

APPARATUS WITH GRIPPING STATION, CUTTING STATION AND LIBRARY FOR CONTROL OF MEDICATION PACK PACKING

5 TECHNICAL FIELD

The present disclosure relates to medication packs. More particularly, the present disclosure relates to automated gripping and cutting of medication packs for various medications and treatment protocols.

10 BACKGROUND

Distribution of medication to patients can be an error-prone and labor-intensive operation. There are several designs in the prior art for automating this operation.

U.S. Patent No. 6,637,174 discloses an apparatus for inserting blister packs into
15 collapsible cardboard boxes has an inserter and a covering tab. During a stationary phase of a first conveyor device that supplies the blister packs, the inserter and covering tab transfer the blister packs into the collapsible cardboard box supplied by a second conveyor device. In order to be able to execute a format change without replacement of the inserter or adaptation of the covering tab, the invention proposes driving the inserter
20 and the covering tab by means of servomotors.

U.S. Patent No. 6,640,684 discloses a device for cutting single blister packs from a blister band, a cutting member acts in a longitudinal direction with respect to the blister band, along the longitudinal edges thereof, so as to cut side extending strips of the
25 blister band which extend beyond the length of the blister pack being produced. Cut out elements operate in alignment with a cutting line of the cutting member to cut shaped pieces of the blister band, so as to define corner zones of the blister packs. Shearing means operate crosswise to the blister band, in alignment with the corner zones defined by the cut out means, to separate single blister packs. The position of the cutting means
30 and cut out means and/or the shearing means can be adjusted to produce blister packs having different sizes.

U.S. Patent No. 8,453,548 discloses an apparatus for cutting unit dose blisters from a blister card. The apparatus may include a blade, a guillotine head and a card holder. The guillotine head may be operatively coupled to the blade. The guillotine head may be configured to move the blade through a range of motion that intersects a plane of a platform on which the blister card is positionable for cutting. The card holder may be operatively coupled to the guillotine head to hold the blister card against the platform in advance of the blade being moved through the plane of the platform. The blade may be biased to maintain a surface of the blade in contact with a cutting base at least until the blade intersects the plane of the platform.

PCT Publication No. WO2012121663A1 discloses a pharmaceutical dispensing apparatus for dispensing pharmaceutical packages containing pharmaceuticals is disclosed herein. In a described embodiment, the apparatus comprises an array of dispensing cartridges adapted to receive a plurality of individual pharmaceutical packages in the form of blister packs. Each dispensing cartridge has a longitudinal axis and arranged to support the individual blister pack at a load angle of between 20° and 38°, the load angle being an angle formed between the longitudinal axis and a horizontal axis of the apparatus. The pharmaceutical dispensing apparatus also includes a pick-and-place mechanism operable to selectively remove the blister pack from the array of dispensing cartridges.

Beyond this art, there is a need for a medication packing apparatus that can grip and cut medication packs in an automated fashion for various medications and treatment protocols.

SUMMARY

A primary embodiment of the invention is a medication packing apparatus comprising: (a) a loading station capable of holding a plurality of magazines, wherein each magazine is capable of holding a plurality of medication packs and each medication pack has a plurality of medication units; (b) a first vision station capable of taking a first image of any medication pack; (c) a gripper station including a gripper capable of holding any medication pack and an orientation platform for moving the gripper; (d) a

cutting station for precision cutting of any medication pack held by the gripper, wherein each medication pack is moved into position by the gripper station prior to cutting; and (e) a controller unit including a library, a microprocessor and a data bus that is in electrical communication with the gripper station, the first vision station and
5 the cutting station. The library includes a plurality of medication parameter sets, each medication parameter set comprising a sample image, a datum point and a medication pack code. The controller unit is capable of determining the medication pack code of each medication pack by matching the first image with at least one sample image in the library. And the controller unit is capable of designating a cutting path for any
10 medication pack by controlling the movement of the orientation platform with respect to the cutting station according to a cutting plan.

In an optional design of the primary embodiment, the orientation platform can optionally include: (a) a rotary unit for rotating the gripper; (b) an x-axis travel unit
15 connected to the gripper for moving the gripper in a first direction; and (c) a y-axis travel unit connected to the gripper for moving the gripper in a second direction perpendicular to the first direction. The cutting station can also optionally comprise an x-axis cutter and a y-axis cutter arranged perpendicularly.

