Feb. 10, 1959 F. SCHÄFER ET AL 2,873,049

PROCESS AND APPARATUS FOR DISTRIBUTING A FLUIDIZED SOLID MATERIAL

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Fig. 1

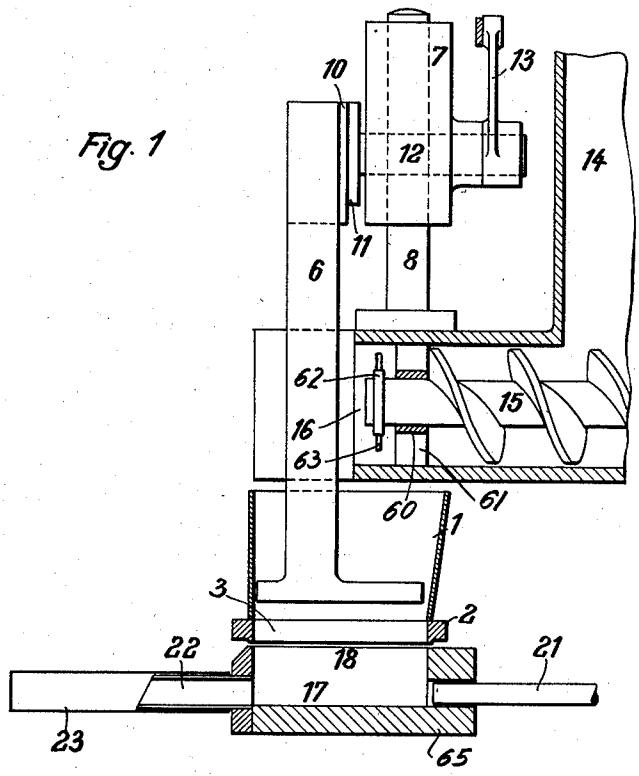
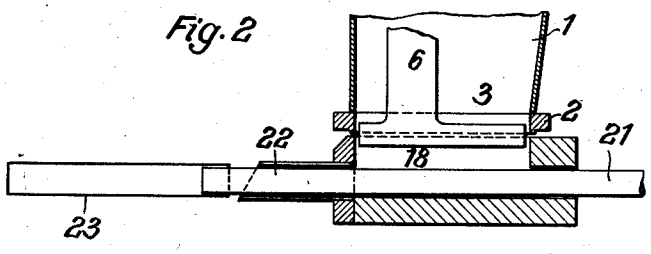


Fig. 2



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Fig. 3

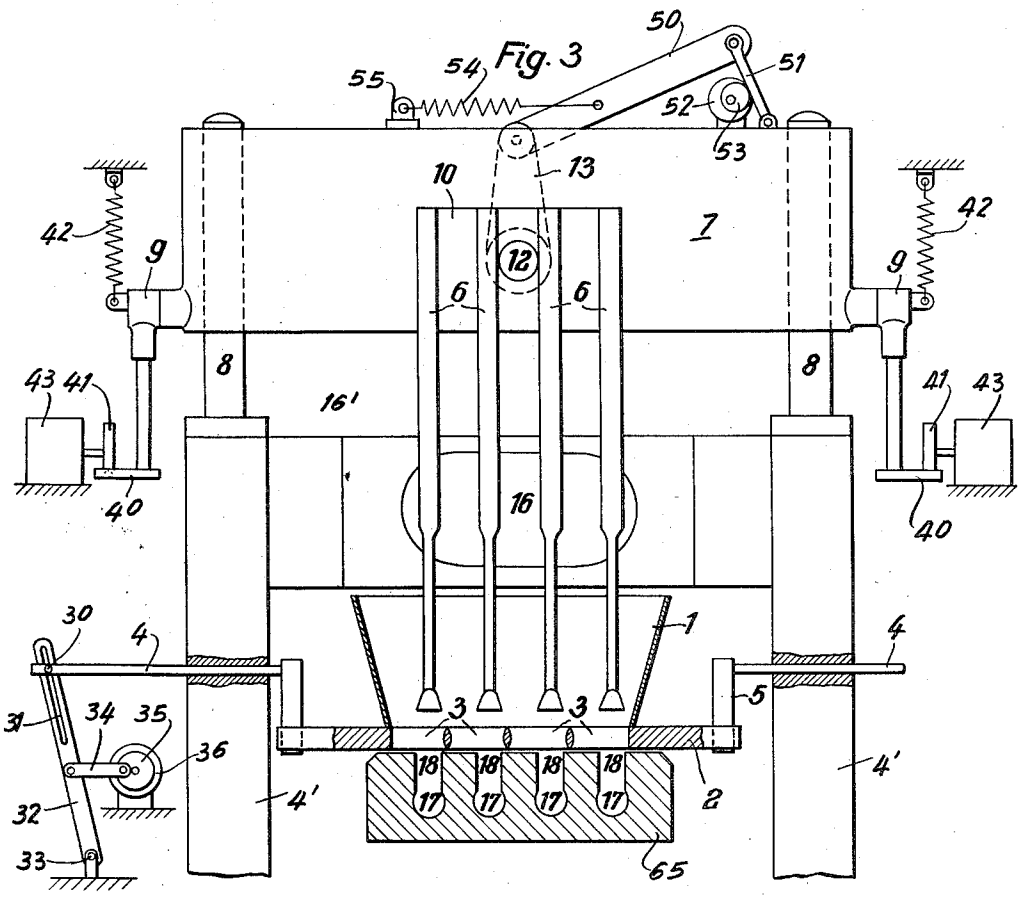
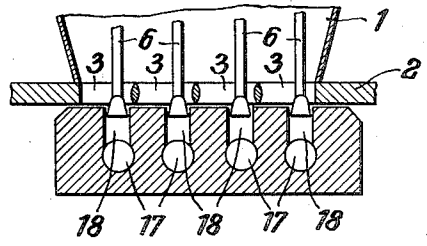


