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(54) **TABLET FILLER DEVICE WITH STAR WHEEL**

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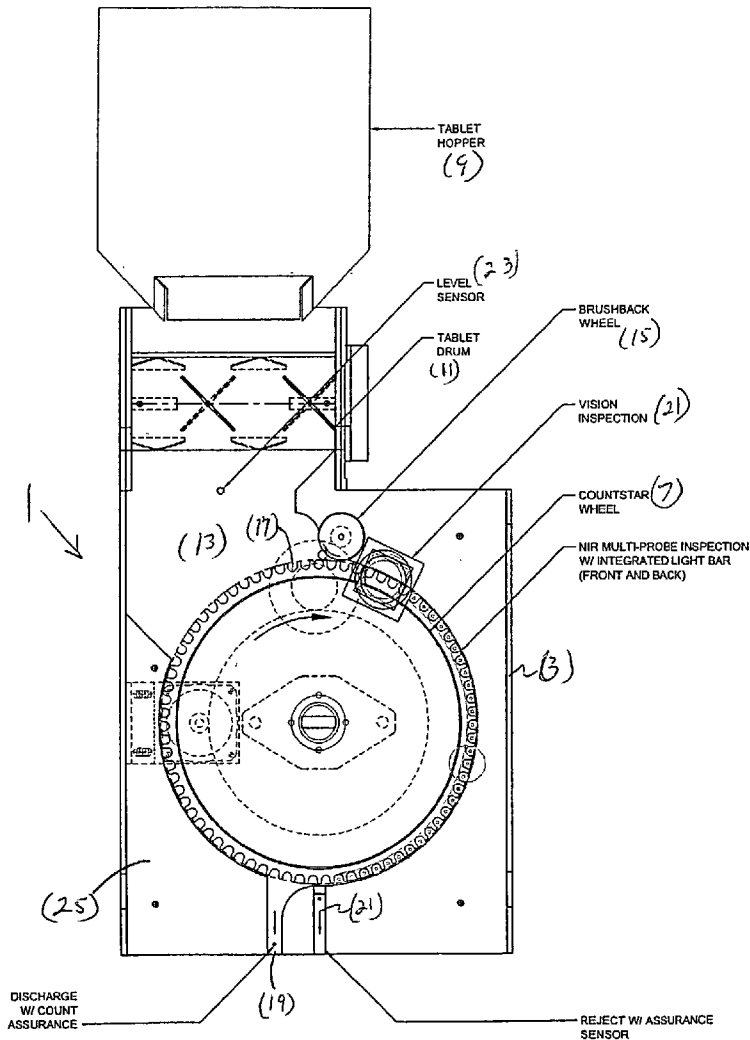
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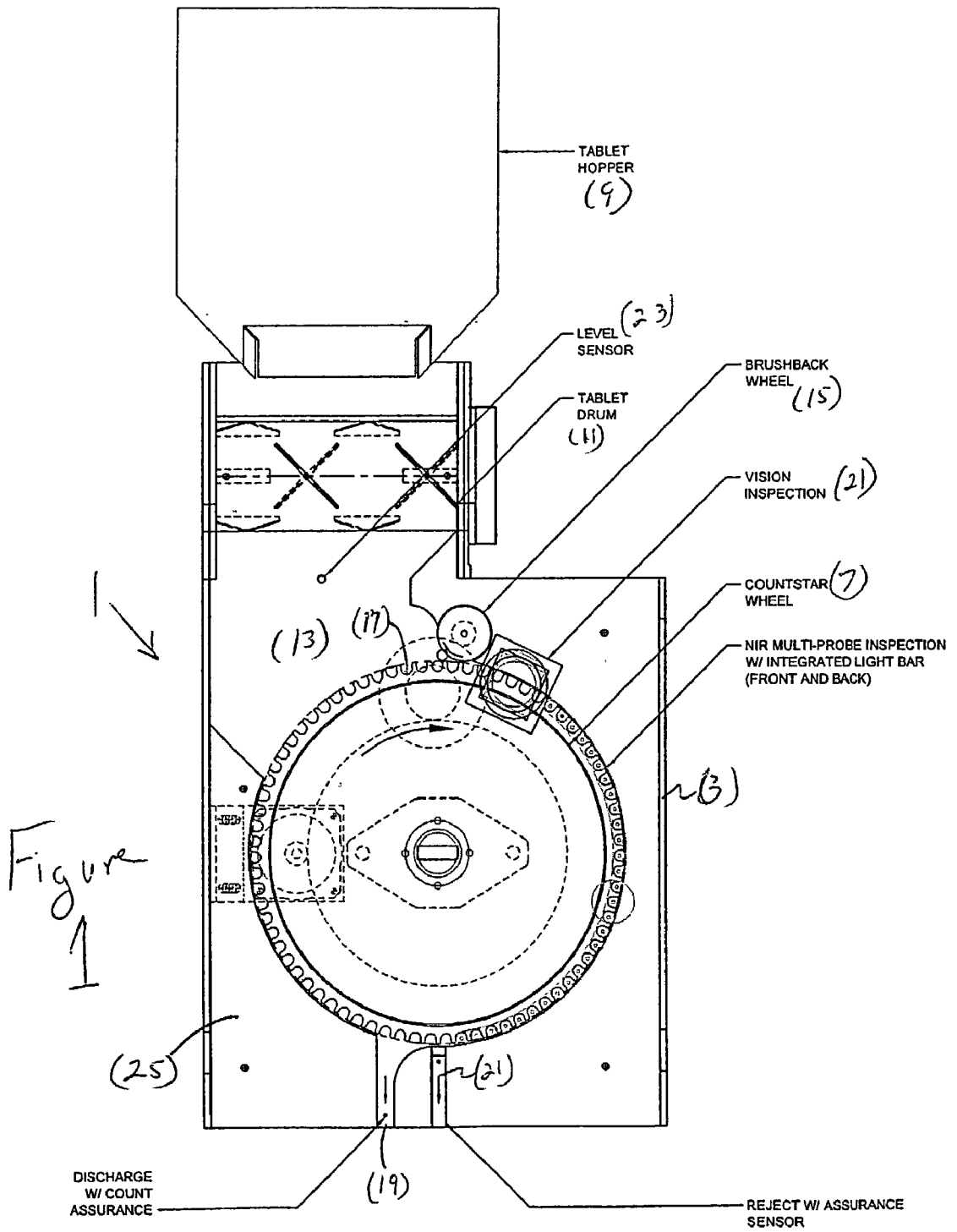
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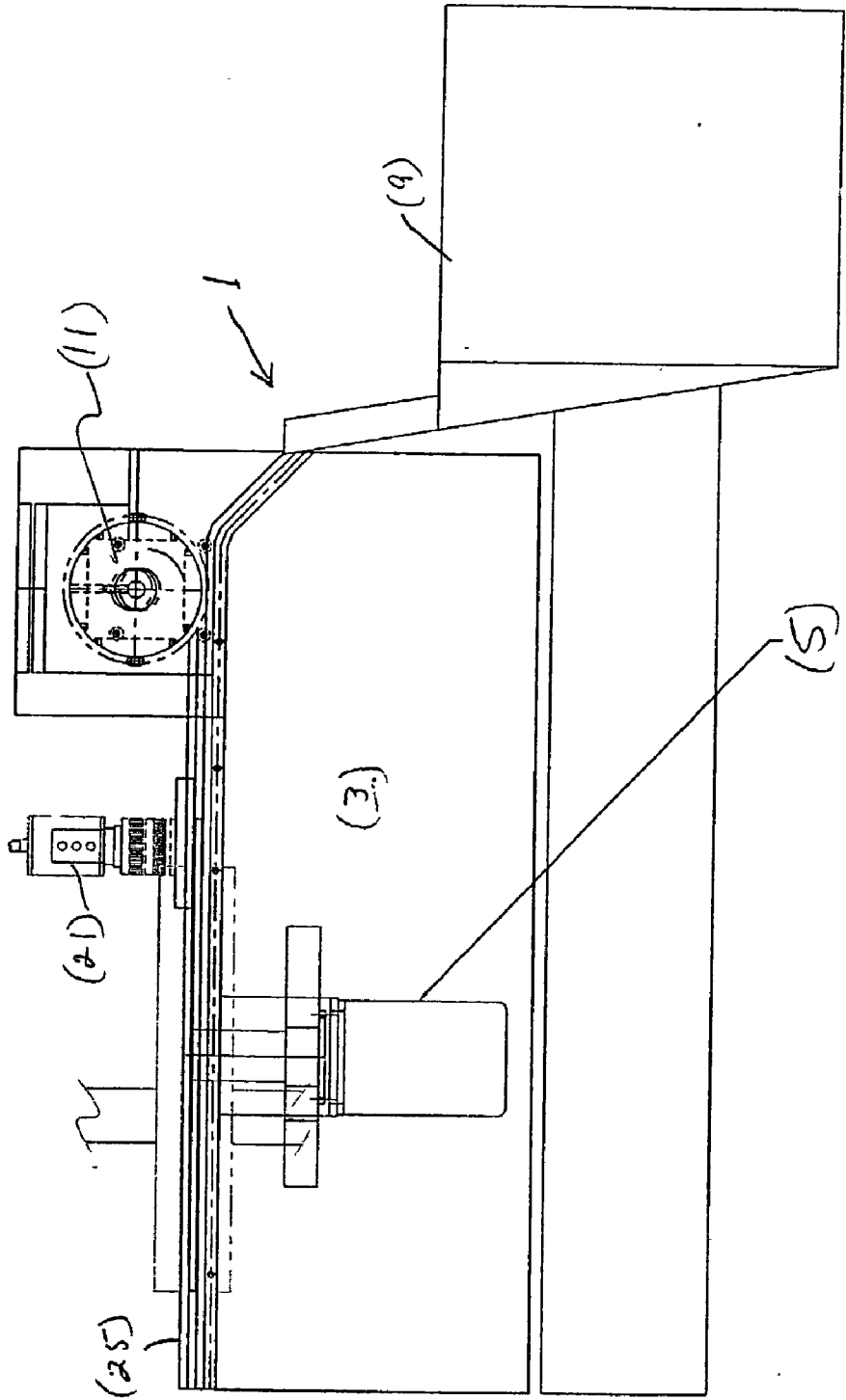
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(57) **ABSTRACT**