20 In an optional design of the primary embodiment: (a) the controller unit is configurable through a user interface by an operator to designate a selected medication pack code; (b) the first image is taken when each medication pack is passing along a conveyor unit from the loading station; and (c) a second image of each medication pack is taken by a second vision station when each medication pack is held by the gripper. The controller
25 unit can optionally be capable of commanding the conveyor unit to pass any medication pack to a reject bin if the first image of the medication does not match the sample image associated with the selected medication pack code. The second vision station can optionally comprise a vision inspection window and a vision inspection camera. And the controller unit can optionally be capable of checking the orientation
30 of each medication pack held by the gripper by matching the second image to the sample image and the datum point associated with the selected medication pack code.

The controller unit can optionally also be configurable through a interface by an operator to designate the cutting plan.

5 In an optional design of the primary embodiment, the apparatus further comprises: (a) a conveyor unit for the passing of each medication pack from each magazine in the loading station through the first vision station; and (b) a robot for passing each medication pack from the conveyor unit to a squatting station.

10 In a second embodiment of the invention: (a) the apparatus of the primary embodiment further comprises a stacking station for stacking a plurality of medication packs, a container forming station for assembling a plurality of containers, an insertion station for inserting the medication packs into the containers, a labeling station for labeling the containers and a weighing station for weighing the containers filled with medication packs; (b) the controller unit is configurable through a user interface by an operator to
15 designate a selected medication pack code, a selected container code and a selected medication count; (c) the library further comprises a plurality of container parameter sets, wherein each container parameter set comprises an internal dimension and a container code; and (d) the controller unit calculates a cutting path for each medication pack based on the selected medication pack code, the selected container code and the
20 selected medication count.

In an optional design of the second embodiment: (a) each medication parameter set can optionally further include a medication pack dimension and a medication pack weight; (b) each container parameter set can optionally further include a container weight; (c)
25 the controller unit can optionally calculate an insertion plan for each container based on the internal container dimension associated with the selected container code, the medication pack dimension associated with the selected medication pack code, and the selected medication count; (d) the controller unit can optionally be capable of calculating an anticipated weight of each container filled with medication packs based
30 on the container weight based on the insertion plan; (e) the controller unit is capable of flagging any container for re-inspection if the measured weight of the container does not match the anticipated weight; and (f) the stacking station can be further capable of

use in the stacking of medication packs prior to cutting of the medication packs by the cutting station as dictated by the controller unit.

In another optional design of this second embodiment: (a) the plurality of medication
5 packs are selected from the group consisting of a plurality of patient specific packs and a plurality of institution specific packs; (b) the container forming station is comprised of at least one of a cardboard box assembler, a plastic bag assembler and a round card assembler; and (c) the insertion station is capable of rotating an orientation of at least one medication pack and inserting at least one medication units into the each container.

10 The ability of the insertion station to rotate the orientation of one medication pack (or a stack of medication packs) allows the insertion station to optimize use of the container space. Containers can be filled with a combination of uncut medication packs and cut medication packs. For instance to reach a medication unit count of 28, a container could be filled with two medication packs each with 10 medication units and also filled
15 with at least one medication pack cut to include eight medication units to reach the count of 28 medication units.

In another optional design of this second embodiment, the labeling station can optionally close each container and seal each container with a tamper evident seal.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present disclosure are described herein with reference to the drawings in which:

25 **FIGs. 1A-1C** are a top view, a front view and a side view, respectively, of an embodiment of the apparatus.

FIGs. 2A-2B are a top view and a side view, respectively, of embodiments of the second vision station, the gripper station and the cutting station.

30 **FIGs. 3A-3B** are a top view and a side view, respectively, of an embodiment of the gripper station.

FIGs. 4A-4B are a top view and a side view, respectively, of embodiments of the second vision station and the cutting station.

