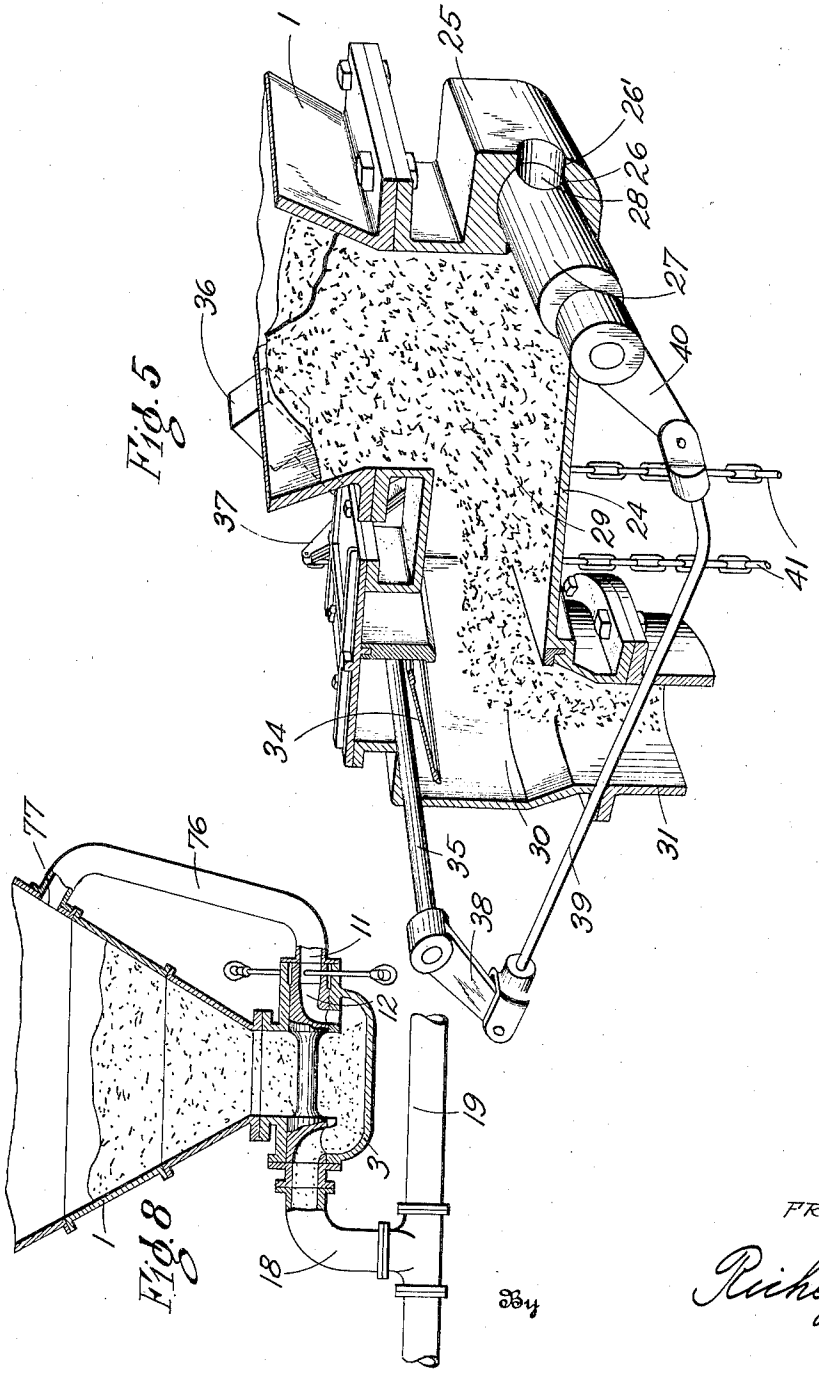


Fig. 8

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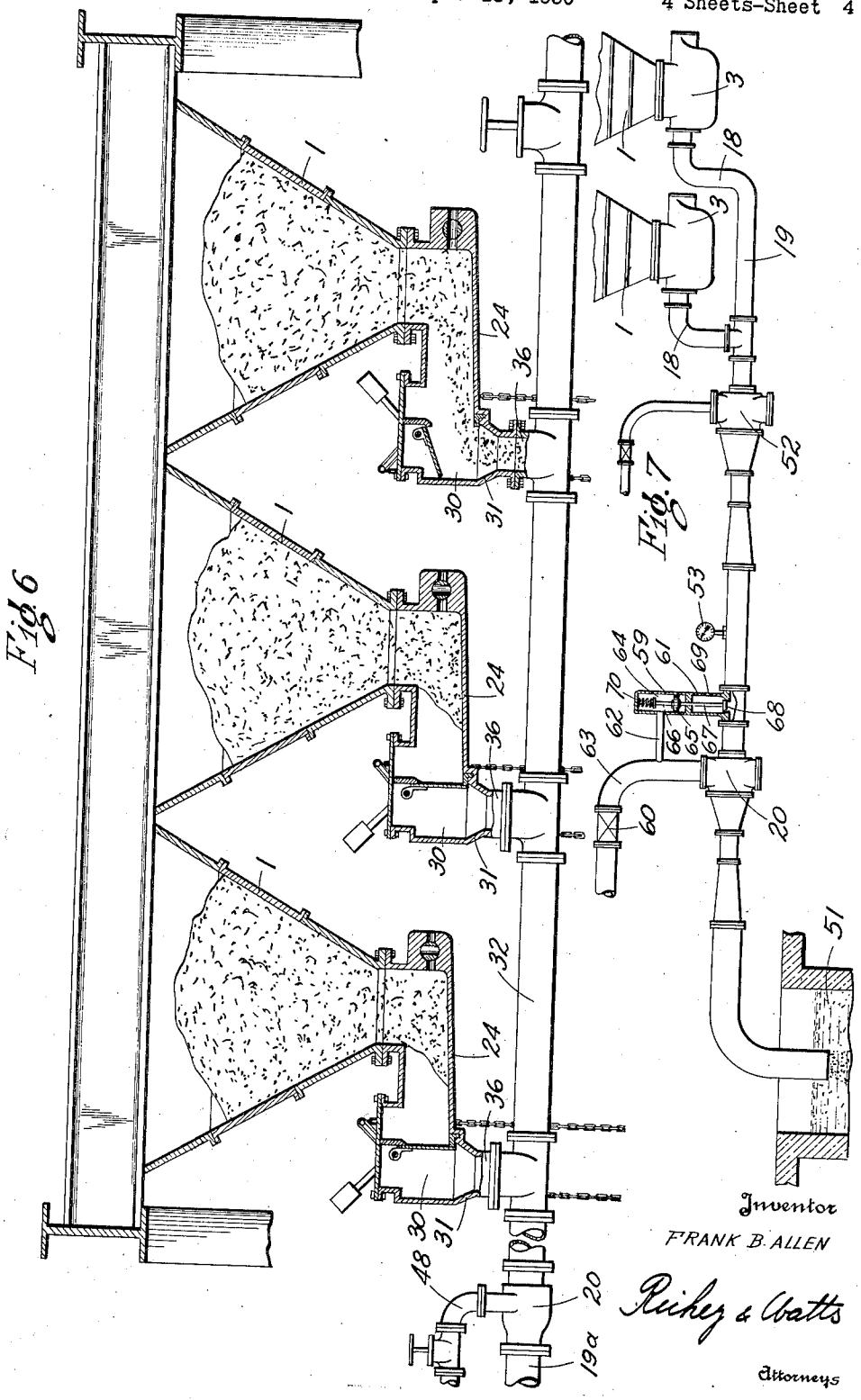


Fig. 6

Fig. 7

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UNITED STATES PATENT OFFICE

1,943,780

APPARATUS FOR DISCHARGING AN ASH HOPPER

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Application September 15, 1930
Serial No. 481,938

9 Claims. (Cl. 302—52)

This invention relates to dust disposal systems and more particularly to new and improved methods of and apparatus for removing fine ash from the bottom of a collecting hopper of a power plant furnace.

