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## SEQUENTIAL PELLET LOADING STATION

### FIELD OF THE INVENTION

5 This invention relates to the field of semiconductor packaging, and particularly to an apparatus and method for facilitating sequential pellet loading process in a semiconductor packaging tool so that inadvertence utilization of stale pellets can be avoided.

### 10 BACKGROUND OF THE INVENTION

Semiconductor devices are encapsulated in thermosetting plastic. The thermosetting plastic comes in a solid pellet form which is later liquefied during the encapsulating process. A number of problems may prevent the encapsulated semiconductor device from functioning properly. The most easily detected problem  
15 is that known as the "incomplete fill". This problem is characterized by the premature hardening of the plastic during the fill-in process, that is, the process where the liquefied plastic is extruded into the mold containing the electronic components. Some of the other more-difficult-to-detect problems are the "internal voids" which are tiny air bubbles disposed in the finished encapsulated device, and  
20 "wire sweep" which is short circuiting of the device caused by the leads making contact with each other.

These are problems that are well known in the semiconductor packaging industry. Though several factors may contribute to the cause, it is commonly known that one of the contributors is the inadvertent utilization of thermosetting pellets  
25 which have been exposed to room temperature for an excessive period. The thermosetting pellets are not particularly stable in room temperature, and its functional properties as an encapsulating material begin to degrade after 48 to 72 hours. Hence, the manufacturing specification calls for the elimination of any pellets which have exceeded the allotted period.



Although the problems caused by stale pellets have not reached a monumental level, stale pellets do continually contribute to the loss of a noticeable number of encapsulated devices despite the fact the cause is well known in the industry. Since yield is a primary concern, there is constant demand to reduce the number of defective devices. Although the industry's efforts to prevent the inadvertent use of stale pellets has led to some improvements, the problems were not wholly eliminated.

One of the measures employed by the industry was to simply rely on the operator of the packaging tool to filter out any pellets which were determined to be stale. But this method often failed due to a number of human factors, and mainly the operator's inability to discern the old pellets from the new ones. Another measure was to incorporate into the software of the packaging tool a warning. This warning was given off whenever an operator attempted to use the tool after several days of non-use. The operator was instructed to remove all of the residual pellets and replace them with new ones. This solution, however, only worked for situations where the packaging tool had not been in use for several days -- it did not work in situations where the device had been operating for a continuous period.

Several reasons can be cited for the partial failure of the attempted solutions stated above, some of which were already mentioned. But the most important reason relates to the current method of loading in the pellets. As illustrated in FIG. 1, the current method uses a cylindrical vibratory feedbowl arrangement or other arrangements employing a similar principle. With this arrangement, a batch of pellets is poured into the sorting plate. The sorting plate slowly loads the pellets onto the track via a vibrating motion. Before all of the pellets on the sorting plate are loaded onto the track, the next batch is poured into the feedbowl. The subsequent batch is consequently mixed in with the previous batch and pellet loading sequence becomes a random process. So after a multitude of batches, while most of the pellets from the earlier batches tend to leave the feedbowl before



the pellets from the later batches, there exists a possibility that a few of the pellets from the earlier batches are left behind. Hence, after several days of continuous use, a few pellets can exceed the maximum period allowed under the specification.

5 The current measures employed by the industry cannot easily detect these pellets that are left behind. The warning that is given off by the computer software is useless for this type of situation because the packaging tool would have been in continuous use, and thus would not meet the criteria for giving off the warning signal. Moreover, the outer appearance of the pellets do not change significantly over time. Hence, the old pellets, which are dispersed throughout the mixed batch,  
10 cannot be detected by an operator.

While one solution to the problem may be to wait until all of the pellets from a batch is loaded on to the track before the next batch is poured into the mix, doing so would significantly increase the time of the loading process and decrease efficiency. If this strategy were to be employed, the last few pellets would take  
15 inordinate amount of time to load onto the track. This is because the vibratory motion is a random process which requires a large number of pellets on the sorting plate to work properly.

Therefore, in light of these shortcomings, it would be highly desirable to have a pellet loading system where the earlier received pellets are certain to be used  
20 before the later received pellets without compromising speed and efficiency.

## OBJECT OF THE INVENTION

It is the object of the invention to have an apparatus and method for efficiently loading thermosetting pellets in a semiconductor packaging device where the  
25 earlier received pellets are loaded before the later received pellets without incurring the shortcomings described above.

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## SUMMARY OF THE INVENTION

The pellet loading station facilitates sequential pellet loading process for a semiconductor packaging tools. The station includes a pellet container fixed in a generally vertical position. The container has top opening a bottom opening. At the bottom opening is an inclined guide plate for directing the pellets which are discharged out of the bottom opening. A chain drive is disposed in the station such that it receives the pellets from the inclined guide plate. The chain drive has a belt with a plurality of grooves wherein each of the grooves is designed to accept a single row of pellets. The chain drive is driven by a conventional set of motorized wheels.

## BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a perspective, elevational view of a prior art cylindrical vibratory feedbowl arrangement.

Fig. 2 is a perspective, elevational view of a preferred embodiment of the present invention.

