

No. 797,145.

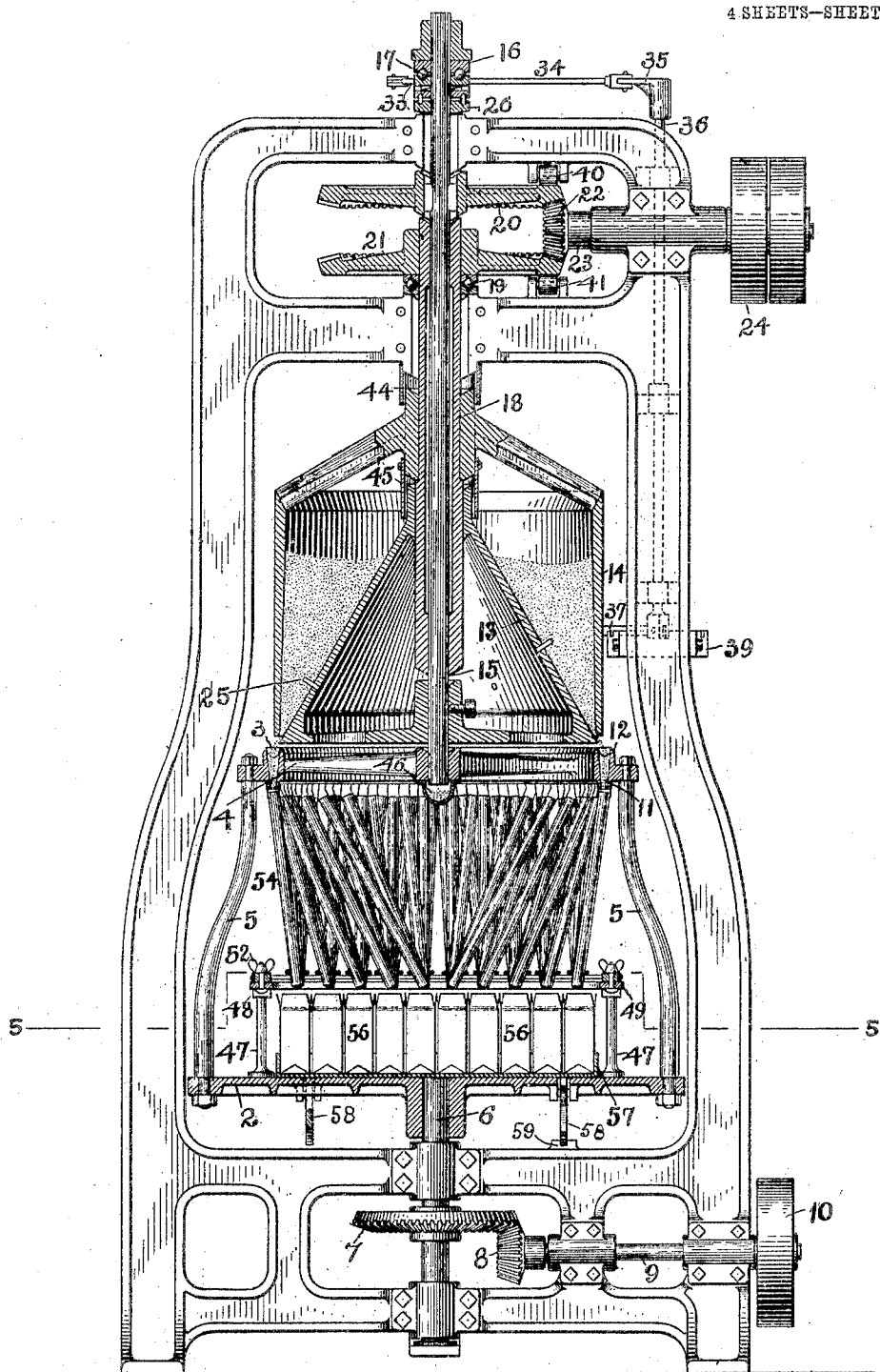
PATENTED AUG. 15, 1905.

W. E. NICKERSON.

APPARATUS FOR OBTAINING DESIRED QUANTITIES OF MATERIAL.

APPLICATION FILED NOV. 25, 1901.

4 SHEETS--SHEET 1.



WITNESSES:

Joseph T. Brennan.
Margaret A. Danaher.

Fig. 1.

INVENTOR:

W. E. Nickerson,
by E. D. Chadwick,
Attorney -

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4 SHEETS—SHEET 2.

