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[54] **ARTICLE PACKAGING MACHINE**

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[52] **U.S. Cl.**..... **53/160,** 53/166, 53/246, 53/249, 221/211

[51] **Int. Cl.**..... **B65b 5/00,** B65b 5/04, B65b 19/34

[58] **Field of Search**..... 53/235, 236, 160, 166, 246, 53/303, 247, 249; 221/211

[56] **References Cited**

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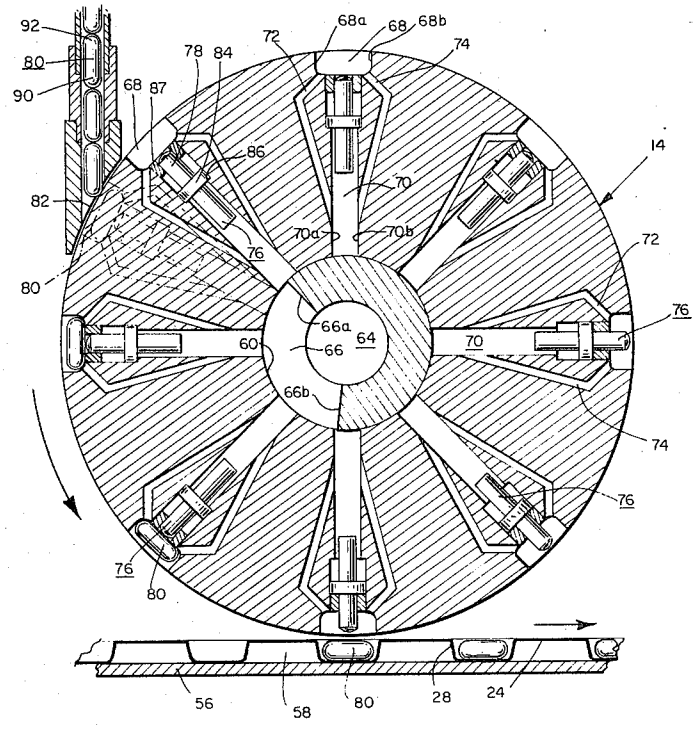
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[57] **ABSTRACT**

A packaging machine utilizes a rotary drum having a circumferential row of pockets formed in the peripheral surface thereof for picking up articles from a pick-up zone, and discharging the articles in a discharge zone. The drum contains a plurality of pistons reciprocably confined therein; a single piston is associated with each pocket and includes a plunger which reciprocates into and out of its associated pocket during rotation of the drum about a horizontal axis. A vacuum is applied to each pocket and to the interior surfaces of its associated piston as the pocket traverses the pick-up zone to pick up an article in the pocket and at the same time, hold the plunger inwardly out of the pocket; this vacuum is terminated as the pocket traverses the discharge zone, thus allowing the article therein to be discharged, and the plunger to descend by gravity into the pocket to assist in the discharge if necessary.