Fig. 3 is side, elevational view of a pellet loading station incorporating the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention solves the problem of inadvertent use of old pellets by facilitating a sequential process. Hence, as the name suggests, the first-received pellets are generally loaded first and the later-received pellets are loaded generally later. There are, of course, various ways to facilitate the sequential process in a semiconductor packaging tool. The pellet loading station described herein,



therefore, is what the inventor considers to be the preferred apparatus for facilitating the sequential process.

FIG. 2 illustrates the preferred embodiment of the present invention. The pellet station 1 includes a base 5, a pellet container 10, and a chain drive 30. The pellet container 10 has a top opening 11 and a bottom opening 12. Pivotal-ly attached adjacent to the bottom opening 12 is an inclined guiding plate 15 having a back plate 20, a pair of side plates 16, bottom plate 17, and a plurality of linear strips 18 disposed on the bottom plate 17. The pellet container is fixedly suspended above the base 5 by a pair of vertical supports 19. A discharge tray 25 is disposed below the guiding plate 15.

The chain drive 30 is pivotally connected to a vertical support 34 such that it can be fixed at different inclined angles. The chain drive 30 includes a belt 31 for transferring the pellets from the pellet container 10. The belt 31 has a surface with a plurality of grooves and each groove is designed to accommodate a single row of pellets. A pair of guide plates 33 lies along the length of the belt to prevent the pellets from falling off the belt. The belt is driven by a set of conventional motorized wheels 32.

FIG. 3 illustrates the pellet loading station in operation. The pellets 40 are poured into the pellet container 10 through the top opening 11 and are discharged through the bottom opening 12. The chain drive 30 is positioned in an inclined angle such that the lower end of the drive receives the pellets 40 from the inclined guiding plate 15. The flow of the pellets 40 is restricted by the inclined guide plate 15 and the belt 31 which blocks the opening. In order to facilitate an steady movement of the pellets 40 into the grooves 34, the guide plate 15 is made to vibrate. The pellets which do not successfully load onto the belt 31 are dropped into the discharge tray 25.

The subsequent batches of pellets are poured into the top opening 11 on top of the existing pellets 40. The pellet container 10 is positioned in a vertical manner



such that gravity naturally pulls the pellets downward. So the flow of the pellets is generally in one direction. Hence, the pellets which are first poured into the pellet container do not mix with the later poured pellets, and because the first-poured pellets are closer to the bottom opening, they are loaded onto the belt 31 before the  
5 later-poured pellets.

Although it is preferred that the pellet container is positioned in a vertical manner to optimally utilized gravitational force, the container may be positioned horizontally or on a slant. But in the case where the container is horizontal, there must be some type of mechanical feature for moving the pellets flow in one  
10 direction. The important principle is that the earlier entered pellets must not excessively mix with the later-entered pellets, and that the earlier-entered pellets generally exit the container earlier.

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## CLAIMS

- 1 1. A pellet loading station for facilitating sequential pellet loading in a  
2 semiconductor packaging tool, said station comprising:
  - 3 a pellet container having a top opening and a bottom opening, said pellet  
4 container adapted for receiving pellets from the top opening and discharging the  
5 pellets from the bottom opening; and
  - 6 a means for receiving and transferring said pellets discharged from said  
7 bottom opening,
  - 8 whereby pellets which entered said pellet container earlier are transferred  
9 earlier than pellets which entered said pellet container later.
- 1 2. The pellet loading station as recited in claim 1 wherein said receiving and  
2 transferring means is a chain drive.
- 1 3. The pellet loading station as recited in claim 2 wherein said chain drive has a  
2 plurality of grooves adapted for receiving a single row of the pellets.
- 1 4. The pellet loading station as recited in claim 1 wherein said pellet container  
2 is substantially vertical such that pellets entering said top opening is pulled by  
3 gravity towards said bottom opening.
- 1 5. The pellet loading station as recited in claim 1 wherein said pellet container  
2 has an inclined guiding plate adapted for receiving and guiding the pellets  
3 discharged from the opening at the bottom of said pellet container.
- 1 6. The pellet loading station as recited in claim 5 wherein said inclined guiding  
2 plate is adapted to be swiveled into a plurality of inclined positions of different  
3 angles.
- 1 7. The pellet loading station as recited in claim 5 wherein said inclined guiding  
2 plate has a plurality of linear strips.
- 1 8. The pellet loading station as recited in claim 5 wherein said chain drive is  
2 disposed in said pellet loading station in an inclined position, said chain drive  
3 having a lower end and an upper end, said lower end positioned closer to said





4 inclined guiding plate than said upper end, whereby the pellets discharged from  
5 said pellet loading station are loaded onto said lower end of said chain drive.

1 9. The pellet loading station as recited in claim 2 wherein said chain drive is  
2 adapted to be swiveled into a plurality of inclined positions of different angles.

1 10. A method for loading thermosetting pellets in a semiconductor packaging  
2 tool comprising:

3 containing a first batch of thermosetting pellets in a pellet container;

4 transferring said first batch of pellets out of said container;

5 delivering a subsequent batch of thermosetting pellets into said container

6 before all of said first batch of pellets are transferred out of said container;

7 whereby said first batch of pellets do not substantially mix with said  
8 subsequent batch of pellets and said first batch leaves said container before said  
9 subsequent batch in a continuous flow.

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