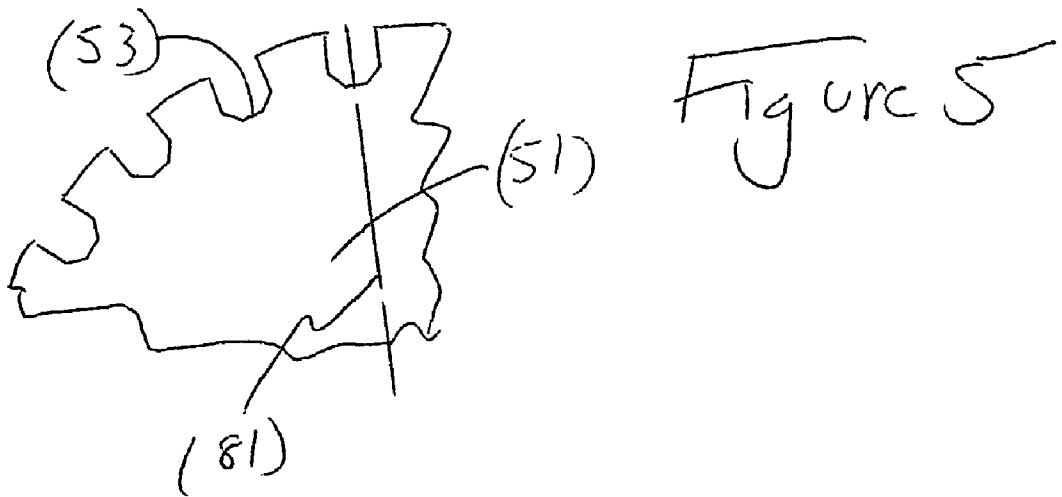
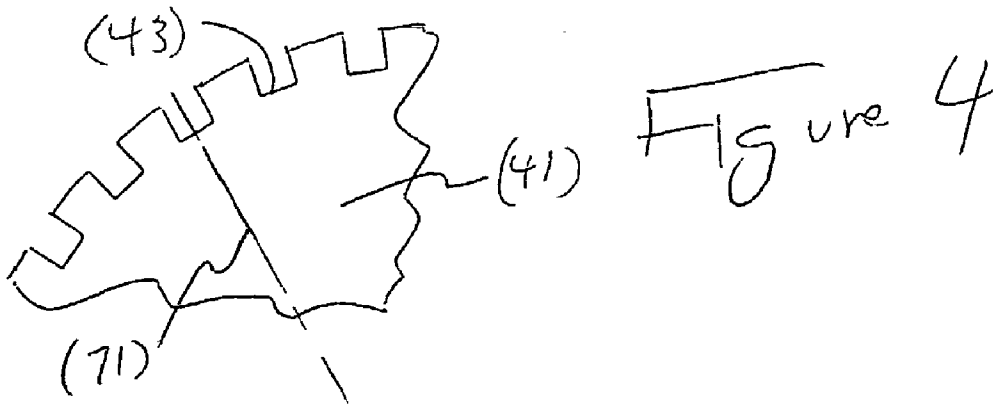
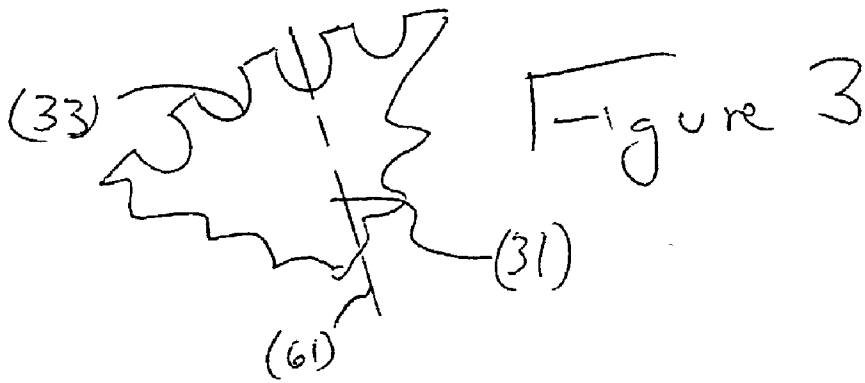
In a tablet filler device having a feeder, a chute, a tablet sorting and advancing mechanism and a gravity feed for filling tablet containers, the improvement is a star wheel tablet sorting and advancing mechanism, having a star wheel that is a flat, circular plate. The star wheel has a plurality of a tablet slots which are complete pass-through slots absent a front or back, and which are arranged sequentially about an outer area of the circular plate. The tablet filler device may also include a rotating segment surface wheel adjacent the star wheel for counter rotation against the star wheel to enhance individual rapid speed placement of tablets into the slots of the star wheel. In other embodiments, the tablet filler device may include a step up, digitally controllable motor connected to the star wheel for driving the star wheel. In most preferred embodiments, there is also a computerized control system that includes star wheel drive control, and a plurality of quality assurance inspection and rejection features.







