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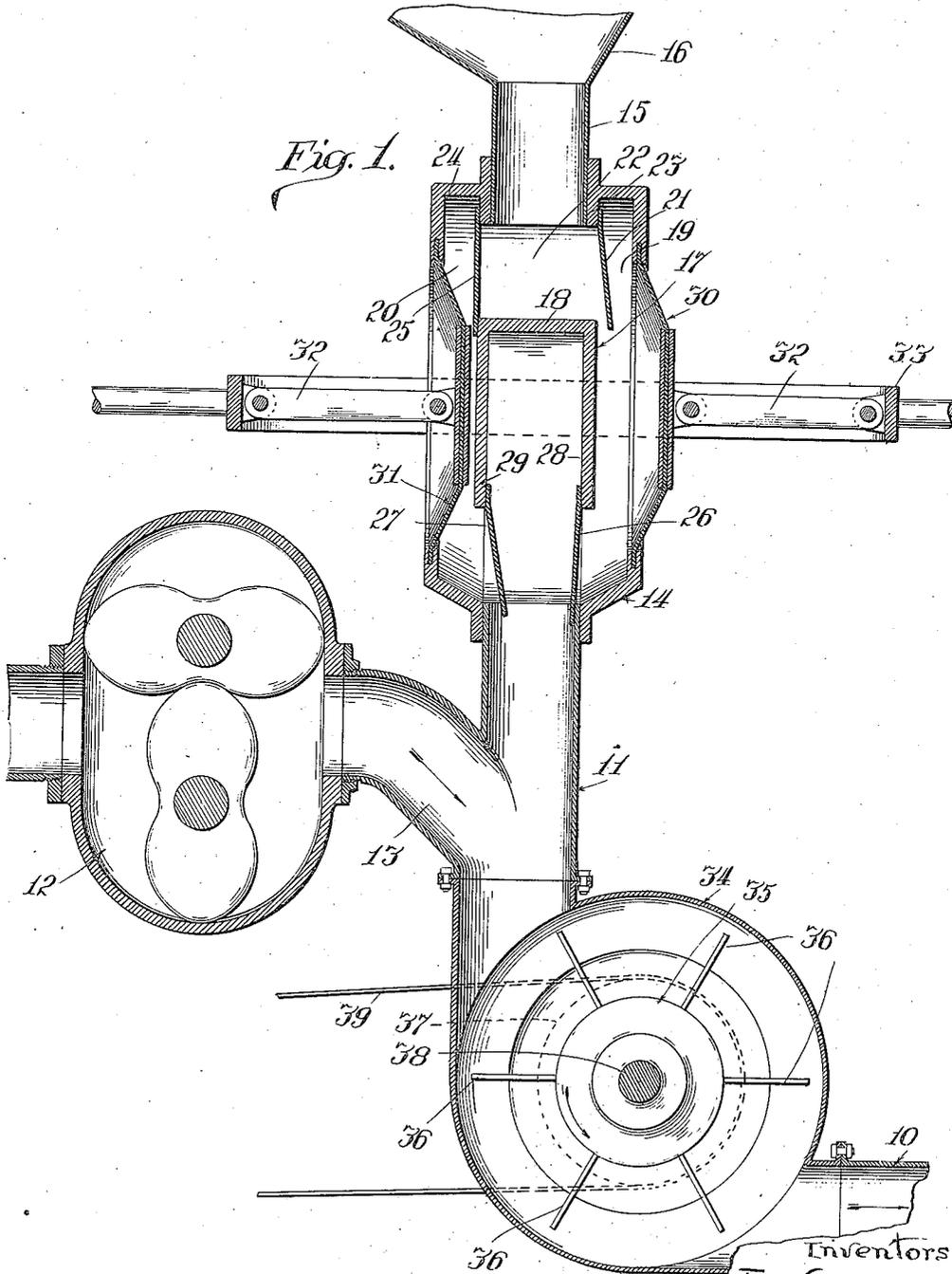
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PNEUMATIC CONVEYER

