(No Model.)

3 Sheets—Sheet 1.

M. RANDOLPH.

COMBINED PNEUMATIC GRAIN ELEVATOR, CONVEYER, AND CLEANER.

No. 276,879. Patented May 1, 1883.

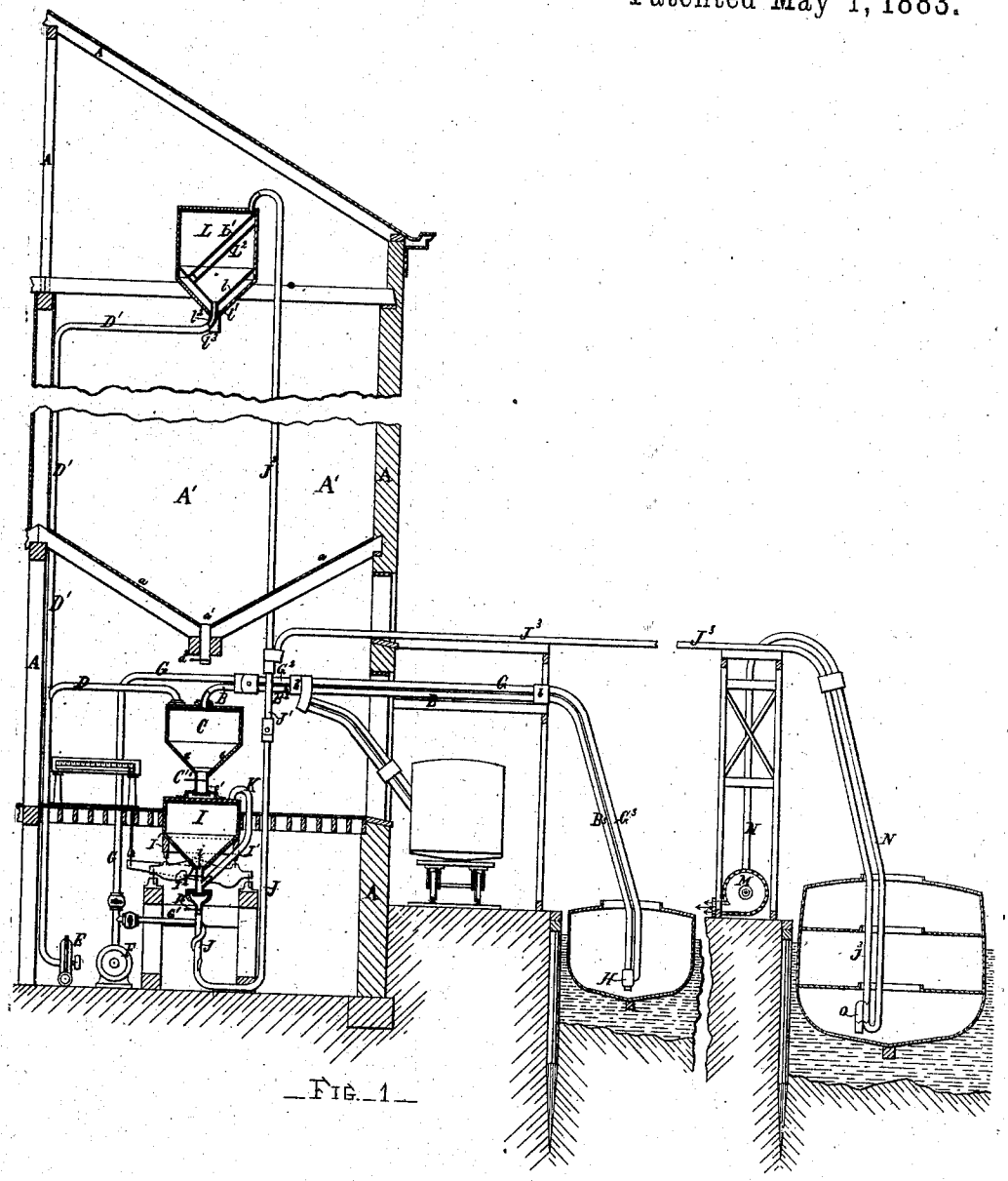


FIG. 1

Witnesses.
Philip C. Raquet
R. Rosenstock

Inventor.
Madison Randolph

(No Model.) 3 Sheets—Sheet 2.