Fig. 4



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Fig. 5

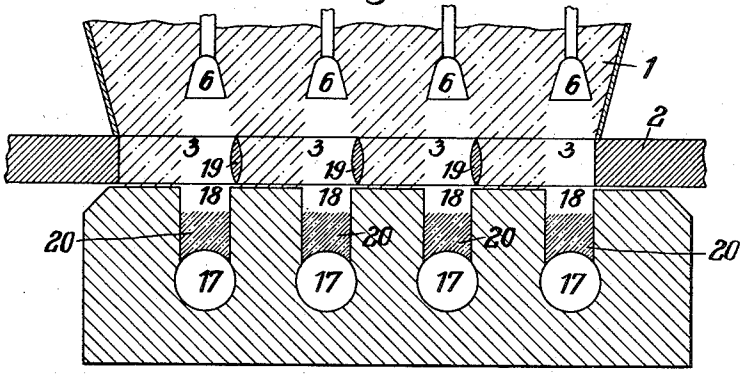


Fig. 6

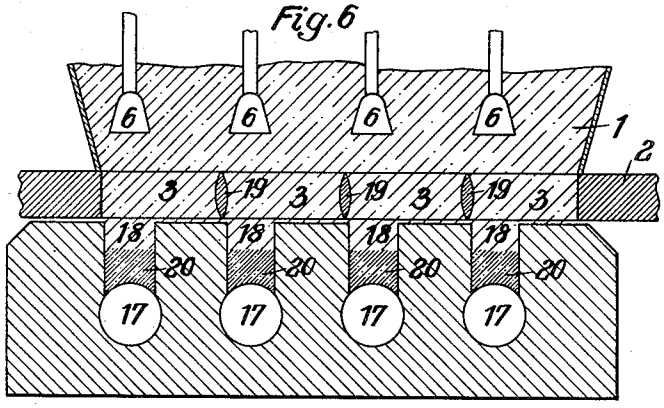
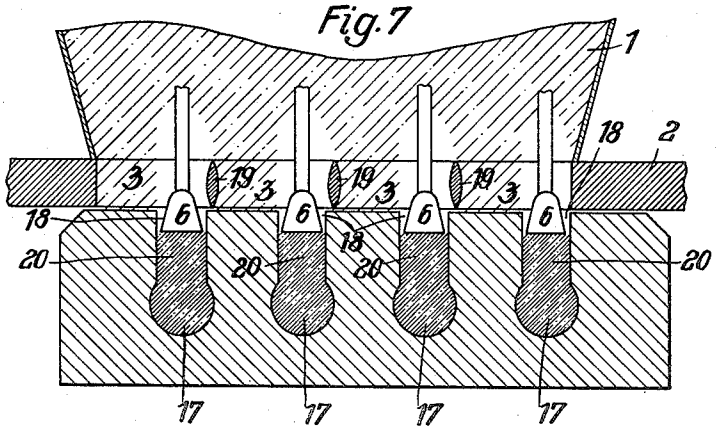


Fig. 7



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PROCESS AND APPARATUS FOR DISTRIBUTING A FLUIDIZED SOLID MATERIAL

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Application May 21, 1956, Serial No. 586,195

Claims priority, application Germany May 20, 1955

8 Claims. (Cl. 222—1)

The present invention relates to a process and apparatus for distributing a fluidized solid material.