Figured



TABLET FILLER DEVICE WITH STAR WHEEL**INCORPORATION BY REFERENCE**

[0001] The following two issued United States patents, having the same assignee as the present application, are incorporated herein by reference, in their entirety:

[0002] U.S. Pat. No. 6,345,487, issued on Feb. 12, 2002, and entitled "High Quality Control Tablet Filler Device"; and,

[0003] U.S. Pat. No. 6,363,687, issued on Apr. 2, 2002, and entitled "Secured Cell, Rapid Fill Automated Tablet Order Filling System".

BACKGROUND OF THE INVENTION**[0004] 1. Field of the Invention**

[0005] The present invention relates to tablet filler devices, which are automated for rapid accurate container filling. More specifically, the present invention involves the use of single plane star wheels with step motors as the primary moving mechanism to transfer tablets from a feeding chute to a gravity drop location into a container. These star wheels control table flow, expose tablets for count, for quality control, for a defect ejection, and for other inspections such as orientation or identity.

[0006] 2. Information Disclosure Statement

[0007] Tablet dispensing is accomplished on a small scale basis at the local level closest to the end user—namely, at pharmacies, dispensaries, clinics, and other medical services related facilities. At this level, simple, manual, dispensing devices are employed, such as "lazy susan" type rotating dispensers with columns containing different types of pharmaceuticals of rows of dispenser columns containing different types of pharmaceuticals. In these environments, the multi-pharmaceutical manual dispenser is typically maintained in some sort of locked fashion, such as in a cabinet or in a secured dispensing room. At the other end of the spectrum, mega quantities of tablets are filled and distributed by pharmaceutical manufacturers. Massive filling equipment is employed in government regulated "clean rooms" or "clean buildings" and macro security in the form of locked rooms and employee ID programs are utilized.

[0008] Recently, a company called "ScriptPro" has developed a prescription fulfillment system for community ambulatory and managed care pharmacies. This has been designed for the local level with a robotic prescription dispensing system which handles 200 or so different types of tablet or capsules and fills and labels up to 90 prescriptions per hour. This is described in ScriptPro LLC's 1998-99 Catalog No. 3000-0000.001, entitled, "Robotic Prescription Dispensing System" and available at <http://www.scriptpro.com/catalog>.