The handling of finely divided solids, such as dust particles, and discharging such material from hopper or collecting chambers has long been a troublesome problem without an adequate solution, so far as I am aware. The dust is ordinarily carried by gases and collected in a gas containing chamber in which the gas pressure is usually somewhat below atmospheric pressure. Often it is dangerous to permit air to mingle with the gases while discharging the dust material from the collecting chambers. An illustration is found where blast furnace dust is to be removed from dust catchers while blast furnace gas is present.

In another field, namely, in steam power plant furnaces and the like which are adapted to burn ash creating fuel and particularly those which are designed for burning powdered coal, a considerable quantity of dust or fine ash is carried from the combustion chamber of the furnace toward the stack by the outflowing gases. This dust usually settles out of the gases before they are discharged into the stack proper and is collected in dust hoppers. In the continuous operation of the furnace these hoppers must be periodically emptied of such dust and ordinarily bottom discharge openings are provided. It will be understood that induced draft fans create a partial vacuum in the furnace and suck gases out of the furnace and deliver the gases into the stack. If these dust hopper openings are closed by an ordinary type of gate or closure, air is allowed to enter the hopper and to pass up into the furnace and to the stack whenever these bottom discharge gates are open. This is undesirable as the admission of air into the dust hoppers may seriously affect the gas balance which is sought to be maintained in the furnace and lower the efficiency of the furnace, and furthermore carry abrasive material into the induced draft fans in the furnace. Elaborate valves have been proposed to keep the dust out of the fans when the hoppers are opened. Often the dust is carried out of the stack and deposited on adjacent property thereby constituting a nuisance.

It is among the objects of my invention, therefore, to provide a means and method of removing dust from a hopper by a suction induced draft of air or gas without creating any undesirable conditions inside or outside of the hopper or container while so doing.

Another object of my invention is to provide a method of removing the contents of a dust hopper without disturbing the gas balance in a furnace in communication with the hopper.

Another object of my invention is to provide an automatic means and method of discharging the contents of a dust hopper without causing a back flow of dust in the hopper or to induced draft fans or other apparatus in communication therewith.

According to my invention the dust is drawn out of the hopper or container by suction which, instead of decreasing or destroying the partial vacuum therein, may actually increase it, thereby favorably effecting the gas balance and effectively preventing dust being carried back into the system from the hopper. Moreover my method and apparatus are automatic in operation while the dust discharge devices or valves are open, and require no attention. The absence of moving parts in the apparatus that are subject to wear makes for long life of the device.

Further objects will be apparent from the following detailed description wherein similar characters of reference designate corresponding parts and wherein:

Fig. 1 is a view partly in section illustrating a dust handling system embodying my invention and applied to three dust hoppers of a fuel burning furnace;

Figure 2 is a sectional view of an ejector adapted to create a suction in the discharge conduits;

Fig. 3 is a vertical longitudinal sectional view of the hopper discharge device of Fig. 1;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a perspective sectional view of a modified form of discharge device;

Fig. 6 is a view similar to Fig. 1 but illustrating a system including the modified form of discharge valve shown in Fig. 5;

Fig. 7 is diagrammatic view of a discharge system embodying a plurality of ejectors disposed in the discharge conduit;

Fig. 8 is a modification of part of the apparatus of Fig. 1 showing the use of gas from the dust container for removing the dust.

In Figs. 1, 3 and 4 of the drawings the structure illustrated includes hoppers 1 which may be secured to the base of the gas chamber of a steam boiler by any suitable means. Disposed at the bottom of each hopper and secured there-

to as by the bolts 2 is a casing 3 provided with oppositely aligned substantially horizontal portions 4 and 5 which serve as bearing housings for a rotary shaft which functions as a valve.

The horizontal portions 4 and 5 are bored longitudinally as at 6 and 7 respectively and are adapted to receive the bearing sleeves 8 and 9. A rotary valve 10 is positioned with its ends in sleeves 8 and 9. The center portion of member 10 is of a somewhat reduced diameter to allow the free passage of fine material from the hopper into the lower part of the valve chamber or casing 3. The inlet end 11 of the valve 10 is bored centrally to provide a tapering aperture 12 having a port 13 at its inner end adapted to co-operate with the port 14 in the wall of portion 4 for effecting communication between the atmosphere and the interior of the valve chamber 3. The outlet end 15 of the rotary valve has a passage 16 of a somewhat greater diameter than the inlet 12 for co-operating with the port 17 in the body portion 3 to lead away any dust and air in the valve chamber.