The process and apparatus of the present invention may be used, for example, for distributing a fluidized solid material such as an explosive which may be in powder form or in a semi-plastic form.

Up to the present time devices for distributing such materials as, for example, explosives of the above type are extremely complicated in construction and the filling process takes a considerable period of time because where the material is filled into a paper envelope, for example, only one envelope is filled at one time.

One of the objects of the present invention is to provide a process and apparatus capable of filling a plurality of containers such as paper envelopes or the like simultaneously with a fluidized solid material such as an explosive powder or the like.

Another object of the present invention is to provide a process and apparatus capable of uniformly distributing the fluidized solid material and at the same time guaranteeing that the material is distributed in such a way that it has a uniform density and weight distribution.

It is also an object of the present invention to provide a machine for distributing a fluidized solid material and characterized by great simplicity.

An additional object of the present invention is to provide a process and apparatus for distributing a fluidized solid material in such a way that the friction between the part of the material which is ejected from a receptacle into a paper container or the like and a part of the material remaining in the receptacle is not undesirably high.

With the above objects in view the present invention mainly consists of an apparatus for distributing a fluidized solid material and including a hopper having an open top and bottom downwardly through which the fluidized solid material is adapted to flow. A ramming means extends into the hopper and is adapted to move in a vertical direction for ramming the fluidized solid material downwardly out of the hopper. The hopper is connected to a means which is capable of reciprocating the same back and forth in a direction transverse to the vertical movement of the ramming means and the downward movement of the fluidized solid material through the hopper, so that the fluidized solid material is prepacked and uniformly distributed beneath the ramming means before the latter moves downwardly along its ramming stroke. Also, with the above objects in view, the present invention mainly consists of a process for distributing a fluidized solid material and including the steps of vibrating a hopper in which the fluidized solid material is located in a horizontal direction which prepacks and uniformly distributes the material beneath a ramming means while simultaneously vibrating the ramming means in a horizontal direction, and then moving the ramming means downwardly along its ramming stroke to ram the fluidized solid material into a row of compartments of a receptacle. The material which is thus rammed into these compartments is ejected therefrom, and just before the ejection the ramming means is raised to a very slight distance so that the friction between the portion of the material which is ejected and that which remains in the compartments is not undesirably high.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a fragmentary, partly sectional, elevational view of one possible construction of an apparatus according to the present invention and capable of carrying out the process of the present invention, the ramming means being shown in Fig. 1 in its upper rest position;

Fig. 2 is a fragmentary sectional, elevational view showing part of the structure of Fig. 2 in the position which it takes when the ramming means is at the bottom of its ramming stroke and when an ejecting means has been actuated to eject the rammed material;

Fig. 3 is a transverse, partly sectional, elevational view showing the apparatus in the same position as in Fig. 1;

Fig. 4 is a transverse, sectional view showing the structure in the position of Fig. 2;

Fig. 5 is a transverse, sectional elevational view illustrating the process of the present invention just before the steps of the process are started;

Fig. 6 illustrates the process at an intermediate stage; and

Fig. 7 shows the process of the present invention at the end of the ramming stroke of the ramming means.

Referring now to the drawings and to Figs. 1–4 in particular, it will be seen that the structure of the invention includes a hopper 1 which is open at its top and bottom so that a fluidized solid material such as an explosive powder, for example, may flow downwardly through the hopper 1. The bottom end of the hopper 1 is formed by an opening in a wall 2 which carries the remainder of the hopper 1, the portion of the hopper 1 which extends upwardly from the wall 2 being fixed thereto as by welding or the like, for example. The wall 2 is horizontal and the bottom opening of the hopper 1 formed by the opening of the wall 2 is provided with a plurality of elongated passages 3, as is evident from Figs. 1–4. These elongated passages 3 are formed by a plurality of bars 19 (Fig. 5) which are fixed to the horizontal wall 2 and which extend across the opening therein, these bars 19 being parallel to each other so as to form the elongated passages 3.