[0009] The ScriptPro SP 200 system described in the above has been developed to handle different types of tablets in a single system and operated at a maximum of 90 prescriptions per hour. On the other hand, the present invention system has been developed for regional level prescription fulfillment such as may be handled by mail order prescription firms and internet firms and similar vitamin firms, etc. Unlike ScriptPro, the present invention system can fulfill 5000 to 6000 prescriptions per hour and relies upon separate filler cells for each different type of

tablet and/or bottle size. Further, the present invention system operates in a totally different manner with different subsystem components.

[0010] The random tablet filler system utilized in the present invention accomplishes objectives set forth below which are unachievable in the prior art systems and the presently commercially available systems.

[0011] The following patents are representative of the state of the art filler devices:

[0012] U.S. Pat. No. 3,871,295 describes a capsule orienting and turning apparatus and method for use in a spin printing procedure in which a printing roll moves at a greater speed than the capsule, thus causing the capsule to rotate about its own axis while it is being printed. Many capsules, randomly arranged in a hopper, are picked up in a rotary conveyor which arranges them first in vertical arrangement relative to the path of movement of the conveyor, some capsules upright and some inverted, and an air jet shifts the body portions of the upright capsules in the machine direction so that the cap portions can subsequently be shifted in a sideways direction by a subsequent sideward-directed air jet. Those capsules which are inverted are not affected by the first air jet because of a barrier which prevents their movement; the cap portions of these inverted capsules are blown sideways by the sidewardly directed air stream. In this way, the positions of the capsules are rectified, with all of the cap portions on one side of the predetermined path and all of the body portions on the other side of the predetermined path.

[0013] U.S. Pat. No. 3,889,591 describes a branding machine for automatically printing indicia on tablets, pills, candies or any other products of any similar shape and/or size, which comprises of a hopper unit, a feed unit including at least one rotary drum having the periphery formed with a plurality of radially inwardly recessed receptacles arranged in at least one row and a printed unit. The receptacles are successively communicated with a vacuum source for receiving the products therein under suction at first, then with a source of compressed air for posture correction of said products within the associated receptacles, again with the vacuum source for holding the posture-corrected products in a definite posture thereby to enable them to be printed by the printing unit, and finally with the compressed air source for successively ejecting the printed products on to a subsequent processing station. A method for reproduction of the indicia on the products.

[0014] U.S. Pat. No. 3,925,960 describes a machine for filling containers with discrete articles comprising a series of elongated slat members movable in a closed path, a portion of the slat members having an outer surface with a multiplicity of spaced apart cavities therein. The path comprises spaced apart cavity charging and discharging stations. Means at the charging station deposit articles in the cavities. The slat outer surfaces tilt at the discharge station for the simultaneous discharging of articles. Container delivery means continuously feed containers at a predetermined uniform speed along a line parallel to the direction of elongation of the slat members and below the level of slat members at the discharge station. A first set of stationary article-guiding chutes is disposed in a side-by-side relation at said discharge station, each chute having an upper inlet and tapering to a narrowed outlet. A second set of chutes is supported for movement in a closed path, each chute being

generally vertically disposed and having an upper inlet wider in the direction of chute travel than any first set chute outlet and a lower outlet smaller than its inlet. The closed chute path includes a portion extending the full length of the slat members with chutes in that path portion aligned with the container feeding line and the first set chute outlets. Drive means are provided for driving the container delivery means, for driving the chutes such that each chute moves with its outlet aligned with a moving container, and for driving the slat members.

[0015] U.S. Pat. No. 4,231,462 describes a turning and orienting apparatus of the type adapted to transport capsules in a plurality of pockets or the like, which pockets are formed in a continuously moveable transport conveyor, and wherein said apparatus is further adapted to rectify the capsules, which have body portions and cap portions of greater transverse dimensions than the body portions, and wherein a vacuum is provided to shift the capsules into the desired rectified position, a capsule portioning guide is provided to retain each capsule in its pocket immediately prior to its being subject to the vacuum. The capsule positioning guide then releases the capsule as it subjected to the vacuum. In a preferred embodiment of the invention, the capsule position is pivotally mounted adjacent the capsule transport conveyor so that it can be easily moved out of its operative condition adjacent the transport conveyor for easy cleaning thereof.

[0016] U.S. Pat. No. 4,377,971 describes an apparatus which is disclosed which transports and rectifies objects, such as pharmaceutical capsules, and prints appropriate indicia in the objects. The apparatus comprises a two-drum system, the first drum being used to shift objects from a radical to a longitudinal position, and then to reorient some of the capsule so that, when the capsules are delivered to a second drum, the cam drum, all capsules are pointing in the same direction. The system takes advantage of gravity for rectification. Spin printing means are provided to print indicia on the rectified objects, as the objects travel along the periphery of the cam drum. A process for operating the apparatus is disclosed.

[0017] U.S. Pat. No. 4,394,933 describes a capsule orienting apparatus in which misoriented asymmetric capsule inadvertently passed by a rectifying unit are segregated from properly oriented capsules. Capsules are delivered by a rectifying drum to capsules carrying pockets in a segregating drum which have recessed portions sized to loosely receive properly oriented capsules and tightly receive misoriented capsules. As the loosely held, properly oriented capsules pass a discharge point, they are released. The tightly held, misoriented capsules remain in the segregating drum past the discharge point and are ejected from the segregating drum downstream from the discharge point.

[0018] U.S. Pat. No. 4,582,201 describes a product transporting apparatus for transporting solid products of generally similar shape and/or size successively from a take-in station towards a take-out station, which has first and second rotary drums rotatable in the opposite directions to each other. The first and second rotary drums are of identical construction each having at least one circumferentially row of tubular receptacles protruding radially outwardly from the outer periphery of the respective drum and circumferentially equally spaced from each other. The products can be suc-

cessively supplied onto the first rotary drum and held by suction in position on the tubular receptacle then communicated with a vacuum source at the take-in station, which are in turn transported, during the rotation of the drums, to the transfer station where they are released from the receptacles on the first drum then communicated with a compressed air source, onto the respective tubular receptacles on the drum then communicated with the vacuum source. The products so transferred onto the secondary drum are then transported in a similar fashion towards the take-out station where they are successively released from the second rotary drum onto a subsequent processing station.

