

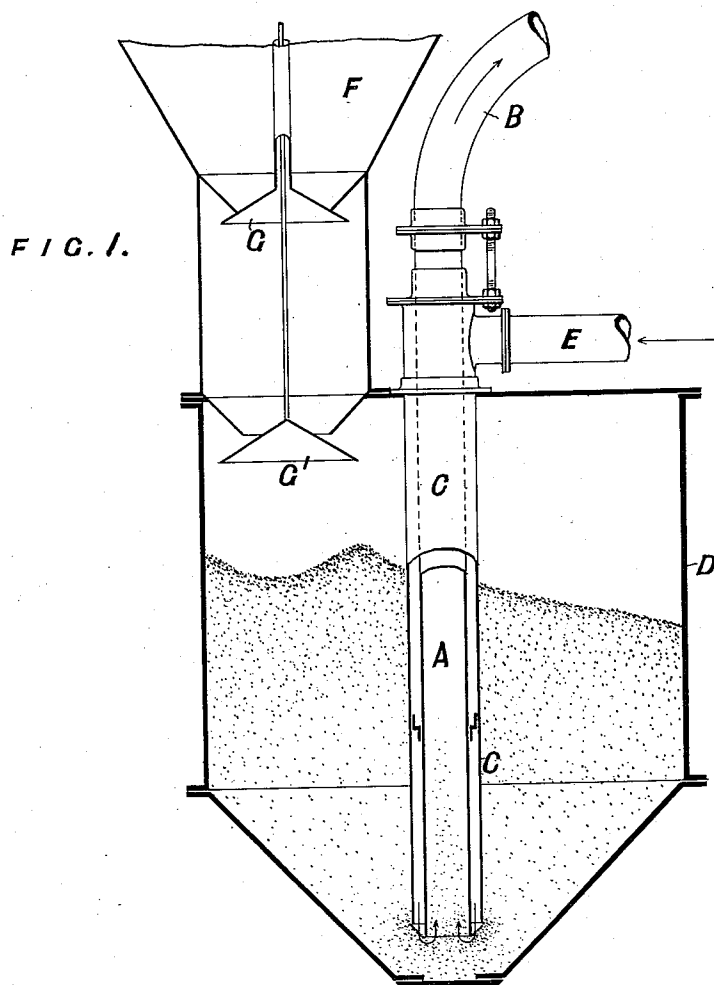
(No Model.)

3 Sheets—Sheet 1.

F. E. DUCKHAM.
METHOD OF CONVEYING MATERIALS.

No. 528,417.

Patented Oct. 30, 1894.



WITNESSES.

C. Sedgwick
A. W. Annaford

INVENTOR:

F. E. Duckham
BY *Munn & Co*

ATTORNEYS

(No Model.)

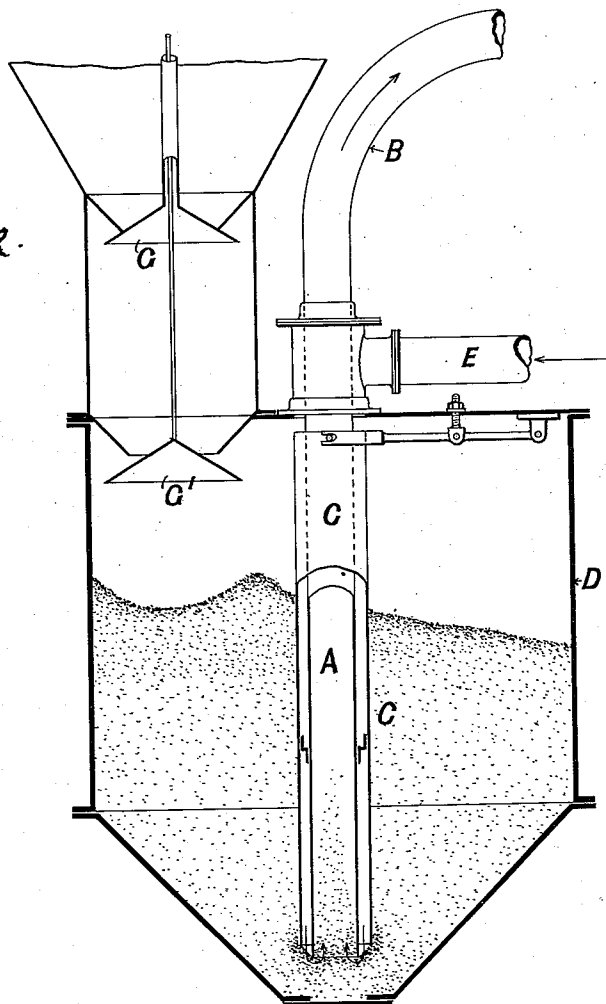
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FIG. 2.