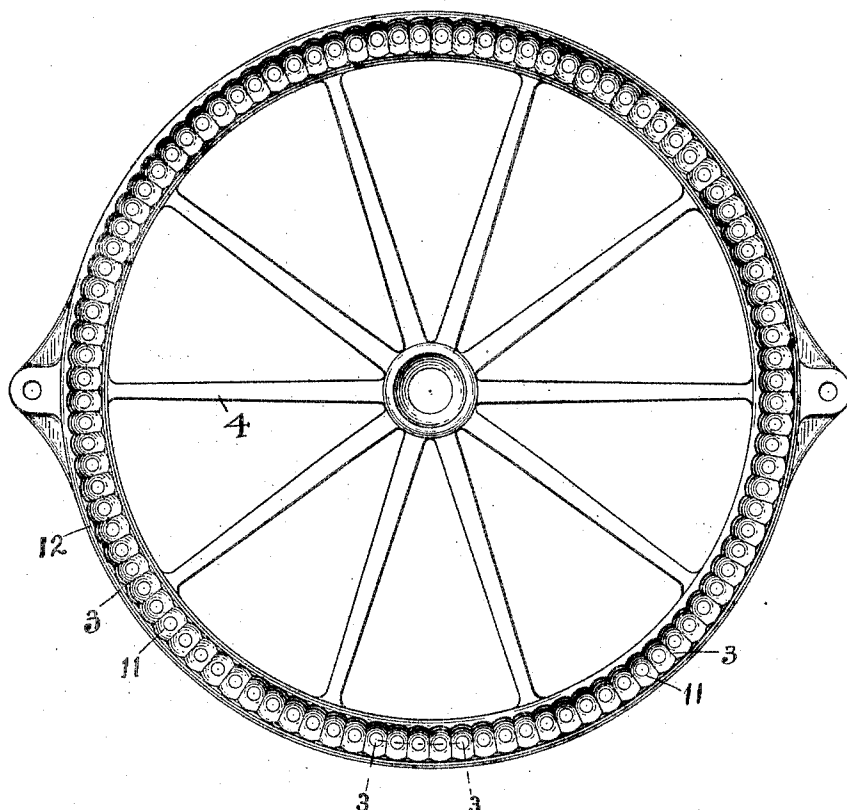


FIG. 2.

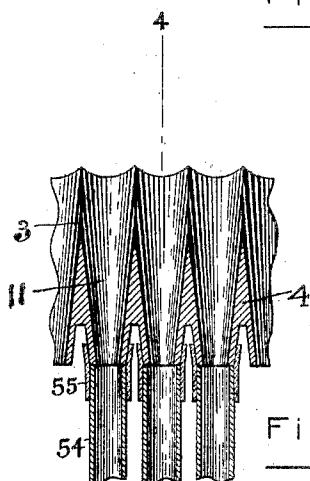


FIG. 3.

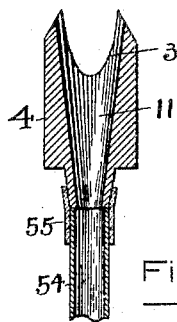


FIG. 4.

WITNESSES.

Joseph T. Benson.
Margaret A. Danaher.

INVENTOR:

W. E. Nickerson,
by E. G. Shadrach,
Attorney.

W. E. NICKERSON.

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4 SHEETS—SHEET 3.