10 Claims, 8 Drawing Figures



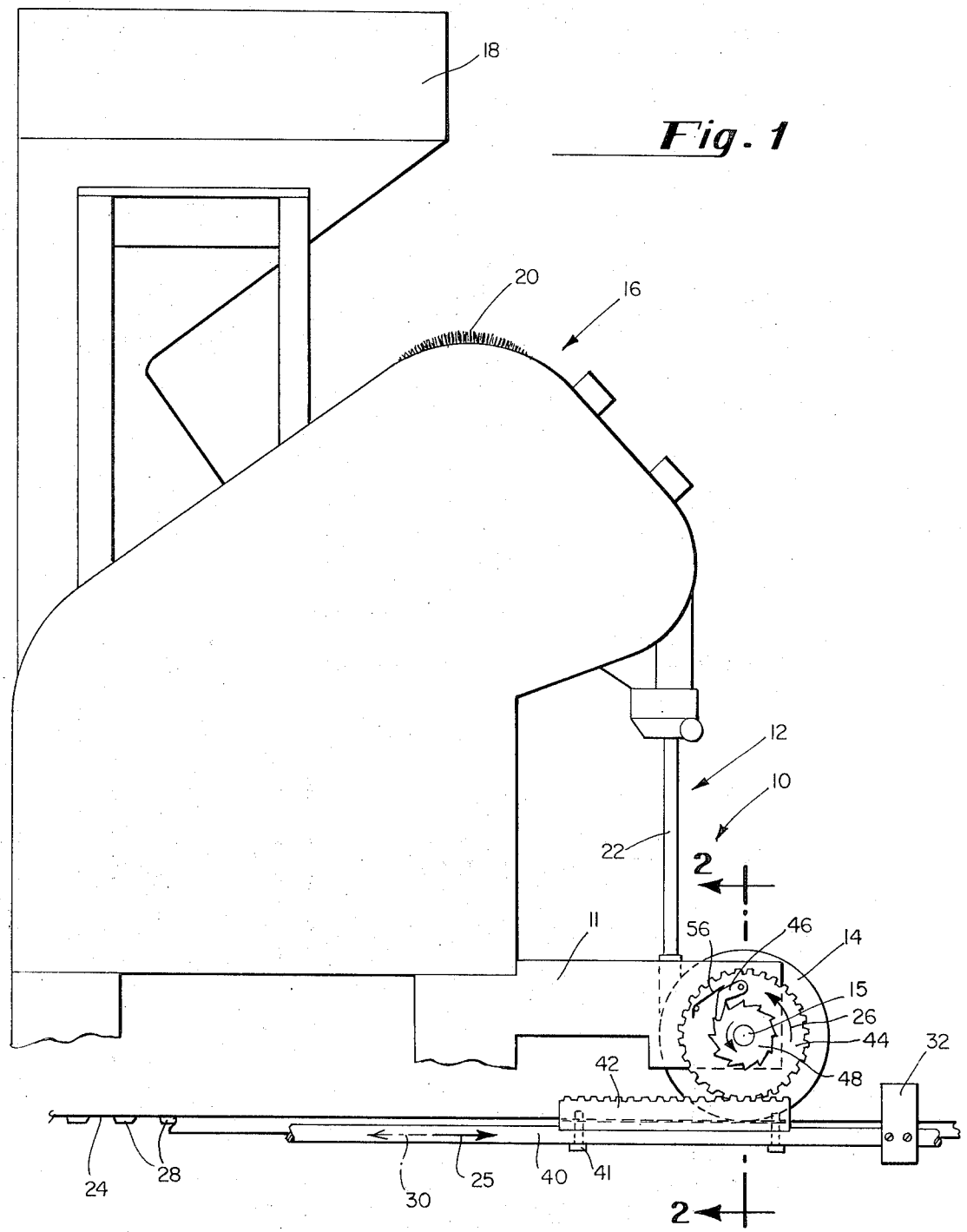


Fig. 1

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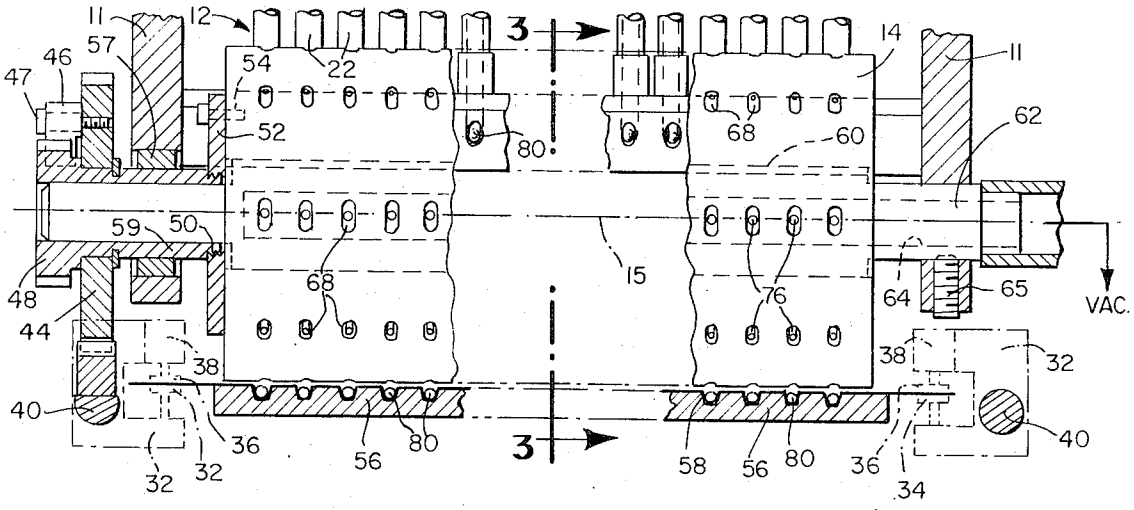