Filed April 25, 1925

2 Sheets-Sheet 1



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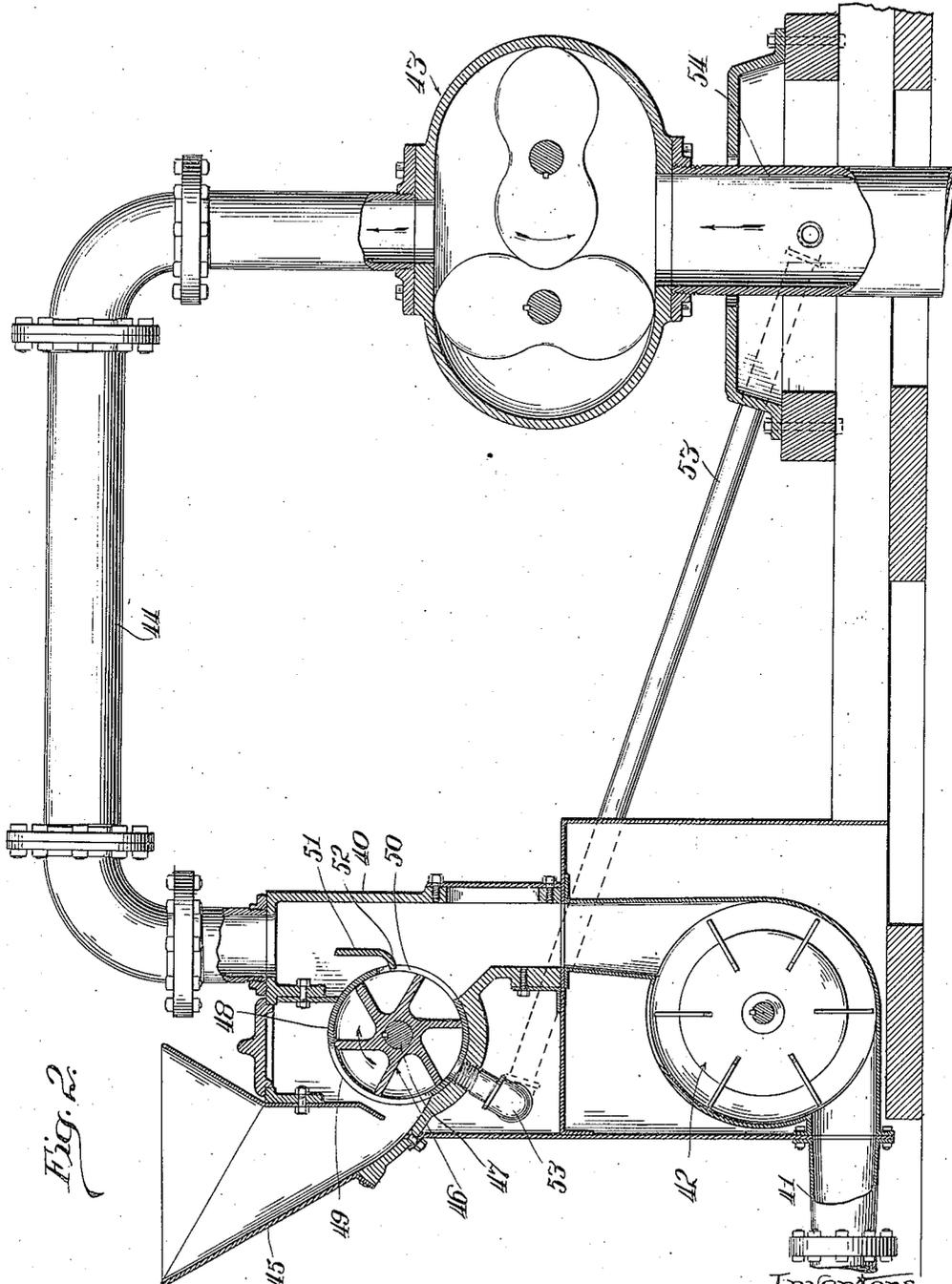


Fig. 2.

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UNITED STATES PATENT OFFICE.

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PNEUMATIC CONVEYER.

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Our invention relates to pneumatic conveying apparatus for bulk materials of granular or pulverulent character and has for its object to provide certain new and improved arrangements and devices for introducing material in measured quantities into the air current by which the material is conveyed from one place to another and for giving the material an initial forward propulsion by impact which overcomes its inertia, thereby preventing the inflow of the material into the conveying duct from arresting or diminishing the velocity of the air current. While the mechanism for introducing the granular or pulverulent material into the conveying duct provided by our invention is of particular utility in this situation such device might be used in other places where measured quantities of material are to be fed into a space, and particularly a space which is under pressure.

A further object of the invention is to provide certain novel improvements relating to the feed of the material to the conveying conduit adapted particularly to an apparatus employing a rotatable pocket feeder for this purpose.