M. RANDOLPH.

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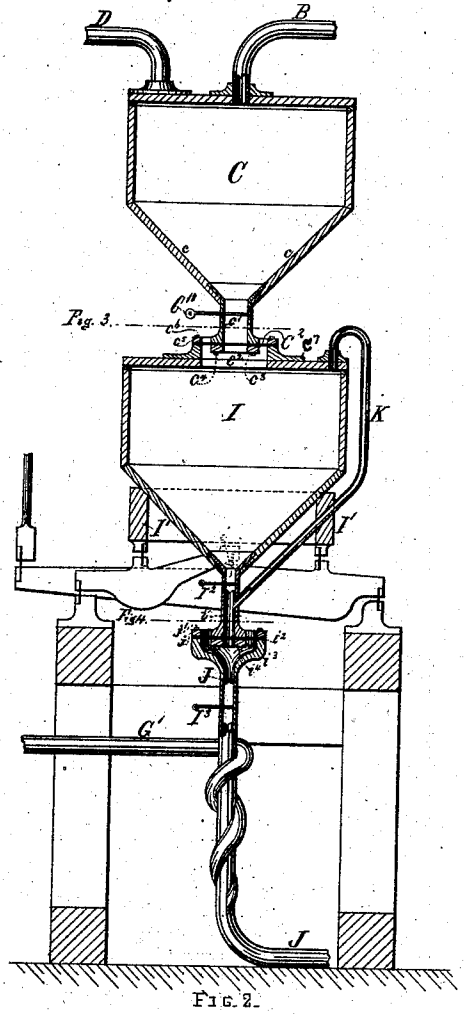


FIG. 2.

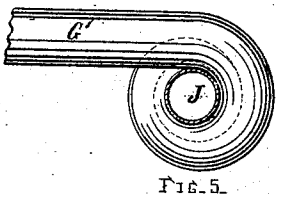


FIG. 5.

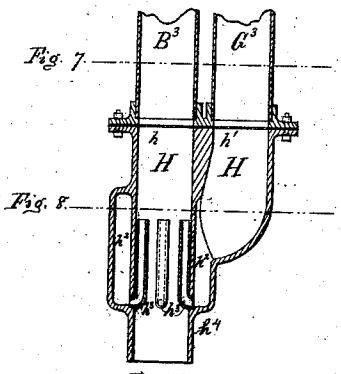


FIG. 6.

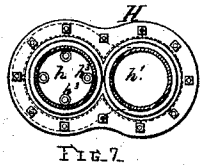


FIG. 7.

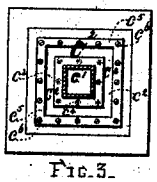


FIG. 3.

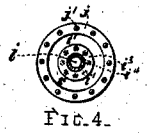


FIG. 4.

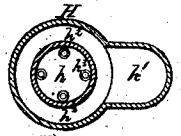


FIG. 8.

WITNESSES.

Philip E. Raquet

R. Wolfenstock

INVENTOR.

Marlon Randolph

(No Model.) 3 Sheets—Sheet 3.

M. RANDOLPH.

COMBINED PNEUMATIC GRAIN ELEVATOR, CONVEYER, AND CLEANER.

No. 276,879. Patented May 1, 1883.

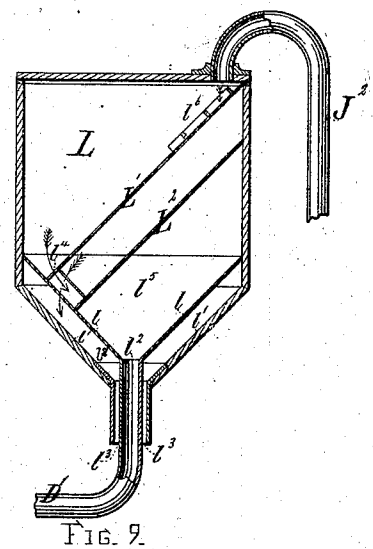


FIG. 9.

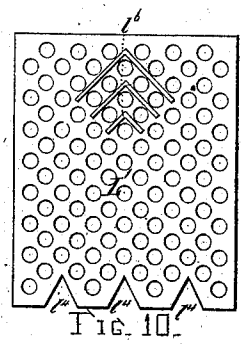


FIG. 10.