5 **FIG. 5** is a flowchart representing the path of medication packs through an embodiment of the apparatus.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings,
10 which form a part hereof. The illustrative embodiments described in the detailed description, drawings and claims are not meant to be limiting. Other embodiments can be utilized, and other changes can be made, without departing from the spirit or scope of the subject matter presented herein. Unless specified otherwise, the terms “comprising,” “comprise,” “including” and “include” used herein, and grammatical
15 variants thereof, are intended to represent “open” or “inclusive” language such that they include recited elements but also permit inclusion of additional, un-recited elements. The term “connect,” “connected,” or “connecting” used herein, and grammatical variants thereof, are intended to represent a linking of two items either directly together or linking them indirectly together.

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Components in **FIGs. 1A** and **2A-4B** are numbered as listed in Table 1 below.

Component	Description
1	conveyor unit
2	robot
3	squatting station
4	second vision station
5	gripper station
6	cutting station
7	stacking station
8	holding tray
9	manual cut magazine

10	first vision station
11	medication pack
12	gripper
13	rotary unit
14	y-axis travel unit
15	x-axis travel unit
16	y-axis cutter
17	x-axis cutter
18	vision inspection window
19	vision inspection camera

Table 1 -- description of common components

FIGs. 1A-1C are a top view **1A-00**, a front view **1B-00** and a side view **1C-00**, respectively, of an embodiment of the medication packing apparatus. As show in **FIG.**

5 **1A**, the apparatus includes the following components: a conveyor unit **1**, a robot **2**, a squatting station **3**, a second vision station **4**, a gripper station **5**, a cutting station **6**, a stacking station **7**, a holding tray **8**, a manual cut magazine **9** and a first vision station

10. **FIGs. 2A-2B** are a top view **2A-00** and side view **2B-00**, respectively, of embodiments of the second vision station **4**, the gripper station **5** and the cutting station

10 **6**. In **FIGs. 2A-2B** the following components are identified: a medication pack **11**, a gripper **12**, a rotary unit **13**, a y-axis travel unit **14**, a x-axis travel unit **15**, a y-axis cutter **16**, a x-axis cutter **17**, a vision inspection window **18** and a vision inspection camera **19**. **FIGs. 3A-3B** are a top view **3A-00** and side view **3B-00**, respectively, of an embodiment of the gripper station **5**. In **FIGs. 2A-2B** the following components are

15 identified: the medication pack **11**, the gripper **12**, the rotary unit **13**, the y-axis travel unit **14** and the x-axis travel unit **15**. **FIGs. 4A-4B** are a top view **4A-00** and a side view **4B-00**, respectively, of embodiments of the second vision station and the cutting station. In **FIGs. 4A-4B**, the following components are visible: the y-axis cutter **16**,

the x-axis cutter **17**, the vision inspection window **18** and the vision inspection camera

20 **19**.

FIG. 5 is a flowchart detailing the passage of the medication packs through an embodiment of the medication packing apparatus. In a first step **5-01**, the loading station magazines are loaded with medication packs **11**. Each specific magazine is generally loaded with a single medication pack **11** product, there may be multiple magazines for multiple medication pack **11** products. In a second step **5-02**, the medication packs **11** are individually loaded onto a conveyor unit **1** for visual inspection at a first vision station **10**. An image of each medication pack **11** is matched to a stored parameter set in a library. Non-matching medication packs **11** are passed to a reject bin. Matching medication packs **11** are passed to a squatting station **3** by a robot **2**. In a third step **5-03**, the robot **2** aligns and sets datum for medication packs **11**, which are visually inspected again at a second vision station **4**. In a fourth step **5-04**, medication packs **11** are individually held by the gripper **12**, cut at a cutting station **6**, then passed to a stacking station **7**. Unused medications (e.g., blisters or pills cut from the medication pack **11**) are passed to a holding tray **8**. The gripper **12** is attached to an x-axis travel unit **15**, a y-axis travel unit **14** and a rotary unit **13**. In a fifth step **5-05**, stacks of cut medication packs **11** are inserted into containers at an insertion station. Containers are formed at the container forming station, closed and labeled and sealed at a labeling station and compared at a weight station to an anticipated weight. Rejected containers are re-inspected for accuracy of their contents. This process is continued until all the medication packs **11** in one or more magazines are processed and the batch is clear.