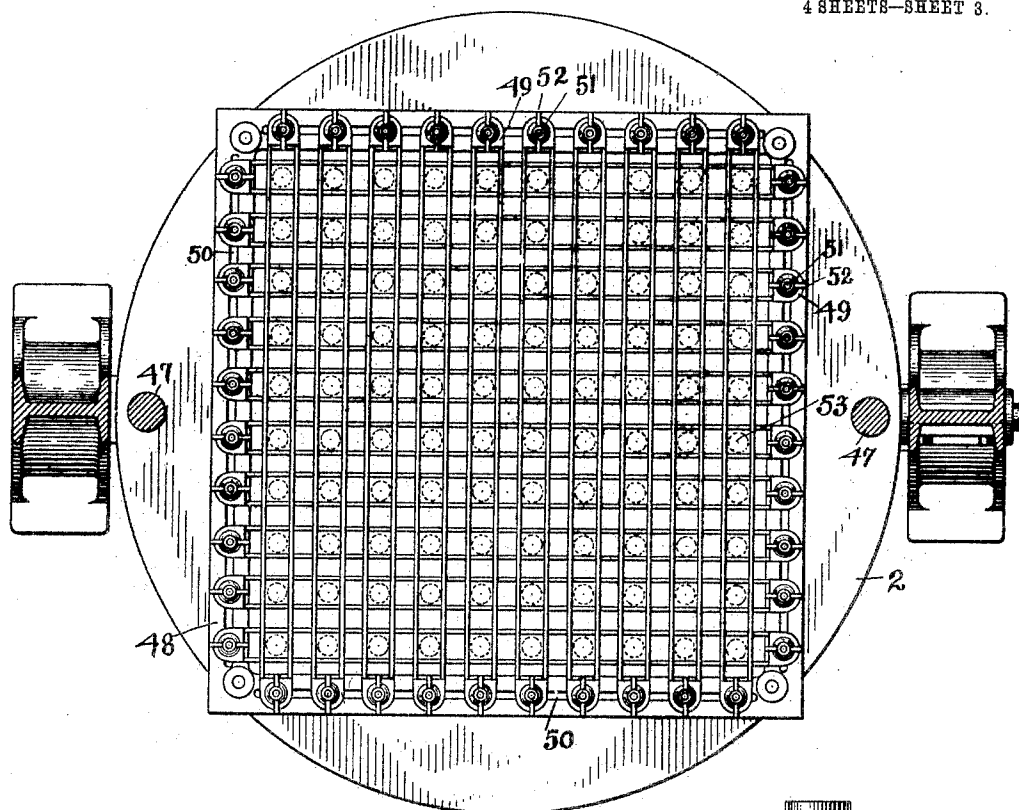


FIG. 5

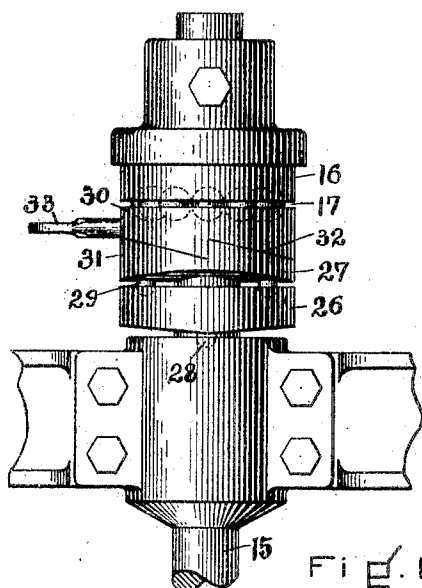


FIG. 6.

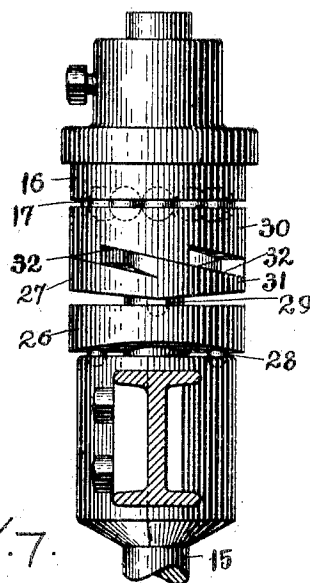


FIG. 7.

WITNESSES:

Joseph T. Brennan
Margaret A. Danaher

INVENTOR:

W. E. Nickerson,
by *E. S. Chadwick*,
Attorney.

No. 797,145.

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W. E. NICKERSON.

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4 SHEETS—SHEET 4.

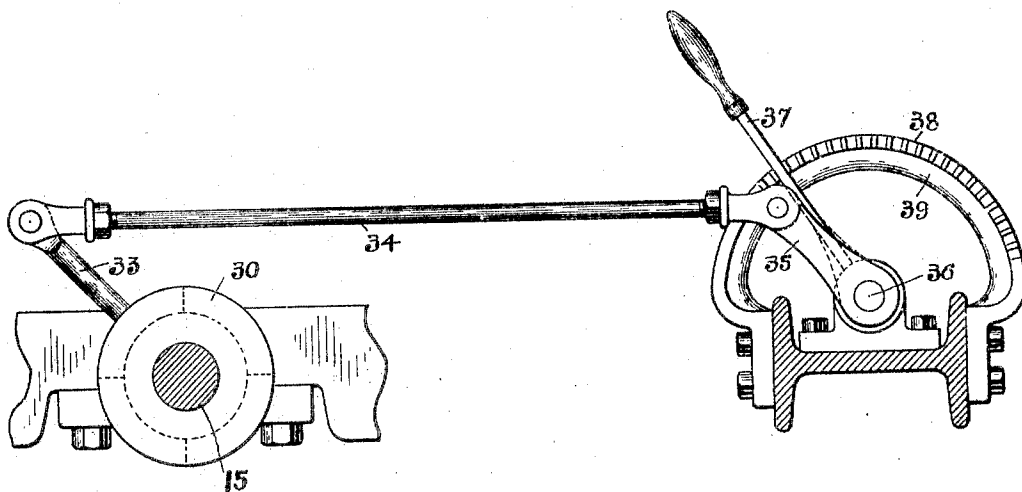


Fig. 8.

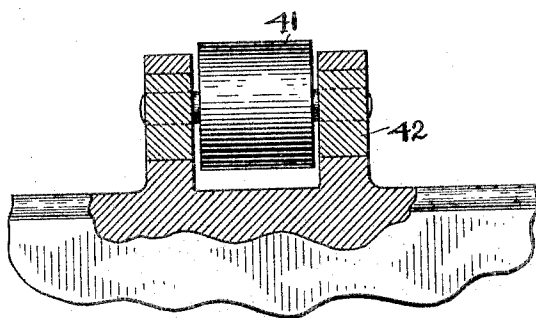


Fig. 9.

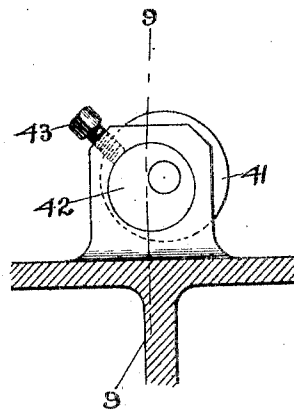


Fig. 10.

WITNESSES:

Joseph T. Brennan.
Margaret A. Danaher.

INVENTOR:

W. E. Nickerson,
by E. D. Chadwick,
Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM EMERY NICKERSON, OF CAMBRIDGE, MASSACHUSETTS,
ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC WEIGH-
ING MACHINE COMPANY, OF NEW YORK, N. Y., A CORPORATION
OF NEW YORK.

APPARATUS FOR OBTAINING DESIRED QUANTITIES OF MATERIAL.