The invention is illustrated, in certain preferred embodiments, in the accompanying drawings wherein

Fig. 1 is a vertical sectional view of an apparatus embodying the invention in one form, and

Fig. 2 is a similar view of a modified form of the invention.

Referring first to Fig. 1 of the drawings, the conveying duct is composed preferably of a substantially horizontal pipe 10 and a substantially vertical pipe 11. The movement of air and suspended solids through the duct is produced by any suitable apparatus. We have shown a compressor 12 of common type, the suction pipe 13 of which is connected with the vertical leg 11 of the conveyer duct. Preferably, but not necessarily, the pipe 13 is of the same or larger diameter than conveyer pipe 10 so air passes from one pipe to the other without resistance and in relatively large volumes. The intention is to use a relatively low air pressure, for example, ten pounds per square inch although the invention is not to be considered as limited to this particular pres-

sure. Arranged at the upper end of the pipe 11 of the conveyer duct is a casing 14 into the top of which projects the spout 15 of a feed chute or funnel 16. Arranged in the casing under the spout of the feed chute is a structure 17 in the form of an inverted channel, the web 18 of which is adapted to receive and support the stream of material entering the casing from the feed chute. The structure 17, and the valves to be hereinafter mentioned, provide within the casing two feed passageways 19, 20. 21 is a valve opening into the passage 19 from the chamber or space 22 below the feed chute, this valve being of the flap valve type, preferably flexible and attached at its upper edge to a flange 23 depending from the top wall 24 of the casing. 25 is a similar valve opening into passage 20 from chamber 22. 26 and 27 are similar valves secured to the lower edges of the flanges 28, 29 of the channel structure 17. The valves 26 and 27 open into the conveyer duct from the passages 19 and 20, respectively. The casing is formed on each side with an opening and in these openings are set flexible diaphragms 30, 31 which are connected by pitmen 32 with a horizontally vibrating yoke 33, the yoke being given reciprocating movements by any suitable mechanism (not shown).

At the junction between the conveyer pipes 10 and 11 is arranged a cylindrical casing 34 in which casing is a rotary impact impeller 35 with blades 36 adapted to act upon material falling through pipe 11 and forward the same in the direction of the air current. The impeller wheel is driven by any suitable means. We have indicated a pulley 37 on the shaft 38 of the impeller wheel, which pulley is driven by a belt 39.

The operation of the mechanism shown in Fig. 1 and above described is as follows: Movement of the air and suspended particles through the conveyer duct is effected by the rotary pump or compressor 12. The pulverulent or granular material flows into the top of casing 14 through the feed chute 16, the stream of material being supported on surface 18. Yoke 33 is given vibratory movements in a horizontal direction causing the flexible diaphragms 30, 31 to be moved back and forward. The outward

movement of diaphragm 30 creates a suction in passageway 19 which opens valve 21 to allow a certain amount of material to enter the passageway, and closes the valve 26 so that the material is trapped. The corresponding inward movement of diaphragm 31 closes the upper valve 25 and opens the lower valve 27 producing a discharge of previously trapped material in passageway 20 into the pipe 11. The arrangement is such that the material enters the air current intermittently in charges, the quantities of which are uniform or substantially so. The charges of material delivered from the hopper into casing 14 fall into dead air spaces, the lower valve being closed in each case. When either lower valve is opened the corresponding upper valve is closed so that there is no back pressure or suction through the feed hopper.

When solids are fed into an air current their inertia tends to arrest or diminish the velocity of the current. The function of the impeller wheel is to give a forward movement by impact to the solid particles which prevents the solid material from checking the air current. Preferably the impeller wheel is operated at a speed corresponding to the velocity of the air in this part of the conveyer duct.

In Fig. 2 I have shown an apparatus modified in respect to the means employed for feeding the material into the conveying duct or conduit. This form of the invention contemplates the use of a rotary pocket feeder. 40 designates the vertical leg of the conveying duct and 41 the horizontal leg between which is arranged a rotary impeller 42 of substantially the same construction as the impeller shown in Fig. 1 and previously described. 43 is an air compressor and 44 a pipe leading from the compressor to the upper end of duct 40. The means for feeding the material into duct 40 consists of a hopper 45 and a rotary pocket feeder 46 having an overshot movement, as indicated by the arrow, the feeder being fixed to a shaft 47 and being arranged in a cylindrical casing 48 having an opening 49 on the side of the hopper and a discharge opening 50 into the duct 40. 51 is a vane in the duct 40 having a curved lip 52 projecting into the discharge opening 50 of the pocket feeder casing, the vane being arranged so as to divert a certain amount of air into the pockets as they come to emptying position so as to clear them of any adherent material. 53 is a relief pipe tapped into the bottom of the feeder casing and extending to the induction pipe 54 of the compressor. The purpose of this pipe is to relieve the pockets of air pressure which might otherwise tend to impede the flow of the material from the hopper into the pockets.