In accordance with the present invention a means is provided for horizontally reciprocating the hopper 1, and this means includes a pair of rods 4 which are guided for reciprocating movement along their axes by extending through suitable openings formed in the side walls 4' of a frame which supports the entire apparatus. The rods 4 are fixed to the upper ends of bars 5 which in turn are fixed at their lower ends to the wall 2, so that when the rods 4 are reciprocated back and forth, to the right and left, as viewed in Fig. 3, then the hopper 1 is reciprocated in a horizontal direction. Any suitable means may be used to provide the reciprocation of the hopper 1, and as is shown in Fig. 3, the left rod 4 has a pin 30 fixed thereto and extending into an elongated slot 31 formed in a lever 32 which is pivotally supported at its bottom end by a pivot pin 33 carried by a stationary support means of the apparatus of the invention. A link 34 is pivotally connected at its left end to the lever 32 and at its right end, as viewed in Fig. 3, to a disk 35

which is centrally fixed to the drive shaft of a motor 36 so that during rotation of the latter the link 34 will cause the lever 32 to turn back and forth through an angle which will give the rods 4 a horizontal reciprocation to be transmitted to the hopper 1.

A ramming means is provided in order to ram the fluidized solid material in the hopper 1 downwardly out of the same, and this ramming means includes a plurality of elongated ramming members 6 having at their bottom ends elongated ramming portions which extend horizontally and which are capable of moving with clearance through the passages 3 at the bottom of the hopper 1. The ramming members 6 are located at their upper end portions in elongated cutouts formed in a block 10 of aluminum, for example, and these ramming members 6 are fixed to the block 10 by any suitable screw members or the like. The block 10 is in turn affixed to a plate 11 as by being screwed thereto, this plate 11 being shown in Fig. 1, and the plate 11 is itself affixed as by welding or the like, for example, to an elongated shaft 12 which is carried for turning movement about its axis by a member 7 formed adjacent its opposite side edges with elongated vertically extending bores through which a pair of guide bars 8 slidably extend in a vertical direction, as is evident from Fig. 3. Thus these guide bars 8 guide the member 7 for vertical movement, and the ramming members 6 together with the members 10 and 11 move vertically with the carrier member 7. The guide bars 8 are carried by the side walls 4' of the supporting frame.

A moving means is provided in order to move the ramming means both upwardly and downwardly and this moving means includes a pair of bars 9 affixed to and extending downwardly from the carrier member 7, these bars 9 being located outwardly of the guide bars 8. The bars 9 are parallel to each other and each bar 9 has a plate 40 affixed to its bottom end in any suitable way as by being threaded thereon or as being welded thereto. A pair of cams 41 of identical construction respectively engage the plates 40, and a pair of coil springs 42 are respectively connected at their bottom ends to the bars 9 so as to urge the latter upwardly and in this way maintain the plates 40 in engagement with the cams 41. The upper ends of the springs 42 are respectively fixed to any stationary members. A pair of motors 43 which are operated in synchronism are connected to the cams 41 to turn the latter, and the cams 41 have a shape which will move the ramming members 6 downwardly along their ramming stroke through a desired distance, then upwardly through a very slight distance such as 1 or 2 mm., and then finally back up to their rest position which is shown in Figs. 1 and 3.

The ramming stroke of the ramming means may be adjusted in any suitable way. Thus, if desired, the ramming members 6 may be connected to the block 10 in such a way that the elevation of the ramming members 6 may be adjusted, or, the cams 41 may be replaced by other cams having somewhat different shapes so that in this way also the stroke of the ramming means may be regulated.

A further feature of the present invention is that the ramming members 6 themselves may be reciprocated in a substantially horizontal direction for a purpose described below, and for this purpose the right end of the shaft 12, as viewed in Fig. 1, has a crank 13 fixed thereto. As may be seen from Fig. 3, the upper end of the crank 13 is pivotally connected to an elongated link 50 which is pivotally connected at its right end, as viewed in Fig. 3, to a second link 51 whose bottom end is pivotally connected to a stationary lug which is fixed to the top surface of the carrier member 7. A motor 52 is carried by this carrier member 7 and rotates a cam 53 which engages the link 51, and a spring 54 is connected at its right end, as viewed in Fig. 3, to the link 50 and at its left end, as viewed in Fig. 3, to a lug 55 fixed to the top face of the carrier member 7, so that the spring 54 maintains the link 51 in engagement with the cam 53. Thus, during operation of the motor 52 the cam 53 will cause the lever 51 to turn back and forth through a relatively small angle, as may be seen from the shape of the cam 53 in Fig. 3, and as a result the crank 13 will turn back and forth through a relatively small angle and the ramming members 6 will reciprocate in a substantially horizontal direction with the hopper 1.