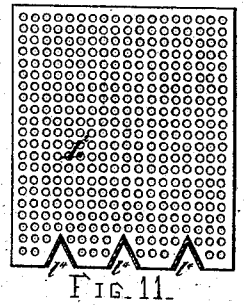


FIG. 11.

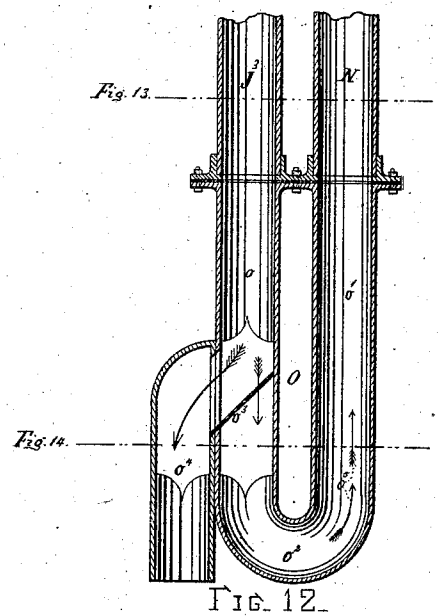


FIG. 12.

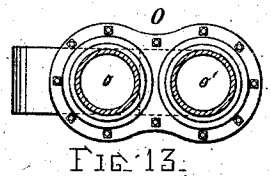


FIG. 13.

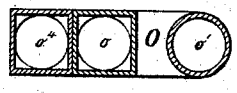


FIG. 14.

WITNESSES.

Philip E. Raquet

C. Rolenstock

INVENTOR.

Marlon Randolph

UNITED STATES PATENT OFFICE.

MAHLON RANDOLPH, OF NEW YORK, ASSIGNOR OF ONE-HALF TO MARGARET A. CASE, OF BROOKLYN, N. Y.

COMBINED PNEUMATIC GRAIN ELEVATOR, CONVEYER, AND CLEANER.

SPECIFICATION forming part of Letters Patent No. 276,879, dated May 1, 1883.

Application filed July 18, 1882. (No model.)

To all whom it may concern:

Be it known that I, MAHLON RANDOLPH, of the city, county, and State of New York, have invented a new and useful Improvement in a Combined Pneumatic Grain Elevator, Conveyer, and Cleaner, of which the following is a full and clear description.

This invention has for its object the construction of a grain-elevator, or machine for moving grain in a vertical or horizontal direction by pneumatic pressure, the grain to be moved into and out of an air-tight receiver and weighing-hopper through air-tight pipes or tubes, and for moving the grain as required both compressed air and exhausted or partially-exhausted receivers are used, so as to utilize both a vacuum-pressure and a forced pressure.

The invention relates to the construction and combination of the air-tight receiver and the weighing-hopper; also to the combined grain and air exhausting and forcing pipes and the machines for operating them; also to an injector for producing an induced auxiliary current in the grain-receiving pipe; and also to exhausting-chambers respectively placed at the top end of the lift and forcing pipe for elevating the grain to the top of a building or other elevation, and at the discharging end of the shipping-pipe.

The invention will be readily understood by reference to the accompanying drawings, Figure 1 of which represents a sectional elevation of the complete improved apparatus. Fig. 2 is a detail sectional elevation of the receiver, weighing-hopper, and discharge-pipe, with the connecting-diaphragms and the compressed-air pipe. Fig. 3 is a sectional plan of the connection between the weighing-hopper and the receiver, showing the diaphragm. Fig. 4 is a sectional plan of the connection between the weighing-hopper and the outlet-pipe, showing the diaphragm. Fig. 5 is a sectional plan of the compressed-air pipe and the connection with the grain-forcing pipe. Fig. 6 is a sectional elevation of the injector in the outer end of the receiving-pipe. Figs. 7 and 8 are sectional plans of the said injector, taken respectively on the dotted lines shown in Fig. 6, and numbered or lettered respectively Fig. 7 and Fig. 8. Fig. 9 is a sectional elevation of the receiver and cleaner at the top of the riser-pipe. Figs. 10 and 11 are plans of the perforated diaphragms of the receiver and cleaner. Fig. 12 is a sectional elevation of the outlet or discharge nozzle. Figs. 13 and 14 are sectional plans of the said outlet-nozzle.