Lubricator fittings 22 and 23 provide means for supplying lubricant to the sleeves 8 and 9 and member 10, the lubricant also serving to seal the relatively movable parts against leakage of air into the casing 3.

The member 10 may be rotated by lever 21 attached to the inlet end 11 of the member. When member 10 is rotated the ports 13 and 16 are aligned with ports 14 and 17 respectively in one position or moved out of alignment in another position. Thus simple rotation of member 10 provides an air passage from outside the casing 3, through the latter and into conduits 18 and 19, or to close this passage completely.

It will be noted that the portions 4 and 5 extend inwardly some distance from the adjacent end walls of the casing 3 and fairly close to the bottom of the casing; also that the upper side walls of the casing project outwardly near the inlet end. By reason of these configurations and the angle of repose of dust in the casing there are provided free spaces about the ports 14 and 17 and other spaces at 3' all of which are in communication with each other and constitute a gas passage from one port to the other through casing 3.

The air or other gaseous fluid as it enters the inlet port 14 of the valve passes upwardly and then horizontally across substantially open passages 3', formed by the contour of the side walls of the valve casing and the dust disposed therein, then downwardly and through the outlet or the exhaust port 17 of the rotary valve member. By passing the gas dust and in contact with the surface of the dust, a small amount of dust will be picked up and carried along, but will not be sufficient to clog the outlet valve.

Conduit 18 which connects with outlet 16 joins a main conduit 19 which connects through a suction creating device or ejector 20, with a conduit 19*a* leading to a sump or other place of refuse disposal (shown in Fig. 7).

In Figs. 5 and 6 I have shown a modified form of dust hopper discharge means embodying a substantially rectangular casing 24 including chambers 29 and 30 adapted to be secured to the discharge opening in the bottom of a hopper 1 and having an outstanding lug or valve sleeve 25 formed integrally with one horizontal wall and provided with a longitudinal bore 26 to receive valve 27 and a transverse bore 26' co-operable with a similar bore 28 in valve 27. The aperture 28 is adapted to register with the aperture 26' in the lug 25 to allow the suction of air or other gaseous fluid into the interior of the casing.

At the end of casing 24 remote from valve 27 an auxiliary chamber 30 is located and in communication with conduit 32 leading through ejector 20 to a place of refuse disposal (not shown). The chamber 30 is optionally in communication with chamber 29 through an opening controlled by a flap valve or door 34. This door is connected to a shaft 35 counter-weighted as at 36 and provided with operating handles or levers 37. The shaft 35 is also connected as by arm 38 and rod 39 to an arm 40 secured to valve 27. Chains 41 may be connected to levers 37 to rotate shaft 35, open or close door 34 and simultaneously rotate valve 27 to open or close the ports 28 and 26'.

The suction creating device or ejector indicated at 20 on Figs. 1 and 6 is shown in some detail in Fig. 2. It comprises a fitting 42 having an axial passage 43 of about the same size as conduits 19 and 32 and a surrounding chamber 44 communicating with conduit 48 and provided with nozzles 45 to discharge fluid under pressure converging past the discharge end of passage 43 and into conduit 19. When fluid particularly in the form of a liquid is discharged through the nozzles a strong suction action is created and fine material, gases and air are thereby drawn through conduits 19 or 32 and connected conduits.

In operating the device of Figs. 1, 3 and 4, dust ash is permitted to accumulate in casings 3 and hoppers 1 for a period of time. When the dust ash is to be removed, fluid is supplied under pressure to the conduit 48 and is effective to create a reduced pressure area in conduits 19 and 18, that is, a zone of higher vacuum than exists in the hopper. Valve 10 is rotated to open ports 13 and 14, and 16 and 17, air or other gas is drawn through passage 12 and through casing 3 carrying with it the fine ash disposed therein. When the air or gas and dust reach ejector 20 they are mixed with the fluid from conduit 48 and propelled to the disposal point. This action is continuous until the ash is substantially all removed from hopper 1 and casing 3 and during the entire time no gas can escape into the chamber above the hopper because the suction created by the ejector is greater than that produced by the induced draft fans in the furnace.