The material which is to be distributed is supplied to a hopper 14, this hopper 14 being shown at the right portion of Fig. 1. The material is advanced to the left, as viewed in Fig. 1, from the hopper 14 by a screw 15 which is supported for rotation about its axis and which is turned from any suitable drive which is not shown in the drawings. The pair of side walls 4' of the frame carry a transverse wall 16' which is formed intermediate the walls 4' with a substantially oval-shaped opening 16, as is evident from Fig. 3, and as is shown in Fig. 1 the screw 15 extends into the opening 16. Within the opening 16 is located a bearing 60 for the screw 15, this bearing 60 being carried by a plurality of members 61 which are fixed to the outer face of the bearing 60 and which extend radially therefrom to the member 16' to which they are fixed as by welding or the like within the opening 16. At its left end, as viewed in Fig. 1, just beyond the bearing 60, the screw 15 carries a ring 62 which is fixed thereto as by any suitable set screw or the like, and this ring 62 has a plurality of bars 63 fixed to and extending radially therefrom so that the fluidized solid material is agitated by the bars 63 which turn with the screw 15 and as a result any of the fluidized solid material which tends to cling together in an undesirable manner is broken up. The material which is supplied in this way simply falls into the hopper 1.

Directly beneath and in engagement with the bottom wall 2 of the hopper 1 is a receptacle 65 provided with a row of compartments each of which includes a lower portion 17 and an upper portion 18. As is evident from the drawings, this row of compartments extends along the space beneath the bottom open end of the hopper 1, and the wall 2 engages the top face of the receptacle 65. The compartments are open at their top so that a fluidized solid material may flow from the hopper 1 directly into the compartments. The upper portions 18 of the compartments are of substantially rectangular cross section while the lower portions 17 are cylindrical. A plurality of ejector members 21 extend slidably into the receptacle 65 which is stationary and these ejector members 21 are respectively in alignment with the bottom portions 17 of the compartments so that when the ejector members 21 are moved in any suitable way from the position of Fig. 1 to that of Fig. 2 they will eject from the lower portions 17 of the compartments material which has been rammed into the same by the ramming members 6. Opposite the ejector members 21, the compartment 65 is provided with a wall carrying a plurality of tubular outlets 22 which respectively communicate with the portions 17 of the compartments and which are respectively in alignment with the ejector members 21 so as to receive the latter, as is evident from Fig. 2. These tubular members 22 are adapted to carry the paper envelopes or the like 23 into which the rammed material is moved by the ejector members 21.

The process performed by the above described structure will be understood by referring to Figs. 5–7. Fig. 5 shows the parts in the position which they take at the beginning of the process and just before the process has started. The dot-dash lines in the hopper 1 in Fig. 5 as well as in Figs. 6 and 7 indicate the places where the fluidized solid material is located. It will be noted that in Fig. 5 there are empty spaces beneath the ramming members 6. These empty spaces have been created by the upward movement of the ramming members 6 at the end of the preceding cycle of operations. The ramming members 6 are shown in their rest position in Fig. 5 and during their upward movement to this rest position

they create in the fluidized solid material the empty spaces shown in Fig. 5 beneath the ramming members 6. Furthermore, it will be noted that a packed material 20 is located within the portions 18 of each of the compartments of the receptacle 65. These bodies 20 of packed material have been formed by the preceding cycles of operations but were not moved out of the receptacle 65. Only the packed material in the lower cylindrical portions 17 of the compartments is ejected from the receptacle 65.

With the parts in the position of Fig. 5, a cycle of operations starts, and this cycle of operations includes first the operation of the motor 36 so as to horizontally reciprocate the hopper 1 to the right and left, as viewed in Figs. 5–7. This hopper 1 is reciprocated in this manner a plurality of times, and as a result the loose material in the hopper 1 becomes distributed beneath the ramming members 6. Furthermore, during this reciprocation of the hopper 1 the bars 19 move back and forth so as to provide a uniform distribution of the fluidized solid material which now fills the portions of the compartment parts 18 located above the bodies 20 of packed material. Also the material fills the spaces beneath the ramming members 6, as is evident from Fig. 6. The drawings show in Figs. 5 and 6 the different positions taken by the hopper 1 during this horizontal reciprocation.