The structure A represents a sectional elevation of a portion of an ordinary grain-warehouse or elevator-building in which the improved pneumatic apparatus is applied. This building, like all similar structures, has storage-bins A′, into which the grain is elevated by suitable machinery, so as to fall into the tops of the bins, and the lower ends of these bins are provided with hopper-bottoms *a*, so as to permit all the grain to run out through the central discharge-openings, *a′*, when the valves a^2 are opened.

A suitable connecting-pipe (not shown) will lead the grain from the opening *a′* to the top of the receiver C, the grain having to pass through the weighing-hopper in going out of the house as well as in coming into it.

The grain is received into the building from any contiguous source—such as a boat, railway-car, wagon, or other receptacle—through the receiving-pipe B, which discharges it into the air-tight or nearly air-tight receiver C, which is provided with a hopper-bottom, *c*. An exhaust-air pipe, D, connects the hopper or receiver C with an air-exhauster, E, located at any convenient place, preferably in the engine-room, and exhausts the air from the said receiver C, so as to form a partial vacuum therein. Both the inlet grain-pipe B and the exhaust-pipe D descend to the top of the hopper or receiver C in a vertical direction, as shown in the drawings, so as to discharge the grain downwardly from the outlet of the pipe B and draw the air upwardly or in an opposite direction from that in which the grain is moving, so as not to draw the grain out of C with the outgoing current of air through D. A perforated diaphragm may, if required, be placed over the inlet end of the pipe D to prevent any outflow of the grain from the receiver C.

An air-compressor, F, is placed in any convenient position, but preferably in or near the

engine-room, as it is the purpose not to use any running machinery in the elevator-building proper, so as to thoroughly obviate danger by fire. This compressor may force its air into a storage-receiver, or directly into the compressed-air pipes G and G'. The compressed-air pipe G is used in connection with the grain-receiving pipe B, and these two pipes will preferably lie side by side for some distance toward or into the building from the outer end, and secured together by proper bands *b*, so that the two may be united into one switch. B^2 G^2, united by bands b^2, for the purpose of changing at will the connection to or from any desired source of supply or receipt, as a boat or a car, &c.

The switch-pipes B^2 G^2 are arranged so as to respectively form air-tight connections at both ends with the contiguous pipes B and G. The outer sections, B^3 and G^3, of these pipes are made of some flexible material, yet of sufficient rigidity to enable them to maintain their cylindrical form, similar to the suction-hose used for fire-engines. At the extreme outer end of the pipes B^3 and G^3 they will be attached to an inlet or injector, H. This injector has at its upper end two chambers, *h* and *h'*, as shown in Fig. 6. The chamber *h* forms the grain way or pipe, and extends entirely through the injector-shell from end to end; but the chamber *h'* leads into and terminates in an air-chamber, h^2, which connects with the chamber *h*. From this air-chamber h^2 one or more pipes or nozzles, h^3, lead up into the cavity of the chamber *h*, the axial lines of the nozzles h^3 being in planes parallel with the axial line of the chamber *h*, so as to discharge compressed air received from the compressor F, through the pipes G, G^2, and G^3, up into the pipes B, B^2, and B^3 in the direction in which the grain is required to move into the receiver C.

In lieu of the separate pipes or nozzles h^3, the air may be discharged into the grain-chamber *h* in an annular sheet surrounding the grain-chamber and next to the walls forming its sides, the annular sheet of air being an equivalent for several separate air-pipes located in annular form and in effect forming one annular blast. This will create in said pipe an induced current and carry the grain along with it into the receiver C, a partial vacuum being at the same time maintained in the said receiver by the action of the exhauster E in the manner already explained. The combined action of this injector and the exhauster will cause a continuous stream of grain to flow into the receiver C so long as the mouth of the injector is placed in contact with or contiguous to the grain to be moved, and as the pipes B^3 G^3 are flexible, one or two men can easily carry the inject end of them around to all parts of a car or boat and take up perfectly any grain therein contained.

It is evident that it would be possible to produce an induced current in the pipe B^3 by the use of only one of the injector-nozzles h^3; but I prefer three (3) or four (4) of the nozzles h^3, as being better adapted to the purpose and as giving better results.

Directly below the receiver C, and connected with it by the pipe *c'*, is placed the weighing-hopper I, which said weighing-hopper rests upon the weigh-frame I' of the scales.

