No. 773,876. PATENTED NOV. 1, 1904.

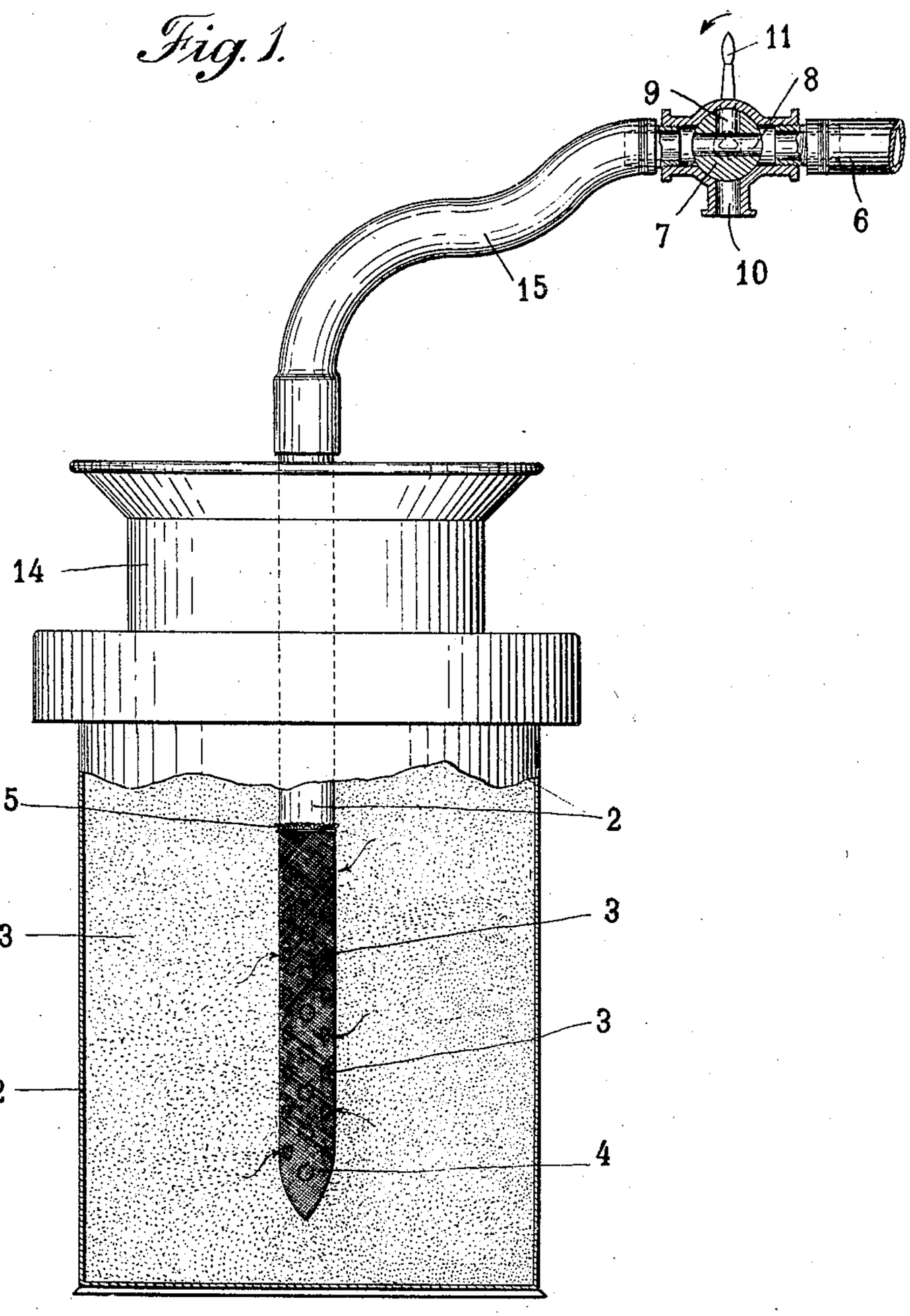
P. LORILLARD.