No. 797,145.

Specification of Letters Patent.

Patented Aug. 15, 1905.

Application filed November 25, 1901. Serial No. 83,567.

To all whom it may concern:

Be it known that I, WILLIAM EMERY NICKERSON, a citizen of the United States, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Obtaining Desired Quantities of Material, of which the following is a specification.

In other Letters Patent of the United States bearing the same date herewith and granted on an application filed by me on November 25, 1901, Serial No. 83,566, is described and claimed an apparatus for obtaining desired quantities of material in the operation of which a stream of material is separated into successive series of proportional increments and the increments are distributed in order among a number of receptacles, to which Letters Patent reference is hereby made for a full understanding of said apparatus and its mode of operation.

My present invention, which is based upon the same principles as the apparatus above referred to, is intended to provide a machine for the same purpose which will be better adapted to handle materials of a powdery or finely-granular form and capable of operating with great accuracy and rapidity.

Further objects of my invention are to provide for the elimination of error when the apparatus is started and stopped and to reduce the liability to systematic errors in the results obtained.

My invention also includes novel means for conducting the resulting quantities into the packages or receptacles to be filled, together with other subordinate features hereinafter set forth.

Like the apparatus above referred to, my machine comprises a series of separators accurately spaced apart, and thus providing between them a series of openings or pockets adapted to receive and distribute successive increments of material, in combination with means for causing a stream of material to sweep laterally across said separators in order, and a main feature of my invention is the provision of means for delivering the material to the series of separators in a sheet-stream which coincides in general contour with the path of its movement relatively to the series of separators. Said sheet-stream is preferably made

to form a circle corresponding to a circular arrangement of separators, so that material will be delivered into all the spaces between the separators at once, thus eliminating that error which will occur when a single-stream apparatus, such as is shown in the patent above referred to, is started and stopped in case one more increment has been delivered into some receptacles than into others. Furthermore, the size of a sheet-stream in its circular dimension is so much greater than that of a single stream that it may be made very thin in that dimension which is at right angles to its path, and hence is not acted upon by the separators, thereby reducing the liability to material variations or fluctuations in the thickness of the stream without decreasing the rapidity of the operation of the apparatus by unduly diminishing the total volume of the stream of material delivered in a given time.

Another feature of my invention is the rotation of the inequalities of the sheet-stream, if any exist, thereby overcoming systematic errors, as hereinafter set forth, this feature, together with others of less importance, being hereinafter described at length.

In the accompanying drawings is illustrated a preferred form of apparatus embodying my invention, in which—

Figure 1 is a side view of the complete machine, partly in elevation and partly in central vertical section. Fig. 2 is a plan view of a series of separators and a wheel-like member by which they are carried. Fig. 3 is a fragmentary sectional view, taken on the line 3 3 in Fig. 2, showing also certain attached parts. Fig. 4 is a vertical section taken on the line 4 4 in Fig. 3. Fig. 5 is a horizontal section on the line 5 5 in Fig. 1. Figs. 6 and 7 are elevations, on an enlarged scale, of a flow-controlling mechanism viewed in directions at right angles to each other. Fig. 8 is a plan view, on an enlarged scale, of means for operating said flow-controlling mechanism. Figs. 9 and 10 are enlarged detail views showing an adjustment hereinafter described.

In the apparatus shown in the drawings the framework is suitably designed to carry a feeding device, a series of separators, and the desired number of receptacles to be filled with material, together with suitable operating mechanism. For supporting the receptacles

a table 2 is provided, which is located at the lower part of the machine and is supported thereby. At some distance above this table 2 is located a series of separators, preferably consisting of a number of sharp radial edges 3, arranged in a circle by being secured to or formed integral with a wheel-like member 4, which may be supported from the table 2 by suitable uprights 5, as shown. It is usually desirable to revolve the series of separators during the operation of the apparatus, and hence I have shown the table 2 as secured to the upper end of a vertical shaft 6, which is journaled on the framework of the machine and is provided with means whereby it may be driven, such as bevel-gears 7 and 8, a shaft 9, and a pulley 10. The separators 3 are ordinarily located at equal distances apart and may be of any desired number, one hundred of them being shown in the drawings, thus providing one hundred equal spaces or pockets 11 between them for the reception of successive increments of the material operated upon. I prefer to form said separators 3 and pockets 11 by drilling a series of holes in the rim 12 of the wheel-like member 4, each hole having the shape of an inverted truncated cone and having such dimensions that the walls of each pair of adjoining cones will intersect, so that each pair of holes will be separated by an edge 3, formed at the curved line of intersection, as illustrated in Fig. 4. The lowest portion of each edge 3 is thus located at some distance below the concentric circular edges of the rim of the wheel-like member 4, so that the stream of material operated upon may be introduced between said concentric edges before it is separated into increments, thereby diminishing any tendency of the material to slop or spill.