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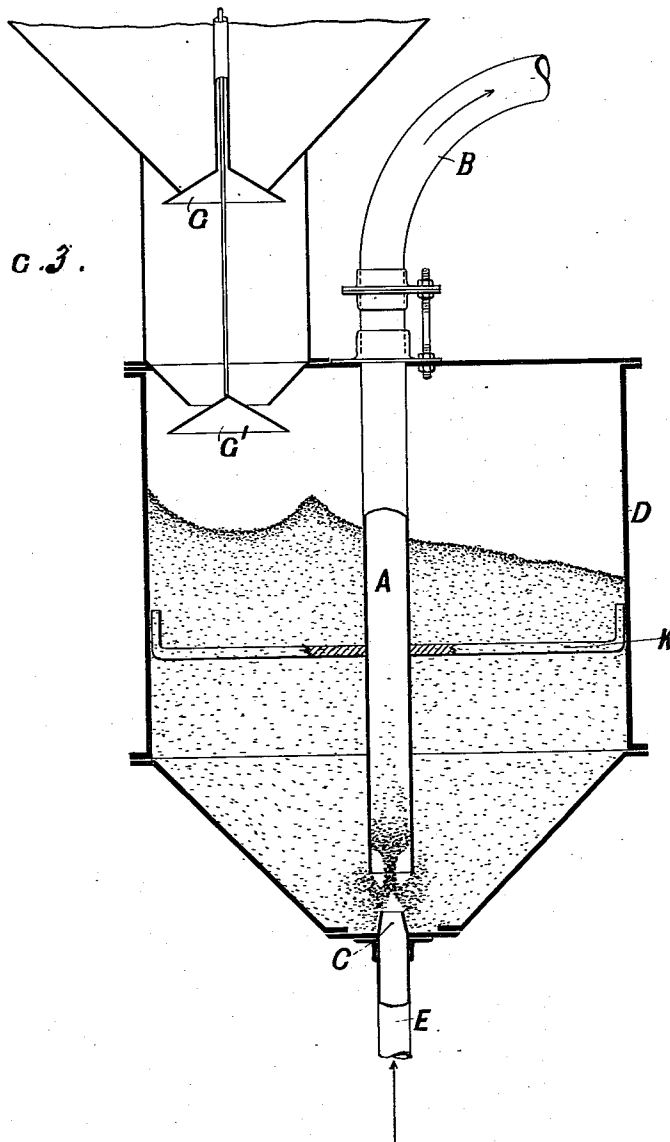
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FIG. 3.



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UNITED STATES PATENT OFFICE.

FREDERIC ELIOT DUCKHAM, OF LONDON, ENGLAND.

METHOD OF CONVEYING MATERIALS.

SPECIFICATION forming part of Letters Patent No. 528,417, dated October 30, 1894.

Application filed January 30, 1894. Serial No. 498,482. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC ELIOT DUCKHAM, civil engineer, of Millwall Docks, London, England, have invented now and useful Improvements in Methods of Elevating and Conveying Grain or other Matters by Pneumatic Agency, of which the following is a full, clear, and exact description.

This invention relates to an improvement in the methods of elevating and conveying grain or other granular or pulverulent matters in bulk by a current of compressed air, and it has for its object to insure the proper relative proportion of air to the solid matters carried thereby, so as to avoid all liability of choking the conveying pipe.

The improvement consists in injecting the air current into the midst of the grain or other material contained within a closed chamber under internal pneumatic pressure corresponding to the pressure of the blast, the air being so injected in such relation to the downwardly-directed mouth of an exit nozzle also immersed in the mass that the grain, &c., will be fed by gravity directly into the path of the blast and will be acted on positively by the direct force of the blast (and not by air currents set up by the inductive action of the blast) and be carried away thereby in an upward direction as fast as it is fed by the gravity of the superincumbent mass into the path of the blast. The exit of the matters thus carried off being in the inverse direction to the feed, the latter can not become so excessive as to cause choking of the exit pipe.