METHOD OF COMPACTING FINELY DIVIDED MATERIALS.

APPLICATION FILED JUNE 23, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

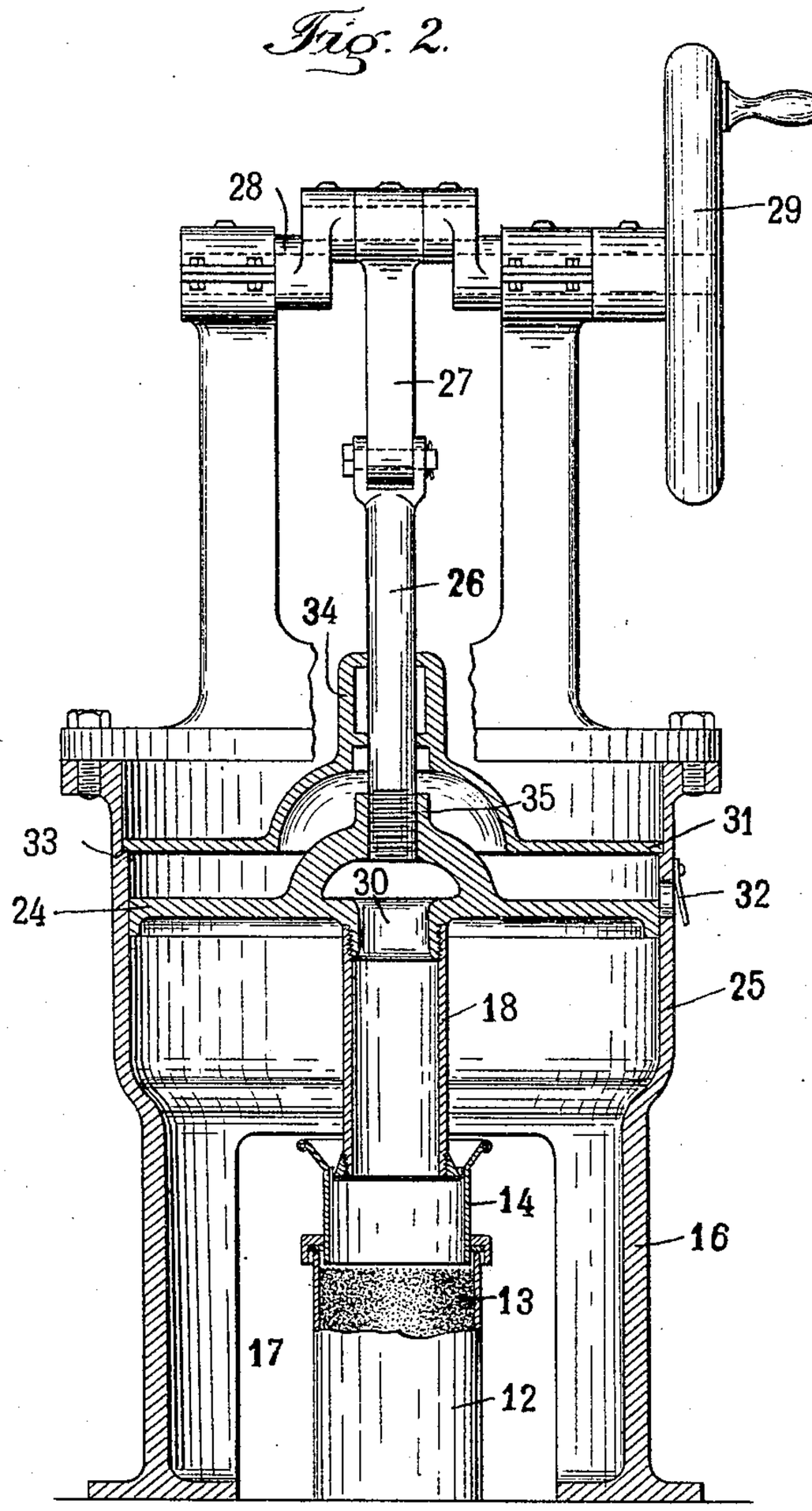


Fig. 3.