Directly above the series of separators 3 is located a device for feeding material thereto in a sheet-stream. To obtain the best results, it is desirable that the stream shall form a complete circle continuous at all points, and for obtaining such a stream I prefer to employ the combination of an internal cone 13 and an external cylindrical shell 14, the bottom edges of which are separated in operation sufficiently to leave an annular aperture having a width equal to the desired thickness of the stream. The space between the cone 13 and the shell 14, above the lower edges thereof, forms a bin or hopper for the reception of a mass of material equal in amount to the sum of the quantities desired to be delivered by the apparatus at one operation thereof. In case the apparatus is intended to operate upon material of such a nature that it will flow freely and evenly and will not clog the cone 13 and the shell 14 may be held stationary, the separation of the material into increments being effected by the movement of the series of separators 3, as explained in the Letters Patent above referred to. I prefer, however, to pro-

vide for the rotation of either the cone 13 or the shell 14, or both, so that said parts will have a relative movement with respect to each other, since the flow of a powdery or similar material is thereby much facilitated, and I have accordingly shown means for obtaining such relative movement. According to the arrangement shown the cone 13 is rigidly secured to a vertical shaft 15, suitably journaled on the framework and provided at or near its upper end with a collar 16, mounted on a supporting ball-bearing 17, and the shell 14 is secured to a sleeve 18, which incloses the shaft 15 and is centered thereby, being supported near its upper end on a ball-bearing 19. The cone 13 and the shell 14 are thus adapted to be rotated independently of each other, and for effecting such rotation the shaft 15 and sleeve 18 may be provided, respectively, with gears 20 and 21, which mesh with a pinion 22, secured to a horizontal shaft 23, which is driven by a pulley 24. As thus constructed the members 13 and 14 will be rotated in opposite directions, so that the body of material contained between them will be acted upon by frictional contact with said rotating members, especially at and near the opening left between the lower edges thereof, whereby a steady and even flow of the material will be promoted.

It is important to keep the members 13 and 14 accurately concentric with each other at all times in order that the width of the opening between their bottom edges may remain constant throughout each rotation of said members, and to this end I prefer not only to journal the sleeve 18 upon the shaft 15, as above described, but also to journal the upper end of the cone 13 upon the sleeve 18, as shown, thereby securing great steadiness in operation, as well as accuracy. The words "cone" and "shell" are to be understood as including any two concentric members forming a bin or hopper between them and adapted to deliver a sheet-stream of material to a series of separators.

In order to keep the top surface of the bulk of material level, so as to maintain constant conditions of pressure therein, a number of pins 25 may be secured to one or both of the members 13 and 14, which will serve to scrape off and level any inequalities which may occur in the height of the material contained between said members. I prefer also to provide beneath the ball-bearing 17 a supporting-gimbal or universal joint in order to render said bearing self-adjusting to a plane perpendicular to the axis of the shaft 15, and thus prevent lateral strains therein. This may be accomplished by interposing between said ball-bearing 17 and the framework of the machine two collars 26 and 27, (see Figs. 6 and 7,) the former being supported on two diametrically opposite pivots 28, bearing on the framework, and the collar 27 being supported on the collar 26 by means of two dia-

metrically opposite pivots 29, arranged at right angles to the line of support of said collar 26, so that each collar will have a rocking motion with respect to its support. A similar device may be placed beneath the ball-bearing 19, if desired. I also prefer to center the wheel-like member 4 by journaling it upon the extended lower end of the shaft 15, whereby the stream of material and the series of separators will be kept concentric with each other.

It is desirable to be able to control the size of the opening through which the circular stream of material is delivered to the separators, both in order that streams of any desired thickness may be obtained and also in order that the flow may be started simultaneously at all points of the circle, and I therefore provide means for varying said opening by giving a vertical movement either to the cone member 13 or to the shell member 14, preferably the former. To this end the collar 27 may be made in two parts 30 and 31, each of the adjacent faces of said parts having a series of inclined surfaces 32, matching the similar surfaces on the other part like a clutch. As shown, the upper member 30 forms the support for the ball-bearing 17 and is provided with an arm 33, by which it may be given a partial rotation. By moving the arm 33 in one direction the members 30 and 31 will be separated by the movement of the opposed inclined surfaces 32 upon each other, thereby raising the shaft 15 and with it the cone 13, and by moving said arm 33 in the other direction the cone 13 will be lowered, the size of the circular opening at its bottom being thus controlled at will whether the parts of the apparatus are in motion or at rest. The gear 20 is splined to the shaft 15 in order to permit the movement just described without interfering with the engagement of said gear with the pinion 22. The arm 33 may be operated by means of a link 34, pivoted thereto and to an arm 35, secured to a vertical shaft 36, which is journaled on the framework of the machine and is provided at any convenient point with an operating-lever 37. The cone 13 may be locked in any desired position by pivoting the lever 37 to the shaft 36, so that by moving said lever vertically it may be engaged with or disengaged from any one of a series of notches 38, formed on a horizontal segment 39, secured to the framework of the machine.

In order to prevent any lateral strains from being imparted to the shaft 15 and sleeve 18 through the gears 20 and 21, I prefer to locate bearing-rollers 40 and 41 above and below the gears 20 and 21, respectively, said rollers forming a support for said gears adapted to resist any vertical thrust imparted thereto by the pinion 22. These rollers 40 and 41 may be made adjustable by mounting them eccentrically in bearings 42, as shown in Figs. 9

and 10, the desired adjustment being obtained by turning the bearings 42 to the proper position and locking them therein by means of set-screws 43.

