

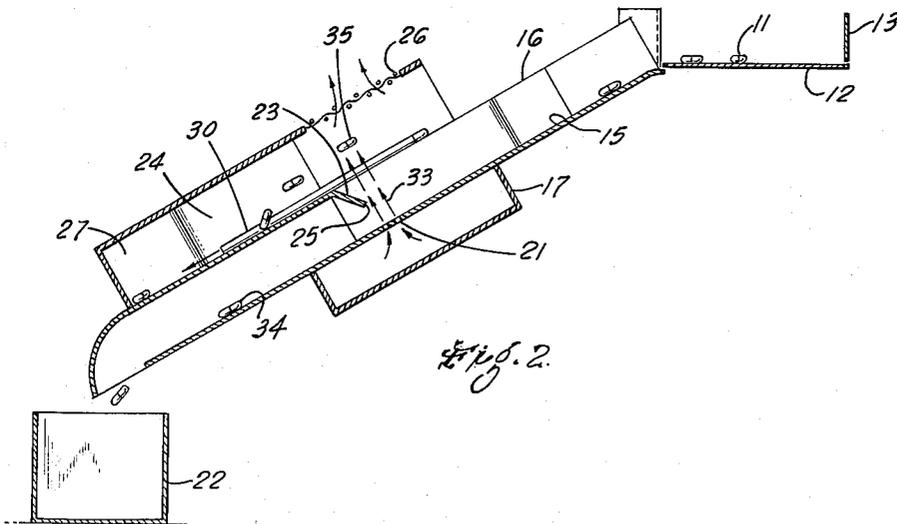
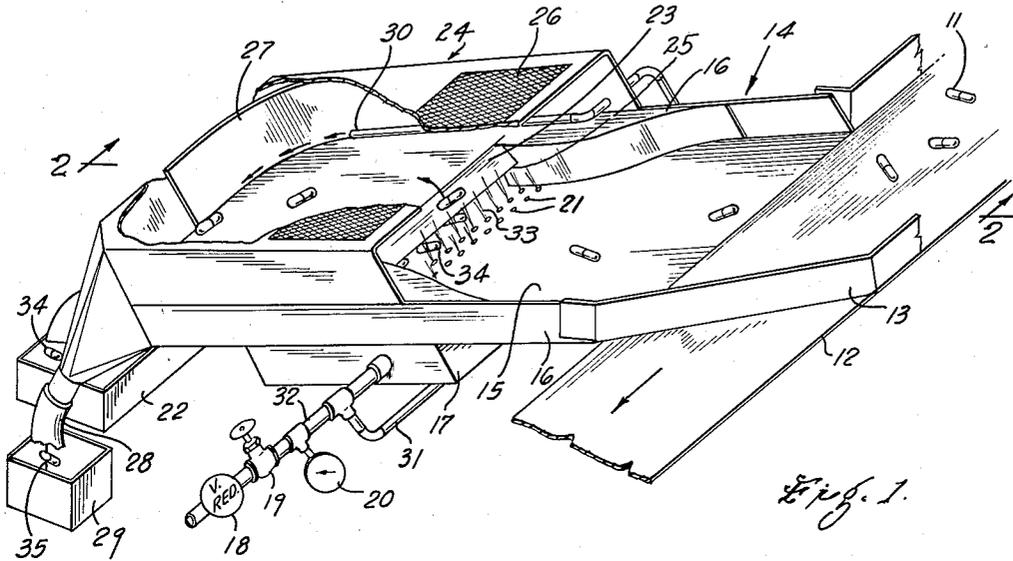
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CAPSULE INSPECTION AND SEPARATION

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CAPSULE INSPECTION AND SEPARATION

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This invention relates to a process and apparatus for inspecting capsules and separating slack-filled capsules from properly filled capsules economically and efficiently by using an air jet system.

In manufacturing capsules, particularly capsules for medicinal purposes, it is necessary that each capsule contain the proper amount of material such as medicament. With some capsules such as those containing vitamins which are used over a long period, primarily for preventive rather than for therapeutic purposes, a single slack filled capsule is not too serious. With capsules containing antibiotics or analgesics and many other therapeutic agents, the contents of a single capsule are relied upon to do a particular job at a particular time, and it is therefore necessary that each capsule contain the desired quantity of medicine.