To guarantee a perfectly uniform distribution of the material prior to the downward movement of the ramming members 6 along their ramming strokes, respectively, these members 6 themselves are reciprocated back and forth horizontally, and in order to accomplish this the motor 52 is operated simultaneously with the motor 36. Thus, the horizontally reciprocating hopper as well as the horizontally reciprocating ramming members 6 provide on the one hand a uniform distribution of the material between the ramming members 6 and the bodies 20 of previously rammed material located in the compartment portions 18, and on the other hand the material which is uniformly distributed in this manner is also prepacked by the reciprocation of the hopper 1 and the ramming members 6. After the ramming members 6 and the hopper 1 have been horizontally reciprocated a number of times, the motors 36 and 52 are stopped, and now the ramming stroke takes place, the motors 43 being started for this purpose. The cams 41 cause the plates 40 and the bars 9 to move down so as to pull the carrier member 7 down against the force of the springs 42. As a result the ramming members 6 move down from the position of Fig. 6 to that of Fig. 7 creating the empty spaces shown in Fig. 7 which remain during the upward movement of the ramming members 6 back to the position of Fig. 5 at the end of the process so as to provide the free spaces beneath the ramming members 6, as shown in Fig. 5. The downward movement of the ramming members 6 along their ramming strokes packs material between the ramming members 6 and the previously packed body 20 into the compartments 17, 18 above these bodies 20 so that the latter are now moved downwardly into the compartment portions 17 and packed therein and new bodies 20 are created, as shown in Fig. 7. In accordance with the present invention, before the ejectors 21 are actuated to eject the packed material in the compartment portions 17, the cams 41 have such a shape that at the end of the ramming stroke the ramming members 6 are raised through a distance of one or two mm. by the springs 42 so that when the ejector members 21 move along their ejecting strokes the part of the packed material within the compartment portions 17 can be moved out of the same without practically any frictional resistance produced by the engagement of the body of ejected material with the bodies 20 which remain in the compartment portions 18 after the ejection is completed. In this way the power required to operate the ejectors 21 is not wasted in overcoming unnecessary friction and the ejectors 21 can operate quickly and easily to eject cylinders of packed fluidized solid material through the tubes 22 and into the paper envelopes 23 which receive the packed cylinders of fluidized solid materials and which are moved by their ejectors members 21 themselves off from the tubes 22, as is evident from Fig. 2, so that the filled envelopes 23 may be very easily removed from the machine. These paper envelopes 23 when they are filled with a packed explosive powder, for example, may be used for cartridges and the like. After the material is ejected the ramming members 6 are raised by the rotation of the cams 41 and the springs 42 to their rest position and the apparatus is ready to carry out the next cycle of operations.

It will be noted that with the process and apparatus of the invention it is possible to fill a plurality of containers similar to the containers 23 simultaneously. Although only four containers 23 can be filled with the particular structure shown in the drawings and described above, it is evident that this number is not critical and that more or less than four containers may be simultaneously filled with the process and apparatus of the present invention. Furthermore, the material which is distributed is of a uniform density and weight distribution and with the process and apparatus of the invention there can be no gaps in the bodies of packed material.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of apparatus and process for distributing a fluidized solid material differing from the types described above.

While the invention has been illustrated and described as embodied in apparatus and process for distributing a fluidized solid material to a plurality of containers simultaneously, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for distributing a fluidized solid material, comprising, in combination, a hopper having open top and bottom ends so that the fluidized solid material can flow downwardly along said hopper; ramming means extending into said hopper for ramming the fluidized solid material therein in a vertical direction; and reciprocating means operatively connected to said hopper for reciprocating the same in a direction transverse to the vertical movement of the ramming means and the direction along which the fluidized solid flows downwardly through the hopper.

2. Apparatus for distributing a fluidized solid material, comprising, in combination, a hopper having open top and bottom ends so that the fluidized solid material can flow downwardly along said hopper; ramming means extending into said hopper for ramming the fluidized solid material therein in a vertical direction; reciprocating means operatively connected to said hopper for reciprocating the same in a direction transverse to the vertical movement of the ramming means and the direction along which the fluidized solid flows downwardly through the hopper; and means located at the bottom end portion of said hopper and forming a plurality of elongated passages at said bottom end portion through which the fluidized solid material moves.