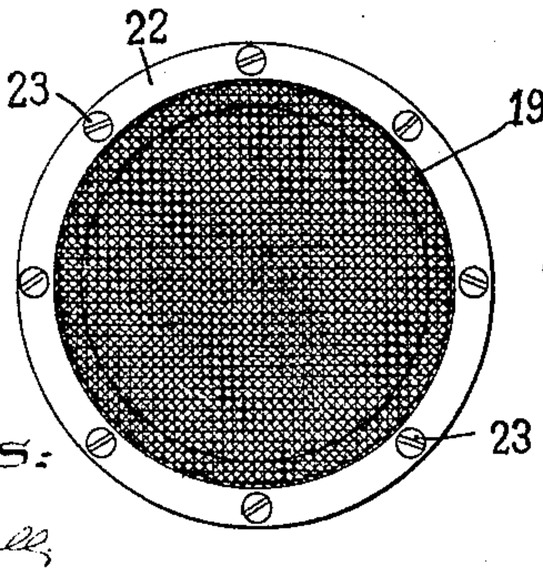
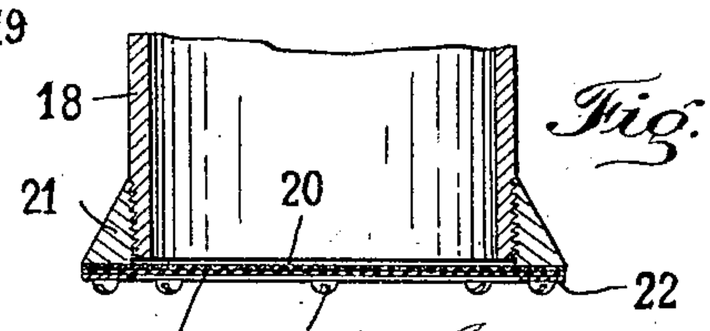


Fig. 4.



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No. 773,876. Patented November 1, 1904.

UNITED STATES PATENT OFFICE.

PIERRE LORILLARD, OF TUXEDO PARK, NEW YORK, ASSIGNOR TO AUTOMATIC WEIGHING MACHINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

METHOD OF COMPACTING FINELY-DIVIDED MATERIALS.

SPECIFICATION forming part of Letters Patent No. 773,876, dated November 1, 1904.

Application filed June 23, 1903. Serial No. 162,819. (No model.)

To all whom it may concern:

Be it known that I, PIERRE LORILLARD, a citizen of the United States, residing at Tuxedo Park, in the county of Orange and State of New York, have invented a new and useful Method of Compacting Finely-Divided Materials, of which the following is a specification.

In another application for Letters Patent of the United States, filed on the 23d day of June, 1903, Serial No. 162,818, I have described and claimed a method of settling or compacting masses of finely-divided materials, and especially fine and dry powders, such as baking-powder, which method resides, broadly speaking, in the withdrawal from a given mass of material of the air or a sufficient portion thereof with which such a material is normally charged or becomes charged during the processes of manufacturing and packaging it by establishing a differential pressure between the exterior and the interior of the mass of material, provision being made for the escape of the air from the material under the influence of the differential pressure referred to.

My present invention provides a method which is based on the method above referred to, but can be practiced more conveniently and effectively, is susceptible of application to a wider range of materials, and by means of which new and important results may be secured.

Briefly described, my present method resides in subjecting the mass of material operated upon, while contained in a suitable receptacle, to the action of a more or less perfect vacuum, and thereby withdrawing air from between the particles thereof and simultaneously subjecting said mass to a compressing pressure. This compressing pressure may be produced by the action of the normal atmospheric pressure upon the mass of material or it may be produced mechanically, as by a compressing-plunger, and in practice I prefer to employ the latter means for applying such a pressure, for reasons which will hereinafter appear.