It will be seen that the upper and lower ends of the gear 20, the sleeve 18, and the interior portion of the cone 13, as well as the bearings by which these parts are supported, are slanted or given a blunt taper inward. This is for the purpose of causing the oil used in lubricating the parts to flow toward the central shaft 15, and thus to be kept away from the material operated upon. The spaces between the supporting portion of the shell 14 and the adjacent bearings are preferably covered by cylindrical casings 44 and 45 to keep out particles of material. I also prefer to secure a drip-cup 46 to the under side of the wheel-like member 4, directly beneath the shaft 15, in order to catch any oil which may drip therefrom.

I will now describe the construction which I prefer to employ for delivering the successively-separated increments of material into the receptacles provided therefor, the arrangement being such that the receptacles may be placed side by side in a tray and introduced into and withdrawn from the apparatus collectively.

Above the table 2 is supported, by means of fixed uprights 47, a preferably rectangular frame 48, upon the four sides of which are supported a number of longitudinally-slotted bars 49, arranged in two sets one above the other, the bars of each set being parallel with and adjustable toward and from one another and also being at right angles to the bars of the other set, as best shown in Fig. 5. To provide for the adjustment of the bars 49, each side of the framework 48 may be slotted, as shown at 50, a bolt 51, provided with a thumb-screw 52, being passed through the end of each bar 49 and through the corresponding slot 50, so that by loosening the thumb-screws at the ends of each bar said bar may be moved laterally when desired. The two sets of slotted bars 49 thus provide at their intersections a number of square openings 53, the number of the bars 49 being such that the number of openings 53 will equal the number of the receptacles to be filled at one operation. In the apparatus shown there are ten bars 49 in each set, thus providing one hundred openings 53. Into each of the openings 53 is introduced the lower end of a tube 54, which leads thereto from the lower end of one of the pockets 11 formed in the wheel member 4. This construction is indicated in Fig. 1 and is such that each pocket 11 will have its own tube 54 leading to a corresponding opening 53. The arrangement of the tubes 54 is preferably such that no one of said tubes will be vertical, since powdery material will flow more freely and with less liability to blow and clog through an inclined tube

than through a vertical one. The connection between the upper end of each tube 54 and the corresponding pocket 11 is made sufficiently flexible to permit of the limited movement of the lower end of said tubes required for the adjustment of the bars 49, and this may be accomplished by uniting each tube 54 with the lower end of its pocket 11 by bringing said parts together and surrounding them by a short piece of rubber tubing 55, as best shown in Figs. 3 and 4. As thus constructed, it will be seen that by properly adjusting the slotted bars 49 the lower ends of the tubes 54 may be located at any desired distance apart within certain limits, and may thus be arranged to deliver into a corresponding number of receptacles arranged in close proximity to one another regardless of the size of said receptacles. In Fig. 5 said tubes are shown in the proper position for the largest size of receptacles which can be accommodated by the particular apparatus shown. The receptacles 56, one hundred in number, are supported side by side on the table 2 beneath the respective tubes 54, and are preferably placed in a tray 57, so that they may be inserted and withdrawn together for convenience in handling. This arrangement also makes it possible to settle the charges in the respective packages in a very simple and expeditious manner by merely agitating or rapping the tray in which said packages are contained, and to this end a number of bell-crank levers 58 may be pivotally suspended from the bottom of the table 2 on radial axes, with their horizontal arms lying in slots in said table adjacent to the bottom of the tray 57, and with their vertical arms projecting downward far enough to be successively engaged as the table rotates by a stop 59 secured to the framework of the machine in the path of said arms.

The horizontal arms of the levers 58 point in the opposite direction to that in which the table 2 rotates, so that each time one of said levers passes the stop 59 the corresponding side of the tray 57 is slightly raised and suddenly dropped, thus jarring and settling its entire contents. It is one of the features of my apparatus that a vigorous settling action can go on throughout the entire operation of the apparatus, as there are no scale-beams to be displaced nor poisoning operations to be interfered with.

To operate the apparatus above described, the cone 13 will be raised by operating the lever 37 until the circular aperture at its lower edge is closed, and a quantity of material equal in amount to the sum of the quantities desired will then be introduced in one mass into the bin formed by said cone 13 and the shell 14. After a tray full of empty receptacles 56 has been placed upon the table 2 the various parts of the apparatus will be set in motion, and the cone 13 will then be lowered until an open-

ing of the desired size has been provided for the flow of the material. Said material will then be fed in a continuous circular sheet-stream to the series of edges 3, each of which by its lateral movement will separate increments of material from every portion of every stream successively. This separation of increments will be simultaneous with respect to all the pockets 11 and continuous with respect to each of said pockets, as would be the case if the separators were stationary, the effect of the revolution of the series of separators being to cause each pocket 11 to receive increments from each portion of the circular stream instead of from one portion only, so that local differences in the volume of the stream will be distributed among all the pockets and will affect all the resultant quantities alike. The increments of material thus separated from the circular stream will fall through the tubes 54 into the respective receptacles 56 until all the material has been distributed, the desired quantities of material being thus built up concurrently in the receptacles 56 with a degree of accuracy depending upon the speed of said separators 3, as explained in the Letters Patent above referred to. Inasmuch as the stream of material will flow into all the spaces between the separators simultaneously, even at the beginning and at the end of the flow, no error can occur on account of the delivery of one more increment into some of the receptacles than into others. The evenness of delivery of the last portion of the charge, and hence its accuracy of distribution, may be increased by raising the cone 13 toward the end of the operation of the apparatus, and thus producing a finer stream. Furthermore, since the stream of material may be made very thin in that dimension which is not acted upon by the separators errors due to possible variations in the thickness of the stream may thus be correspondingly reduced without undesirably decreasing the amount of material delivered in a given time because the thinness of the stream is compensated by its size in its circular dimension.