3. Apparatus for distributing a fluidized solid mate-

rial, comprising, in combination, a hopper having open top and bottom ends so that the fluidized solid material can flow downwardly along said hopper; ramming means extending into said hopper for ramming the fluidized solid material therein in a vertical direction; reciprocating means operatively connected to said hopper for reciprocating the same in a direction transverse to the vertical movement of the ramming means and the direction along which the fluidized solid flows downwardly through the hopper; and reciprocating means operatively connected to said ramming means for reciprocating the latter back and forth in a direction transverse to the direction of vertical movement thereof.

4. Apparatus for distributing a fluidized solid material, comprising, in combination, a hopper having open top and bottom ends so that the fluidized solid material can flow downwardly along said hopper; ramming means extending into said hopper for ramming the fluidized solid material therein in a vertical direction; reciprocating means operatively connected to said hopper for reciprocating the same in a direction transverse to the vertical movement of the ramming means and the direction along which the fluidized solid flows downwardly through the hopper; and a plurality of elongated substantially parallel bars spaced from each other and fixed to said hopper at said bottom end thereof for forming a plurality of elongated passages for the fluidized solid material at the bottom end of said hopper.

5. In a process for distributing a fluidized solid material, the steps of reciprocating a hopper in a horizontal direction transverse to the direction of flow of the fluidized solid material therethrough; and simultaneously reciprocating in a horizontal direction a ramming means which extends into said hopper and which performs its ramming action by movement in a vertical direction.

6. Apparatus for distributing a fluidized solid material comprising, in combination, a receptacle having a row of compartments which are open at the top; a plurality of substantially vertical ramming members respectively located over said compartments in alignment therewith; moving means operatively connected to said ramming members for simultaneously moving the same from a rest position where the bottom ends of said ramming members are respectively located above said compartments downwardly along a ramming stroke at the end of which said ramming members are partly located within said compartments and then back up to said rest position; a hopper located directly over said receptacle, partly surrounding said ramming members, and having a bottom open end communicating with said compartments; and reciprocating means operatively connected to said hopper for reciprocating the same back and forth in the direction in which said row of compartments extends, so that when said ramming members are in their rest position the horizontal reciprocation of said hopper will distribute and prepack fluidized solid material in said hopper in the space beneath said ramming members.

7. Apparatus for distributing a fluidized solid material comprising, in combination, a receptacle having a row of compartments which are open at the top; a plurality of substantially vertical ramming members respectively located over said compartments in alignment therewith; moving means operatively connected to said ramming members for simultaneously moving the same from a rest position where the bottom ends of said ramming members are respectively located above said compartments downwardly along a ramming stroke at the end of which said ramming members are partly located within said compartments and then back up to said rest position; a hopper located directly over said receptacle, partly surrounding said ramming members, and having a bottom open end communicating with said compartments; reciprocating means operatively connected to said hopper for reciprocating the same back and forth in the direction in which said row of compartments extends, so that when said ramming members are in their rest position the horizontal reciprocation of said hopepr will distribute and prepack fluidized solid material in said hopper in the space beneath said ramming members; and a plurality of elongated bars respectively located between said compartments directly over said receptacle and being fixed to said hopper at the bottom end thereof so that said ramming members move between said bars when said ramming members are moved by said moving means along their ramming strokes and so that said bars evenly distribute the fluidized solid material into said compartments during horizontal reciprocation of said hopper.

8. Apparatus for distributing a fluidized solid material comprising, in combination, a receptacle having a row of compartments which are open at the top; a plurality of substantially vertical ramming members respectively located over said compartments in alignment therewith; moving means operatively connected to said ramming members for simultaneously moving the same from a rest position where the bottom ends of said ramming members are respectively located above said compartments downwardly along a ramming stroke at the end of which said ramming members are partly located within said compartments and then back up to said rest position; a hopper located directly over said receptacle, partly surrounding said ramming members, and having a bottom open end communicating with said compartments; reciprocating means operatively connected to said hopper for reciprocating the same back and forth in the direction in which said row of compartments extends, so that when said ramming members are in their rest position the horizontal reciprocation of said hopper will distribute and prepack fluidized solid material in said hopper in the space beneath said ramming members; and reciprocating means operatively connected to said ramming members for reciprocating the same in a substantially horizontal direction substantially parallel to said row of compartments while said ramming members are in their upper rest position to aid in the uniform distribution of the fluidized solid material in the spaces beneath the ramming members and in the compartments.

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