[0019] U.S. Pat. No. 4,619,360 describes a product transporting apparatus for transporting solid products of generally similar shape and/or size successively from a take-in station towards a take-out station, which comprises first and second rotary drum rotatable in the opposite directions with each other. The first and second rotary drums are of identical construction each having at least one circumferential row of tubular receptacles protruding radially outwardly from the other periphery of the respective drum and circumferentially equally spaced from each other. The products can be successively supplied onto the first rotary drum and held in position sucked by the tubular receptacles than communicated with a vacuum source at the take-in station, which are in turn transported, during the rotation of the drums, to the transfer station where they are released from the receptacles on the first drum then communicated with a compressed air source, on to the respective tubular receptacles on the second rotary drum then communicated with the vacuum source. The products so transferred onto the second rotary drum are then transported in a similar fashion towards the take-out station where they are successively released from the second rotary drum onto a subsequent processing station.

[0020] U.S. Pat. No. 5,208,762 describes a method and apparatus for dispensing drugs, wherein a patient's order of one or more prescriptions is automatically filled. Various drugs are stored in three or more filler lines. A vial size is assigned to each line. When a prescription is filled, it is automatically assigned to a line in view of the vial size requirements and processed accordingly. Provisions are made for the inability to fill a prescription or order. Subsequently, all of the patient's prescriptions are collected and made available as a single order.

[0021] U.S. Pat. No. 5,240,118 describes an apparatus for feeding tablets in an aligned and uniformly oriented sequence onto a tablet measuring device, including a moveable turntable having a deflector for guiding the tablets to a circumferential edge, a guide member and plow assembly respectively aligned in a parallel and spaced apart relationship, the guide member having longitudinally-spaced air jets and the plow assembly having respective edge surfaces for slidably guiding tablets from the channel to prevent them from being conveyed on the measuring system.

[0022] U.S. Pat. No. 5,463,839 describes an apparatus for packaging a pre determined quantity of objects and a counting device therefore is disclosed. The counting device includes a feed chute for singularizing objects, and the tray has at least one guide path including segments defining a direction of movement orientated at an angle with respect to the drive axis of the tray. The packaging apparatus includes the counting device and associated components and controls for the automatic, high speed filling of containers.

[0023] U.S. Pat. No. 5,568,715 describes an automated inspection system for inspecting packages, such as blister packages, to verify the presence therein of products, such as contact lenses, prior to heat sealing of the blister packages. The automated inspection system includes a transport and ejector mechanism for ejecting any defective packaging determined by the automated inspection system not to have a product therein. The automated inspection system includes an optical inspection station at which packages are optically inspected by video cameras to verify that a product is, in fact, present in each package base. A package conveyor system is provided for conveying the packages by the optical inspection station. Following the optical inspection station, an ejector ramp of the transport and ejector mechanism is selectively switchable between a first raised position in which package bases are passed on for further processing, and a second lowered position in which defective packages are transferred from the package conveyor system to the ejector ramp and a buffer area for ejected packages.

[0024] U.S. Pat. No. 5,596,865 describes the invention that relates to a process for removing tablets or pills or the like issuing from a tablet or pill press and processing them further in a plurality of containers standing cramped on a restricted area. After leaving the tablet or pill press, the tablets or pills are conveyed upwards and, by gravity alone without the application of further energy, pass from top to bottom through an oblique deburring and dust-removing station and a distributing guide to divide the flow of tablets or pills into two partial streams which are taken to either a metal testing device or a tablet or pill testing device with a sample collector; the tablets or pills found to be faultless are taken further by gravity to a belt conveyor which takes the tablets or pills to and inserts them in a predetermined container.

[0025] U.S. Pat. No. 5,771,657 describes in an automated prescription dispensing and packaging system, empty prescription bottles are labeled and loaded in assigned locations in carriers. Pills are automatically dispensed into the prescription bottles in the carriers. Ranks of carriers containing filled prescriptions bottles are unloaded and packed into shipping containers with literature printed by the system. Multiple bottles of an order are automatically packed in the same shipping container.

[0026] U.S. Pat. No. 5,963,453 describes a system and method for batch processing or filing prescriptions. Broadly stated, the prescription processing system comprises a packaging subsystem, a sorting subsystem, an optional medical reclamation subsystem, a system controller and prescription input means. The packaging subsystem, sorting subsystem and medical reclamation subsystem are all under the direction of the system controller. The system controller is in communication with prescription input device means, which is typically a plurality of remote terminals located at pharmacies, drug stores and hospitals. The prescription input device transmits prescriptions orders to the system controller where they are analyzed and sorted according to predetermined criteria to formulate a batch. The prescriptions are then packaged and sorted under the supervision of the system controller.

[0027] U.S. Pat. No. 6,185,901 describes an automated positive count rotary slat packaging apparatus and related methods include independently rotatable rotary slats. In one

embodiment, the apparatus also includes a positive count mechanism disposed in the pill delivery path adjacent the containers and a controller which is capable of generating an alarm or determining when a bottle is filled incorrectly. Accordingly, underfilled containers can be independently filled by further rotating only the respective rotary slat. A drive device for each rotary slat is also provided having frustoconical drive wheels connected to the ends of counterrotating drive shafts. The drive wheels, which are driven by a motor, engage corresponding frustoconical drive surfaces of the rotary slats to thereby rotate the slots.