If the cone 13 and the shell 14 are rotated at the same speed in opposite directions, they will tend to prevent circular movement of the material as a whole, and therefore the distribution of variations in the size of the stream among the several receptacles must in such case be accomplished by the rotation of the separators 3. Consequently if there is anything in the construction or operation of the cone and shell tending to affect the quantities obtained with systematic errors there will be nothing in the operation of the apparatus as a whole which will eliminate such errors, and accordingly I prefer to make the cone 13 and the shell 14 to rotate at different speeds, as by providing one more tooth in one of the gears 20 and 21 than in the other. The result of such a construction will be that any inequality

in the size of the stream due to a variation in the distance between the walls of the aperture through which the stream is delivered or to any other lack of structural exactness in the mechanism for delivering the stream will be rotated around the central axis of the apparatus at a rate substantially equal to the difference between the speeds of the cone 13 and the shell 14, and hence in this manner variations in the stream due to any structural imperfection such as above referred to may be distributed among all the receptacles by the combination of the rotation of the inequalities of the stream and the rotation of the separators, as will be clearly understood by referring to the principles set forth in the Letters Patent hereinbefore referred to, to which reference is hereby made. In place of rotating the cone 13 and the shell 14 in opposite directions at different speeds they may be rotated in the same direction at different speeds, or even at the same speed, provided in the latter case the material is such as will flow with sufficient steadiness without requiring a relative movement between the said parts 13 and 14.

I do not consider my present invention to be limited to any specific means for delivering a quantity of material in a sheet-stream, nor to the specific form of separators herein shown and described, nor to the herein-described arrangement of parts for conveying the distributed material into appropriate receptacles, as each of said elements may be greatly varied without departing from my invention.

I do not claim herein, broadly, the combination with a series of separators of means for delivering thereto a definite quantity of material in a stream and means for simultaneously giving both the stream and the series of separators a lateral movement with respect to each other in order to eliminate systematic errors, as the same is described and claimed in the aforesaid Letters Patent.

I claim as my invention—

1. In an apparatus of the character described, the combination with a series of separators accurately spaced apart and providing a series of openings or pockets between them, of means for delivering to said separators a definite quantity of material in a sheet-stream, and means for producing a relative lateral movement between said sheet-stream and the series of separators.

2. In an apparatus of the character described, the combination with a series of separators arranged in a circle and accurately spaced apart, thereby providing a circular series of openings or pockets between them, of means for delivering thereto simultaneously a definite quantity of material in a sheet-stream, and means for producing a relative lateral movement between said stream and series of separators.

3. In an apparatus of the character described, a feeding device comprising a cone and a shell constructed to meet at their lower ends and thereby form a retaining bin or hopper, and means for moving vertically one of said members and thereby producing or closing at will an opening between said lower ends adapted to deliver a circular sheet-stream of material.

4. In an apparatus of the character described, the combination with a circular series of separators and means for revolving the same, of a cone and a shell independently journaled on a vertical axis and providing at their adjacent lower edges an opening adapted to deliver a circular sheet-stream of material to said separators, and means for rotating said cone and shell in opposite directions.

5. In an apparatus of the character described, the combination with a circular series of separators, of a cone and a shell independently journaled on a vertical axis and providing at their adjacent lower edges an opening adapted to deliver a circular sheet-stream of material to said separators, and means for rotating said cone and shell at different speeds.

6. In an apparatus of the character described, the combination of a cone and a shell forming together a bin or hopper adapted to deliver at its bottom a circular stream of material, means for rotating said cone and shell at different speeds, a circular series of separators providing between them a corresponding series of openings or pockets, and means for revolving said series of separators.

7. In an apparatus of the character described, the combination of a series of separators arranged in a horizontal circle and means for revolving the same, and a feeding device comprising a cone rotatably mounted on a vertical axis and surrounded by a cylindrical shell forming therewith a bin or hopper and providing an opening at the bottom thereof adapted to deliver a circular sheet-stream of material to the separators, and means for rotating said cone and shell at different speeds in opposite directions.

8. In an apparatus of the character described, the combination of a vertical shaft and means for rotating the same, means carried by said shaft for delivering a circular sheet-stream of material, and a wheel-like member journaled on said shaft below said feeding device and having its rim provided with a series of separators forming a corresponding series of openings between them.

9. In an apparatus of the character described, the combination of a vertical shaft, a sleeve journaled thereon, means for rotating said sleeve and shaft with respect to each other, a cone and a shell secured to said shaft and sleeve respectively and forming a bin or hopper adapted to deliver a circular sheet-stream of material of substantially uniform thickness, the sides of the cone being formed to extend

beneath the lower edge of the shell, and means for moving one of said parts vertically to bring the lower edges of said cone and shell into contact or to separate them as desired, for the purpose set forth.