When all the dust has been removed from any casing 3 the valve 10 is rotated to close the ports 13 and 14, and 16 and 17. One or more casings may be discharged at the same time.

The operation of the devices of Figs. 5 and 6 is substantially like that just described, except that valve 27 and flap door 34 are opened to permit ash discharge and closed when the ash is all removed. This device of Figs. 5 and 6 may be employed where there is little or no danger of the dust clogging the conduits.

In operating the systems of Figs. 1 or 6 several auxiliary phases of the operation and apparatus are important. It is desirable that some means be provided for indicating the fact that the dust has all been removed from a hopper. It is also desirable that means should be provided for preventing any back flow of dust laden liquid in the conduits when the suction creating devices are shut off. If back flow occurs the nozzles may become clogged. Furthermore, it is desirable that provision be made for using steam

as a suction producing medium in the system, preferably in conjunction with other fluid since steam may be employed to attenuate the air or gas in the system and thereby create some of the vacuum or suction required.

In Fig. 7 these various considerations have been represented by suitable apparatus. In this figure, is diagrammatically shown a complete dust handling system. The hoppers 1, casings 3 and conduits 18 and 19 of Fig. 1 are similarly identified by reference characters, the conduit 19 discharging into a sump 51.

An ejector 20, adapted for use with fluid such as water, and another ejector 52, adapted for use with a fluid such as steam are associated with the conduit 19. These ejectors may be similar in construction and either may be operated alone or both together. The ejector 52 may be started first to attenuate the gas in the system and the ejector 20 then started to carry on the vacuum so created or increase it and thereby effecting the transmission of gas through the system.

A vacuum gauge 53 communicating with the conduit 19 serves to indicate the degree of vacuum in the conduit. Since the vacuum will decrease when the dust is cleared out of a given hopper because the air or gas can flow through the valves more freely, the gauge will indicate when the dust has been removed from the hopper. The gauge should be located on the intake side of the first ejector nearest the hopper. As shown in Fig. 7 it may be used when ejector 52 is not in use.

To prevent back flow of liquid and dust in conduit 19 I have provided a means automatically operative to break the vacuum in the conduit when the fluid supply to the ejector 20 is shut off. This device includes a bypass valve structure 59 which operates simultaneously with the valve 60 to relieve any vacuum pressure in the main conduit 19. The valve 59 comprises a casing 61 having one end thereof disposed in the conduit 19. A pipe 62 is adapted to lead fluid pressure from the main supply line 63 to a piston chamber 64 having a piston 65 reciprocably mounted therein. The piston 65 has stems 66 and 67 mounted on the opposing sides thereof. The end of the stem 66 is secured to a spring 70 which is in turn secured in the end wall of the piston chamber. The outer end of the stem 67 has a seat valve 68 secured thereto. When the valve 68 is open communication is effected between the interior of the discharge line 19 and the atmosphere through port 69 in the wall of the casing 61. Under normal operation the suction creating device being in operation the valve is held in seated position by fluid pressure acting against the upper face of the piston 65. When the valve 60 is closed pressure is relieved in the piston chamber and the valve 68 is unseated by the spring 70 to relieve any pressure in the conduit 19.

The location of pressure gauge, ejector controls and suction breakers all at one place make the apparatus susceptible to control from a common station. If in addition the valves are equipped with operating devices, such as fluid pressure valves, they may be controlled from the common station and have the entire apparatus and its operation brought under the control of one person.

In cases where the gas when mixed with air will form an explosive mixture, the gas in the hopper or dust container may be used in discharging the dust. Apparatus for this purpose is shown in Fig. 8 which embodies the apparatus of Fig. 1 with an added part. This added construction embodies a conduit 76 having one end communicating with the interior of the hopper 1 as at 77 and above the highest level of dust therein, and the other end thereof cooperating with the inlet end 11 of the rotary valve. When the valve is opened and the ejector creates a suction in casing 3, gas is drawn from hopper 1 into passage 12 and the dust is removed as above described but without the formation of any dangerous gas mixture. It will be understood that similar additions may be made to the apparatus of Fig. 6.