Fig. 2

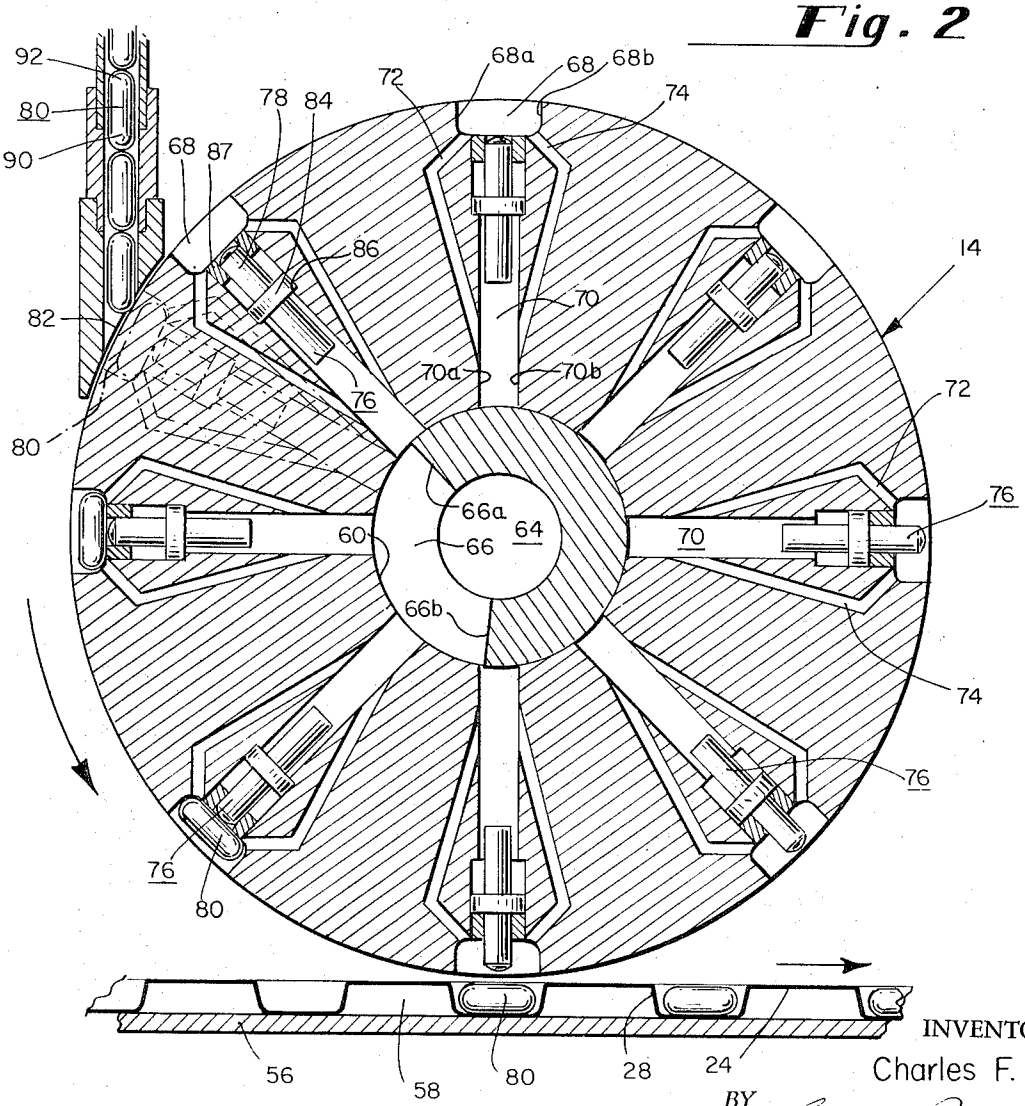
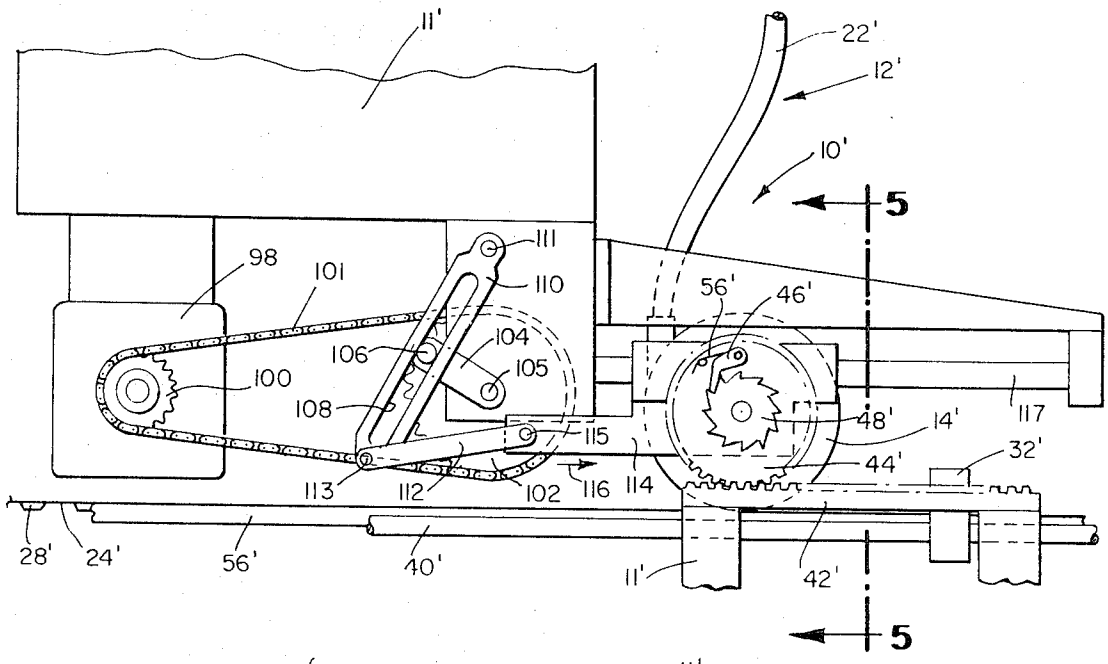