The medication packs **11** can be of various packaging formats for various medication purposes. The medication packs **11** can be either blister packs and/or strip packs. The medication packs **11** can be cut into single medication units such for a single tablet or a single capsule. The container for the medication packs **11** can be a rectangular cardboard box, a plastic bag or a flat card board holder. The card board holder can be square, rectangular or circular. The labeling station can print information about the medication units included within the container. The labeling station can close the container and/or also provide tamper evident sealing.

The medication packing apparatus can be configured to pack medication for therapy-specific treatments, institution-specific treatments or patient-specific treatments. All these types of treatment are directed toward relieving or healing a specific disorder or disease with specific medication and specific dosages, however the treatment plan is finalized in a different manner between these types of treatment. Therapy-specific treatments usually follow a standardized treatment protocol for each condition, where the standardize treatment protocol is recommended by the original manufacturer or mandated by clinical trials, and can vary based on the race, region and gender of the patient. Institution-specific treatments are defined by a healthcare institution, where the treatment protocols for each medical condition are determined based on the experience of the institution. Patient-specific treatments are defined by the physician treating the patient, where the treatment protocol is determined based on the experience of the physician and/or monitoring of patient response to the treatment protocol. Larger numbers of medication packs **11** are likely to be included in a batch for therapy-specific treatment plans, do to the standardized treatment protocol intended for multiple patients. Batches of institution-specific treatments in turn will likely be fewer medication packs **11** and the batches for patient-specific treatments are likely to be even fewer medication packs **11**. Some prescriptions are rounded to the nearest number; for instance, if the prescribed dose is 28 tabs, an institution may round it to 30 to ease the workflow.

A primary embodiment of the invention is a medication packing apparatus comprising: (a) a loading station capable of holding a plurality of magazines, wherein each magazine is capable of holding a plurality of medication packs **11** and each medication pack **11** has a plurality of medication units; (b) a first vision station **10** capable of taking a first image of any medication pack **11**; (c) a gripper station **5** including a gripper **12** capable of holding any medication pack **11** and an orientation platform for moving the gripper **12**; (d) a cutting station **6** for precision cutting of any medication pack **11** held by the gripper **12**, wherein each medication pack **11** is moved into position by the gripper **12** station **5** prior to cutting; and (e) a controller unit including a library, a microprocessor and a data bus that is in electrical communication with the gripper station **5**, the first vision station **10** and the cutting station **6**. The library

includes a plurality of medication parameter sets, each medication parameter set comprising a sample image, a datum point and a medication pack **11** code. The controller unit is capable of determining the medication pack **11** code of each medication pack **11** by matching the first image with at least one sample image in the library. And the controller unit is capable of designating a cutting path for any medication pack **11** by controlling the movement of the orientation platform with respect to the cutting station **6** according to a cutting plan.

In an optional design of the primary embodiment, the orientation platform can optionally include: (a) a rotary unit **13** for rotating the gripper **12**; (b) an x-axis travel unit **15** connected to the gripper **12** for moving the gripper **12** in a first direction; and (c) a y-axis travel unit **14** connected to the gripper **12** for moving the gripper **12** in a second direction perpendicular to the first direction. The cutting station **6** can also optionally comprise an x-axis cutter **17** and a y-axis cutter **16** arranged perpendicularly.

In an optional design of the primary embodiment: (a) the controller unit is configurable through a user interface by an operator to designate a selected medication pack **11** code; (b) the first image is taken when each medication pack **11** is passing along a conveyor unit **1** from the loading station; and (c) a second image of each medication pack **11** is taken by a second vision station **4** when each medication pack **11** is held by the gripper **12**. The controller unit can optionally be capable of commanding the conveyor unit **1** to pass any medication pack **11** to a reject bin if the first image of the medication does not match the sample image associated with the selected medication pack **11** code. The second vision station **4** can optionally comprise a vision inspection window **18** and a vision inspection camera **19**. And the controller unit can optionally be capable of checking the orientation of each medication pack **11** held by the gripper **12** by matching the second image to the sample image and the datum point associated with the selected medication pack **11** code. The controller unit can optionally also be configurable through a interface by an operator to designate the cutting plan.

In an optional design of the primary embodiment, the apparatus further comprises: (a) a conveyor unit **1** for the passing of each medication pack **11** from each magazine in

the loading station through the first vision station **10**; and (b) a robot **2** for passing each medication pack **11** from the conveyor unit **1** to a squatting station **3**.