Any filling operation for the filling of capsules can go wrong, even though highly reliable apparatus and processes are used so that the number of defects is a small fraction of 1%. Nonetheless, it is necessary or desirable that the defective capsules, no matter how small their percentage, be selected and rejected. In many instances, the capsules are opaque so that visual inspection does not give a reliable answer. It is usually desirable that a visual inspection be used, and additionally some other method of eliminating defectively filled capsules. Medical capsules are usually either hard-shell capsules, in which two pre-formed parts of the capsule are telescoped together to contain the filled material, or soft-shell capsules which are formed from strips of soft plastic such as gelatin, with water and plasticizers. The wall thicknesses are uniform, hence any variation in weight is indicative of an improperly filled capsule. The size of capsule is usually chosen so that it is impossible to overfill the capsule because it is desired that the maximum contents be placed in the capsule so that the capsule is as small and easily swallowed as possible. The individual weighing of the filled capsules on a sufficiently sensitive scale or balance would give an adequate check; but individual weighing is too expensive and time-consuming to be used in production quantities, if other processes can be devised.

One method of filling capsules is set forth in United States Patent No. 2,775,080, Method of Forming Powder-and-Liquid Filled Capsules, F. E. Stirn and A. S. Taylor, December 25, 1956. FIGURE 16 of this patent shows an air conveyor system for removing capsules from the filling machines.

One method of separating improperly filled capsules, that is, slack-filled capsules, is described in United States Patent No. 2,727,833, Capsule Finishing Process, E. C. Yen and F. E. Stirn, December 20, 1955. This patent describes a method of treating the capsules with a washing and coating composition and uses a solution for washing and coating of such specific gravity that the properly filled capsules sink and slack-filled capsules float, thus permitting the skimming off of slack-filled capsules. Such a process is limited by the specific gravity of available solutions and leaves the capsules wet so that they must be dried. Whereas this is highly advantageous as a combined process where a coating is desired, at times a coating step is not necessary or desired, and it is hence not desirable to wet the capsules, as is necessary for

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such a sink or float process. Additionally, a drying step is required, and at times the coating liquids present fire or health hazards.

The present invention provides a method of rapidly separating slack-filled capsules and other defective capsules by passing the capsules to be inspected down an inspection belt. At an inspection station on this belt, the capsules are brightly illuminated and inspectors pick out and reject capsules which appear to be questionable or defective.

The capsules are then deflected from the inspection belt down a capsule chute down which the capsules slide, preferably as a single thickness layer. An air jet underneath the chute blows a current of air upwardly from the floor of the chute, or at least slightly in the direction of capsule travel, so that each capsule in turn is subjected to the aerodynamic influence of an air blast. The strength of the air blast is chosen such that the properly filled capsules follow one path, while slack-filled capsules, being lighter, are picked up by the air from the air blast and caused to follow a separate path. This separate path leads to a slack-filled capsule waste basket. The identical apparatus may be used for capsules having a wide variation in apparent density by changing the force of the air blast. The air blast can be chosen of such strength that only capsules of at least a specific weight will pass without rejection, thus giving an extremely rapid and very inexpensive method of inspection.

The air jet may consist of a single narrow, comparatively long jet or a plurality of single jets; but conveniently is at least one row and preferably a double row of individual air jets spaced such that no capsules can escape the influence of the air blast from one or more such air jets as it passes down the chute, and at the same time by varying the air pressure capsules having different characteristics may be checked on the same machine. It is easier to use air jets which are small, round, drilled holes preferably in two or more rows, although other shapes may be used. For most pharmaceutical capsules two rows of jets, each consisting of a 1/16-inch hole, spaced 1/4-inch on centers and staggered gives excellent results.

After the visual inspection and air blast, any dirt or impurities on the capsules is picked up by the air blast and blown away and the inspected capsules may be passed to inspected capsule receivers as acceptable production, for counting, packaging or other procedures.

Whereas variation in the type and size of air jets and the size and proportion of chutes and slack-filled capsules dividers may be used, and various types of shields to prevent grossly underfilled capsules from being blown completely out of the apparatus, the accompanying drawings show one embodiment of the present invention; the full scope of the invention being as set forth in the appended claims.

In the drawings:

FIGURE 1 is a pictorial view, in partial section, of the present capsule inspector, showing the paths traversed by properly filled capsules and slack-filled capsules.

FIGURE 2 is a sectional view along line 2-2 of FIGURE 1 showing a cross section of the capsule inspection apparatus, and its method of operation.

Inasmuch as the suspending frame and the pulleys for the conveyor belt, etc., are conventional, such conventional items are not shown in the drawings.