Fig. 3

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Fig. 4



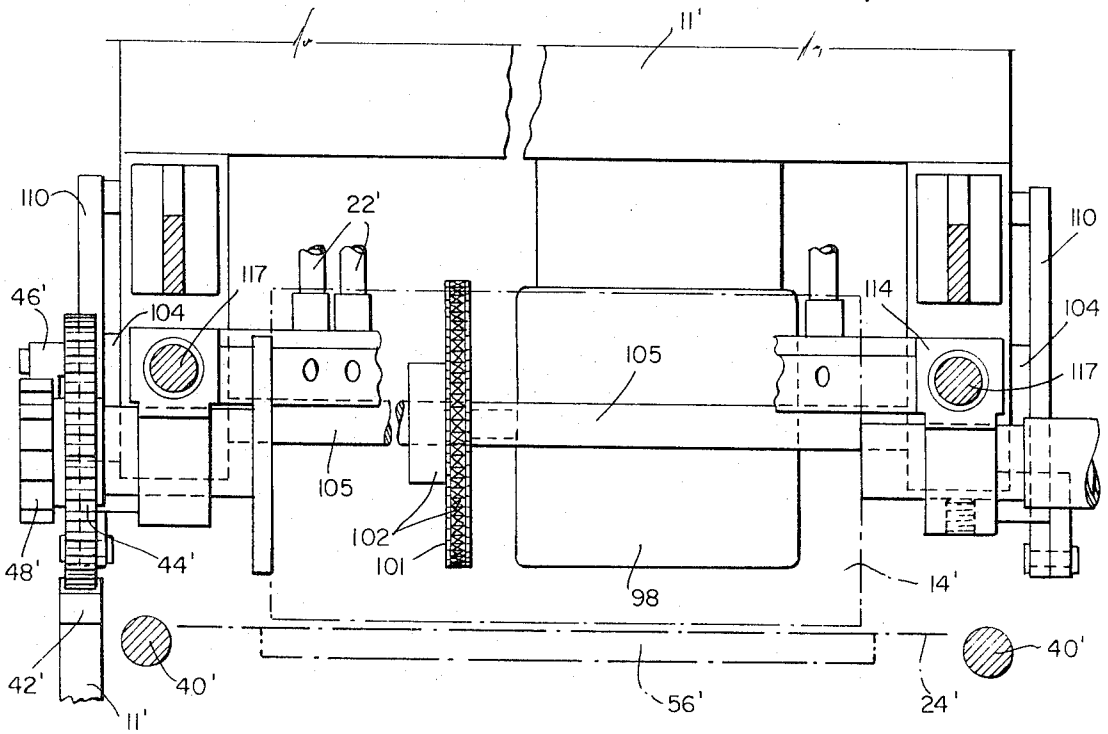


Fig. 5

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Fig. 6

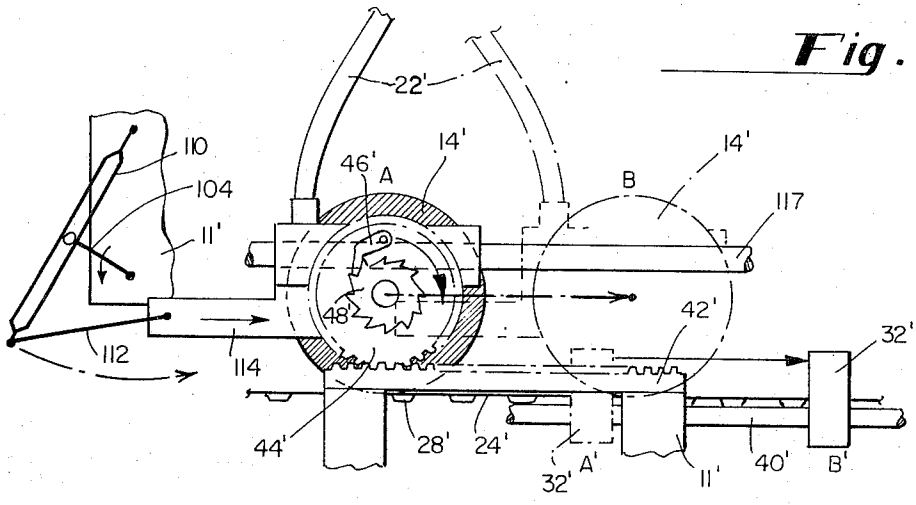


Fig. 7

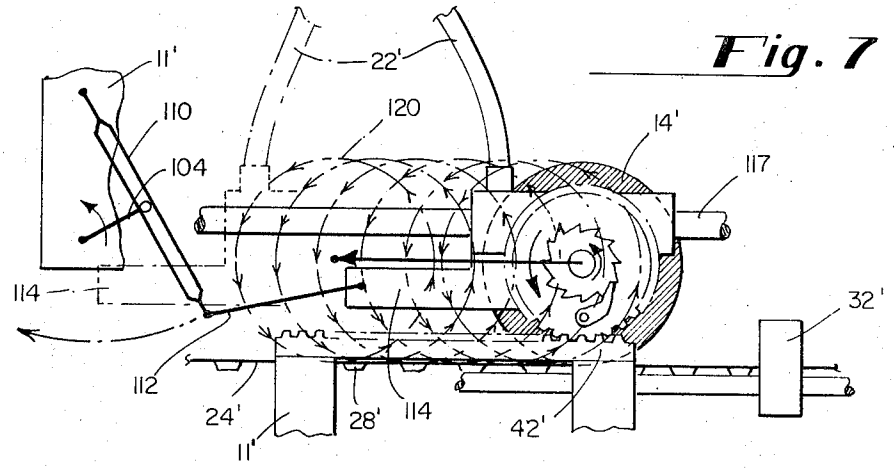
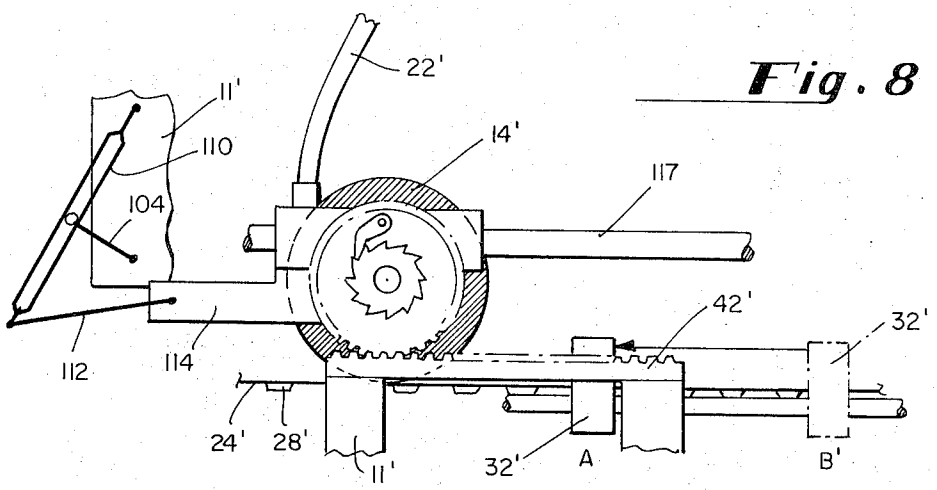


Fig. 8



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ARTICLE PACKAGING MACHINE

BACKGROUND OF THE INVENTION

This invention relates in general to an ariicle packaging machine for picking up a plurality of articles from a source, and depositing each of the articles at a precise location.