In the accompanying drawings I have illustrated the practicing of my method in both ways above referred to, Figure 1 being a side elevation, partly in vertical section, of an apparatus used in connection with a receptacle containing material to be compacted and arranged to subject said material to the simultaneous action of a more or less perfect vacuum and of the normal atmospheric pressure; and Fig. 2 being a side elevation, partly in central vertical section, of an apparatus for subjecting a mass of material to the action of a more or less perfect vacuum and simultaneously compressing said mass by mechanical means. Figs. 3 and 4 are respectively a bottom plan view and a detail section of the lower end of a plunger shown in Fig. 2.

Referring to Fig. 1 of the drawings, the apparatus therein illustrated comprises a tube 2, provided at or near one end with a number of perforations 3, formed in the walls of the tube, the perforated portion of the tube being covered with a strainer of such fineness that it is pervious to air, but impervious to particles of the material to be operated upon. For fine and dry powders, such as baking-powder, this strainer may consist of a hood or sheath 4, made of thin fabric, such as bolting-cloth, and tightly secured to the tube 2, as at 5, which tube thus provides a rigid backing and support for the strainer. The other end of the tube 2 is connected with a pipe 6, which leads to an air-pump (not shown) or other suitable device for exhausting or withdrawing air from it and the tube 2. The withdrawal of air from the tube may be controlled by the two-way valve 7, which is provided with a passage 8, arranged to establish communication between the tube 2 and the pipe 6 when the valve is in the position shown and with a supplemental passage 9, arranged to establish communication between the tube 2 and an inlet 10 whenever the operating-handle 11 is turned in the direction indicated by the arrow through an angle of ninety degrees from the position shown. When the valve is in the former position, the inlet 10 will evidently be closed, and when the valve is in the latter position communication between the tube 2 and the air-pump will be cut off. 12 represents a

receptacle containing a quantity of material 13, and 14 represents a riser, such as is commonly employed for holding the excess material until the latter has been compacted.

In practicing my method with the apparatus above described the strainer end of the tube 2 is inserted into the uncompacted mass of material contained in the receptacle and riser, and the valve 7 is then turned into the position shown, thus establishing communication between the tube 2 and the pipe 6. A more or less perfect vacuum is thereupon produced within the perforated lower end of the tube 2 and at the adjacent or inclosing surface of the mass of material, and by reason of this reduction of air-pressure the air with which the material is charged flows from all directions toward and into the tube through the strainer 4 and perforations 3, while at the same time the normal atmospheric pressure acting upon the exposed top surface of the mass of material through the open top of the riser exerts a compressing action upon said mass. The result is that the material is instantly compacted and settled by gravity and by the atmospheric pressure acting upon it and is forced into the receptacle 12, which is to contain it. The valve 7 is thereupon turned to cut off communication between the tube 2 and the air-pump and to establish communication between the tube and the external air, and said tube is then withdrawn from the receptacle and the contained material. The hole left in the material by withdrawing the tube may be filled by giving a slight tap or jar to the receptacle.

For the purpose of enabling the tube 2 to be conveniently inserted into and withdrawn from the receptacle it may be connected with the pipe 6 by means of a piece of flexible tubing 15.

My method when practiced as described will give quick and satisfactory results with powders the particles of which are dry and mobile and do not tend to stick to one another; but the results are less satisfactory when materials of a less mobile nature—such as flour, for example—are operated upon, and in practicing my method in connection with such materials I therefore prefer to develop the compressing pressure by mechanical means instead of relying upon the pressure of the atmosphere for that purpose. I can thereby secure a compressing force of any desired amount, and I can also prevent cracks from forming in the mass of material operated upon under the influence of the vacuum to which it is simultaneously subjected. Such cracks are likely to be formed in some materials in the absence of any mechanical compressing action, and the atmospheric pressure will obviously have no tendency to close them in case they extend through the exposed surface of the material.