As shown in FIGURE 1, capsules 11 which may be either hard- or soft-shell, pass along a conveyor belt or inspection belt 12. The capsules are put on the inspection belt in accordance with conventional practice, where the number on the belt is not greater than can be inspected by an operator looking at the belt, and is such that the

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capsules are in a single layer on the belt. A conventional drive is used. As the belt moves along, the capsules are deflected from the inspection belt by a deflector 13, which is conveniently a strip of sheet metal at an angle of 30° to 60° with the direction of travel of the inspection belt, and mounted slightly above so as not to drag on the inspection belt, which picks up the capsules and deflects them at an angle to the inspection belt and down the capsule chute 14. The capsule chute is at such an angle that the capsules slide readily down the chute by the influence of gravity. An angle of about 20° to 45° is very convenient, although a greater or lesser angle may be used. The capsule chute has a capsule chute floor 15, and capsule chute side guides 16. The side guides are at such a position as to control the path of the capsules, and keep them on the chute floor.

Underneath the capsule chute floor is an air pressure box 17 which is supplied with the air under pressure from a suitable source, and which air preferably passes through an air pressure reduction valve 18, a control valve 19, and into the air pressure box 17. An air pressure gauge 20 is used to indicate the pressure of air to aid in adjusting the air pressure to a desired value.

A plurality of air jets 21 are drilled in the floor of the capsule chute. These jets may be at approximately a right angle to the floor, or may be inclined slightly in the direction of capsule travel so that the air blast from the air jets not only gives a lifting effect to the capsules as they pass over air going to the air jets, but also cause the capsules to develop an additional velocity component in the direction of their travel. Usually, the velocity of the capsules in sliding down the chute is sufficient that an additional directional component to the air jets in the direction of motion is not necessary, although it sometimes aids in speeding operations. Capsules which are not blown from the capsule chute floor continue to slide down the capsule chute and into an inspected capsule receiver 22, which receives the capsules having a proper fill.

Above the bottom of the capsule chute is a divider 23. This divider is adjacent to the path of the air blast from the air jets, and extends down towards the floor of the capsule chute so that there is just sufficient clearance between the divider and the floor of the chute for the largest capsules which are to be inspected on the apparatus. The divider extends between the sides of the capsule chute forming the slack-filled capsule trap 24.

Conveniently, the leading edge of the divider 25 is closely spaced from the air blast from the air jets so that slack-filled capsules cannot pass between the air blast and the leading edge of the divider. The remainder of the divider is conveniently spaced a somewhat greater distance from, and is parallel to, the capsule chute floor, although this parallelity is not necessary. The top of the slack-filled capsule trap is conveniently a rectangular cover which extends from and between the capsule chute side guides and has a top parallel thereto. A screen 26 forms part of the slack-filled capsule traps to permit air to escape from the trap. In the slack-filled capsule trap, is a vane 27, which guides the slack-filled capsules towards a conveyor tube 28, which leads to a slack-filled capsule waste basket 29. A conveying jet 30 is directed along the vane and to the conveyor tube so as to pick up and carry the slack-filled capsules and convey them to the waste basket. This conveying jet is fed by a bleeder pipe 31 from the air line 32 to the air pressure box 17.

Operation

In operation, after visual inspection on the belt, the capsules 11 are deflected from the inspection belt 12 and drop down the capsule chute 14. As they slide down the chute, each capsule individually encounters the air blast 33 from the air jets 21. The properly filled capsules 34 are jostled by the air blast, but are not lifted by the air blast, and continue to slide down the chute. The slack-filled capsules 35 being lighter are lifted by the air blast

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and with the velocity from sliding down the chute to give them forward motion, pass up and over the divider 23 and into the slack-filled capsule trap 24 from which they are blown by the conveying jet 30 down the conveyor tube 28 into the slack-filled capsule waste basket 29.

It is to be understood that the air pressure to be used can vary over fairly wide limits depending upon the size of the air jet and the apparent density of the capsules which are being inspected. With $\frac{1}{16}$ -inch holes in two lines spaced $\frac{1}{4}$ -inch on centers, an air pressure of around 8 to 15 lbs. per square inch gives good results with most pharmaceutical capsules. The air pressure in the air pressure box is great enough so that the air blast causes all of the capsules to be jostled and almost lifted to the divider 23. Then, capsules which are known to be slack-filled, and perhaps identified by separate color markings, are fed with the properly filled capsules down the chute to see if they are blown over the divider 23, and if not, the air blast is increased until the slack-filled capsules are blown over the divider. In initial operation, it is frequently convenient to increase the pressure of air until the air blast picks up the few of the lighter filled capsules or until some capsules are caused to be blown over the divider into the slack-filled capsule trap, and these capsules are weighed to see if they are actually slack-filled or if the air blast is sufficiently strong to lift properly filled capsules.