One example of where such a machine can be utilized is in filling a receptacle such as a "web" the latter commonly being a sheet of plastic material having a plurality of pockets formed therein, each pocket being sized to receive one or more of such articles. The receptacles which are to receive the articles need not necessarily be in the form of such a web however; they might also be bottles or other type containers capable of receiving one or more of such articles. After each receptacle is filled, it it generally closed at a subsequent station to complete the packaging operation.

The problems encountered at present with such machinery revolve around the speed of operation, reliability, and/or the complexity thereof. As the speed of operation is increased, the reliability of the machinery decreases; because of the increased speed of operation of the machinery, there is increased likelihood of the machinery not discharging the articles at the proper time or place, or of not discharging the articles at all. To provide for more accurate and positive discharge of the articles, more complex machinery has been devised utilizing cams, etc., with the result that the speed of operation may decrease; also, the more complex machinery required a larger number of moving parts, and is necessarily larger, the increased complexity tending to increase maintenance problems. Typical machinery utilized at the present time for handling articles which are to be picked up, and then deposited or discharged at some particular location are illustrated in U.S. Pat. Nos. 1,457,775; 2,198,976; 3,206,062; 3,387,746; and 3,533,535.

Thus, what is required is a compact machine of relatively simple construction which is capable of rapidly and accurately picking up a plurality of articles from a source, and depositing these artilces into one or more receptacles or containers. Also, since a typical environment in which such a machine might be utilized is that of packaging tablets, pills, or capsules, it is also desirable that such a machine be readily usable in conjunction with standard commercial tablet counting machinery. While the present invention is not so limited, this is the environment which will be used as an example in discussing the operation of each of the embodiments of the present invention.

SUMMARY OF THE INVENTION

The present invention relates to an article packaging machine which utilizes a rotary drum which rotates about a horizontal axis. The drum has a pluraluty of pockets formed in the outer peripheral surface thereof, the pockets being arranged in one or more circumferential rows.

The drum has a transverse bore formed about the axis of rotation, and a plurality of cylinder bores formed therein, each cylinder bore extending between a single associated drum pocket and the transverse bore. The drum also includes two passageways extending between each drum pocket and the transverse bore, one of the passageways communicating with the leading bottom portion of its associated drum pocket, and the other passageway communicating with the trailing bottom portion of the drum pocket.

Reciprocably confined within each cylinder bore is a piston having a plunger, the latter reciprocating into and out of its associated drum pocket as the drum rotates about its axis of rotation.

A circular plug of substantially the same diameter as the transverse bore is stationarily mounted therein, the former having a vacuum passageway formed therein which includes an arcuate portion or part which extends radially inwardly from the outer peripheral surface of the plug. The arcuate portion overlies the cylinder bores andd passageways leading to a circumferential row of drum pockets, so that as the drum rotates around the plug, each pocket and the interior surfaces of its associated piston has a vacuum periodically applied thereto; the plug acts as a valve.

While each drum pocket traverses the outlet of a supply manifold containing a plurality of articles, the vacuum is applied to the pocket and its associated piston as stated above, and a predetermined number of articles are drawn into the drum pocket, the pocket being sized to accept only this number of articles. Because vacuum is also applied to the interior surfaces of the piston associated with each drum pocket, the plunger of the piston is held radially inwardly out of the drum pocket. As the drum pocket with its contents rotates to a lower position where it is desired to discharge the article(s), the vacuum to the pocket and its associated piston is terminated, thus, allowing the article(s) to be discharged, and the plunger to descend by gravity into the drum pocket to assist in the discharge if necessary. The drum then continues to rotate, and as each pocket approaches the pick-up zone once again, its associated piston reciprocates radially inwardly due to gravity before vacuum is once again applied to the piston to hold it in this position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view showing an article packaging machine in accordance with the invention being utilized in conjunction with a standard commercial tablet counting apparatus, and illustrating a web into which the articles are discharged.

FIG. 2 is a sectional view taken through line 2—2 of FIG. 1, showing the details of the drum and manifold of the packaging machine, along with the means for moving the web beneath the drum and for driving the drum.

FIG. 3 is a sectional view taken through line 3—3 of FIG. 2 showing the interior construction of the drum.

FIG. 4 illustrates a second embodiment of the invention in which the entire drum assembly along with the manifold is mounted upon a carriage for horizontal movement.

FIG. 5 is a sectional view taken through line 5—5 of FIG. 4 and illustrating the means for driving the drum, and for moving the drum assembly and manifold in a horizontal direction.

FIGS. 6, 7 and 8 are sequential views showing various positions of the drum and manifold assembly illustrated in FIGS. 4 and 5 during operation of the packaging machine.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a side elevational view of the article packaging machine of the present invention is shown being utilized in conjunction with a standard commercially available tablet counting apparatus such as that manufactured by the Merrill Division of Pennwalt Corporation in Chicago, Ill.