10. In an apparatus of the character described, the combination of a vertical shaft, a sleeve journaled thereon, means for rotating said sleeve and shaft with respect to each other, and a cone and a shell secured to said shaft and sleeve respectively and forming a bin or hopper, the upper portion of the cone carried by said shaft being journaled on said sleeve.

11. In an apparatus of the character described, the combination of a vertical shaft, a sleeve journaled thereon, means for rotating said shaft and sleeve with respect to each other, a cone and a shell carried by said shaft and sleeve and cooperating to form a bin or hopper, and means for moving said shaft vertically, comprising a two-part collar supporting said shaft and provided with cooperating inclined faces, and means for partially rotating one of the parts of said collar.

12. In an apparatus of the character described, the combination of a vertical shaft, a sleeve journaled thereon, means for rotating said sleeve and shaft with respect to each other, and a cone and a shell secured to said shaft and sleeve respectively and forming a bin or hopper, the ends of the parts carried by said shaft above and within the bin being bluntly slanted inward and downward, for the purpose set forth.

13. In an apparatus of the character described, the combination of a shaft, a sleeve journaled thereon, a feeding device comprising a cone and a shell carried by said shaft and sleeve respectively, two gears secured to said shaft and sleeve respectively and meshing with a driving-pinion, the shaft-gear being splined thereto, and a supporting roller-bearing behind each of said gears at the point where it engages said pinion.

14. In an apparatus of the character described, the combination with a feeding device of a series of separators accurately spaced apart, thereby providing a series of openings or pockets between them, means for producing a relative lateral movement between said separators and feeding device, a series of inclined tubes leading respectively from the bottoms of said pockets and flexibly secured thereto, and means for adjusting the lower ends of said tubes laterally.

15. In an apparatus of the character described, the combination with a series of separators 3 and pockets 11, of a frame, two sets of longitudinally-slotted bars supported on said frame, the slots in each set of bars being parallel to one another and crossing those of the other set, thereby forming at their intersections a number of openings, and chutes leading from said pockets respectively through said openings.

16. In an apparatus of the character described, the combination with a series of separators 3 and pockets 11 of a table carrying the same and adapted to receive a tray full of receptacles arranged side by side, a frame above said table, two sets of longitudinally-slotted bars supported on said frame, the slots in each set of bars being parallel to one another and crossing those of the other set, thereby forming at their intersections a number of openings, each of said bars being adjustable sidewise on said frame, and a chute flexibly connected to the bottom of each of said pockets and leading therefrom through one of said openings.

17. In an apparatus of the character described, the combination of a tray adapted to hold a number of receptacles, a separator and means for conveying charges of material therefrom to said receptacles simultaneously, and means for agitating said tray during such delivery.

18. In an apparatus of the character described, the combination of a table, means for rotating the same, a tray carried by said table and adapted to hold a number of receptacles, means for delivering charges of material to said receptacles simultaneously, and means operated by the rotation of the table for agitating said tray.

19. In an apparatus of the character described, the combination of a feeding device comprising a cone and a shell mounted concentrically and forming a bin or hopper having a circular discharge-opening, a circular series of separators, and means for producing a relative rotation between said separators and the cone and shell.

20. In an apparatus of the character described, a feeding device comprising a vertical shaft, a cone secured to the lower portion thereof, a sleeve journaled on said shaft, a concentric shell carried by said sleeve and forming in connection with the cone a bin or hopper adapted to provide at its bottom an opening for delivering a circular sheet-stream of material of substantially uniform thickness, and means for raising and lowering one of said ports to vary the delivery capacity of said opening, for the purpose set forth.

21. In an apparatus of the character described, the combination of a feeding device, a series of separators accurately spaced apart, thereby providing a series of openings or pockets between them, means for producing a relative lateral movement between said separators and feeding device, and a series of inclined tubes leading respectively from the bottoms of said pockets, the lower ends of said tubes being grouped at substantially equal distances from one another.

22. In an apparatus of the character described, the combination with a circular series of separators providing pockets between them, of a support adapted to receive a tray,

and a series of inclined tubes leading from the bottom of said pockets respectively and having their lower ends grouped over an area substantially corresponding to that of the top of said tray.

23. In an apparatus of the character described, the combination of a rotatable table, a ring-shaped series of separators carried thereby and providing a corresponding series of openings or pockets between them, a series of inclined tubes leading respectively from the bottoms of said pockets and movably secured thereto, and means for adjusting the lower ends of said tubes laterally.

24. In an apparatus of the character described, the combination of a ring-shaped

member provided with a series of intersecting conical holes the walls of which form by their intersection a corresponding series of downwardly-curving separating edges, means for delivering a sheet-stream of material to said edges, and means for producing a relative rotation between said stream and ring-shaped member.

In testimony whereof I have hereunto subscribed my name this 29th day of October, 1901.

WILLIAM EMERY NICKERSON.

Witnesses:

E. D. CHADWICK,
JOSEPH T. BRENNAN.