The lower part of the weighing-hopper has an outlet-pipe, *i*, which said pipe is connected with the grain-forcing pipe J. In order to weigh the grain it is evident the hopper I must have a free vertical movement of sufficient extent to allow the scales to act properly for the weighing of the contents of the said hopper. It is also required that the said weighing-hopper shall be connected air-tightly with the receiver C and the outlet forcing-pipe J, so as to maintain the pneumatic pressure for moving the grain, as desired. To accomplish this result I use thin diaphragms c^2 and i^2 to respectively couple the pipe *c'* with the weighing-hopper flange c^7 and the pipe *i* with the pipe J, as shown best in the detailed drawing, Fig. 2. The diaphragm c^2 is held up to the lower end of the pipe *c'* by the plate c^3 and the screws c^4, and it is held down to the end of the weighing-hopper flange c^7 by the plate c^5 and the screws c^6. These parts *c'* c^3 and c^5 c^7 respectively clamp the inner and outer edges of the diaphragm c^2 and constitute its bearings. These parts are constructed so as to leave a free span of one or two inches (or more, if required) between the bearings *c'* c^3 and c^5 c^7, and this free span between the said bearings permits the flange c^7, with its attached weighing-hopper, to rise and fall, as desired, for the weighing operation. In a similar manner the thin diaphragm i^2 is attached to the lower end of the pipe *i* by the plate i^3, and the screws i^4 of the forcing-pipe J by the plate *j* and the screws *j'*, and a free span of one or two inches (or more, if required) is also allowed between the bearings *i* i^3 and the bearings J *j* for the said diaphragm i^2 in a similar manner to that above described for the diaphragm c^2.

The diaphragms c^2 and i^2 are to be made of some thin flexible material—such, for instance, as sheet metal or india-rubber. These thin diaphragms, connected, as above described, to the relatively-fixed inlet and outlet of the weighing-hopper, and also to the said hopper or its attachments, will by their flexibility permit the weighing-hopper free vertical play for the purpose of permitting the weighing operation to be conducted undisturbed, and at same time will form, with the other attached parts, a continuous air-retainer for the proper development of the pneumatic action of the machine.

The pipe *c'*, which is attached to the bottom of the reservoir C, has a slide or cut-off, *c''*, which is to be moved by a lever from the outside, so as to open and close it quickly and at will when it is required to let the grain run into the weighing-hopper or shut it off therefrom.

Between the weighing-hopper and the grain-forcing pipe J there are two slides or cut-offs, I^2 and I^3, the first of which is used for holding the grain in the hopper while it is being weighed, and the other one is designed to hold the compressed air (which fills the pipe below it) from pressing up against the grain-slide, so as to interfere with the weighing operation. Both of these slides should move air-tightly in their ways, or should shut air-tightly when closed, and they should be operated by a single lever, so as to be opened and closed simultaneously. The air-compressor F drives compressed air through the pipe G′ into the grain force-pipe J, so as to carry the grain along with it through the said pipe J when the grain is let fall from the hopper I by the opening of the valves I^2 and I^3.

In order to prevent the air-blast from G′, when it first enters the pipe J, from driving the grain against the sides of the said pipe J with such force as to injure the grain, I lead the said pipe G′ into the pipe J by a helical curve, so as to gradually curve the air-current around and down into the pipe J in such a manner as to form an air cushion between the said pipe J and its contained moving column of grain. This air cushion between the grain and the pipe J will be maintained throughout the entire length of the said pipe with more or less continuity, and will prevent the attrition of the grain against the pipe to any injurious extent. As the air forcing-current, driven through the pipe G′ into the pipe J, will have a tendency to drive the grain in the direction of the line of the least resistance, it will be required to have the top of the hopper I closed air-tightly, so as to prevent the compressed air from blowing the grain out at the top of this hopper, and for the purpose of equalizing the air-pressure at the top and bottom of the grain in the weighing-hopper I conduct the compressed air from the pipe G′ into the top of the hopper I, above the grain therein contained, by means of an equilibrium pipe, K, through which the compressed air will pass into the top of the weighing-hopper and fill the cavity thereof as rapidly as the grain is drawn out, and by this construction the compressed air will be allowed to press on top of the entire mass of the grain in the said hopper with such force as to drive it out and up through the pipe J as soon as the valves I^2 and I^3 are open.