The article packaging machine 10 includes a manifold 12 containing a supply of articles, and a drum 14 for picking up articles from the manifold and discharging them at a lower discharge zone. Manifold 12 receives the articles (tablets or capsules in the instant illustration) from tablet counting apparatus 16, the latter periodically starting and stopping depending upon the level or quantity of articles contained within manifold 12.

Articles are released from an auxiliary hopper (not shown) into primary hopper 18 of apparatus 16. A plurality of slats move beneath hopper 18 to pick up articles therefrom, and move them upward beneath an anti-shingling brush 20 which serves to assure that the articles in each of the slats are not stacked on top of each other. The slats move the articles from hopper 18 beneath brush 20, and deliver them into manifold 12, the latter comprising a plurality of tubes 22 (see FIG. 2 also) which deliver the tablets to a rotary drum 14. Machine 10 utilizes vacuum to pick up articles from manifold 12, and hold them on the outer periphery of the drum discharging the articles into a web 24 moving beneath the drum.

Drum 14 rotates about horizontal axis 15 while picking up and depositing the articles during the operation of the machine. In this embodiment of the invention, axis 15 of the drum remains stationary during the operation of the machine while web 24 is pulled in a horizontal direction as indicated by the arrow 25; that is, axis 15 does not move forward and rearward in a horizontal plane during operation of the machine as it does in a second embodiment to be discussed below. As web 24 is pulled forward in the direction of arrow 25, the rotation of drum 14 is synchronized therewith so that the drum rotates in a counterclockwise direction as indicated by arrow 26 to pick up articles from manifold 12 and deposit them into each of the pockets 28 formed in the web.

The web moving mechanism 32 moves forward from a first stationary position to a second stationary position in the direction of arrow 25, the clamps holding the web during this forward stroke or movement are released, and mechanism 32 is returned in the rearward direction of arrow 30 to the first stationary position. The clamps of mechanism 32 then once again clamp or grasp web 24 for the next forward stroke. It is noted that drum 14 does not rotate when web moving mechanism 32 is returning in the direction of arrow 30 to its first stationary position. Consequently, no articles are picked up or discharged by the drum on the rearward stroke of mechanism 32. Drum 14 picks up articles from manifold 12 only when rotating in the counterclockwise direction indicated by arrow 26, i.e., when web 24 is moving in the forward direction indicated by arrow 25.

The means for moving web 24 forward, includes mechanism 32 which includes lower clamps 34, and upper clamps 36, the latter being operated by solenoid 38. Web 24 is between clamps 34 and 36, and moved forward a distance determined by the stroke length of mechanism 32, after which the upper clamps 36 are released so that mechanism 32 can be returned to its initial position where the cycle is repeated; once again, clamps 34 and 36 grasp or clamp web 24, and move the latter in a forward direction. As web moving mechanism 32 moves forward in the direction of arrow 25, rod 40 fixedly connected to mechanism 32 is moved forward; consequently, rack 42, which is secured to rod 40 by means of bolts 41, is also moved forward. As rack 42 moves in a forward direction, it rotates gear 44 in a counterclockwise direction as indicated by arrow 26 in FIG. 1. As gear 44 moves in a counterclockwise direction pawl 46, which is pivotedly connected to the gear, engages the teeth of ratchet 49, the latter being rigidly connected to drum 14 by being threadly connected at 50 to plate 52, the latter being secured to the drum by bolts 54. Thus, drum 14 is moved in a counterclockwise direction. A spring 56 maintains contact between the pawl 46 and ratchet 48 during rotation of the drum. Rotation of drum 14 is terminated upon mechanism 32 reaching the end of its forward stroke. When reaching this latter position, solenoid 38 releases upper clamps 36, and mechanism 32 is returned to the rearward or initial position.

During rearward movement of mechanism 32, rack 42 rotates gear 44 in a clockwise direction. Since the gear 44 is now moving in a clockwise direction, pawl 46 is doing likewise and thus riding over the teeth of ratchet 48 in a non-engaging manner, thus preventing rotation of drum 14 during this rearward movement of mechanism 32. Thus, in this embodiment, when web 24 not moving, drum 14 is not rotating. Referring to FIG. 2, it is noted that a support member 56 having a plurality of grooves 58 formed therein, is located beneath web 24 and supports the latter during its forward movement. Pockets 28 of the web slide in grooves 58 of the support member as the web is moved forward. Although not shown, there is a second group of clamps similar to clamps 34 and 36, which grasp web 24 during the rearward movement of mechanism 32 to prevent web 24 from accidentially being moved rearwardly also. This second group of clamps is released when mechanism 32 reaches its most rearward or first stationary position at the end of its rearward stroke.

Drum 14 has a transverse bore 60 formed about axis 15, and extending inwardly from one end of the drum. Extending into transverse bore 60 is a stationarily mounted circular plug 62 having a vacuum passageway 64 formed therein, the latter passageway terminating with an arcuate portion 66.

Referring to FIG. 3, it can be seen that a circumferential row of pockets 68 is formed in the outer peripheral surface of drum 14, and that a cylinder bore 70 extends radially inwardly from each of the drum pockets, each cylinder bore communicating with transverse bore 60. As drum 14 rotates in a counterclockwise direction, the leading edge 70*a* of each cylinder bore rotates past edge 66*a* of arcuate portion 66 of the vacuum passageway formed within plug 62, thus opening communication between the vacuum passageway and the associated drum pocket via passageways 72 and 74.