In a second embodiment of the invention: (a) the apparatus of the primary embodiment
5 further comprises a stacking station **7** for stacking a plurality of medication packs **11**, a
container forming station for assembling a plurality of containers, an insertion station
for inserting the medication packs **11** into the containers, a labeling station for labeling
the containers and a weighing station for weighing the containers filled with medication
packs **11**; (b) the controller unit is configurable through a user interface by an operator
10 to designate a selected medication pack **11** code, a selected container code and a
selected medication count; (c) the library further comprises a plurality of container
parameter sets, wherein each container parameter set comprises an internal dimension
and a container code; and (d) the controller unit calculates a cutting path for each
medication pack **11** based on the selected medication pack **11** code, the selected
15 container code and the selected medication count. The plurality of medication packs
stacked on the stacking station can be a combination of both cut medication packs and
uncut medication packs, as a container may include a combination of cut and uncut
medication packs.

20 In an optional design of the second embodiment: (a) each medication parameter set can
optionally further include a medication pack **11** dimension and a medication pack **11**
weight; (b) each container parameter set can optionally further include a container
weight; (c) the controller unit can optionally calculate an insertion plan for each
container based on the internal container dimension associated with the selected
25 container code, the medication pack **11** dimension associated with the selected
medication pack **11** code, and the selected medication count; (d) the controller unit can
optionally be capable of calculating an anticipated weight of each container filled with
medication packs **11** based on the container weight based on the insertion plan; (e) the
controller unit is capable of flagging any container for re-inspection if the measured
30 weight of the container does not match the anticipated weight; and (f) the stacking
station **7** can be further capable of use in the stacking of medication packs **11** prior to

cutting of the medication packs **11** by the cutting station **6** as dictated by the controller unit.

In another optional design of this second embodiment: (a) the plurality of medication
5 packs **11** are selected from the group consisting of a plurality of patient specific packs
and a plurality of institution specific packs; (b) the container forming station is
comprised of at least one of a cardboard box assembler, a plastic bag assembler and a
round card assembler; and (c) the insertion station is capable of rotating an orientation
10 of at least one medication pack **11** and inserting at least one medication unit into each
container. The ability of the insertion station to rotate the orientation of one
medication pack **11** (or a stack of medication packs **11**) allows the insertion station to
optimize use of the container space. Containers can be filled with a combination of
uncut medication packs **11** and cut medication packs **11**. For instance to reach a
15 medication unit count of 28, a container could be filled with two medication packs **11**
each with 10 medication units and also filled with at least one medication pack **11** cut
to include eight medication units to reach the count of 28 medication units.

In another optional design of this second embodiment, the labeling station can
optionally close each container and seal each container with a tamper evident seal.
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While various aspects and embodiments have been disclosed herein, it will be apparent
that various other modifications and adaptations of the invention will be apparent to the
person skilled in the art after reading the foregoing disclosure without departing from
the spirit and scope of the invention and it is intended that all such modifications and
25 adaptations come within the scope of the appended claims. The various aspects and
embodiments disclosed herein are for purposes of illustration and are not intended to be
limiting, with the true scope and spirit of the invention being indicated by the appended
claims.

30 REFERENCES

1. U.S. Patent No. 6,637,174
2. U.S. Patent No. 6,640,684

3. U.S. Patent No. 8,453,548
4. PCT Publication No. WO2012121663A1

We claim:

1. A medication packing apparatus comprising:

(a) a loading station capable of holding a plurality of magazines, wherein each magazine is capable of holding a plurality of medication packs **11** and each medication pack **11** has a plurality of medication units;

(b) a first vision station **10** capable of taking a first image of any medication pack **11**;

(c) a gripper station **5** including a gripper **12** capable of holding any medication pack **11** and an orientation platform for moving the gripper **12**;

(d) a cutting station **6** for precision cutting of any medication pack **11** held by the gripper **12**, wherein each medication pack **11** is moved into position by the gripper station **5** prior to cutting;

(e) a controller unit including a library, a microprocessor and a data bus that is in electrical communication with the gripper station **5**, the first vision station **10** and the cutting station **6**, wherein:

(i) the library includes a plurality of medication parameter sets, each medication parameter set comprising a sample image, a datum point and a medication pack **11** code;

(ii) the controller unit is capable of determining the medication pack **11** code of each medication pack **11** by matching the first image with at least one sample image in the library; and

(iii) the controller unit is capable of designating a cutting path for any medication pack **11** by controlling the movement of the orientation platform with respect to the cutting station **6** according to a cutting plan.