[0028] U.S. Pat. No. 6,256,967 describes a method and a system is provided for automatically dispensing prescriptions according to a patient's order. The system includes at least one line of machines that can automatically fill a patient's prescription order with countable oral solid drugs and unit of use drugs, under the control of an appropriate control system, within the same machine. The apparatus of the invention includes numerous components that are integrated into a singular process. A robotic assembly may be used to manipulate and transport vials, canisters, and bins within the system. The robotic assembly may further include a gripper assembly. The canister may include means to accelerate a drug during the drug's movement through the canister in order to increase the separation distance between drugs. The canister may also include singulation control for maintaining drugs in a nearly single-file order as the drugs move through the canister. An unscrambler may be used to position the vial for pick up by the robotic assembly. The robotic assembly moves the vial to a vibratory dispenser where it is filled with a drug according to the patient's order. The vibratory dispenser may further include at least a single drive unit for vibrating the canister and a quick coupling mechanism for fixedly engaging the canister. A labeler applies a patient specific label to the vial. Vials and unit of use drugs may be collected in accumulation receptacles prior to delivery to a patient. The methods of the invention include a process for varying the vibrations of the canister by the vibratory dispenser in response to the amount of drug in the canister. A process for optimizing the storage location of a canister based on drug use is also provided.

SUMMARY OF THE INVENTION

[0029] The primary purpose of the present invention is to provide a means of filling tablets, capsules, and similar products that are supplied in bulk whereby they may be automatically inspected, counted, and placed in a container (i.e., a medicine bottle, jar, or the like) with absolute assurance that the finally filled container contains the exact, required number of tablets and, that all of the tablets are the correct type and of the correct quality. Thus the present invention device operates to assure the correct formulation; the correct count; and that each tablet has no cracks, blemishes, broken parts, or other disfigurements. As of the date of this writing, no existing tablet filling machine can make these claims or achieve these results.

[0030] The present invention single plane star wheel provides a method of taking tablets in a bulk form and singulating them into a physical condition whereby each tablet is individually oriented, placed, recognized, and completely tracked until it is placed into the final container.

[0031] Hence, the primary innovative attributes of the invention arise not only from the methodology by which the

tablets are singulated from a bulk condition and oriented into a known, trackable position (i.e. a single lane or a fixed pocket) but, from the fact that once the position of each tablet is known, that tablet is individualized and it can be incrementally and positively tracked throughout the remainder of the system, until it is deposited into the final container, at extremely rapid speeds using the star wheel. Furthermore, at these very high speeds, the entire system may be controlled by a dedicated computer working in conjunction with a digitally responsive motor (either a stepping motor or a servomotor) and a system of sensors, strategically located at key points throughout the system. Sensors and motor may be controlled by and responsive to the computer; hence, the whereabouts and physical condition of each tablet can be exactly known at any time during its transit through the filling system, again, at very high speeds. By correctly utilizing these elements, with the star wheel, a tablet filling system can be created that is truly guided by innate self intelligence at very high speeds, such that the physical quality and condition of each tablet, before entering the final container, can be exactly ascertained by an appropriately located sensor/camera mounted in a position wherein the exact position and orientation of the tablet (or capsule) can be recognized by the computer and, subsequently tracked. Without the present invention star wheel device, then objectives have not been achieved in the tablet filling arts.

[0032] Each tablet that does not meet preset quality standards is automatically rejected from the star wheel before it can enter the container. Further, the fact that the tablet has actually been rejected can be verified by means provided by an appropriately located sensor at the reject station.

[0033] Further, the system, by virtue of its computer intelligence, knowing that a rejected tablet has occurred, will automatically increment the star wheel one additional filled pocket for each tablet rejected to reconcile the proper count of total tablets to be deposited in the container.

[0034] An additional feature of this filling system, in one preferred application, is that the filling nozzle may be retractable and, during filling, it descends and makes a loose "seal" with the open neck of the container such that the annular opening between the nozzle and the container is too small at all points to allow a stray tablet to escape.

[0035] In the filling nozzle itself, a "defined area" sensor is located to provide means for counting the tablets as they pass through into the container. This count is then continuously reconciled by the computer versus the preset tablet count requirements for the container. In addition, the computer also continuously reconciles the count to the known filled pockets of the star wheel that were selected, previously by the computer, to be placed into the container. Further, there is an additional sensor viewing the star wheel pockets after they have passed their emptying position over the filling nozzle. This sensor is there to provide assurance that each designated tablet has, indeed, been dropped into the fill nozzle; hence, into the container. The results of this sensor inspection is reconciled into the tablet count by the computer.

[0036] By these redundant means, absolute assurance can be provided that the exact, proper count of tablets has entered the container and, by virtue of the pre-inspection, positive tracking control, and verified rejection when required, only tablets of pre-selected quality levels are deposited.

[0037] Further, all computer tracking and sensing are accomplished by "failsafe" programming. That is: all events looked for by the computer are treated as failures until the event actually happens; thus all misread or non read events will be registered as a failed event, alarming the reconciliation.

[0038] Further, the star wheel provides means whereby very high speeds can be attained while still maintaining the assurances outlined above. Actual models have been successfully built and successfully tested at speeds in the order of 2,500 to 3,000 tablets/minute that were able to absolutely differentiate present quality levels in $\frac{5}{16}$ " diameter tablets, although this could realistically have been any common size of tablet or capsule.

[0039] Further, the means by which the tablets are singulated, oriented, and placed into the star wheel are innovative and unique. There is no combination of design elements that exists in the marketplace that matched this configuration, either in its design configuration or its functional capabilities.

[0040] As with prior art, the bulk tablets are spread laterally behind a counter rotating drum that has protruding features that alternately agitate the tablets, then allow a plurality of them to slide under and through its parallel, spaced opening above the bottom plate. (Typically this drum could be of a segmented brush design or, as in the model that was built and successfully tested, it could contain a smooth, elastomeric circumferential surface that had on its surface, equi-spaced, v-profiled, chevron protruding stripes).

[0041] This counter rotating drum is adjustably placed above a tilted (or vertical) plate such that the parallel space between the peripheral surface of the drum and the plate can be accurately adjusted, by suitable mechanical adjusters, to provide a "loose fit" for tablets on their "faces" to slide under and through but not for tablets on their "edges" or multiple, stacked tablets. Abutting the exit side of the drum, such that no tablet escapes, a clear plate is placed parallel to the plate, spaced for a "loose" slide fit for tablets on their faces to easily slide under and, by gravity, down the surface of the bottom plate.