Reciprocably confined within each cylinder bore 70 is a piston 76 having a plunger 78 which reciprocates into and out of its associated drum pocket during rotation of drum 14. Each piston includes an annular stop 84 which abuts against an annular shoulder 86 to limit

the inward movement of the piston, and against an annular piston retainer **87**, which is removably mounted within the cylinder bore, to limit the outward movement of the piston.

As the leading edge **68***a* of each drum pocket begins to rotate past opening **82**, an article **80** will begin to descend into the drum pocket due to gravity and the vacuum which is being applied to the drum pocket via passageway **72**. The leading portion **90** of each article is pulled into the leading bottom portion of the drum pocket as a result of the vacuum being applied to the latter through the latter mentioned passageway. As the drum continues to rotate, drum pocket **68** continues to traverse the pick-up zone defined by the manifold and drum until the trailing edge **68***b* of the drum pocket reaches position **88**. At this position the entire article **80** is resting within the drum pocket the trailing portion **92** of the article being pulled into the trailing bottom portion of the drum pocket by the vacuum being applied through passageway **74**. By arranging passageways **72** and **74** as shown, each article **80** is properly directed into each drum pocket **68**.

It should also be noted that vacuum is also applied to the interior surfaces of piston **76**. This acts to hold piston **76** inwardly as each pocket rotates from the pick-up zone to the discharge zone. When a drum pocket **68** with article **80** therein reaches the discharge zone where it is desired that the article be discharged, the vacuum to the drum pocket is terminated. This is accomplished when trailing edge **70***b* of the associated cylinder bore is substantially in line with edge **66***b* of arcuate portion **66** so that article **80** may be discharged via the force of gravity into pocket **28** of web **24**. At this point, piston **76** also descends via the force of gravity to provide assistance in discharging the article if it is necessary.

As drum **14** continues to rotate, piston **76** will reciprocate inwardly once more prior to reaching the piston where the vacuum is applied once again.

Referring to FIGS. **4** and **5**, a second embodiment of the invention is illustrated wherein the web moving mechanism moves the web forward to a predetermined forward position while the drum and manifold are also moved to a forward position; the sequence is timed so that the drum and manifold arrive at the forward position either substantially at the same time, or slightly behind the time the web reaches its forward position.

Referring to FIG. **4**, it can be seen that a motor **98** is utilized for driving a sprocket **100**, motor **98** being fixedly mounted to frame **11'** of the machine. As sprocket **100** rotates in counterclockwise direction, chain **101** is driven in the same direction, thus rotating a larger sprocket **102** in a counterclockwise direction. The rotation of the latter causes crank **104** which is fixedly connected to a shaft **105** on which sprocket **102** is mounted, to rotate in a counterclockwise direction; this causes follower **106** to ride in slot **108** of crank **110**, causing the latter to rotate in a counterclockwise direction about axis **111** which causes crank **112** to move in a forward direction by means of being connected at **113** to crank **110**. Carriage **114**, thus moves forward in a horizontal direction because crank **112** is pivotly connected to the carriage **114** at point **115**. The carriage is guided by supporting guide rods **117** to its extreme forward position as determined by the stroke of the crank arrangement **104–110–112**.

Since the manifold **12'** and **14'** are mounted on carriage **114**, each is moved in a forward direction, gear **44'** rotating in a clockwise direction as it moves over rack **42'**, the latter being stationarily mounted to frame **11'** of the machine. As gear **44'** rotates in a clockwise direction, pawl **46'** rides over the teeth of ratchet **48'** thus allowing drum **14'** to move forward without rotating. After drum **14'** reaches it extreme forward position as determined by the crank mechanism, the drum will be returned to its rearward position, thus rotating gear **44'** over rack **42'** and causing the former to rotate in a counterclockwise direction. This causes pawl **46'** which is pivotly connected to gear **44'** to also rotate in a counterclockwise direction and drivingly engage the teeth of ratchet **48'**, thus rotating drum as carriage **114** returns to its rearward position and discharging articles into pockets **28'** of web **24'**. The construction of drum **14'** and the means for rotating the same are identical to that shown in FIGS. **1–3**. Thus, it can be seen that forward movement of carriage **114** moves the drum and manifold forward without rotating the drum; the discharge portion of the cycle is on the return or rearward stroke of carriage **114** which acts to rotate drum **14'** in a counterclockwise direction to pick-up and deposit articles into web **24'**. At the completion of the rearward stroke of carriage **114**, the web moving mechanism is once again moved forward simultaneously with the forward stroke of carriage **114**, the latter reaching the end of its forward stroke substantially at the same time, or slightly behind the time that web moving mechanism **32'** reaches its extreme forward position. The web moving mechanism **32'** is similar to that shown in FIGS. **1 – 3**, and its operation is synchronized wth the operation of drum **14'**.

The operation of the machine is shown more clearly in FIGS. **6**, **7** and **8**. FIG. **6** illustrates carriage **114** at position A prior to beginning its forward stroke; during the forward stroke, gear **44'** is rotated over rack **42'**, thus causing the former to rotate about horizontal axis in a clockwise direction and causing pawl **46'** to ride over the teeth of ratchet **48'**, thus preventing rotation of drum **15'** during the forward stroke or movement of carriage **114**. As previously noted, web moving mechanism **32'** will reach the end B' of its forward stroke substantially at the same time as or prior to the time carriage **114** reaches the end B of its forward stroke.