The pipe J may be conducted any desired distance or direction, and it will be provided with one or more switch-pipes, J′, for the purpose of forming a connection with a bin-pipe, J^2, or a shipping or distributing pipe, J^3. The bin-pipe J^2 extends to the top of the storage-bins—preferably one or more pipes to each bin. At the top end of this pipe it curves downwardly and enters the top of the receiver and cleaner L, into which it discharges the grain as it is elevated.

This receiver and cleaner has a double hopper-bottom, l and l', and each of these has a separate outlet, the outlet l^2 belonging to the upper bottom, l, and the outlet l^3 belonging to the lower bottom, l'. There are two sloping perforated diaphragms, L′ and L^2, set in the receiver L, as shown in detail in Fig. 9. The upper one of these diaphragms, L′, has its perforations large enough to permit the grain to pass through them; but large dirt, sticks, &c., will slide down on the top of this diaphragm and escape through the openings l^4 into the lower dirt-chamber, l^5, below the diaphragm L^2.

Secured to the top of the diaphragm L′, immediately below the discharge end of the pipe J^2, will be a series of deflectors, l^6, formed in the shape of the letter A and placed with their apexes on the medial line and pointing toward the top, while their arms are distended obliquely downwardly and outwardly, so as to distribute the current of the grain over the whole surface of the diaphragm in order to secure for each of the perforations the proper amount of grain to be passed. The lower diaphragm, L^2, has its perforations made so small as to prohibit the grain from passing through them, but large enough to permit all of the dust to go through along with the air which has been driven up through the pipe J^2. The air and dust thus passed through the diaphragm L^2 will mingle in the chamber l^5 with the dirt that has passed thereto through the chutes l^4 from the top of the diaphragm L′, and the dirt, dust, air, &c., thus mingled together in the said chamber l^5 will be drawn down through the pipe D′ to the exhauster E, whence they will be blown out and thrown away. The top end of the exhaust pipe D′ is connected air-tightly with the hopper-bottom outlet l^2, leading from the dirt-chamber l^5; and the lower end of the said pipe D′ may be connected with the exhaust-pipe D, or lead directly to the exhauster E. In either case the exhauster acts so as to draw a large part of the air out of the receiver L that is blown into it through the pipe J^2, so as to form or tend to form a partial vacuum in the said receiver, and thereby the column of grain passing up through the pipe J^2 is drawn up toward the top as well as forced up from the bottom by the action of the blast from the compressor F. The receiver L is is formed air-tight, except the openings for the inlet-pipe J^2 and the outlet-pipes l^2 and l^3. The grain which passes down over the top of the diaphragm L^2 escapes between the chutes l^4 into the grain-outlet chamber l^6, which is the space between the hopper-bottoms l and l', whence it escapes through the outlet l^3 into the bin A. The chutes l^4 are A-shaped in plan, and placed with their apexes toward the top, so as to permit the grain to pass between them without lodging on them. Small inclines will be constructed on top of the diaphragm L′, so as to turn all of the refuse from the top of this diaphragm into these chutes.

The diaphragms L′ and L^2 above described

may be fixed in the receiver L, so as to form a part of it; or they may be connected with suitable machinery, so as to be agitated, if required, so as to facilitate the cleaning operation.

The number of the diaphragms may readily be increased, if required, for any specific purpose; or there may be only the lower diaphragm, L^2, used if the cleaning be not further required. In this case the cleansing or removing the fine dust will be incidentally accomplished, the exhaust-blast through the perforations of the diaphragm L^2 and thence down through the exhaust-pipe D′ and exhauster E being required for the elevating process, the object being to lessen the pressure in the said receiver L below the normal atmospheric pressure in order to facilitate the lifting of the grain through the riser-pipe J^2.

When it is required to move the grain through the pipe J^3 any considerable distance longitudinally—as for shipping purposes—a discharging-exhauster M will be used, and connected by means of the exhaust-pipe N with a discharger, O, with which, also, the said pipe J^3 will be connected. This discharger O consists of two parallel chambers, O and O′, united together at their bottom ends by the curve O^2. An inclined perforated diaphragm, O^3, placed across the grain-pipe J^3, deflects the current of grain aside into the outlet-chute O^4, while the air will largely pass on through the perforations of the said diaphragm O^3, and return in the air-passage o' in the direction of the arrows o^5, and be thence drawn out through the exhaust-pipe N and expelled through the exhauster M. By means of this arrangement a partial vacuum is produced in the lower end of the outlet-pipe J^3, and the compressed air from the compressor F removed from the pipe J^3 just before it reaches the grain-outlet, and the combined action of the exhaust and force blasts are thus blended together for the economical and rapid movement of the grain.