[0042] By these means the tablets fan out in a bulk lateral direction but are oriented and captured correctly on their face surfaces and slide, en masse, downward on the bottom plate into contact with to rotating, externally pocketed star wheel. These pockets are specifically spaced and shaped to conform to the peripheral shape of each tablet (or capsule) being processed. The star wheel as it rotates, agitates and successfully picks up the tablets in its pockets as they pass through the lateral bulk of tablets. By virtue of the fact that the unidirectionally confined tablet are free to move and be agitated in only the lateral directions and the comparatively long peripheral contact length (hence, agitation length) of the star wheel, with them, all the pockets fill up with tablets.

[0043] It is important that the unidirectionally confined tablets remain free for the agitation provided by the star wheel in order that they can "find" and locate themselves into the preferred, shaped pockets of the wheel. There are two important features necessary for this:

[0044] 1. There is a smaller segment surface wheel (similar to the drum but only one tablet thickness wide) that counter rotates, between the two plates,

against the star wheel at the juncture where the star wheel leaves the unidirectionally oriented bulk tablet chamber.

[0045] 2. There is a sensor beam that looks across the top surface of unidirectional bulk tablet chamber positioned such that it will shut off the flow of tablets emanating under the main bulk feed drum by shutting the drum rotation off whenever the beam is blocked. Hence, a free space is assured between the tablets and the rotating drum.

[0046] By these means, unidirectionally oriented tablets are enabled to flow freely in their lateral direction with no catch or jam to impede tablet flow. Without these features, tablets are prone to jam and/or break.

[0047] Once the tablets (capsules) are picked up and captured in the pockets of the star wheel, they are progressively delivered and presented to:

[0048] 1. A positioned sensor that determines their quality correctness. Depending on the type of sensor used, typical attributes inspected for will include:

[0049] Color

[0050] Shape

[0051] Broken or Damaged Tablets

[0052] Correct Formulation of Tablet Contents

[0053] Foreign Materials

[0054] 2. A reject station:

[0055] Includes a reject verification sensor

[0056] 3. A retractable fill nozzle station:

[0057] Includes a "defined area" tablet verification sensor

[0058] 4. An "incorrectly filled" pocket sensor after the fill nozzle sensor.

[0059] As described above, the star wheel is driven by a digitally controllable motor which, in conjunction with the system's control computer, and the above describes sensors, assures all of the count and quality features as described herein.

[0060] Because of the plurality of shaped pockets, continuously presented to and agitating the free flowing bulk of unidirectionally oriented tablets, high speeds are attainable on a continuous basis.

[0061] One further refinement of this tablet filling system is that, unlike any other known system of captured tablets; it has the capability of being able to inspect both faces of a tablet at the same speed potentials when specially configured, as follows:

[0062] In this configuration, the star wheel and the associated plate that it rides upon are mounted vertically.

[0063] It is important, for good inspection that the tablet faces be inspected directly, not through a transparent interface such as glass or clear plastic or surrounded by adjacent, higher, machine elements. Proper lighting is a very important feature for this type of inspection. Shadows and/or reflections are

particularly prone to produce inspection errors. For this purpose, the tablets (captured in the wheel pockets) travel past alternate, widely open radial slots in, respectively, the outer guard and the base plate. Since the star wheel is virtually the same thickness as the tablet (capsule) being inspected, the widely open slot configuration provides means for "pure", shadow and reflection free illumination.

[0064] An appropriate sensor with strategically placed lighting is mounted above each open slot to provide means for shadow or glare free detection of defects, successively, in each face of the tablet.

[0065] On the opposite plate from each slot, a strategically placed plurality of holes is provided to access a vacuum chamber mounted on the other side of the plate. These holes are strategically located to hold and provide positive position control of the tablet as it passes through the open slot area.

[0066] In this manner, tablets are checked continually and alternately on their full faces, fully open to the sensor/camera under full control of their proper orientation and, because they are individually captured in the pockets of the star wheel (which is digitally driven) and held by the vacuum, their position and quality condition will be known to the control computer at all times. As described above, this enables positive acceptance/rejection, counting into the final container, reconciliation at all stations, etc., as described above.

[0067] A further feature of the star is its basic construction which features ease of cleanability and its resistance to trapping "tramp" tablets. The base plate and the transparent top guard plate are both smooth unbroken surfaces, except for the points where fixed spacers and the drive shafts protrude above the base plate. There are no interstices, cracks, crannies, etc. where tablets, particles, or dust can be trapped. All parts of the system are designed for easy assembly/disassembly and once disassembled, ease of cleaning.

[0068] The star filling system can be further enhanced to provide another industry needed feature that does not currently exist in commercially available tablet filling machinery. In the industry it is often necessary to precondition tablets before finally filling then into the container. Such preconditioning operations might ordinarily be a printing operation of a drilling operation. Typically, printing might be accomplished by ink jet or laser printing techniques. Laser drilling is another operation frequently used to enhance time release properties of a medication. As the available technology currently exists these preconditioning operations are typically accomplished on separate machinery and then, inspected and returned to a bulk condition before being, finally, processed on filing machinery. The reason for these separate operations is that, up to now, no filling method is available that will accurately inspect, accept/reject, track, and fill the conditioned tablets by a method such that exact count into the final container can be absolutely assured.

[0069] The star wheel system is capable of accomplishing these objectives. A suitable printing device or drilling device can be mounted over the circumferential path of the tablets as they are carried in the wheel pockets, positioned prior to the inspection station. A "tablet assurance" sensor is also

located in conjunction with the conditioning device such that whenever a passing tablet is present it activates the conditioning device. After being conditioned the tablet proceeds through the filling process as a "normal" tablet would, being subject to inspection, acceptance/rejection, etc. In this manner, tablets can be conditioned and filled with absolute assurance, continuously, and high speeds, with no need for more costly and time consuming interrupted operations.