For each individual type of capsule, depending upon the aerodynamic qualities of the particular capsules, their size and their particular fill, the air blast must be adjusted; but once the air blast is adjusted the same pressure reading on the air pressure gauge 20 may be used if the same type of capsule is run at a later date, rather than recalibrating. Similarly, the reading on the air pressure gauge shows that the pressure is continuing to be maintained at proper value, although the air pressure reduction valve and the control valve settings should be sufficiently stable that no adjustments are required during the average production day.

It is preferred that the capsules be inspected visually as they come down the belt 12 to be certain that the colors, sizes and shapes are in conformity with the desired inspection standards. Such inspection may be either continuous or intermittent depending upon the quality of the machine forming the capsules. Frequently, with high grade machines, after the machines are once adjusted and working properly, no additional inspection is required of the individual capsules for considerable periods, and frequently merely a spot inspection by the machine operator is sufficient to insure quality control.

In many instances, with reliable encapsulation machines, slack-filled capsules will be found to exist only when the machine is being first started up, or when bridging occurs in the feed hoppers which feed the contents to the encapsulation machines. If a powder filling is being used, at times the powder can bridge in the feeding device to the encapsulation machine, resulting in a considerable number of slack-filled capsules, or bridging may occur only for one or two capsules in which case only a small number will be rejected.

As will be obvious to those skilled in the art, the machine as described and illustrated may be modified somewhat and remain within the scope of the present invention which is defined by the appended claims.

I claim:

1. An apparatus for inspecting capsules and separating out of slack-filled capsules which comprises: an endless inspection belt, means for continuously moving said belt on which is a single layer of capsules, an inclined capsule chute having at least one directional air jet in the capsule traversing floor thereof, a deflector adjacent to said belt to deflect said single layer of capsules from said belt to and down said chute, an air pressure box under said chute, means for supplying air under controlled pressure to said air pressure box, and by way of said box to said

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air jet in the floor of the capsule chute, an inspected capsule receiver below said chute to receive inspected capsules from said chute, a divider above said capsule chute spaced with just sufficient clearance from the floor of the chute for a single layer of the largest capsules to be inspected to pass under said divider, and adjacent to the air blast from the air jet in the floor of said capsule chute, and spaced so closely to the air blast that a slack-filled capsule cannot pass between the air blast and the divider, said divider forming with the sides of the chute a slack-filled capsule trap, to receive slack-filled capsules blown upwardly by said blast, a screen over the said divider, to prevent slack-filled capsules from being blown out into the apparatus, a slack-filled capsule basket, and an air conveyor to transfer slack-filled capsules from said slack-filled capsule trap to said slack-filled capsule basket.

2. An apparatus for inspecting capsules and separating out of slack-filled capsules which comprises: an endless inspection belt, means for continuously moving said belt on which is a single layer of capsules, an inclined capsule chute having at least one directional air jet in the capsule traversing floor thereof, a deflector adjacent to said belt to deflect said single layer of capsules from said belt to and down said chute, an air pressure box under said chute, means for supplying air under controlled pressure to said air pressure box, and by way of said box to said air jet in the floor of the capsule chute, an inspected capsule receiver below said chute to receive inspected capsules from said chute, and a divider above said capsule chute

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spaced with just sufficient clearance from the floor of the chute for a single layer of the largest capsules to be inspected to pass under said divider, and adjacent to the air blast from the air jet in the floor of said capsule chute, and spaced so closely to the air blast that a slack-filled capsule cannot pass between the air blast and the divider, said divider forming a slack-filled capsule trap, to receive slack-filled capsules blown upwardly by said blast.

3. A process for inspecting capsules and separating out slack-filled capsules which comprises: passing a plurality of capsules in a single layer past a visual inspection station, visually inspecting, picking out, and discarding capsules of defective appearance, passing the visually inspected and passed capsules under the influence of gravity down a sloped path in a single layer, blowing at least one air blast across said sloped path, whereby each capsule is separately subjected to the effect of the air blast thus blowing the individual slack-filled capsules to one fully defined path, separating out and discarding all of the same, and passing the heavier properly filled capsules down a second path, and separately receiving and storing the visually inspected and properly filled capsules.

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