In the accompanying drawings, Figure 1 is mainly a central, vertical section of my preferred means for carrying my process into effect—the blast pipe being shown extended through the top of the air chamber and connected directly with the air-supply pipe. Fig. 2 is a view similar to Fig. 1, save that the blast pipe is not extended through the top of the air chamber, but adapted to slide on the nozzle of the air-supply pipe, which is connected directly with the said chamber. Fig. 3 shows a similar view of a modification, in which the top of the air chamber is closed and the air-supply pipe connected with the bottom of the same and so constructed and arranged relatively to the grain nozzle as to produce the

same operation or effect as in the apparatus shown in Figs. 1 and 2.

In all the figures A is the exit nozzle having its mouth directed downward, the nozzle leading upward in a more or less nearly vertical direction and being connected to a conveying pipe B leading to the place where the grain, &c., is to be conveyed and delivered.

C is the blast injecting pipe supplied with compressed air through a pipe E connected with a blowing engine or other supply of air under pressure, and D is a closed chamber, in the lower and preferably hopper-shaped part whereof the air blast is injected into the midst of, and caused to act on, the grain, &c., to be conveyed.

In Fig. 1 the blast pipe C is a sleeve surrounding the exit nozzle A and terminating at its lower end at such a height above the lower end of the nozzle that the grain, &c., will constantly flow by gravity beneath the end of the sleeve directly into the path of the air blast passing from the sleeve to the exit nozzle A so that the grain, &c., must be carried along with, and by the air, which can only escape through the nozzle, and that by carrying the grain along with it. In this case the motion of the air coming from the sleeve is similar in direction to that of the descending grain so that the air will assist the action of gravity in carrying the grain toward the mouth of the nozzle A. The depth of the grain, &c., thus directly interposed in the path of the blast is determined by the height at which the sleeve terminates above the mouth of the nozzle A and depends upon the angle of repose of the matters to be conveyed (which angle varies for different matters or for the same matters under different physical conditions) and upon the amount of air pressure employed, and other variable conditions of working. The relative height of the lower end of the sleeve C and of the mouth of the nozzle A is accordingly varied by making the one adjustable with regard to the other.

The chamber D is surmounted by a charging hopper F communicating with the chamber D through any suitable form of air lock chamber provided with independently-operated valves G G' which will permit of the entry of the solid matters without allowing the

compressed air to escape. At first starting any air that may escape from the blast otherwise than through the exit nozzle will percolate through the grain until the upper part of the vessel D is under substantially the same air pressure as the blast, so that equilibrium of pressure being established the head of grain, &c., in the chamber D need only be sufficient to maintain a constant feed to the point of application of the blast.

In Fig. 1 the sleeve C is closed at top and the compressed-air supply pipe is connected directly to it; whereas in Fig. 2 the compressed air supply pipe E is connected to the upper part of the vessel D, to which the upper end of the sleeve C is open above the level of the grain, &c., in said vessel, so that the sleeve receives the air from the upper part of vessel D and conveys it down to the point of action on the grain.

In Fig. 3 the chamber D is closed. The exit nozzle A has the mouth downwardly directed as before, but the blast injecting nozzle C instead of being of larger diameter than and surrounding the nozzle A in the manner of a sleeve is of lesser diameter than the nozzle A and is situated in axial alignment therewith and at a short distance therefrom so that the blast injected through C will be upwardly directed and enter the nozzle A after passing across the intervening space. The minimum distance intervening between the blast and exit nozzles must be such, having regard to the angle of repose of the grain or other matters, that the latter will flow by gravity di-

rectly into the path of the jet issuing from the nozzle C so as to be acted on directly and positively by the blast and be thereby carried up into the nozzle A. The maximum intervening distance is limited by the force or carrying power of the blast and should be so regulated that the relative proportion of air (reckoned at atmospheric pressure) to grain carried by it through the exit nozzle will be as about twenty-three to one by volume. The blast and exit nozzles are accordingly made adjustable relatively to one another to vary the intervening space. Karecrossbars in which the exit nozzle is supported and guided.

I claim—

The improvement in the art of conveying material from a closed vessel which consists in applying to the said material pneumatic pressure corresponding to the pressure of the air blast, and in injecting the air blast into the midst of such material, the current so injected being in such relation to an exit nozzle immersed in the mass that the material will be fed by gravity directly into the path of the blast, and will then be acted upon directly and positively by the blast and be carried thereby through the exit nozzle.

FREDERIC ELIOT DUCKHAM.

In presence of—

THOMAS LAKE,
17 Gracechurch Street, London, Notary's Clerk.

W. M. HARRIS,
17 Gracechurch Street, London, Notary Public.