My method may be practiced in the manner last described by means of the apparatus shown in Fig. 2, in which 16 represents a supporting-frame provided at its bottom with an aperture 17, through which a receptacle and riser filled with material to be operated upon may be inserted and withdrawn, and 18 represents a hollow plunger, the lower end of which is covered by a strainer of a fineness suitable for the material to be operated upon. For very finely-divided materials this strainer, like the strainer shown in Fig. 1, is preferably composed of a sheet of bolting-cloth 19, supported by a suitable backing 20, which in this case is made of wire-gauze, the gauze and bolting-cloth being carried by a ring 21, which is adapted to be screwed onto the lower end of the plunger 18. The gauze and bolting-cloth are secured to the ring 21 by means of a supplementary ring 22, which is fastened to the ring 21 by screws 23 and between which and said ring 21 the edges of the gauze and bolting-cloth are thus clamped. For coarser materials a coarser strainer may be used. For example, the wire-gauze alone may serve as a suitable strainer in some cases, the object in all cases being to permit the passage of air from the material into the hollow plunger and to prevent the passage of particles of the material itself. The plunger 18 is provided with suitable means for reciprocating it, and in connection therewith means are also provided for exhausting air more or less perfectly from within the plunger during its downward or compressing stroke. These means comprise a piston 24, mounted to slide in a casing 25, forming the upper portion of the framework 16, a guided rod 26, connected to said piston, a connecting-rod 27, a crank-shaft 28, and a hand-wheel 29. The piston 24 is provided with an opening 30, establishing communication between the hollow plunger and the casing above the piston, and the top of the casing is closed during at least a portion of the downward stroke of the plunger by means of a cover 31. Thus as the plunger 18 descends the separation of the piston 24 from the cover 31 produces a partial vacuum within the casing above the piston, and therefore within the hollow plunger itself and behind the strainer. The area of the piston is considerably greater than the transverse area of the plunger in order that a slight downward movement of these parts may effect a substantial reduction of pressure within the plunger. It is desirable to reëstablish a substantially normal atmospheric pressure above the piston 24 before it commences an upward stroke in order to prevent any tendency of the material to adhere to the plunger and be lifted by it out of the receptacle, and to this end the piston is made to fit the casing somewhat loosely, so that during the slight dwell at the bottom of each stroke of the piston sufficient air will pass around it and into the casing to break the vacuum above the piston, and as the

piston rises the air thus admitted above it is expelled through a check-valve 32, so that it does not have to pass out through the strainer, and thus blow the material in the receptacle. It is often desirable, however, to provide for a slight blow through the strainer near the end of the upward stroke of the piston in order to clear the strainer from adhering particles of material, and in this case the check-valve 32 is located in the side of the casing at such a point that it will be passed by the piston just before the latter reaches the end of its upward stroke. The result of this arrangement is that the last portion of each upward movement of the piston will slightly compress the air above it and produce the slight blow through the strainer above referred to.

In practicing my method with the apparatus shown in Fig. 2 a receptacle 12, provided with the usual riser 14, if necessary, and containing the uncompacted material 13, is placed beneath the plunger 18, while the latter is at the limit of its upward stroke. The piston 24 and plunger 18 are then moved downward, whereupon the working face of the plunger, which is formed by the strainer above described, engages the top surface of the material and forcibly compresses it, and at the same time the movement of the piston away from the top of the casing produces a partial vacuum above the piston and in the plunger, and consequently at the surface of the material adjacent to the strainer at the lower end of the plunger, with the result that a considerable portion of the air with which the material is charged expands and is drawn through the strainer and into and through the hollow plunger, while the particles of material, being unable to pass through the strainer, are compressed and compacted by the pressure exerted upon them.