BRIEF SUMMARY OF THE DRAWINGS

[0070] The present invention should be more fully understood when the specification herein is taken in conjunction with the drawings appended hereto wherein:

[0071] FIGS. 1 and 2 illustrate a side view, respectively, of one preferred embodiment present invention star wheel in a system; and,

[0072] FIGS. 3, 4, and 5 illustrate partial, front cut views of alternative embodiment star wheels of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0073] Referring now to the appended FIGS. 1 and 2, FIG. 1 represents a front view and FIG. 2 represents a side view of one embodiment of the present invention device. In the figures, tablet filler device 1 includes a base (3) which contains stepping motor (5) which drives star wheel (7). Tablet hopper (9) feeds tablets in a flood fashion (rather than in a single tablet straight line) to tablet drum (11) which rotates on a horizontal axis and takes up tablets and moves them to flood area (13) for flood feeding to star wheel (7). Brushback wheel (15) aids in forcing tablets into individual "U" slots such as "U" slot (17) in star wheel (7). Brushback wheel (15) and star wheel (7) are both running clockwise but are in proximity at the bottom of Brushback wheel (15) and the top of star wheel (7) to operate opposingly to compel tablets into the slots of star wheel (7) for ultimate discharge at filler shoot (19) for filling a container. Visual inspection station (21) examines each tablet and by computer connection to stepping motor (5) and rejecter (21), eliminates any defective tablets.

[0074] A clear Plexiglas plate (25) or similar plate may be imposed atop the star wheel (7) and flood area (13) to prevent tablets from falling forward. A level sensor (23) will stop tablets from (11) to prevent overflow of flood area (13).

[0075] FIGS. 3, 4 and 5 show various alternative embodiment filler device star wheels that may be utilized in the present invention. Thus, FIG. 3 shows star wheel (31), with slots such as slot (33) adapted for oval shaped tablets; star wheel (41) of FIG. 4 has slots such as slot (43) adapted for rectangular tablets; and star wheel (51) of FIG. 5 has slots such as slot (53) adapted for hexagonal tablets. Note that in FIGS. 3, 4, and 5 these pass-through slots are symmetrical relative to radii (61), (71), and (81) respectively. Alternatively, they could be tilted towards or away from direction of travel, i.e. biased so as to be asymmetrical relative to radii of the circular plate, as shown in FIGS. 3, 5, and 6 of U.S. Pat. No. 6,363,687, incorporated herein by reference. Other configurations could be used without exceeding the scope of the present invention.

[0076] Obviously, numerous modifications and variations of the present invention are possible in light of the above

teachings. For example, the star wheel could have any orientation relative to a floor, i.e., vertical, horizontal (parallel to floor), oblique angle, inverted completely or partially upside down). Preferred is vertical or non-horizontal. It is therefore understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. In a tablet filler device having a feeder, a chute, a tablet sorting and advancing mechanism and a gravity feed for filling tablet containers, the improvement which comprises:

a star wheel tablet sorting and advancing mechanism, having a star wheel that is a flat, circular plate, said star wheel having a plurality of a tablet slots which are complete pass-through slots absent a front or back, and which are arranged sequentially about an outer area of said circular plate.

2. The tablet filler device of claim 1 wherein said pass-through slots have a perimeter adapted to receive tablets of a specified footprint shape.

3. The filler device of claim 2 wherein said specified footprint shape is selected from the group consisting of circular, elliptic, oval, square, and rectangular.

4. The tablet filler of claim 1 wherein said pass-through slots are arranged symmetrical to radii of said circular plate.

5. The tablet filler of claim 2 wherein said pass-through slots are arranged symmetrical to radii of said circular plate.

6. The tablet filler of claim 1 wherein pass-through slots are arranged asymmetrical to radii of said circular plate.

7. The tablet filler of claim 2 wherein pass-through slots are arranged asymmetrical to radii of said circular plate.

8. The tablet filler device of claim 1 wherein said star wheel is positioned downstream from said chute in a substantially horizontal position with a stationary back panel therebehind.

9. The tablet filler device of claim 1 wherein said star wheel is positioned downstream from said shoot in a substantially vertical position with a stationary back panel therebehind.

10. The tablet filler device of claim 1 wherein said star wheel is positioned downstream from said shoot in a substantially nonvertical and a substantially nonhorizontal position with a stationary back panel therebehind.

11. The tablet filler device of claim 8 wherein there is a stationary front panel in front of said star wheel.

12. The tablet filler device of claim 9 wherein there is a stationary front panel in front of said star wheel.

13. The tablet filler device of claim 10 wherein there is a stationary front panel in front of said star wheel.

14. The tablet filler device of claim 1 wherein said improvement also comprises:

a rotating segment surface wheel adjacent said star wheel for counter rotation against said star wheel to enhance individual rapid speed placement of tablets into said slots of said star wheel.

15. The tablet filler device of claim 1 wherein said improvement also comprises:

a step up, digitally controllable motor connected to said star wheel for driving said star wheel.

16. The tablet filler device of claim 14 wherein said improvement also comprises:

a step up, digitally controllable motor connected to said star wheel for driving said star wheel.

17. The tablet filler device of claim 1 wherein said improvement also comprises:

a computerized control system that includes star wheel drive control, and a plurality of quality assurance inspection and rejection features.

18. The tablet filler device of claim 14 wherein said improvement also comprises:

a computerized control system that includes star wheel drive control, and a plurality of quality assurance inspection and rejection features.

19. The tablet filler device of claim 15 wherein said improvement also comprises:

a computerized control system that includes star wheel drive control, and a plurality of quality assurance inspection and rejection features.

20. The tablet filler device of claim 16 wherein said improvement also comprises:

a computerized control system that includes star wheel drive control, and a plurality of quality assurance inspection and rejection features.

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