While we have described our invention

in two preferred embodiments, it is realized that changes might be made without departure from the principles of the invention. Therefore we desire to be understood as intending to cover by this patent all modifications within the scope of the appended claims.

We claim:

1. In a pneumatic conveyer for granular or pulverulent material, the combination of a duct conveying material in a substantially horizontal direction, means for forcing air under pressure into said duct to create a current of air therethrough, means for feeding the pulverulent material by gravity into this air current, and an impeller positioned in the duct below the feeding means and acting on the material suspended in the air current to forward the same in the direction of the air current.

2. In a pneumatic conveyer for granular or pulverulent material, the combination of a duct for conveying material in a substantially horizontal direction, means for forcing air under pressure into said duct to create a current of air therethrough, means for feeding the pulverulent material by gravity into this air current, and a rotary impact impeller positioned in the duct below the feeding means and acting on the material suspended in the air current to forward the same in the direction of the air current.

3. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, having a substantially horizontal leg and a substantially vertical leg, means for forcing air under pressure into the vertical leg to create a downward current of air therethrough, means for feeding the pulverulent material by gravity into this air current, and an impeller located between the legs of the duct to act upon the material and forward same in the direction of the air current through the horizontal leg.

4. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, having a substantially horizontal leg and a substantially vertical leg, means for forcing air under pressure into the vertical leg to create a downward current of air therethrough, means for feeding the pulverulent material by gravity into this air current, and a rotary impact impeller located within the duct at the junction of the legs for acting upon the material to forward same in the direction of the air current through the horizontal leg.

5. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material directly into said air current in said duct comprising a chamber into which the material is initially introduced, a passageway of variable volume be-

tween said chamber and duct, an inlet valve between said chamber and passageway, an outlet valve between said passageway and duct, and means for alternately increasing and decreasing the volume of the passageway whereby said valves are alternately opened and closed.

6. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising a chamber into which the material is initially introduced, a passageway between said chamber and duct, a valve between said chamber and passageway, a valve between said passageway and duct, and means for opening each of the valves and closing the other in alternation and for alternately providing a suction and pressure which draws a charge of material into the passageway and thereafter forces the same into the duct.

7. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising a chamber into which the material is initially introduced, a passageway between said chamber and duct, a valve between said chamber and passageway, a valve between said passageway and duct, and means producing alternately suction and pressure in the passageway operating to open each of the valves and close the other valve in alternation.

8. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, mechanism for feeding material into said duct comprising a chamber into which the material is initially introduced, a passageway between said chamber and duct, a valve between said chamber and passageway, a valve between said passageway and duct, which valves are adapted to be opened and closed in alternation, a flexible diaphragm forming part of the wall of said passageway, and means for vibrating said diaphragm.

9. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, mechanism for feeding material into said duct comprising a chamber into which the material is initially introduced, a passageway between said chamber and duct, a valve between said chamber and passageway, a valve between said passageway and duct opening oppositely from the passageway and opened and closed by suction and pressure in said passageway, and means for alternately producing suction and pressure in said passageway.

10. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, mechanism for feeding material into said duct comprising a chamber into which the material is initially introduced, a passageway between said chamber and duct, a valve between said chamber and passageway, a valve between said passageway and duct opening oppositely from the passageway and opened and closed by suction and pressure in said passageway, and a flexible diaphragm for alternately rarefying and compressing the air in said passageway.

11. In a pneumatic conveyer, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising passageways leading from opposite sides of the chamber to the duct, a pair of valves between said chamber and passageways opening into the passageways, a pair of valves between said passageways and duct which open into the duct, and means for rarefying the air in each of said passageways alternately and compressing the air in the other passageway.

12. In a pneumatic conveyer, the combination of a conveying duct, means for creating a movement of air therethrough, mechanism for feeding material into said duct comprising passageways leading from opposite sides of the chamber to the duct, a pair of valves between said chamber and passageways opening into the passageways, a pair of valves between said passageways and duct which open into the duct, a pair of diaphragms associated with said passageways, respectively, and means for moving said diaphragms first in one direction and then in the other.