Although the foregoing description is necessarily of a detailed character in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of structural detail may be resorted to without departing from the scope of the invention as herein claimed.

I claim:

1. In apparatus for handling finely divided material, the combination of a hopper having a discharge opening, a valve housing secured to said hopper and in communication with said opening, said housing having air inlet and outlet passages, means for simultaneously opening and closing said passages, and means for creating a suction in the said outlet passage.

2. In apparatus for discharging finely divided material, the combination of a hopper having a discharge opening, a valve housing secured to said hopper and communicating with said opening, said housing having an air inlet passage adapted to connect the interior of said housing to the atmosphere and an oppositely disposed outlet passage to connect the interior of the housing with a conduit, means for simultaneously opening and closing said inlet and outlet passages, a conduit leading from said discharge opening, and means for creating a suction in said conduit.

3. The combination with the dust chamber of a fuel burning chamber, of a casing adapted to receive fine ash from said chamber, valve means in the casing adapted to simultaneously open the interior of the casing to the atmosphere and to a conduit, and suction creating means in said conduit for creating a partial vacuum in the conduit and casing and for drawing gas through the casing whereby the fine material therein will be carried out through the conduit.

4. In apparatus of the class described, a hopper having a bottom discharge opening, a valve housing below said discharge opening and adapted to receive material therefrom, valve mechanism in said housing, a conduit leading from said housing, means associated with said conduit for creating a partial vacuum therein, said valve mechanism being adapted when in one position to close off said valve housing from said conduit and the atmosphere and when in another to establish connections between said valve housing, said conduit and the atmosphere.

5. In apparatus of the class described, a hopper having a discharge opening, a valve housing adapted to receive material from said discharge opening, said valve housing having oppositely disposed gas inlet and outlet openings, a conduit leading from the gas discharge opening of said

valve housing and adapted to carry material therefrom, said inlet opening being adapted to provide a passage between said housing and the atmosphere, valve means in said valve housing, said valve means including interconnected closure members adapted to open and close said inlet and outlet openings simultaneously, and means for creating a partial vacuum in said conduit.

6. In apparatus of the class described, a hopper having a discharge opening, a valve housing mounted on said hopper and adapted to receive material from said discharge opening, said housing having oppositely disposed gas inlet and outlet openings, a conduit extending from said gas outlet opening and adapted to carry away material discharged therethrough, a second conduit extending from said gas inlet opening to said hopper, valve means in said valve housing, said valve means including interconnected closure members adapted to open and close said inlet and outlet openings simultaneously, and means for creating a suction in the conduit which extends from the outlet opening of the valve housing.

7. In apparatus of the class described, a hopper having a discharge opening, a valve housing adapted to receive material from said hopper discharge opening, said valve housing having gas inlet and outlet openings, valve mechanism in said valve housing including interconnected closure members adapted to open and close said inlet and outlet openings simultaneously, a conduit leading from said gas outlet opening, an ejector associated with said conduit and adapted to create a suction therein, a conduit adapted to conduct fluid under pressure to said ejector, and fluid pressure actuated vacuum relief valve means, responsive to the fluid pressure within said conduit for conducting fluid to said ejector, said vacuum relief valve being adapted to connect the conduit leading from the valve housing outlet to the atmosphere when said ejector is shut off.

8. In apparatus for handling finely divided material, the combination of a hopper having a discharge opening, a valve housing secured to said hopper and in communication with said hopper, said housing having air inlet and outlet passages, means for positively and simultaneously opening and closing said passages and means for creating a suction in said outlet passage.

9. The combination with an ash hopper of a combustion furnace, said ash hopper having a discharge opening, of a valve housing secured to said hopper and in communication with said discharge opening, said housing having air inlet and outlet passages, means for simultaneously opening and closing said passages and means for creating a suction in said outlet passage.

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