2. The apparatus of claim **1**, wherein the orientation platform includes:

(a) a rotary unit **13** for rotating the gripper **12**;

(b) an x-axis travel unit **15** connected to the gripper **12** for moving the gripper **12** in a first direction; and

(c) a y-axis travel unit **14** connected to the gripper **12** for moving the gripper **12** in a second direction perpendicular to the first direction.

3. The apparatus of claim 1, wherein the cutting station 6 comprises an x-axis cutter 17 and a y-axis cutter 16 arranged perpendicularly.

4. The apparatus of claim 1, wherein:

5 (a) the controller unit is configurable through a user interface by an operator to designate a selected medication pack 11 code;

(b) the first image is taken when each medication pack 11 is passing along a conveyor unit 1 from the loading station, wherein the controller unit is capable of commanding the conveyor unit 1 to pass any medication pack 11 to a reject bin if the
10 first image of the medication does not match the sample image associated with the selected medication pack 11 code;

(c) a second image of each medication pack 11 is taken by a second vision station 4 when each medication pack 11 is held by the gripper 12, wherein:

15 (i) the second vision station 4 comprises a vision inspection window 18 and a vision inspection camera 19; and

(ii) the controller unit is capable of checking the orientation of each medication pack 11 held by the gripper 12 by matching the second image to the sample image and the datum point associated with the selected medication pack 11 code.

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5. The apparatus of claim 1, wherein the controller unit is configurable through a interface by an operator to designate the cutting plan.

6. The apparatus of claim 1, further comprising:

25 (a) a conveyor unit 1 for the passing of each medication pack 11 from each magazine in the loading station through the first vision station 10; and

(b) a robot 2 for passing each medication pack 11 from the conveyor unit 1 to a squatting station 3.

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7. The apparatus of claim 1, wherein:

(a) the apparatus further comprises a stacking station 7 for stacking a plurality of medication packs 11, a container forming station for assembling a plurality of containers, an insertion station for inserting the medication packs 11 into the containers, a labeling station for labeling the containers and a weighing station for weighing the containers filled with medication packs 11;

(b) the controller unit is configurable through a user interface by an operator to designate:

(i) a selected medication pack 11 code;

(ii) a selected container code;

(iii) a selected medication count;

(c) the library further comprises a plurality of container parameter sets, wherein each container parameter set comprises an internal dimension and a container code; and

(d) the controller unit calculates a cutting path for each medication pack 11 based on the selected medication pack 11 code, the selected container code and the selected medication count.

8. The apparatus of claim 7, wherein:

(a) each medication parameter set further includes a medication pack 11 dimension and a medication pack 11 weight;

(b) each container parameter set further includes a container weight;

(c) the controller unit calculates an insertion plan for each container based on the internal container dimension associated with the selected container code, the medication pack 11 dimension associated with the selected medication pack 11 code, and the selected medication count;

(d) the controller unit is capable of calculating an anticipated weight of each container filled with medication packs 11 based on the container weight based on the insertion plan; and

(e) the controller unit is capable of flagging any container for re-inspection if the measured weight of the container does not match the anticipated weight.

9. The apparatus of claim **7**, wherein:

(a) the plurality of medication packs **11** are selected from the group consisting of a plurality of patient specific packs and a plurality of institution specific packs;

(b) the container forming station is comprised of at least one of a cardboard box assembler, a plastic bag assembler and a round card assembler; and

(c) the insertion station is capable of rotating an orientation of at least one medication pack **11** and inserting at least one medication unit into each container.

10. The apparatus of claim **7**, wherein the labeling station closes each container and

seals each container with a tamper evident seal.

11. The apparatus of claim **7**, wherein the stacking station **7** is further capable of use in the stacking of medication packs **11** prior to cutting of the medication packs **11** by the cutting station **6**.

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