The machine constructed as described operates in the following manner: A partial vacuum is created in the closed receiver C by the action of the exhauster E, and this partial vacuum, together with the induced current from the injector H, will cause the grain to flow into the said receiver C in a rapid and strong current from any contiguous source of supply—as, for instance, a wagon, a railway-car, or a vessel. The receiver C should be large enough to permit the flow of grain into it to be continuous until the boat or car could be emptied, and for this purpose it should be considerably larger than the weighing-hopper, as the action of the weighing-hopper or the discharge of grain from it must necessarily be intermittent. One charge of the weighing-hopper must be weighed and discharged before another charge can be let in from the receiver C. From the weighing-hopper the grain is discharged through the outlet-pipe J principally by the action of the forced pressure from the compressor F, though this may be aided somewhat for long or high distances by means of the partial vacuum created at the outlet end of the pipe J, in the manner fully described in the foregoing specification.

Although the machine above described has been alluded to only as a grain elevator and conveyer, it is obvious it may be used for other purposes—as, for instance, the excavation and removal of sand, either for dry or sub-aquatic excavation, with only such modifications as would fit it for such work, no weighing-hopper or cleaning mechanism being required for such other work.

Having described my invention, I claim—

1. The process of moving grain into a closed receiver by means of a partial vacuum formed in said receiver, and a combined current of compressed air injected into the grain-receiving pipe.

2. An air-tight weighing-hopper, in combination with and respectively attached to an air-tight receiver and a discharge-pipe by means of flexible attachments, so as to preserve the continuity of the air-passages, and at the same time permit the weighing-hopper free vertical play.

3. The injector H, having one or more nozzles, h^3, in combination with the grain-receiving pipe B B^3 and the compressed-air pipe G G^3.

4. The receiver C and the weighing-hopper I, with their connecting-pipe c', and the weighing-hopper flange c^7 and the interposed flexible diaphragm c^2, combined together substantially as and for the purpose set forth.

5. The weighing-hopper I, the discharge-pipe J, and the connecting-pipe i, and the interposed flexible diaphragm i^2, combined together substantially as and for the purpose set forth.

6. The compressed-air pipe G, constructed with a helical curve for blending it with the grain force-pipe J in a manner to gradually surround and propel the column of grain within the pipe J.

7. The twin slides or cut-offs I^2 and I^3, in combination with the weighing-hopper I and the pipes i and J, as and for the purpose described.

8. The weighing-hopper I and the pipes G′, i, J, and K, combined and arranged as and for the purpose set forth.

9. The receiver L, with its exhaust-pipes D D′, and exhauster E, in combination with the grain-forcing pipe J J^2 and the air-compressor F.

10. The receiver L, constructed air-tight except as to its inlet and outlet pipes, and provided with one or more perforated diaphragms, L′ L^2, and a dirt and air outlet, l^2, and a grain-outlet, l^3, substantially as and for the purpose set forth.

11. The receiver L, with its diaphragms L′ and L^2, the dirt-chutes l^4, the dirt-chamber

l^5, and the grain-chamber l^6, hopper-bottoms l and l', and outlets l^2 and l^3, constructed and arranged as and for the purpose set forth.

12. The receiver L, the weighing-hopper I, the exhauster E, and air-compressor F, with their respective pipes J J^2, D D′, and G G′, combined and arranged as and for the purpose set forth.

13. The discharger O, combined with the grain-discharging pipe J^3 and the air-exhauster M, substantially as and for the purpose set forth.

14. The discharger O, having inlet and outlet air-chambers O and O′, connected together by a curved coupling, O^2, and provided with a perforated diaphragm, O^3, for separating the grain from the air and discharging the grain through the chute O^4, substantially as described and set forth.

15. The weighing-hopper I, the grain-pipes J and J^3, the compressed-air pipes G and G′, the discharger O, the pipe N, and the exhauster M, combined together as and for the purpose set forth.

MAHLON RANDOLPH.

Witnesses:
PHILIP E. RAQUÉ,
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