Once carriage **114** has reached the end B of its forward stroke rearward or return movement of the carriage causes gear **44'** to rotate in a counterclockwise direction, thus picking up articles from manifold **12'**, and depositing them into pockets **28'** of web **24'** as illustrated by the arrows **120**. This operation or sequence operates in the same respect as that illustrated in FIG. **3**; that is the pockets of drum **14'** rotate past the pick up zone to receive articles **80** from the outlet of the manifold; drum **14'** then continues to rotate in a counterclockwise direction until reaching the discharge zone where the vacuum to each of the drum pockets is terminated to release the article into a web pocket while receiving additional assistance if necessary from piston **76** to positively discharge the article into its associated web pocket. The entire operation must be timed so that web **24'** is stationary while the carriage **114** is moving in a rearward direction to discharge the articles. However, at the completion of rearward stroke of carriage **114** the web advancing mechanism is again returned to its extreme rearward position

A' to grasp the web and move it forward to its extreme forward position B'.

In both embodiments described herein, the operation of the drum is synchronized with that of the web moving mechanism, and the spacing between ajacent drum pockets in a circumferential row must be coordinated with the spacing between adjacent web pockets in a row.

I claim:

1. An article packaging machine for picking-up a plurality of articles from a manifold and discharging said articles into a web having a row of web pockets formed therein, said machine comprising a rotatably mounted drum adapted to rotate about a generally horizontally disposed axis, means for rotating said drum unidirectionally about said axis, said drum having a circumferential row of drum pockets formed in the outer peripheral surface thereof, each of said drum pockets being sized to receive a predetermined number of articles therein, said drum including a cylinder bore extending radially inwardly from each of said drum pockets, said manifold having an outlet disposed adjacent said peripheral surface of said drum to define a pick-up zone therewith, said outlet being disposed in line with said circumferential row of drum pockets, each of said drum pockets being adapted to rotate past said pick-up zone to a discharge zone adjacent said web, and vacuum control means for applying a vacuum to each of said drum pockets while traversing said pick-up zone, and for terminating said vacuum to each of said drum pockets while traversing said discharge zone, said vacuum control means including valve means, said drum being adapted to rotate with respect to said valve means, and piston means including an annular stop to close each cylinder bore and further including a plunger movable therewith in said cylinder bore and associated with a drum pocket for assisting in the discharge of articles from such drum pocket if necessary, each piston means being movable by gravity and being held retracted by a vacuum from said vacuum control means while its associated drum pocket is traversing said pick-up zone.

2. An article packaging machine according to claim 1, wherein said piston means comprises a piston reciprocably confined within each of said cylinder bores and the plunger associated therewith is adapted to reciprocate into and out of its associated drum pocket, said vacuum control means including means for applying vacuum to the interior surfaces of each said piston at substantially the same time as vacuum is applied to its associated drum pocket and further including means for terminating said vacuum to each said piston at substantially the same time as vacuum is terminated to its associated drum pocket so as to allow each said piston to descend by gravity and thus allow said plunger to enter said drum pocket.

3. An article packaging machine according to claim 2, wherein said drum has a transverse bore formed about said axis and extending to one end of said drum, each of said cylinder bores extending radially inwardly to said transverse bore so as to communicate therewith, said valve means comprising a circular plug having substantially the same diameter as said transverse bore, said plug being stationarily mounted within said transverse bore, said plug having a vacuum passageway formed in said plug comprising an arcuate portion formed in said plug and extending radially inwardly from the outer periphery thereof, said arcuate portion overlying said cylinder bores so as to periodically communicate with each of said cylinder bores as said drum rotates about said axis.

4. An article packaging machine according to claim 3 wherein said manifold outlet is disposed above said axis to allow said articles to descend into said drum pockets at least partially by gravity.

5. An article packaging machine according to claim 4, wherein said vacuum control means includes a first passageway extending from said transverse bore to the leading bottom portion of said drum pocket, and a second passageway extending from said transverse bore to the trailing bottom portion of said drum pocket.

6. An article packaging machine according to claim 3, wherein each said cylinder bore includes a radially outwardly facing annular shoulder for limiting the inward movement of its associated piston, said machine further including a piston retainer removably mounted at the outer end of said cylinder bore adjacent its respective drum pocket for limiting the outward movement of each said pistons.

7. An article packaging machine according to claim 3, including means for moving said web in a forward direction beneath said drum, means operatively connected to said web moving means for rotating said drum with said forward movement of said web moving means to discharge said articles into said web pockets.

8. An article packaging machine according to claim 7, wherein said drum rotating means includes a rack fixedly connected to said web moving means, a gear adapted to rotate about said axis and disposed in driving relation to said rack, a pawl pivotly connected to said gear and adapted to rotate therewith, and a ratchet fixedly connected to said drum and adapted to be driven by said pawl when said web moving means is moved in said forward direction.

9. An article packaging machine according to claim 3, including means for moving said web in a forward direction from a first stationary position beneath said drum to a second stationary position beneath said drum, and means for non-rotatingly moving said drum forward from a first stationary position to a second stationary position along with said manifold, and rotatingly returning said drum from its second stationary position to said first stationary position along with said manifold to deposit said articles into said web pockets.

10. An article packaging machine according to claim 9, wherein said drum and said manifold are mounted on a carriage, said carriage being movably mounted on generally horizontally disposed support means, and further including drive means for moving said carriage via said support means from said first stationary position to said second stationary position, and returning said carriage to said first stationary position.

* * * * *