In case it is desirable to cause the piston 24 to perform a portion of its downward stroke before producing any reduction of the air-pressure behind it, as when the riser 14 is only partially filled with material, for example, the cover 31, which closes the top of the casing, is made separable from the casing proper, as shown, and is so located and arranged that when the piston reaches a certain point in its upward stroke it will engage said cover and lift it away from the top of the casing. This mode of operation is provided for by forming a ledge 33 on the inside of the casing, on which ledge the cover 31 is adapted to rest, and said cover is provided with a central guiding portion 34, through which the rod 26 passes and which forms a stop adapted to be engaged by the upper end 35 of the piston 24 when the latter has reached a certain point in its upward stroke. When the point just referred to has been reached in the operation of the piston, the upper end 35 of the latter engages the cover 31 and lifts said cover with it during the remainder of its upward stroke, and no vacuum can be produced during the downward stroke of the piston until said cover has been lowered sufficiently to cause it to rest upon the ledge 33, whereupon the remainder of the downward stroke of the piston produces the necessary vacuum, as above described. In all cases there should be some reduction of pressure within the plunger before the strainer engages the material.

My method has an important application in compacting many kinds of finely-divided materials other than fine powders, especially those which are light and flaky and which, although normally of excessive bulk and containing a considerable amount of air, are not so troublesome on account of blowing as are fine and dry powders. The light and flaky type of materials is well represented by many of the cereal foods now commonly used, which are usually put up in paper or pasteboard packages or cartons, as distinguished from rigid metallic receptacles. It is possible to compress such materials by ordinary plungers in most cases, but it has been necessary in such cases to support the yielding walls of the cartons externally in order to prevent them from bursting under the pressure exerted by the compressing-plunger. I have found, however, that when my method is employed for compacting such materials in non-rigid cartons a sufficient vacuum may be produced within the mass of material operated upon to cause the normal atmospheric pressure, acting upon the exterior of the carton, to afford an ample support for the walls of the latter, thus rendering the use of mechanical supports unnecessary. Furthermore, I have found that by my method materials, such as flour and flour preparations, may be very solidly compacted in cloth or paper bags without either bursting the bags or requiring them to be supported externally by mechanical means.

I do not claim, broadly, herein the method of compacting finely-divided materials which forms the subject-matter of my prior application Serial No. 162,818, above referred to, nor do I claim herein the forms of apparatus herein shown and described for practicing my present method, this apparatus being claimed in other applications for Letters Patent filed by me on the 23d day of June, 1903, and serially numbered, respectively, 162,820 and 162,821.

I do not consider my present method to be limited to the use of any specific devices or apparatus for developing and applying the concurrent vacuum and compressing pressure, the apparatus shown in the drawings being merely illustrative of simple and efficient means for practicing my method.

I claim as my invention—

1. The method of compacting a mass of finely-divided material which consists in si-

multaneously subjecting said mass, in a retaining-receptacle to the action of a compressing pressure and of a less than normal atmospheric pressure.

2. The method of compacting a mass of finely-divided material in a retaining-receptacle which consists in withdrawing air from between the particles composing said mass and simultaneously applying a compressing pressure thereto.

3. The method of compacting a mass of finely-divided material in a retaining-receptacle which consists in subjecting said mass to the action of a less than normal atmospheric pressure and simultaneously compressing said mass mechanically.

4. The method of compacting a mass of finely-divided material in a retaining-receptacle which consists in mechanically applying a compressing pressure to an exposed surface of said mass and simultaneously producing a less than normal atmospheric pressure at said surface.

5. The method of compacting a mass of finely-divided material in a non-rigid receptacle which consists in simultaneously subjecting said mass to the action of a compressing pressure and of a less than normal atmospheric pressure, and also exposing the exterior of said receptacle to atmospheric pressure.

6. The method of compacting a mass of finely-divided material in a non-rigid receptacle which consists in subjecting said mass to the action of a less than normal atmospheric pressure and simultaneously compressing said mass mechanically, and also exposing the exterior of said receptacle to atmospheric pressure.

In testimony whereof I have hereunto subscribed my name this 17th day of June, 1903.

PIERRE LORILLARD.

Witnesses:
E. D. CHADWICK,
ROLLA W. BARTLETT.