13. In a pneumatic conveyer, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding the material into said duct comprising passageways leading from opposite sides of the chamber to the duct, a pair of valves between said chamber and passageways opening into the passageways by suction and closed by pressure, a pair of valves between said passageways and duct which open into the duct by pressure and are closed by suction, a pair of diaphragms associated with said passageways respectively, and means for moving said diaphragms first in one direction and then in the other.

14. In a pneumatic conveyer, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising passageways leading from opposite sides of the chamber to the duct, a pair of valves between said chamber and passageways opening into the passageways, a pair of

valves between said passageways and duct which open into the duct, and means for alternately reversing the movements of the valves so that when one of the first named pair of valves is opened the valve of the second named pair which is on the other side of the apparatus is also opened and the other two valves closed.

15. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising a chamber into which the material is initially introduced, a passageway between said chamber and duct, flexible flap valves between said chamber and passageway and passageway and duct, and means for alternately producing suction and pressure in said passageways operating to open said valves in alternation and close the other valve.

16. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising a casing arranged above said duct, having a feed passageway, a feed chute, a valve between said chute and passageway which opens into the latter, a valve between said passageway and duct which opens into the duct, a diaphragm, and means for vibrating the same so as to open and close said valves in alternation.

17. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising a casing arranged above said duct, having a feed passageway, a feed chute, a flexible flap valve between said chute and passageway which opens into the latter, a flexible flap valve between said passageway and duct which opens into the duct, a diaphragm, and means for vibrating the same so as to open said valves in alternation.

18. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, means for creating a movement of air therethrough, and mechanism for feeding material into said duct comprising a casing arranged above said duct, having a feed passageway, a feed chute opening into the top of the casing, said casing being formed with a receiving surface below said chute, a valve between said chute and passageway opening into the latter, a valve between the passageway and duct opening into the duct, a flexible diaphragm arranged in the side wall of the casing, and means for vibrating said diaphragm.

19. In feeding mechanism for granular or

pulverulent material, the combination of a casing having an inlet and outlet, a feed passageway, a valve between said inlet and passageway which opens into the latter, a valve between the passageway and outlet which opens toward the outlet, and means for alternately rarefying and compressing the air in said passageway.

20. In feeding mechanism for granular or pulverulent material, the combination of a casing having an inlet and outlet, a feed passageway, a valve between said inlet and passageway which opens into the latter, a valve between the passageway and outlet which opens toward the outlet, a diaphragm in the side wall of the casing, and means for vibrating said diaphragm.

21. In feed mechanism for granular or pulverulent material, the combination of a casing having a discharge opening in the bottom, a feed chute for introducing the material into the upper part of the casing, a receiving surface for the material below said feed chute, a pair of valves which open into the casing from said feed chute, a pair of valves for controlling flow of material through the outlet of the casing, which valves open toward said outlet, a pair of flexible diaphragms in the side walls of said casing, and means for vibrating said diaphragms together first in one direction and then in the other.

22. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, an air compressor, a pipe the cross sectional area of which is not substantially less than the cross sectional area of said duct extending between said compressor and said duct, means for introducing the material into said duct, and a rotary impact impeller located in said duct to act upon the material and forward the same in the direction of the air current.

23. In a pneumatic conveyer for granular or pulverulent material, the combination of a conveying duct, an air compressor, a pipe, the cross-sectional area of which is not substantially less than the cross-sectional area of said duct, extending between said compressor and said duct, means for introducing the material in measured quantities into said duct at regularly timed intervals, and a rotary impact impeller located in said duct to act upon the material and forward the same in the direction of the air current.

24. In a pneumatic conveyer for granular or pulverulent material, the combination of a duct for conveying material in a substantially horizontal direction, means for forcing air under pressure into said duct to create a current of air therethrough, means for intermittently feeding measured quantities of material downwardly into this air current, and an impeller positioned in the duct below the feeding means and acting on

the material suspended in the air current to forward the same in the direction of the air current.

5 25. In a pneumatic conveyer for granular or pulverulent material, the combination of a duct for conveying material in a substantially horizontal direction, means for forcing air under pressure into said duct to create a current of air therethrough, means

for intermittently feeding measured quantities of material downwardly into this air current, and a rotary impeller having blades positioned in the duct below the feeding means and acting on the material suspended in the air current to forward same in the direction of the air current. 10 15

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